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PART 3 OF 9 RECEIVED 7/10/2012

VISTA LANDFILL PERMIT APP SC-019

Florida Department of Environmental Protection
Twin Towers Office Bldg. • 2600 Blair Stone Road • Tallahassee, FL 32399-2400

DEP Form # 62-701.900(1)
Form Title Solid Waste Management Facility Permit
Effective Date 05-27-01

DEP Application No. ____________________
(Filled by DEP)

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

APPLICATION FOR A PERMIT 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	7825 Baymeadows Way, Ste. B200	3319 Maguire Blvd., Ste. 232	3804 Coconut Palm Dr.	2295 Victoria Ave., Ste. 364	400 North Congress Ave.
Pensacola, FL 32501-5794	Jacksonville, FL 32256-7590	Orlando, FL 32803-3767	Tampa, FL 33619	Fort Myers, FL 33901-3881	West Palm Beach, FL 33401
850-595-8360	904-448-4300	407-894-7555	813-744-6100	941-332-6975	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 Department's District 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,B, D through T
B. Asbestos Monofills - Submit parts A,B,D,E,F,G,J,L,N, P through S, and T
C. Industrial Solid Waste Facilities - Submit parts A,B, D through T
D. Non-Disposal Facilities - Submit parts A,C,D,E,J,N,S and T

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,C and D 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,M, O through T
B. Asbestos Monofills - Submit parts A,B,N, P through T
C. Industrial Solid Waste Facilities - Submit parts A,B, M through T
D. Non-Disposal Facilities - Submit parts A,C,N,S and T

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:	NON-DISPOSAL FACILITY GENERAL INFORMATION
PART D:	PROHIBITIONS
PART E:	SOLID WASTE MANAGEMENT FACILITY PERMIT REQUIREMENTS, GENERAL
PART F:	LANDFILL PERMIT REQUIREMENTS
PART G:	GENERAL CRITERIA FOR LANDFILLS
PART H:	LANDFILL CONSTRUCTION REQUIREMENTS
PART I:	HYDROGEOLOGICAL INVESTIGATION REQUIREMENTS
PART J:	GEOTECHNICAL INVESTIGATION REQUIREMENTS
PART K:	VERTICAL EXPANSION OF LANDFILLS
PART L:	LANDFILL OPERATION REQUIREMENTS
PART M:	WATER QUALITY AND LEACHATE MONITORING REQUIREMENTS
PART N:	SPECIAL WASTE HANDLING REQUIREMENTS
PART O:	GAS MANAGEMENT SYSTEM REQUIREMENTS
PART P:	LANDFILL CLOSURE REQUIREMENTS
PART Q:	CLOSURE PROCEDURES
PART R:	LONG TERM CARE REQUIREMENTS
PART S:	FINANCIAL RESPONSIBILITY REQUIREMENTS
PART T:	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

A. GENERAL INFORMATION

1. Type of facility (check all that apply):

☑ Disposal

☐ Class I Landfill	☐ Ash Monofill
☐ Class II Landfill	☐ Asbestos Monofill
☑ Class III Landfill	☐ Industrial Solid Waste

☐ Other Describe: ______

☐ Non-Disposal
  - ☐ Incinerator For Non-biomedical Waste
  - ☐ Waste to Energy Without Power Plant Certification
  - ☐ Other Describe: ______

NOTE: Waste Processing Facilities should apply on Form 62-701.900(4), FAC;
Land Clearing Disposal Facilities should notify on Form 62-701.900(3), FAC;
Compost Facilities should apply on Form 62-701.900(10), FAC; and
C&D Disposal Facilities should apply on Form 62-701.900(6), FAC

2. Type of application:
  - ☐ Construction
  - ☐ Operation
  - ☑ Construction/Operation
  - ☐ Closure

3. Classification of application:

☐ New	☑ Substantial Modification
☐ Renewal	☐ Intermediate Modification
	☐ Minor Modification

4. Facility name: **Vista Landfill, Class III**

5. DEP ID number: **SO48-0165969-013** County: **Orange**

6. Facility location (main entrance): **242 West Keene Road**
Apopka, Florida 32703

7. Location coordinates:

Section: **28** Township: **21** Range: **28E**

Latitude: **28** ° **38** ' **24.5** " Longitude: **81** ° **30** ' **41.7** "

8. Applicant name (operating authority): **Vista Landfill, L.L.C.**

Mailing address: **242 West Keene Road, Apopka, Florida 32703**
Street or P.O. Box City State Zip

Contact person: **Ray Chewning** Telephone: (**407**) **886-2920**

Title: **Senior Engineer**

rchewning@wm.com
E-Mail address (if available)

9. Authorized agent/Consultant: **Geosyntec Consultants**

Mailing address: **14055 Riveredge Drive, Suite 300, Tampa, FL 33637**
Street or P.O. Box City State Zip

Contact person: **Juan D. Quiroz** Telephone: (**813**) **558-0990**

Title: **Project Engineer**

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

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

Mailing address: **N/A**
Street or P.O. Box City State Zip

Contact person: **N/A** Telephone: (___) **N/A**

N/A
E-Mail address (if available)

11. Cities, towns and areas to be served: **Northwest Orange County and Metro Orlando**

12. Population to be served:

Current: **+100,000** Five-Year Projection: **+100,000**

13. Date site will be ready to be inspected for completion: ________________

14. Expected life of the facility: **17.5** years

15. Estimated costs:

Total Construction: $ **N/A** Closing Costs: $ **N/a**

16. Anticipated construction starting and completion dates:

From: ________________ To: ________________

17. Expected volume or weight of waste to be received:

________ yds^3/day **2,500** tons/day ________ gallons/day

B. DISPOSAL FACILITY GENERAL INFORMATION

1. Provide brief description of disposal facility design and operations planned under this application:

Vista Landfill, Class III facility, is currently permitted as an unlined Class III landfill. This substantial permit modification application is submitted for the purpose of obtaining FDEP approval to construct and operate a liner and leachate collection system for the currently permitted Class III landfill facility. The liner and leachate collection system will augment and improve the environmental controls at the landfill facility.

2. Facility site supervisor: **Sheree Henniger**

Title: **District Engineer** Telephone: (**407**) **886-2920**

shennig@wm.com
E-Mail address (if available)

3. Disposal area: Total **102** acres; Used **0** acres; Available **102** acres.

4. Weighing scales used: ☑ Yes ☐ No

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

6. Charge for waste received: **N/A** $/yds^3 **N/A** $/ton

7. Surrounding land use, zoning:

☑ Residential (low density)
☑ Agricultural
☐ Commercial
☐ Industrial
☐ None
☑ Other Describe: **Institutional, parks and** recreation

8. Types of waste received:

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

9. Salvaging permitted: ☐ Yes ☑ No

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

11. Spotters: Yes ☑ No ☐ Number of spotters used: ______

12. Site located in: ☐ Floodplain ☐ Wetlands ☑ Other **Uplands Only**

13. Property recorded as a Disposal Site in County Land Records: ☑ Yes ☐ No

14. Days of operation: **Monday - Saturday**

15. Hours of operation: **7a.m.-6 p.m., Mon-Fri/7a.m.-12p.m. Sat**

16. Days Working Face covered: **Weekly**

17. Elevation of water table: **55-90** Ft. (NGVD 1929)

18. Number of monitoring wells: **30 total**

19. Number of surface monitoring points: **N/A**

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

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

21. Landfill unit liner type:

☐ Natural soils
☐ Single clay liner
☑ Single geomembrane
☐ Single composite
☐ Slurry wall
☐ Other Describe:
☐ Double geomembrane
☐ Geomembrane & composite
☐ Double composite
☐ None

22. Leachate collection method:

☑ Collection pipes
☑ Geonets
☐ Well points
☐ Perimeter ditch
☐ Other Describe:
☐ Sand layer
☐ Gravel layer
☐ Interceptor trench
☐ None

23. Leachate storage method:

☑ Tanks (Auxiliary)
☐ Surface impoundments
☐ Other Describe:

24. Leachate treatment method:

☐ Oxidation
☐ Secondary
☐ Advanced
☐ None
☐ Other **N/A**
☐ Chemical treatment
☐ Settling

25. Leachate disposal method:

☐ Recirculated
☐ Transported to WWTP
☐ Injection well
☐ Evaporation
☐ Other ______
☑ Pumped to WWTP
☐ Discharged to surface water
☐ Percolation ponds

26. For leachate discharged to surface waters:

Name and Class of receiving water: **N/A**

27. Storm Water:

Collected: ☑ Yes ☐ No

Type of treatment: N/A

Name and Class of receiving water: N/A

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

ERP48-0111044-005-EM (Issued August 2005)

C. NON-DISPOSAL FACILITY GENERAL INFORMATION **N/A**

1. Provide brief description of the non-disposal facility design and operations planned under this application:

____

____

____

____

2. Facility site supervisor: ____________________________________

Title: ______________________ Telephone: (___)____________________

____
E-Mail address (if available)

3. Site area: Facility __________ acres; Property ____________ acres

4. Security to prevent unauthorized use: [ ] Yes [ ] No

5. Site located in: [ ] Floodplain [ ] Wetlands [ ] Other _______________

6. Days of operation: ____

7. Hours of operation: ____

8. Number of operating staff: __________________

9. Expected useful life: ________ Years

10. Weighing scales used: [ ] Yes [ ] No

11. Normal processing rate: _________ yd^3/day __________ tons/day ________ gal/day

12. Maximum processing rate: ________ yd^3/day __________ tons/day ________ gal/day

13. Charge for waste received: ______________________________________

14. Storm Water Collected: [ ] Yes [ ] No

Type of treatment: ____

Name and Class of receiving water: ___________________________________

15. Environmental Resources Permit (ERP) number or status: __________________

____

16. Final residue produced:

______% of normal processing rate ________% of maximum processing rate

______Tons/day ________Tons/day

Disposed of at:

Facility name: __________________________ County: ____________________

17. Estimated operating costs: $ ________________

Total cost/ton: $ ______________________ Net cost/ton: $ ______________________

18. Provide a site plan, at a scale not greater than 200 feet to the inch, which shows the facility location and identifies the proposed waste and final residue storage areas, total acreage of the site, and any other features which are relevant to the prohibitions or location restrictions in Rule 62-701.300, FAC, such as water bodies or wetlands on or within 200 feet of the site, and potable water wells on or within 500 feet of the site.

19. Provide a description of how the waste and final residue will be managed to not be expected to cause violations of the Department's ground water, surface water or air standards or criteria

20. Provide an estimate of the maximum amount of waste and final residue that will be store on-site.

21. Provide a detailed description of the technology use at the facility and the functions of all processing equipment that will be utilized. The descriptions shall explain the flow of waste and residue through all the proposed unit operations and shall include: (1) regular facility operations as they are expected to occur; (2) procedures for start up operations, and scheduled and unscheduled shut down operations; (3) potential safety hazards and control methods, including fire detection and control; (4) a description of any expected air emissions and wastewater discharges from the facility which may be potential pollution sources; (5) a description and usage rate of any chemical or biological additives that will be used in the process; and (6) process flow diagrams for the facility operations.

22. Provide a description of the loading, unloading and processing areas.

23. Provide a description of the leachate control system that will be used to prevent discharge of leachate to the environment and mixing of leachate with stormwater. Note: Ground water monitoring may be required for the facility depending on the method of leachate control used.

24. Provide an operation plan for the facility which includes: (1) a description of general facility operations, the number of personnel responsible for the operations including their respective job descriptions, and the types of equipment that will be used at the facility; (2) procedures to ensure any unauthorized wastes received at the site will be properly managed; (3) a contingency plan to cover operation interruptions and emergencies such as fires, explosions, or natural disasters; (4) procedures to ensure operational records needed for the facility will be adequately prepared and maintained; and (5) procedures to ensure that the wastes and final residue will be managed to not be expected to cause pollution.

25. Provide a closure plan that describes the procedures that will be implemented when the facility closes including: (1) estimated time to complete closure; (2) procedures for removing and properly managing or disposing of all wastes and final residues; (3) notification of the Department upon ceasing operations and completion of final closure.

D. **PROHIBITIONS** (62-701.300, FAC)

S	**LOCATION**	**N/A**	**N/C**		
			X	1.	Provide documentation that each of the siting criteria will be satisfied for the facility; (62-701.300(2), FAC)
			X	2.	If the facility qualifies for any of the exemptions contained in Rules 62-701.300(12) through (16), FAC, then document this qualification(s).
			X	3.	Provide documentation that the facility will be in compliance with the burning restrictions; (62-701.300(3), FAC)
			X	4.	Provide documentation that the facility will be in compliance with the hazardous waste restrictions; (62-701.300(4), FAC)
			X	5.	Provide documentation that the facility will be in compliance with the PCB disposal restrictions; (62-701.300(5), FAC)
			X	6.	Provide documentation that the facility will be in compliance with the biomedical waste restrictions; (62-701.300(6), FAC)
			X	7.	Provide documentation that the facility will be in compliance with the Class I surface water restrictions; (62-701.300(7), FAC)
			X	8.	Provide documentation that the facility will be in compliance with the special waste for landfills restrictions; (62-701.300(8), FAC)
			X	9.	Provide documentation that the facility will be in compliance with the special waste for waste-to-energy facilities restrictions; (62-701.300(9), FAC)
			X	10.	Provide documentation that the facility will be in compliance with the liquid restrictions; (62-701.300(10), FAC)
			X	11.	Provide documentation that the facility will be in compliance with the used oil restrictions; (62-701.300(11), FAC)

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

S	LOCATION	N/A	N/C		
X				1.	Four copies, at minimum, of the completed application form, all supporting data and reports; (62-701.320(5)(a),FAC)
X				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)
X				3.	A letter of transmittal to the Department; (62-701.320(7)(a),FAC)
X				4.	A completed application form dated and signed by the applicant; (62-701.320(7)(b),FAC)
X				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)
X				6.	An engineering report addressing the requirements of this rule and with the following format: a cover sheet, text printed on 8 1/2 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)
X	App. L			7.	Operation Plan and Closure Plan; (62-701.320(7)(e)1,FAC)
X	App. L			8.	Contingency Plan; (62-701.320(7)(e)2,FAC)
				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; (62-702.320(7)(f),FAC)
X	Permit Dwgs			a.	A regional map or plan with the project location;
X	Permit Dwgs			b.	A vicinity map or aerial photograph no more than 1 year old;
		X		c.	A site plan showing all property boundaries certified by a registered Florida land surveyor;

PART E CONTINUED

S	LOCATION	N/A	N/C		
X				d.	Other necessary details to support the engineering report.
			X	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)
		X		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)
		X		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 this state; (62-701.320(7)(i),FAC)
X	Sec. 2.2			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; (62-702.320(8),FAC)
			X	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)
X	App. L			15.	Explain how the operator training requirements will be satisfied for the facility; (62-701.320(15), FAC)

F. LANDFILL PERMIT REQUIREMENTS (62-701.330, FAC)

S	LOCATION	N/A	N/C		
		X		1.	Vicinity map or aerial photograph no more than 1 year old and of appropriate scale showing land use and local zoning within one mile of the landfill and of sufficient scale to show all homes or other structures, water bodies, and roads other significant features of the vicinity. All significant features shall be labeled; (62-701.330(3)(a),FAC)
		X		2.	Vicinity map or aerial photograph no more than 1 year old showing all airports that are located within five miles of the proposed landfill; (62-701.330(3)(b),FAC)
X				3.	Plot plan with a scale not greater than 200 feet to the inch showing; (62-701.330(3)(c),FAC)
X	Permit Dwgs			a.	Dimensions;
X	App. K			b.	Locations of proposed and existing water quality monitoring wells;
		X		c.	Locations of soil borings;
		X		d.	Proposed plan of trenching or disposal areas;
X	Permit Dwgs			e.	Cross sections showing original elevations and proposed final contours which shall be included either on the plot plan or on separate sheets;
		X		f.	Any previously filled waste disposal areas;
		X		g.	Fencing or other measures to restrict access.
				4.	Topographic maps with a scale not greater than 200 feet to the inch with 5-foot contour intervals showing; (62-701.330(3)(d),FAC):
X	Permit Dwgs			a.	Proposed fill areas;
		X		b.	Borrow areas;
X	Permit Dwgs			c.	Access roads;
X	Permit Dwgs			d.	Grades required for proper drainage;
X	Permit Dwgs			e.	Cross sections of lifts;

PART F CONTINUED

S	LOCATION	N/A	N/C		
		X			f. Special drainage devices if necessary;
		X			g. Fencing;
X	Permit Dwgs				h. Equipment facilities.
				5.	A report on the landfill describing the following; (62-701.330(3)(e),FAC)
		X			a. The current and projected population and area to be served by the proposed site;
		X			b. The anticipated type, annual quantity, and source of solid waste, expressed in tons;
X	Sec. 2.3.1				c. The anticipated facility life;
		X			d. The source and type of cover material used for the landfill.
X	App. K			6.	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)(h),FAC)
X	App. O			7.	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)(i),FAC)

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

			X	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(4)(b),FAC)
		X		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(4)(c),FAC)
		X		3.	Describe what methods shall be taken to screen the landfill from public view where such screening can practically be provided; (62-701.340(4)(d),FAC)

H. LANDFILL CONSTRUCTION REQUIREMENTS (62-701.400,FAC)

S	LOCATION	N/A	N/C	
X	Eng. Rep and Permit Dwgs			1. Describe how the landfill shall be designed so that solid waste disposal units will be constructed and closed at planned intervals throughout the design period of the landfill; (62-701.400(2),FAC)
				2. Landfill liner requirements; (62-701.400(3),FAC)
				a. General construction requirements; (62-701.400(3)(a),FAC):
X	Sec. 4.4			(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;
X	Sec. 3.3			(2) Document foundation is adequate to prevent liner failure;
X	Sec. 3.2.1			(3) Constructed so bottom liner will not be adversely impacted by fluctuations of the ground water;
		X		(4) Designed to resist hydrostatic uplift if bottom liner located below seasonal high ground water table;
X	Permit Dwgs			(5) Installed to cover all surrounding earth which could come into contact with the waste or leachate.
				b. Composite liners; (62-701.400(3)(b),FAC)
X	Sec. 4.4.4			(1) Upper geomembrane thickness and properties;
X	Sec. 4.2			(2) Design leachate head for primary LCRS including leachate recirculation if appropriate;
		X		(3) Design thickness in accordance with Table A and number of lifts planned for lower soil component.

PART H CONTINUED

S	LOCATION	N/A	N/C	
				c. Double liners; (62-701.400(3)(c),FAC)
		X		(1) Upper and lower geomembrane thicknesses and properties;
		X		(2) Design leachate head for primary LCRS to limit the head to one foot above the liner;
		X		(3) Lower geomembrane sub-base design;
		X		(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);
				d. Standards for geosynthetic components; (62-701.400(3)(d),FAC)
X	App. J			(1) Field seam test methods to ensure all field seams are at least 90 percent of the yield strength for the lining material;
X	App. J			(2) Geomembranes to be used shall pass a continuous spark test by the manufacturer;
X	Sec. 4.4			(3) Design of 24-inch-thick protective layer above upper geomembrane liner;
X	App. L			(4) Describe operational plans to protect the liner and leachate collection system when placing the first layer of waste above 24-inch-thick protective layer.
X	App. I			(5) HDPE geomembranes, if used, meet the specifications in GRI GM13;
		X		(6) PVC geomembranes, if used, meet the specifications in PGI 1197;
X	App. I and J			(7) Interface shear strength testing results of the actual components which will be used in the liner system;
X	App. I and J			(8) Transmissivity testing results of geonets if they are used in the liner system;
		X		(9) Hydraulic conductivity testing results of geosynthetic clay liners if they are used in the liner system;

PART H CONTINUED

S	**LOCATION**	**N/A**	**N/C**	
				e. Geosynthetic specification requirements; (62-701.400(3)(e),FAC)
X	App. J			(1) Definition and qualifications of the designer, manufacturer, installer, QA consultant and laboratory, and QA program;
X	App. I			(2) Material specifications for geomembranes, geocomposites, geotextiles, geogrids, and geonets;
X	App. I			(3) Manufacturing and fabrication specifications including geomembrane raw material and roll QA, fabrication personnel qualifications, seaming equipment and procedures, overlaps, trial seams, destructive and nondestructive seam testing, seam testing location, frequency, procedure, sample size and geomembrane repairs;
X	App. I			(4) Geomembrane installation specifications including earthwork, conformance testing, geomembrane placement, installation personnel qualifications, field seaming and testing, overlapping and repairs, materials in contact with geomembrane and procedures for lining system acceptance;
X	App. I			(5) Geotextile and geogrid specifications including handling and placement, conformance testing, seams and overlaps, repair, and placement of soil materials and any overlying materials;
X	App. I			(6) Geonet and geocomposite specifications including handling and placement, conformance testing, stacking and joining, repair, and placement of soil materials and any overlying materials;
X	App. I			(7) Geosynthetic clay liner specifications including handling and placement, conformance testing, seams and overlaps, repair, and placement of soil material and any overlying materials;
				f. Standards for soil components (62-710.400(3)(f),FAC):
X	App. I			(1) Description of construction procedures including overexcavation and backfilling to preclude structural inconsistencies and procedures for placing and compacting soil component in layers;

S	LOCATION	N/A	N/C	PART H CONTINUED
		X		(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;
		X		(3) Procedures for testing in-situ soils to demonstrate they meet the specifications for soil liners;
				(4) Specifications for soil component of liner including at a minimum:
		X		(a) Allowable particle size distribution, Atterberg limits, shrinkage limit;
		X		(b) Placement moisture and dry density criteria;
		X		(c) Maximum laboratory-determined saturated hydraulic conductivity using simulated leachate;
		X		(d) Minimum thickness of soil liner;
		X		(e) Lift thickness;
		X		(f) Surface preparation (scarification);
		X		(g) Type and percentage of clay mineral within the soil component;
		X		(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.
				3. Leachate collection and removal system (LCRS); (62-701.400(4),FAC)
				a. The primary and secondary LCRS requirements; (62-701.400(4)(a),FAC)
X	Sec. 4.4			(1) Constructed of materials chemically resistant to the waste and leachate;
X	Sec. 4.5.3			(2) Have sufficient mechanical properties to prevent collapse under pressure;
X	Sec. 4.4			(3) Have granular material or synthetic geotextile to prevent clogging;
X	Sec. 4.2.2			(4) Have method for testing and cleaning clogged pipes or contingent designs for rerouting leachate around failed areas;

PART H CONTINUED

S	LOCATION	N/A	N/C	
				b. Primary LCRS requirements; (62-701.400(4)(b),FAC)
		X		(1) Bottom 12 inches having hydraulic conductivity $\geq 1 \times 10^{-3}$ cm/sec;
X	Sec. 4.4			(2) Total thickness of 24 inches of material chemically resistant to the waste and leachate;
X	Sec. 3.4			(3) Bottom slope design to accomodate for predicted settlement;
X	Sec. 4.4.3			(4) Demonstration that synthetic drainage material, if used, is equivalent or better than granular material in chemical compatibility, flow under load and protection of geomembrane liner.
				4. Leachate recirculation; (62-701.400(5),FAC)
		X		a. Describe general procedures for recirculating leachate;
		X		b. Describe procedures for controlling leachate runoff and minimizing mixing of leachate runoff with storm water;
		X		c. Describe procedures for preventing perched water conditions and gas buildup;
		X		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;
		X		e. Describe methods of gas management in accordance with Rule 62-701.530, FAC;
		X		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	LOCATION	N/A	N/C	PART H CONTINUED
				5. Leachate storage tanks and leachate surface impoundments; (62-701.400(6),FAC)
				a. Surface impoundment requirements; (62-701.400(6)(b),FAC)
		X		(1) Documentation that the design of the bottom liner will not be adversely impacted by fluctuations of the ground water;
		X		(2) Designed in segments to allow for inspection and repair as needed without interruption of service;
				(3) General design requirements;
		X		(a) Double liner system consisting of an upper and lower 60-mil minimum thickness geomembrane;
		X		(b) Leak detection and collection system with hydraulic conductivity $\geq$ 1 cm/sec;
		X		(c) Lower geomembrane placed on subbase $\geq$ 6 inches thick with k $\leq 1x10^{-5}$ cm/sec or on an approved geosynthetic clay liner with k $\leq 1x10^{-7}$ cm/sec;
		X		(d) Design calculation to predict potential leakage through the upper liner;
		X		(e) Daily inspection requirements and notification and corrective action requirements if leakage rates exceed that predicted by design calculations;
		X		(4) Description of procedures to prevent uplift, if applicable;
		X		(5) Design calculations to demonstrate minimum two feet of freeboard will be maintained;
		X		(6) Procedures for controlling disease vectors and off-site odors.

PART H CONTINUED

S	LOCATION	N/A	N/C	
				b. Above-ground leachate storage tanks; (62-701.400(6)(c),FAC)
		X		(1) Describe tank materials of construction and ensure foundation is sufficient to support tank;
		X		(2) Describe procedures for cathodic protection if needed for the tank;
		X		(3) Describe exterior painting and interior lining of the tank to protect it from the weather and the leachate stored;
		X		(4) Describe secondary containment design to ensure adequate capacity will be provided and compatibility of materials of construction;
		X		(5) Describe design to remove and dispose of stormwater from the secondary containment system;
		X		(6) Describe an overfill prevention system such as level sensors, gauges, alarms and shutoff controls to prevent overfilling;
				(7) Inspections, corrective action and reporting requirements;
		X		(a) Overfill prevention system weekly;
		X		(b) Exposed tank exteriors weekly;
		X		(c) Tank interiors when tank is drained or at least every three years;
		X		(d) Procedures for immediate corrective action if failures detected;
		X		(e) Inspection reports available for department review.
				c. Underground leachate storage tanks; (62-701.400(6)(d),FAC)
		X		(1) Describe materials of construction;
		X		(2) A double-walled tank design system to be used with the following requirements;

PART H CONTINUED

S	**LOCATION**	**N/A**	**N/C**	
		X		(a) Interstitial space monitoring at least weekly;
		X		(b) Corrosion protection provided for primary tank interior and external surface of outer shell;
		X		(c) Interior tank coatings compatible with stored leachate;
		X		(d) Cathodic protection inspected weekly and repaired as needed;
		X		(3) Describe an overfill prevention system such as level sensors, gauges, alarms and shutoff controls to prevent overfilling and provide for weekly inspections;
		X		(4) Inspection reports available for department review.
		X		d. Schedule provided for routine maintenance of LCRS; (62-701.400(6)(e),FAC)
				6. Liner systems construction quality assurance (CQA); (62-701.400(7),FAC)
X	App. J			a. Provide CQA Plan including:
X	App. J			(1) Specifications and construction requirements for liner system;
X	App. J			(2) Detailed description of quality control testing procedures and frequencies;
X	App. J			(3) Identification of supervising professional engineer;
X	App. J			(4) Identify responsibility and authority of all appropriate organizations and key personnel involved in the construction project;
X	App. J			(5) State qualifications of CQA professional engineer and support personnel;
X	App. J			(6) Description of CQA reporting forms and documents;

S	LOCATION	N/A	N/C	PART H CONTINUED
X	App. J			b. An independent laboratory experienced in the testing of geosynthetics to perform required testing;
				7. Soil Liner CQA (62-701.400(8)FAC)
		X		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;
		X		b. Description of field test section construction and test methods to be implemented prior to liner installation;
		X		c. Description of field test methods including rejection criteria and corrective measures to insure proper liner installation.
				8. Surface water management systems; (62-701.400(9),FAC)
		X		a. Provide a copy of a Department permit for stormwater control or documentation that no such permit is required;
		X		b. Design of surface water management system to isolate surface water from waste filled areas and to control stormwater run-off;
X	Permit Dwgs			c. Details of stormwater control design including retention ponds, detention ponds, and drainage ways;
				9. Gas control systems; (62-701.400(10),FAC)
		X		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;
		X		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)

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

S	**LOCATION**	**N/A**	**N/C**	
				1. Submit a hydrogeological investigation and site report including at least the following information:
			X	a. Regional and site specific geology and hydrogeology;
			X	b. Direction and rate of ground water and surface water flow including seasonal variations;
			X	c. Background quality of ground water and surface water;
			X	d. Any on-site hydraulic connections between aquifers;
			X	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;
			X	f. Description of topography, soil types and surface water drainage systems;
			X	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;
			X	h. Identify and locate any existing contaminated areas on the site;
			X	i. Include a map showing the locations of all potable wells within 500 feet, and all community water suupply wells within 1000 feet, of the waste storage and disposal areas;
			X	2. Report signed, sealed and dated by PE or PG.

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

S	LOCATION	N/A	N/C	
				1. Submit a geotechnical site investigation report defining the engineering properties of the site including at least the following:
			X	a. Description of subsurface conditions including soil stratigraphy and ground water table conditions;
			X	b. Investigate for the presence of muck, previously filled areas, soft ground, lineaments and sink holes;
			X	c. Estimates of average and maximum high water table across the site;
				d. Foundation analysis including:
X	Sec. 3.3			(1) Foundation bearing capacity analysis;
X	Sec. 3.4			(2) Total and differential subgrade settlement analysis;
X	Sec. 3.3			(3) Slope stability analysis;
			X	e. Description of methods used in the investigation and includes soil boring logs, laboratory results, analytical calculations, cross sections, interpretations and conclusions;
			X	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.
			X	2. Report signed, sealed and dated by PE or PG.

K. **VERTICAL EXPANSION OF LANDFILLS** (62-701.430,FAC) N/A

S	**LOCATION**	**N/A**	**N/C**	
		X		1. Describe how the vertical expansion shall not cause or contribute to leachate leakage from the existing landfill or adversely affect the closure design of the existing landfill;
		X		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;
		X		3. Provide foundation and settlement analysis for the vertical expansion;
		X		4. Provide total settlement calculations demonstrating that the final elevations of the lining system, that gravity drainage, and that no other component of the design will be adversely affected;
		X		5. Minimum stability safety factor of 1.5 for the lining system component interface stability and deep stability;
		X		6. Provide documentation to show the surface water management system will not be adversely affected by the vertical expansion;
		X		7. Provide gas control designs to prevent accumulation of gas under the new liner for the vertical expansion.

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

X	App. L			1.	Provide documentation that 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)
				2.	Provide a landfill operation plan including procedures for: (62-701.500(2), FAC)
X	App. L			a.	Designating responsible operating and maintenance personnel;
X	App. L			b.	Contingency operations for emergencies;
X	App. L			c.	Controlling types of waste received at the landfill;
X	App. L			d.	Weighing incoming waste;
X	App. L			e.	Vehicle traffic control and unloading;
X	App. L			f.	Method and sequence of filling waste;
X	App. L			g.	Waste compaction and application of cover;
X	App. L			h.	Operations of gas, leachate, and stormwater controls;
X	App. K			i.	Water quality monitoring.
X	Sec 4.2.2			j.	Maintaining and cleaning the leachate collection system;
X	App. L			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. FDEP permit, engineering drawings, water quality records, etc.) (62-701.500(3),FAC)
X	App. L			4.	Describe the waste records that will be compiled monthly and provided to the Department quarterly; (62-701.500(4),FAC)
X	App. L			5.	Describe methods of access control; (62-701.500(5),FAC)
X	App. L			6.	Describe load checking program to be implemented at the landfill to discourage disposal of unauthorized wastes at the landfill; (62-701.500(6),FAC)
				7.	Describe procedures for spreading and compacting waste at the landfill that include: (62-701.500(7),FAC)
X	App. L			a.	Waste layer thickness and compaction frequencies;

PART L CONTINUED

S	LOCATION	N/A	N/C	
X	App. L			b. Special considerations for first layer of waste placed above liner and leachate collection system;
X	App. L			c. Slopes of cell working face and side grades above land surface, planned lift depths during operation;
X	App. L			d. Maximum width of working face;
				e. Description of type of initial cover to be used at the facility that controls:
X	App. L			(1) Disease vector breeding/animal attraction
X	App. L			(2) Fires
X	App. L			(3) Odors
X	App. L			(4) Blowing litter
X	App. L			(5) Moisture infiltration
X	App. L			f. Procedures for applying initial cover including minimum cover frequencies;
X	App. L			g. Procedures for applying intermediate cover;
X	App. L			h. Time frames for applying final cover;
X	App. L			i. Procedures for controlling scavenging and salvaging.
X	App. L			j. Description of litter policing methods;
X	App. L			k. Erosion control procedures.
				8. Describe operational procedures for leachate management including; (62-701.500(8), FAC)
X	Eng. Rep./App. L			a. Leachate level monitoring, sampling, analysis and data results submitted to the Department;
X	Eng. Rep./App. L			b. Operation and maintenance of leachate collection and removal system, and treatment as required;
X	Eng. Rep./App. L			c. Procedures for managing leachate if it becomes regulated as a hazardous waste;
		X		d. Agreements for off-site discharge and treatment of leachate;
X	Eng. Rep./App. L			e. Contingency plan for managing leachate during emergencies or equipment problems;

PART L CONTINUED

S	LOCATION	N/A	N/C	
X	App. L			f. Procedures for recording quantities of leachate generated in gal/day and including this in the operating record;
X	App. L			g. Procedures for comparing precipitation experienced at the landfill with leachate generation rates and including this information in the operating record;
X	Sec 4.2.2			h. Procedures for water pressure cleaning or video inspecting leachate collection systems.
		X		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)
X	Sec 7.4.7			10. Describe procedures for operating and maintaining the landfill stormwater management system to comply with the requirements of Rule 62-701.400(9); (62-701.500(10),FAC)
				11. Equipment and operation feature requirements; (62-701.500(11),FAC)
X	App. L			a. Sufficient equipment for excavating, spreading, compacting and covering waste;
X	App. L			b. Reserve equipment or arrangements to obtain additional equipment within 24 hours of breakdown;
X	App. L			c. Communications equipment;
X	App. L			d. Dust control methods;
X	App. L			e. Fire protection capabilities and procedures for notifying local fire department authorities in emergencies;
X	App. L			f. Litter control devices;
X	App. L			g. Signs indicating operating authority, traffic flow, hours of operation, disposal restrictions.
X	App. L			12. Provide a description of all-weather access road, inside perimeter road and other roads necessary for access which shall be provided at the landfill; (62-701.500(12),FAC)
				13. Additional record keeping and reporting requirements; (62-701.500(13),FAC)

S	LOCATION	N/A	N/C	PART L CONTINUED
X	App. L			a. Records used for developing permit applications and supplemental information maintained for the design period of the landfill;
X	App. L			b. Monitoring information, calibration and maintenance records, copies of reports required by permit maintained for at least 10 years;
X	App. L			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;
X	App. L			d. Procedures for archiving and retrieving records which are more than five year old.

M. WATER QUALITY AND LEACHATE MONITORING REQUIREMENTS (62-701.510, FAC)

S	**LOCATION**	**N/A**	**N/C**	
X	App. K			1. Water quality and leachate monitoring plan shall be submitted describing the proposed ground water, surface water and leachate monitoring systems and shall meet at least the following requirements;
			X	a. Based on the information obtained in the hydrogeological investigation and signed, dated and sealed by the PG or PE who prepared it; (62-701.510(2)(a),FAC)
X	App. K			b. All sampling and analysis preformed in accordance with Chapter 62-160, FAC; (62-701.510(2)(b),FAC)
				c. Ground water monitoring requirements; (62-701.510(3),FAC)
X	App. K			(1) Detection wells located downgradient from and within 50 feet of disposal units;
X	App. K			(2) Downgradient compliance wells as required;
X	App. K			(3) Background wells screened in all aquifers below the landfill that may be affected by the landfill;
X	App. K			(4) Location information for each monitoring well;
X	App. K			(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;
X	App. K			(6) Well screen locations properly selected;
X	App. K			(7) Procedures for properly abandoning monitoring wells;
X	App. K			(8) Detailed description of detection sensors if proposed.

PART M CONTINUED

S	LOCATION	N/A	N/C	
				d. Surface water monitoring requirements; (62-701.510(4),FAC)
		X		(1) Location of and justification for all proposed surface water monitoring points;
		X		(2) Each monitoring location to be marked and its position determined by a registered Florida land surveyor;
X	App. K			e. Leachate sampling locations proposed; (62-701.510(5),FAC)
				f. Initial and routine sampling frequency and requirements; (62-701.510(6),FAC)
X	App. K			(1) Initial background ground water and surface water sampling and analysis requirements;
X	App. K			(2) Routine leachate sampling and analysis requirements;
X	App. K			(3) Routine monitoring well sampling and analysis requirements;
		X		(4) Routine surface water sampling and analysis requirements.
X	App. K			g. Describe procedures for implementing evaluation monitoring, prevention measures and corrective action as required; (62-701.510(7),FAC)
X	App. K			h. Water quality monitoring report requirements; (62-701.510(9),FAC)
X	App. K			(1) Semi-annual report requirements;
X	App. K			(2) Bi-annual report requirements signed, dated and sealed by PG or PE.

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

S	LOCATION	N/A	N/C		
		X		1.	Describe procedures for managing motor vehicles; (62-701.520(1),FAC)
		X		2.	Describe procedures for landfilling shredded waste; (62-701.520(2),FAC)
X	App. L			3.	Describe procedures for asbestos waste disposal; (62-701.520(3),FAC)
		X		4.	Describe procedures for disposal or management of contaminated soil; (62-701.520(4), FAC)
		X		5.	Describe procedures for disposal of biological wastes; (62-701.520(5), FAC)

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

				1.	Provide the design for a gas management systems that will (62-701.530(1), FAC):
			X	a.	Be designed to prevent concentrations of combustible gases from exceeding 25% the LEL in structures and 100% the LEL at the property boundary;
			X	b.	Be designed for site-specific conditions;
			X	c.	Be designed to reduce gas pressure in the interior of the landfill;
			X	d.	Be designed to not interfere with the liner, leachate control system or final cover.
			X	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):
X	App. L			3.	Provide documentation describing how the gas remediation plan and odor remediation plan will be implemented; (62-701.530(3), FAC):
				4.	Landfill gas recovery facilities; (62-701.530(5), FAC):
		X		a.	Information required in Rules 62-701.320(7) and 62-701.330(3), FAC supplied;
		X		b.	Information required in Rule 62-701.600(4), FAC supplied where relevant and practical;
		X		c.	Estimate of current and expected gas generation rates and description of condensate disposal methods provided;

PART O CONTINUED

S	LOCATION	N/A	N/C		
		X		d.	Description of procedures for condensate sampling, analyzing and data reporting provided;

		X		e.	Closure plan provided describing methods to control gas after recovery facility ceases operation and any other requirements contained in Rule 62-701.400(10), FAC;
		X		f.	Performance bond provided to cover closure costs if not already included in other landfill closure costs.

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

				1.	Closure schedule requirements; (62-701.600(2),FAC)
X	Sec 7.3			a.	Documentation that a written notice including a schedule for closure will be provided to the Department at least one year prior to final receipt of wastes;
X	Sec 7.3			b.	Notice to user requirements within 120 days of final receipt of wastes;
X	Sec 7.3			c.	Notice to public requirements within 10 days of final receipt of wastes.
				2.	Closure permit general requirements; (62-701.600(3),FAC)
		X		a.	Application submitted to Department at least 90 days prior to final receipt of wastes;
				b.	Closure plan shall include the following:
		X		(1)	Closure report;
		X		(2)	Closure design plan;
		X		(3)	Closure operation plan;
		X		(4)	Closure procedures;
		X		(5)	Plan for long term care;
		X		(6)	A demonstration that proof of financial responsibility for long term care will be provided.
				3.	Closure report requirements; (62-701.600(4),FAC)
				a.	General information requirements;
		X		(1)	Identification of landfill;

PART P CONTINUED

S	**LOCATION**	**N/A**	**N/C**	
		X		(2) Location, description and vicinity map;
		X		(3) Total acres of disposal areas and landfill property;
		X		(4) Legal property description;
		X		(5) History of landfill;
		X		(6) Identification of types of waste disposed of at the landfill.
		X		b. Geotechnical investigation report and water quality monitoring plan required by Rule 62-701.330(3),FAC;
		X		c. Land use information report indicating: identification of adjacent landowners; zoning; present land uses; and roads, highways right-of-way, or easements.
		X		d. Report on actual or potential gas migration at landfills containing degradable wastes which would allow migration of gas off the landfill property;
		X		e. Report assessing the effectiveness of the landfill design and operation including results of geotechnical investigations, surface water and storm water management, gas migration and concentrations, condition of existing cover, and nature of waste disposed of at the landfill;
				4. Closure design requirements to be included in the closure design plan: (62-701.600(5),FAC)
		X		a. Plan sheet showing phases of site closing;
		X		b. Drawings showing existing topography and proposed final grades;
		X		c. Provisions to close units when they reach approved design dimensions;
		X		d. Final elevations before settlement;
		X		e. Side slope design including benches, terraces, down slope drainage ways, energy dissipators and discussion of expected precipitation effects;
				f. Final cover installation plans including:
		X		(1) CQA plan for installing and testing final cover;

PART P CONTINUED

S	LOCATION	N/A	N/C	
		X		(2) Schedule for installing final cover after final receipt of waste;
		X		(3) Description of drought-resistant species to be used in the vegetative cover;
		X		(4) Top gradient design to maximize runoff and minimize erosion;
		X		(5) Provisions for cover material to be used for final cover maintenance.
				g. Final cover design requirements:
		X		(1) Protective soil layer design;
		X		(2) Barrier soil layer design;
		X		(3) Erosion control vegetation;
		X		(4) Geomembrane barrier layer design;
		X		(5) Geosynthetic clay liner design if used;
		X		(6) Stability analysis of the cover system and the disposed waste.
		X		h. Proposed method of stormwater control;
		X		i. Proposed method of access control;
		X		j. Description of proposed final use of the closed landfill, if any;
		X		k. Description of the proposed or existing gas management system which complies with Rule 62-701.530, FAC.
				5. Closure operation plan shall include: (62-701.600(6),FAC)
		X		a. Detailed description of actions which will be taken to close the landfill;
		X		b. Time schedule for completion of closing and long term care;
		X		c. Describe proposed method for demonstrating financial responsibility;
		X		d. Indicate any additional equipment and personnel needed to complete closure.

S	LOCATION	N/A	N/C	PART P CONTINUED
		X		e. Development and implementation of the water quality monitoring plan required in Rule 62-701.510, FAC.
		X		f. Development and implementation of gas management system required in Rule 62-701.530, FAC.
		X		6. Justification for and detailed description of procedures to be followed for temporary closure of the landfill, if desired; (62-701.600(7),FAC)

Q. CLOSURE PROCEDURES (62-701.610,FAC)

S	LOCATION	N/A	N/C		
		X		1.	Survey monuments; (62-701.610(2),FAC)
		X		2.	Final survey report; (62-701.610(3),FAC)
		X		3.	Certification of closure construction completion; (62-701.610(4),FAC)
		X		4.	Declaration to the public; (62-701.610(5),FAC)
		X		5.	Official date of closing; (62-701.610(6),FAC)
		X		6.	Use of closed landfill areas; (62-701.610(7),FAC)
		X		7.	Relocation of wastes; (62-701.610(8), FAC)

R. LONG TERM CARE REQUIREMENTS (62-701.620,FAC)

		X		1.	Maintaining the gas collection and monitoring system; (62-701.620(5), FAC)
		X		2.	Right of property access requirements; (62-701.620(6),FAC)
		X		3.	Successors of interest requirements; (62-701.620(7),FAC)
		X		4.	Requirements for replacement of monitoring devices; (62-701.620(9),FAC)
		X		5.	Completion of long term care signed and sealed by professional engineer (62-701.620(10), FAC).

S. FINANCIAL RESPONSIBILITY REQUIREMENTS (62-701.630,FAC)

X	App. O			1.	Provide cost estimates for closing, long term care, and corrective action costs estimated by a PE for a third party performing the work, on a per unit basis, with the source of estimates indicated; (62-701.630(3)&(7), FAC).
X	Sec 7.5			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).
X	Sec 7.5			3.	Describe funding mechanisms for providing proof of financial assurance and include appropriate financial assurance forms; (62-701.630(5),(6),&(9), FAC).

T. CERTIFICATION BY APPLICANT AND ENGINEER OR PUBLIC OFFICER

1. Applicant:

The undersigned applicant or authorized representative of Waste Management, Inc. of Florida is aware that statements made in this form and attached information are an application for a Construct / Operate 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.

Signature of Applicant or Agent	242 West Keene Road Mailing Address
Ray Chewning, Senior Engineer Name and Title (please type)	Apopka, Florida 32703 City, State, Zip Code
rchewning@wm.com E-Mail address (if available)	(407) 886-2920 Telephone Number
	Date:

Attach letter of authorization if agent is not a governmental 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	14055 Riveredge Drive, Suite 300 Mailing Address
Juan D. Quiroz, Project Engineer Name and Title (please type)	Tampa, Florida 33637 City, State, Zip Code
	jdquiroz@geosyntec.com E-Mail address (if available)
65275 Florida Registration Number (please affix seal)	(813) 558-0990 Telephone Number
	Date:

T. CERTIFICATION BY APPLICANT AND ENGINEER OR PUBLIC OFFICER

1. Applicant:

The undersigned applicant or authorized representative of Waste Management, Inc. of Florida is aware that statements made in this form and attached information are an application for a Construct / Operate 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.

Signature of Applicant or Agent

Ray Chewning, Senior Engineer
Name and Title (please type)

rchewning@wm.com
E-Mail address (if available)

242 West Keene Road
Mailing Address

Apopka, Florida 32703
City, State, Zip Code

(407) 886-2920
Telephone Number

Date:

Attach letter of authorization if agent is not a governmental 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

Juan D. Quiroz, Project Engineer
Name and Title (please type)

65275
Florida Registration Number
(please affix seal)

14055 Riveredge Drive, Suite 300
Mailing Address

Tampa, Florida 33637
City, State, Zip Code

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

(813) 558-0990
Telephone Number

Date:

Geosyntec
consultants

COMPUTATION COVER SHEET

Client: **Vista LF, LLC** Project: **Vista Landfill – Substantial Permit Mod** Project No.: **FL1229**
Phase No.:

Title of Computations **SITE GEOTECHNICAL MODEL**

Computations by:
Signature
Printed Name Wade Tyner, E.I.T.
Title Staff Engineer
11 June 2007
Date

Assumptions and Procedures Checked by:
(peer reviewer)
Signature Juan D. Quiroz
Printed Name Juan D. Quiroz, Ph.D., P.E.
Title Project Engineer
15 June 2007
Date

Computations Checked by:
Signature
Printed Name Sangho "Jay" Eun, E.I.T.
Title Senior Staff Engineer
15 June 2007
Date

Computations Backchecked by:
(originator)
Signature
Printed Name Wade Tyner, E.I.T.
Title Staff Engineer
25 July 2007
Date

Approved by:
(pm or designate)
Signature Juan D. Quiroz
Printed Name Juan D. Quiroz, Ph.D., P.E.
Title Project Engineer
27 July 2007
Date

Approval notes:

Revisions (number and initial all revisions)

No.	Sheet	Date	By	Checked by	Approval

Written by: **W. Tyner** Date: **06/11/07** Reviewed by: **J. Quiroz** Date: **06/15/07**

Client: **Vista LF** Project: **Vista LF – Substantial** Project No.: **FL1229** Phase No.:

SITE GEOTECHNICAL MODEL VISTA CLASS III LANDFILL APOPKA, FLORIDA

PURPOSE

The purpose of this calculation package is to present the site geotechnical model that was developed for the Vista Class III Landfill facility located in Apopka, Florida. This subsurface model will then be utilized to evaluate the geotechnical stability of the landfill configuration.

The subsequent sections present several aspects of the site's geotechnical features, and include the following items:

- Summary of documents reviewed to establish the site's subsurface model;
- General description of site geology, and subsurface stratigraphy;
- Presentation of the previous geotechnical site investigation results, including a general description of subsurface soils; and
- Geosyntec Consultants' (Geosyntec's) interpretation of the site's geotechnical model.

DOCUMENTS REVIEWED

The documents that were reviewed to establish the site's subsurface model were obtained from three permit applications prepared by Ed Chesney, P.E. of Bishop and Buttrey, Inc. located in Orlando, Florida. A listing of the reviewed documents is provided below.

- Section IV – Hydrogeologic Survey and Groundwater Monitoring Plan, "Buttrey Development Two, L.L.C., Application for Keene Road Disposal, Class III Landfill," Bishop and Buttrey, Inc., March 2001.

- Section III – Engineering Report, "Buttrey Development Three, L.L.C., Application for Keene Road Disposal, Class III Landfill," Bishop and Buttrey, Inc., August 2003.
- Section II – Engineering Report, "Buttrey Development Four, L.L.C., Application for Keene Road Disposal, Class III Landfill," Bishop and Buttrey, Inc., May 2004.

GEOLOGY OF THE VISTA LANDFILL SITE

The landfill site lies within the Apopka Upland physiographic subdivision, a part of the Central Lake District [Brooks, 1981] which is characterized by sand hills and small lakes. These features are developed on 80 to 100 ft of surficial sands and clays underlain by a thick sequence of limestone.

The subsurface stratigraphy at the site primarily includes three lithologic units (from top to bottom), as described below [Soil Conservation Service, 1989].

- The upper zone is mostly undifferentiated marine sediments consisting of loose quarts sands and occasional lenses of clay with small quantities of phosphatic grains. These surficial soils are generally characterized as fine sands approximately 30 to 60 ft thick with a deep water table.
- The middle zone is the Hawthorne Formation consisting of greenish clayey sand and sandy clay with interbedded sands and clays; dolomites and limestones are encountered towards the bottom of the formation. The Hawthorne Formation has a variable thickness from about 50 to 80 ft, and generally forms a confining layer between the surficial and underlying Floridan aquifer.
- The lower zone is the Ocala Limestone consisting of cream to tan, fine-grained, porous limestone approximately 30 ft thick. The estimated top of the Ocala Formation in the vicinity of the site is at approximately EL. 0 ft, NGVD [Scott, 1988]. Beneath the Ocala Formation there is approximately 1,200 ft of limestone belonging to the Avon Park Formation.

The ground water in western Orange County occurs under artesian and non-artesian conditions. The non-artesian ground water occurs in the upper undifferentiated marine deposits, while the artesian ground water is derived from Floridan aquifer. Generally, in the vicinity of the site, the potentiometric surface typically ranges from EL. 50 to 60 ft, NGVD.

GEOTECHNICAL SITE INVESTIGATION

Overview of Geotechnical Testing Program

Three separate geotechnical site investigations were performed to evaluate the subsurface conditions at the Vista Landfill. Each site investigation focused on a separate phase of the landfill development footprint, i.e., Phases 1 through 3. Phase 1 includes Cells 1 through 4 along the northern portion of the landfill, Phase 2 includes Cells 5 through 8 along the central portion of the landfill, and Phase 3 includes Cells 9 through 12 along the southern portion of the landfill.

The geotechnical investigation program included soil borings consisting of Standard Penetration Tests (SPTs), and laboratory geotechnical index tests were performed on selected soil samples. Continuous SPTs with a split spoon barrel were conducted to provide N-values (blows/ft) and a continuous visual examination of the soil profile. Soil index tests for samples obtained during the SPTs included water contents, grain size analyses and Atterberg limits. In addition, hydraulic conductivity tests were also performed on selected fine-grained soil samples to confirm the presence and thickness of a low permeability confining layer below the surficial fine sands. The soil borings were performed by Universal Engineering Sciences, Inc. located in Orlando, Florida. Each site investigation is briefly described below:

- Twenty nine soil borings (B-1 through B-29) were performed for Phase 1 from 1998 through 2000. Soil boring depths varied from about 30 to 100 ft below ground surface.

- Seventeen soil borings (EB-1 through EB-17) were performed for Phase 2 in 2001. Soil boring depths varied from about 32 to 78 ft below ground surface.

- Twenty three soil borings (CB-1 through CB-23) were performed for Phase 3 in 2003 and 2004. Soil boring depths varied from about 40 to 115 ft below ground surface.

The soil boring logs and corresponding boring locations for each phase of landfill development are provided in Attachment 1. (Note: Only boring logs that included survey information, i.e., ground surface elevations, were utilized to evaluate the subsurface conditions.)

Results of Field Exploration Program

The subsurface conditions varied throughout the site. Measured N-values versus depth were plotted for each phase of landfill development, and are provided in Attachment 2. Given the variability of the measure N-values versus depth, an average N-value was conservatively established to estimate soil properties of the soils. The general subsurface stratigraphic profile based on the SPT borings for each landfill development phase is broadly summarized below.

For Phase 1 along the northern portion of the landfill, from EL. 105 to 50 ft, NGVD the soil consists of a loose fine sand and silty fine sand to clayey sand with average N-values of about 5 to 10. From EL. 50 to 30 ft, NGVD the soil consists of a medium sandy to silty clay, and clayey sand and silt with an average N-value of about 8. From EL. 30 to 0 ft, NGVD the soil consists of medium fine sand and clayey sand with an average N-value of about 20.

For Phase 2 along the central portion of the landfill, from EL. 105 to 65 ft, NGVD the soil consists of a loose to medium fine sand and silty fine sand to clayey sand with average N-values of about 4 to 12. From EL. 65 to 45 ft, NGVD the soil consists of a medium sandy to silty clay, and clayey sand and silt with an average N-value of about 7. From EL. 45 to 20 ft, NGVD the soil consists of loose to medium clayey sand and silt with an average N-value of about 10.

For Phase 3 along the southern portion of the landfill, from EL. 115 to 60 ft, NGVD the soil consists of loose to medium fine sand and silty fine sand to clayey sand with average N-values of about 4 to 10. From EL. 60 to 40 ft, NGVD the soil consists of a medium sandy and silty clay, and clayey sand with an average N-value of about 7.

From EL. 40 to 30 ft, NGVD the soil consists of a loose to medium clayey sand with an average N-value of about 10.

GENERALIZED SUBSURFACE GEOTECHNICAL MODEL

Subsurface Stratigraphy

The generalized subsurface geotechnical model for the site was based on the SPTs performed for each phase of landfill development. Figures 1 and 2 present the two generalized cross sections that were developed for the site. Section 1 is an east-west cross section that incorporates SPT data from Phase 1; and Section 2 is a north-south cross section that incorporates SPT data from Phases 2 and 3. Local site geology indicates that the subsurface is characterized by marine deposits underlain by limestone formations at a depth approximately 100 ft below ground surface. The generalized subsurface profile, from top to bottom, for Sections 1 and 2 is summarized below.

- Layer 1: The upper soil layer consists of loose fine sand and silty to clayey sand deposits.
- Layer 2: The next soil layer consists of medium dense fine sand and silty to clayey sand deposits.
- Layer 3: Below Layer 2, the geologic formation consists of a fine-grained soil characterized as medium sandy to silty clay and clayey sand deposits.
- Layer 4: The lower portions of the soil profile consist of fine sand, clayey sand and silt deposits.
- Layer 5: The bottom of the geotechnical model consists of a bedrock formation characterized as limestone. The top of bedrock was assumed to occur at EL. 0 ft, NGVD, approximately 100 ft below ground surface.
- Ground Water: The ground water table (GWT) varies throughout the site. The seasonal high GWT as shown in Sheet 3 of the Permit Drawings was conservatively used for Sections 1 and 2 (see Figures 1 and 2).

Material Properties

The subsurface soil properties required for geotechnical stability analyses (e.g., foundation settlement and slope stability) are also presented in Figures 1 and 2. These values are based on empirical correlations with SPT measurements and simple weight-volume relationships.

Unit Weight

The unit weight values selected for design purposes are consistent with typical values associated with similar fine sands and clayey soils. Layers 1, 2 and 4 consist of loose to medium dense soils; thus a total unit weight of 110 pcf was assumed for these layers. The unit weight of the medium clayey soil layer (i.e., Layer 3) was assumed to be 120 pcf.

Shear Strength

The shear strength parameters were based on empirical correlations to the measured N-values from the SPTs as presented by Peck et al. [1974]. Note that soils characterized as cohesionless, i.e., sands, were assigned an angle of internal friction (ϕ); and cohesive soils, i.e., clays, were assigned a cohesion (c). The N-values and corresponding c or ϕ values for each subsurface layer are summarized below.

- Layer 1: For average N-values that varied from about 4 to 5, an average ϕ value of 28° was selected.
- Layer 2: For average N-values that varied from about 10 to 12, an average ϕ value of 30° was selected.
- Layer 3: For average N-values that varied from about 7 to 8, an average c value of 700 psf was selected.
- Layer 4: For average N-values of 20 (for Section 1) and 10 (for Section 2), average ϕ values of 33° and 30° were selected, respectively.

Written by: **W. Tyner** Date: **06/11/07** Reviewed by: **J. Quiroz** Date: **06/15/07**

Client: **Vista LF** Project: **Vista LF – Substantial** Project No.: **FL1229** Phase No.:

Elastic Settlement Parameters

The settlement of the sandy soil layers can be estimated using one-dimensional stress-strain relationships [Lambe and Whitman, 1969]. The modulus of elasticity (E_s) and Poisson's ratio (μ) are required parameters for estimating elastic deformation or settlement of sandy soils such as Layers 1, 2 and 4.

The modulus of elasticity of the sandy soil layers was estimated in accordance with the relation established by Schmertmann [1970] where E_s in tons/ft^2 is calculated as follows:

$E_s = 8\ N$

where N = blows/ft as measured in the SPT (i.e., measured N-value).

Poisson's ratio (μ) for the sandy soil layers was assumed to be 0.35 [Das, 1999], and a summary of E_s for each sandy soil layer is provided below.

- Layer 1: For average N-values that varied from about 4 to 5, an average E_s value of 80,000 psf was calculated.
- Layer 2: For average N-values that varied from about 10 to 12, an average E_s value of 176,000 psf was calculated.
- Layer 4: For average N-values of 20 (for Section 1) and 10 (for Section 2), average E_s values of 320,000 psf and 160,000 psf were calculated, respectively.

Consolidation Parameters

The settlement of the clayey soil layers can be estimated using conventional one-dimensional consolidation theory. The compression index (C_c) and initial void ratio (e_o) are required parameters for estimating consolidation settlement of the clayey soil layer, i.e., Layer 3.

An e_o of 1.08 was estimated for the clayey soil layer based on the weight-volume relationship:

$G\omega = Se$

where G = specific gravity of soil (assume 2.70);

ω = water content of the soil (average ω = 40%);

S = degree of saturation (assume 100%); and

e = void ratio.

A C_c of 0.270 was estimated for the clayey soil layer based on the following relationship as established by Terzaghi and Peck [1967]:

$C_c = 0.009\ (LL\text{-}10)$

where LL = Liquid Limit of the soil from Atterberg limit testing (average LL = 40).

Written by: **W. Tyner** Date: **06/11/07** Reviewed by: **J. Quiroz** Date: **06/15/07**

Client: **Vista LF** Project: **Vista LF – Substantial** Project No.: **FL1229** Phase No.:

REFERENCES

Brooks, H. K., "Guide to the Physiographic Divisions of Florida," Center for Environmental and Natural Resources, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, 16 p., 1981.

Bishop and Buttrey, Inc., "Buttrey Development Two, L.L.C., Application for Keene Road Disposal, Class III Landfill," March 2001.

Bishop and Buttrey, Inc., "Buttrey Development Three, L.L.C., Application for Keene Road Disposal, Class III Landfill," August 2003.

Bishop and Buttrey, Inc., "Buttrey Development Three, L.L.C., Application for Keene Road Disposal, Class III Landfill," May 2004.

Das, B.M., "Principles of Foundation Engineering," 4th Ed., PWS Publishing, New York, 1999.

Lambe, T.W. and Whitman, R.V., "Soil Mechanics," John Wiley and Sons, New york, 1969.

Peck, R.B., Hanson, W.E. and Thornburn, T.H., "Foundation Engineering," 2nd Ed., John Wiley and Sons, New York, 1974.

Soil Conservation Service, "Soil Survey of Orange County Florida," United States Department of Agriculture, 175 p., 1989.

Scott, T.M., "Lithostragriphy of the Hawthorne (Miocene) of Florida," Florida Geological Survey Bulletin No. 59, 148 p., 1988.

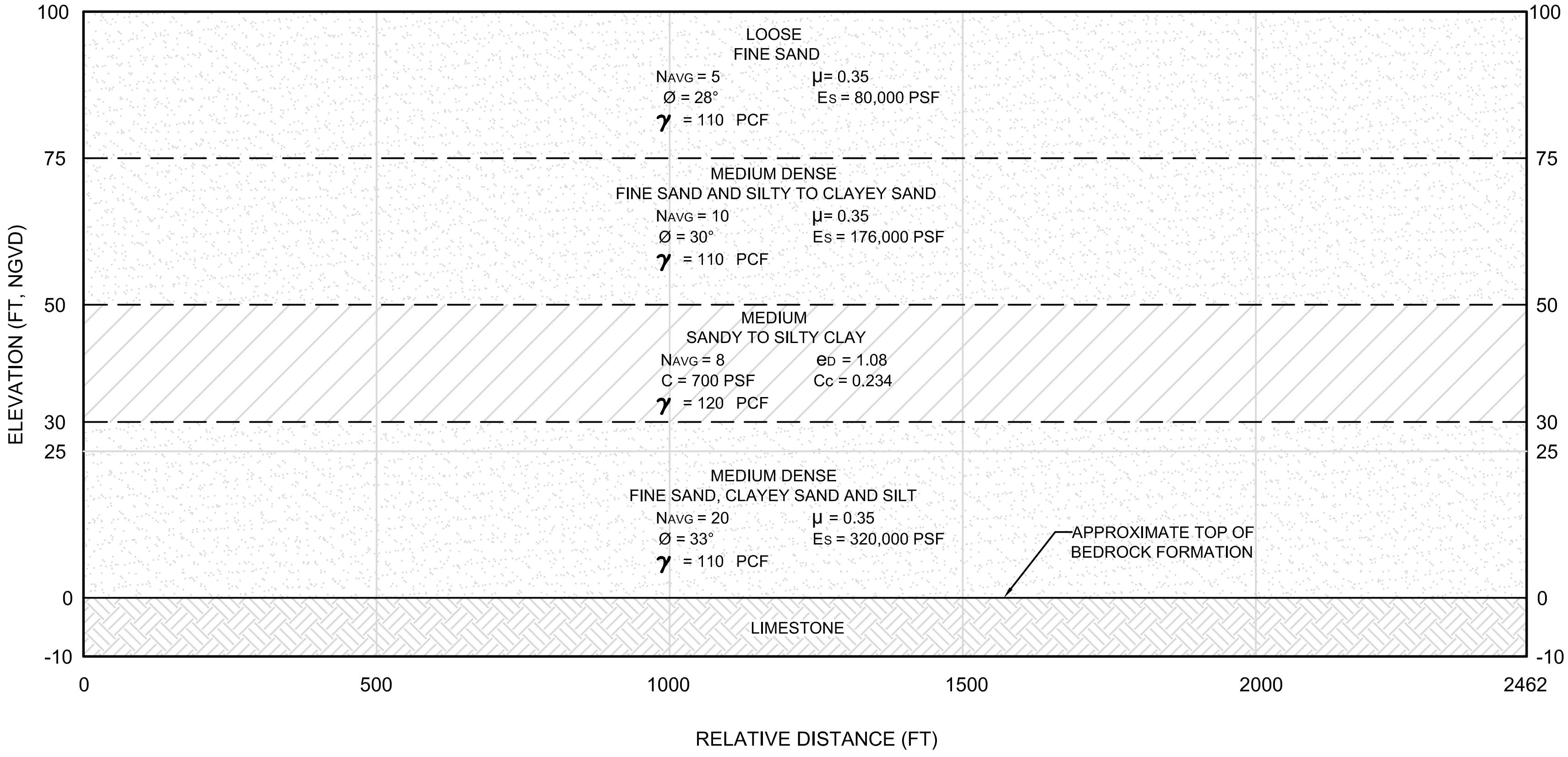
Schmertmann, J.H., "Static Cone to Compute Settlement Over Sand," Journal of the Soil Mechanics and Foundations Division, ASCE, Vol. 96, No. SM3, pp. 1011-1043, 1970.

Terzaghi, K. and Peck, R.B., "Soil Mechanics in Engineering Practice," 2nd Ed., John Wiley and Sons, New York, 1967.

FIGURES

P:\CADD\VISTA LANDFILL\FL1229.02\FIGURES\FL122902F001.DWG (5 December 2006) jjvail

E-W CROSS SECTION



0 30'

VERTICAL SCALE: 1"=30'

0 300'

HORIZONTAL SCALE: 1"=300'

SECTION 1 GEOTECHNICAL SUBSURFACE SOIL MODEL

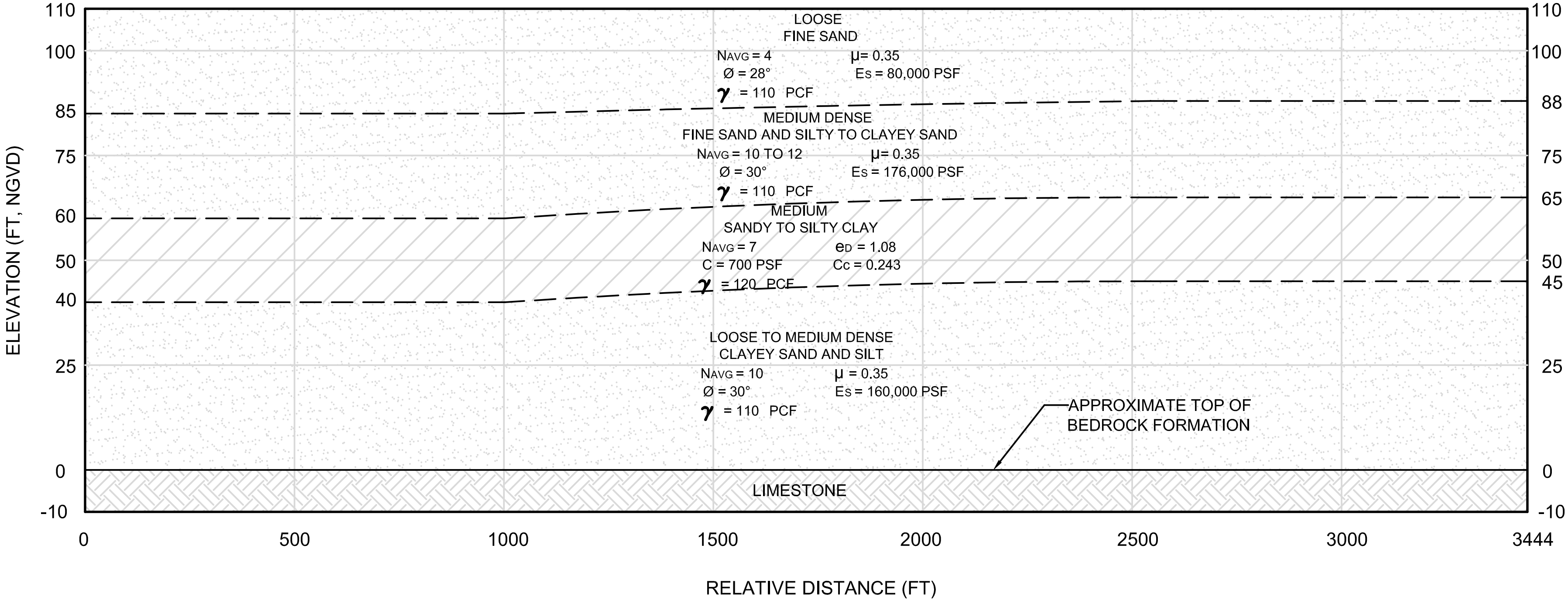
Geosyntec consultants

TAMPA, FL

DATE:	JUNE 2007	FILE NO.	FL122902F001
PROJECT NO.	FL1229.02	FIGURE NO.	1

P:\CADD\VISTA LANDFILL\FL1229.02\FIGURES\FL122902F002.DWG (5 December 2006) jjvail

N-S CROSS SECTION



0 40'

VERTICAL SCALE: 1"=40'

0 400'

HORIZONTAL SCALE: 1"=400'

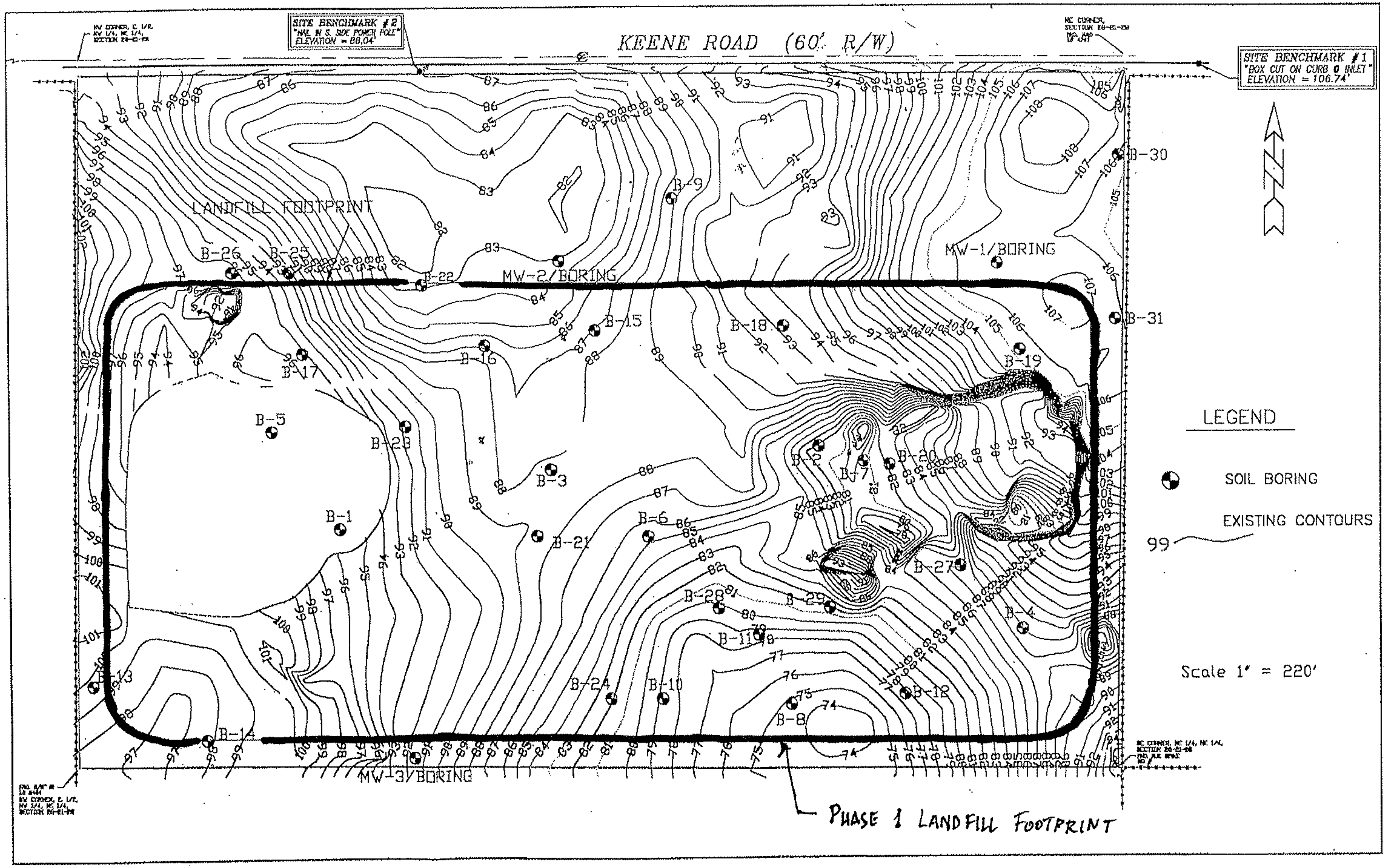
SECTION 2 GEOTECHNICAL SUBSURFACE SOIL MODEL

Geosyntec consultants

TAMPA, FL

DATE:	JUNE 2007	FILE NO.	FL122902F002
PROJECT NO.	FL1229.02	FIGURE NO.	2

ATTACHMENT 1



SOIL BORING LOCATIONS

DRAWN BY		EC
CHKD BY		EC
	REVISIONS	
1	07/18/00	
2	11/03/00	
3		
4		
5		
6		

DESIGN\PIT9IL\SOILBOR

DRAWING DESCRIPTION

BORING
LOCATIONS

FIGURE 2

UNIVERSAL
ENGINEERING SCIENCES
Consultants in: Geotechnical Engineering • Environmental Sciences •
Construction Materials Testing • Threshold Inspections
3532 Maggie Blvd. • Orlando, FL 32811 • (407) 423-0504 • FAX (407) 423-3106

Project No.: 17862-085-04
Report No.: 136900
Date: October 3, 2000

REPORT ON REMOLDED
TRIAXIAL PERMEABILITY/WASH 200/MOISTURE CONTENT/DRY DENSITY

Client:
Bishop and Buttrey, Inc.
Attn: Mr. Ed Chesney
6239 Edgewater Drive, Suite D1
Orlando, Florida 32810

Project: B & B 91, Keene Road, State of Florida

Date Tested: 9-29-00

Tested By: L. Bass

Date Sampled: 4-00

Sample No.: Combined

TEST RESULTS

Date Sampled	Composite Samples	Soil Description	Moisture Content (%)	Dry Density (pcf)	Permeability cm/sec	% Passing No. 200 Sieve
4-00	B-18, S-11, B-21, S-21, S-22	A-6 Material, Orange Sandy Clay (CL)	36.8	83.0	3.45 E-07	38.6
4-00	B-13, S-11, B-14, S-10, B-21, S-15 and 16	A-7-5 Material, Orange Clay (CH)	41.5	82.4	5.22 E-09	41.5

Note: The tests noted above were performed by qualified laboratory personnel with over 3 years experience performing these tests. Each test and the equipment used was in current calibration and meets or exceeds the minimum requirements set out in the applicable ASTM , ANSI and/or USEPA standards as outlined in the project specifications Section 02778 for the Orange County Landfill.

Certified in accordance with Florida State Statue as defined in Chapter 471.005 Section No. 61G15-18.011(4), based upon our knowledge, information and belief, consistent with applicable standards of practice, and is not a guaranty or warranty either *expressed or implied.*

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

[illegible]	[illegible]
REPORT NO.:	10727
PAGE:	A-1.1

PROJECT: BORROW PIT NO. #1
ORANGE COUNTY, FLORIDA
CLIENT: BISHOP & BUTTREY, INC.
LOCATION:
REMARKS:

BORING DESIGNATION: B-1
SECTION:
TOWNSHIP:
SHEET: 1 of 1
RANGE:

G.S. ELEVATION (ft): 95.50' NGVD
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):

DATE STARTED: 4/7/88
DATE FINISHED: 4/7/88
DRILLED BY: U.E.S.
TYPE OF SAMPLING: ASTM D-1586

	DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./DAY)	ORG. CONT. (%)
	0						Very loose yellow - brown fine SAND (SP) (A-3)						
		☒	2-2-2	4									
		☒	2-1-1	2				1	3				
	5	☒	1-2-1	3									
		☒	2-2-1	3									
		☒	2-1-2	3									
	10	☒	2-2-2	4									
	15	☒	3-3-3	6				4	7				
	20	☒	5-5-5	10				2	6				
							Dense yellow SAND with silt (SP-SM) (A-3) —dense						
	25	☒	10-11-23	34				9	12				
							—very dense, light grey - orange						
NGVD 65.5'	30	☒	16-30-34	64			Proposed Bottom Landfill	9	16				
							Medium dense light grey silty clayey SAND (SM-SC) (A-2-6/A-2-4)						
	35	☒	10-8-6	14				31	25	37	13		
							—loose						
	40	☒	5-4-3	7				28	33	31	6		
							Firm orange sandy CLAY (CL) (A-6)						
50.5'	45	☒	4-3-4	7									
	50	☒	2-3-3	6									
							BORING TERMINATED AT 50.0'						
	55												

01513

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 17862-073-02
REPORT NO.: 50458
PAGE:

AOJECT: KEENE ROAD LANDFILL B & B 100
ORANGE COUNTY, FLORIDA
CLIENT: BISHOP & BUTTREY, INC.
LOCATION:
REMARKS:

BORING DESIGNATION: B-5
SHEET: 1 of 3
SECTION:
TOWNSHIP:
RANGE:
G.S. ELEVATION (ft): 96.00' NGVD
WATER TABLE (ft): 41.3
DATE OF READING: 1/11/99
EST. W.S.W.T. (ft):
DATE STARTED: 1/11/99
DATE FINISHED: 1/11/99
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./DAY)	pH
									LL	PI		
0						Very loose light orange-brown fine SAND [A-3]						5.25
	☒	2-1-1	2									4.67
	☒	2-1-1	2				1	2				4.43
5	☒	1-1-1	2									
	☒	2-1-1	2									4.08
	☒	2-1-2	3									
10	☒	2-2-2	4			- loose						4.07
	☒	2-2-3	5									
	☒	2-2-3	5									
	☒	3-3-4	7			- light brown						
15	☒	4-4-4	8									
	☒	4-5-3	8									
	☒	5-5-5	10									
20	☒	4-5-4	9									
	☒	4-5-5	10			- medium dense						
	☒	7-6-8	14									
25	☒	6-8-7	13			- loose						
	☒	4-5-4	9			- medium dense						
	☒	3-5-6	11									
	☒	8-7-8	15									
30	☒	7-7-8	16									
	☒	4-5-6	10									
	☒	5-6-8	14			- light gray to white						
36	☒	7-9-10	19									
						Proposed Bottom Landfill	3	4				
	☒	12-12-16	28			- dense						
	☒	13-16-17	33									
40	☒	12-18-21	39				2	3				

NGVD
61.00'

02313

7862-073-02
OG58

T: 1 of 3
3E:

1/11/99
1/11/99
UES - ORLANDO
G: ASTM D-1586

K (FT./ DAY)	pH
	5.25
	4.67
	4.43
	4.08
	4.07

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 17862-073-02
REPORT NO.: 50655
PAGE:

PROJECT: KEENE ROAD LANDFILL 9 & 8 100
ORANGE COUNTY, FLORIDA

BORING DESIGNATION: B-5
SECTION:
TOWNSHIP:
SHEET: 2 of 3
RANGE:

51.00'

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./ DAY)	pH
40		20-16-20	36	▼		-- light orange-brown	54	22				
		8-7-7	14			Stiff orange & gray mottled sandy CLAY [A-6, A-7]						
		5-4-7	11			Medium dense light orange-brown clayey SAND with silt [A-2-4]						
45		5-10-8	18									
		6-6-6	12									
		4-3-4	7			Firm orange & gray mottled sandy CLAY [A-6, A-7]	23	29				
50		3-2-2	4			Loose orange-brown silty fine SAND; trace of clay [A-2-4]						
		3-3-4	7			Firm orange & gray mottled sandy CLAY [A-6, A-7]						
		3-3-3	6			-- stiff						
		4-5-6	11				58	38			1.50E-03 5292Y	0.7 [illegible]
55	■											
		5-5-7	12									
		6-5-6	11									
60		4-6-6	12			Loose dark orange-brown silty fine SAND; trace of cemented silt [A-2-4]						
		3-4-4	8									
		2-2-4	6			Loose light brown silty fine SAND with cemented silt [A-2-4]						
65		3-5-4	8			-- very loose						
		3-2-2	4									
		10-17-15	32			Dense light brown fine SAND with cemented silt [A-3, A-2-4]						
		3-4-7	11			Medium dense light brown fine SAND [A-3] Medium dense light brown silty fine SAND with cemented silt [A-2-4]						
70		9-6-7	13									
		7-12-9	21			Medium dense brown cemented SILT; trace of fine sand [A-5]						
		11-19-19	38			Dense light brown silty fine SAND [A-2-4]						
75		20-19-13	32			Dense light brown LIMESILT; trace of fine sand [A-5]						
		9-19-13	32			-- medium dense						
		10-10-14	24			-- with cemented silt						
80												

02215

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 17862-073-02
REPORT NO.: 50685
PAGE:

PROJECT: KEENE ROAD LANDFILL B & B 100
ORANGE COUNTY, FLORIDA

BORING DESIGNATION: B-5
SHEET: 3 of 3
SECTION:
TOWNSHIP:
RANGE:

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	PI	K (FT./ DAY)	pH
80	☒	8-6-13	19									
	☒	11-9-10	19									
	☒	8-9-9	18									
85	☒	18-16-18	31			~ dense						
	☒	13-13-19	32									
	☒	12-17-17	34									
	☒	16-21-18	39									
90	☒	21-26-32	58			~ very dense						
	☒	19-29-20	49			~ dense						
	☒	15-15-18	33									
95	☒	12-17-17	34				27	34				
	☒	14-14-14	28			~ medium dense						
	☒	11-13-12	25									
	☒	12-12-15	27				32	35				
100						BORING TERMINATED AT 100.0'						
105												
110												
115												
120												

02313

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10842-001-02
REPORT NO.: 115929
PAGE: A-2.5

PROJECT: BORROW PIT 91
KEENE ROAD LANDFILL
APOPKA, FLORIDA

CLIENT: BUTTREY DEVELOPMENT LLC
LOCATION: BORING LOCATIONS SELECTED BY CLIENT
REMARKS:

BORING DESIGNATION: B-12
SHEET: 1 of 1
SECTION:
TOWNSHIP:
RANGE:

G.S. ELEVATION (ft): 78.10' NGVD
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):

DATE STARTED: 4/5/00
DATE FINISHED: 4/5/00
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	PI	K (FT./ DAY)	ORG. CONT. (%)
0						Loose light brown fine SAND [A-3]						
	☒	2-2-3	5			~ light orange brown						
	☒	3-2-3	5									

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 17862-073-02
REPORT NO.: 50689
PAGE:

PROJECT: KEENE ROAD LANDFILL B & B 100
ORANGE COUNTY, FLORIDA
CLIENT: BISHOP & BUTTREY, INC.
LOCATION:
REMARKS:

BORING DESIGNATION: B-6
SHEET: 1 of 2
SECTION:
TOWNSHIP:
RANGE:
G.S. ELEVATION (ft):
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):
DATE STARTED: 1/12/99
DATE FINISHED: 1/12/99
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT., DAY)	pH
									LL	PI		
0						Very loose light brown fine SAND [A-3]						
	☒	2-2-2	4									
	☒	3-1-2	3									
5	☒	2-1-1	2									
	☒	2-2-3	5			-- loose						
	☒	2-1-2	3			-- very loose; light orange-brown						
	☒	4-5-6	11			-- medium deense						
10	☒	6-6-6	12			-- orange-brown						
	☒	6-5-4	9			Loose light orange-brown clayey fine SAND [A-2-4]						
	☒	3-3-6	9			Loose light brown to white fine SAND [A-3]						
15	☒	8-8-16	24			Medium dense light orange-brown clayey SAND [A-2-4]						
	☒	16-26-40	66			-- very dense						
	☒	26-35-28	63			-- light gray						
20	☒	12-10-8	18			-- medium dense						
	☒	9-10-11	21									
	☒	6-7-10	17			Medium dense light gray SILT with sand [A-5]						
25	☒	9-9-12	21			Medium dense light brown silty fine SAND [A-2-4]						
	☒	5-6-8	14									
	☒	7-5-6	11									
	☒	4-3-4	7			Firm light gray & orange mottled silty CLAY [A-6]						
30	☒	4-4-5	9			-- stiff						
	☒	3-4-5	9									
	■						45	31	34	10	8.54E-03	
35	☒	4-5-7	12									
	☒	6-5-5	10									
	☒	2-2-2	4			-- soft						
40	☒	2-1-2	3									

02313

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 17862-073-02
REPORT NO.: 50689
PAGE:

PROJECT: KEENE ROAD LANDFILL B & B 100

ORANGE COUNTY, FLORIDA

BORING DESIGNATION: B-6
SECTION:
TOWNSHIP:
SHEET: 2 of 2
RANGE:

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./ DAY)	pH
									LL	PI		
40						Very loose orange-brown silty fine SAND [A-2-4]						
	☒	0-0-0	WOR									
	☒	0-0-0	WOR									
	☒	0-0-0	WOR									
45	☒	0-0-0	WOR									
	☒	0-0-0	WOR									
	☒	0-0-0	WOR									
50	☒	0-0-0	WOR									
	☒	0-0-0	WOR			Loose light brown LIMESILT [A-5]						
	☒	4-2-3	5									
	☒	1-1-1	2			-- very loose						
55	☒	50	50/2"			LIMESTONE with cemented sand						
						BORING TERMINATED AT 56.5'						
60												
65												
70												
75												
80												

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 17802-073-02
REPORT NO.: 50685
PAGE:

BORING DESIGNATION: B-8
SHEET: 1 of 2
SECTION:
TOWNSHIP:
RANGE:

ROJECT: KEENE ROAD LANDFILL B & B 100
ORANGE COUNTY, FLORIDA
CLIENT: BISHOP & BUTTREY, INC.
LOCATION:
REMARKS:

G.S. ELEVATION (ft): 75.10' NGVD
WATER TABLE (ft): 23.0
DATE OF READING: 1/13/99
EST. W.S.W.T. (ft):
DATE STARTED: 1/13/99
DATE FINISHED: 1/13/99
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	PI	K (FT./ DAY)	pH
0						Very loose light brown fine SAND (A-3)						
	☒	1-1-2	3									
	☒	1-2-1	3			-- orange-brown						
5	☒	2-1-3	4									
	☒	2-3-3	6			-- loose						
	☒	3-3-2	5									
10	☒	2-3-4	7			-- light brown Proposed Bottom Landfill						
	☒	4-4-3	7									
	☒	3-4-4	8									
	☒	3-4-4	8									
15	☒	3-6-4	9			Replace with compacted clays	5	4				
	☒	4-4-4	8			-- medium dense; brown						
	☒	6-8-7	13									
20	☒	8-8-7	15			-- gray-brown						
	☒	8-8-8	16									
	☒	4-6-7	13	▼								
25	☒	4-7-7	14			Top; proposed clay liner						
	☒	6-11-12	23			-- light brown						
	☒	11-14-13	27			-- dense	2	19				
	☒	15-19-20	39			-- medium dense						
30	☒	4-7-11	18			-- dense						
	☒	7-14-20	34									
	☒	16-16-20	36			-- very dense						
35	☒	12-23-32	55									
	☒	35-50-75	125			-- dense						
	☒	15-21-27	48									
	☒	24-20-23	43									
40												

NGVD

45.10'

02313

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-001-02
REPORT NO.: 115929
PAGE: A-2.8

BORING DESIGNATION: B-14
SHEET: 1 of 2
SECTION:
TOWNSHIP:
RANGE:

PROJECT: BORROW PIT 81
KEENE ROAD LANDFILL
APOPKA, FLORIDA
CLIENT: BUTTREY DEVELOPMENT LLC
LOCATION: BORING LOCATIONS SELECTED BY CLIENT
REMARKS:

G.S. ELEVATION (ft): 98.10' NGVD
WATER TABLE (ft): 22.6
DATE OF READING: 4/4/00
EST. W.S.W.T. (ft):
DATE STARTED: 4/4/00
DATE FINISHED: 4/4/00
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	PI	K (FT./ DAY)	ORG. CONT. (%)
0						Very loose light brown fine SAND with large root pieces (A-3)						
	☒	2-2-2	4									
	☒	3-2-3	5			orange/brown mottled clayey						

BUTTREY DEVELOPMENT TW

EC

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 17842-073-02
REPORT NO.: 50655
PAGE:

PROJECT: KEENE ROAD LANDFILL B & B 100
ORANGE COUNTY, FLORIDA

BORING DESIGNATION: B-8
SECTION:
TOWNSHIP:
SHEET: 2 of 2
RANGE:

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./ DAY)	pH
40						← medium dense						
	☒	8-11-12	23			← dense						
	☒	10-17-15	32									
	☒	21-16-14	30									
45	☒	6-7-7	14									
	☒	10-12-18	30			← very dense						
	☒	24-24-28	52									
50	☒	13-25-31	56									
	☒	25-35-50	85									
	☒	33-37-40	77			← dense						
	☒	16-23-25	48									
55	☒	17-28-30	58			← very dense						
	☒	20-30-22	52			← dense						
	☒	12-22-27	49			← very dense						
60	☒	21-30-26	56									
	☒	19-23-31	54									
	☒	30-30-56	86									
65	☒	24-34-35	69									
	☒	21-25-28	53									
	☒	20-33-45	78									
	☒	15-34-43	77									
70	☒	37-80-55	135									
	☒	28-77-50	127									
	☒	60-71-58	129									
75						BORING TERMINATED AT 75.0'						
80												

02213

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-001-02
REPORT NO.: 115929
PAGE: A-2.9

PROJECT: BORROW PIT 81
KEENE ROAD LANDFILL
APOPKA, FLORIDA

BORING DESIGNATION: B-14
SECTION:
TOWNSHIP:
SHEET: 2 of 2
RANGE:

	DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./ DAY)	ORG. CONT. (%)
NGVD 53.10'	45	■				▨							

III LANDFILL
O, L.L.C.

BISHOP &
BUTTREY,
INC.

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10842-001-02
REPORT NO.: 115929
PAGE: A-2.3

PROJECT: BORROW PIT #1
KEENE ROAD LANDFILL
APOPKA, FLORIDA

BORING DESIGNATION: B-11
SHEET: 1 of 2
SECTION:
TOWNSHIP:
RANGE:

CLIENT: BUTTREY DEVELOPMENT LLC
LOCATION: BORING LOCATIONS SELECTED BY CLIENT
REMARKS:

G.S. ELEVATION (ft): 78.40' NGVD
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):
DATE STARTED: 4/5/00
DATE FINISHED: 4/5/00
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./ DAY)	ORG. CONT. (%)
									LL	PI		
0						Very loose brown fine SAND (A-3)						
	☒	1-2-1	3			— orange						
	☒	2-1-1	2									
5	☒	1-0-0	WOR									
	☒	1-1-1	2			— light gray						
	☒	2-2-2	4									
	☒	2-1-2	3									
10												
						Proposed Bottom Landfill						
						— loose; gray, with some orange/brown mottling						
	☒	2-3-5	8			Replace with compacted clay						
15												
						— light orange/brown						
						Top, proposed clay liner						
	☒	2-3-7	10									
20												
						— brown						
	☒	3-3-5	8									
25												
						— medium dense; gray/brown						
	☒	7-12-15	27									
30												
	☒	6-7-10	17									
35												
	☒	8-8-11	19									
40												
	☒	7-11-15	26									
45												

NGVD
48.4' 30

NGVD
28.4

02887

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10842-001-02
REPORT NO.: 115929
PAGE: A-2.10

PROJECT: BORROW PIT B1
KEENE ROAD LANDFILL
APOPKA, FLORIDA

BORING DESIGNATION: B-15
SHEET: 1 of 2
SECTION:
TOWNSHIP:
RANGE:

CLIENT: BUTTREY DEVELOPMENT LLC
LOCATION: BORING LOCATIONS SELECTED BY CLIENT
REMARKS:

G.S. ELEVATION (ft): 87.02' NGVD
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):
DATE STARTED: 4/3/00
DATE FINISHED: 4/3/00
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./ DAY)	ORG. CONT. (%)
									LL	PI		
0						Medium dense orange/brown fine SAND (A-3)						
	☒	4-5-6	11			— loose; orange						
	☒	5-4-4	8									
5	☒	2-3-3	6									
						— light brown						
	☒	2-3-2	5			— very loose						
	☒	2-2-2	4									
	☒	3-3-3	6									
10												

ROJECT NO.: 17862-073-01
EPORT NO.: 50686
AGE:

SHEET: 1 of 2
RANGE:

DATE STARTED: 1/13/99
DATE FINISHED: 1/13/99
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D-1586

C)	ATTERBERG LIMITS		K (FT/DAY)	pH
	LL	PI		

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-001-02
REPORT NO.: 115929
PAGE: A-2.4

PROJECT: BORROW PIT 91
KEENE ROAD LANDFILL
APOPKA, FLORIDA

BORING DESIGNATION: B-11
SECTION:
TOWNSHIP:
SHEET: 2 of 2
RANGE:

NGVD
28.40'

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./DAY)	ORG. CONT. (%)
									LL	PI		
45												
	☒	5-4-5	9			Loose light gray clayey fine SAND, mottled with red (A-2-6)						
50							61	28			9.58E-05 = 3.38x10^-8 cm/sec	
	☒	3-5-7	12			Medium dense light gray to white silty fine SAND with clay (A-2-4)						
	☒	2-3-2	5			Loose light gray clayey fine SAND with silt (A-2-6)						
55												
	☒	1-1-2	3			Very soft light gray to white CLAY with fine sand (A-7-6)						
60						BORING TERMINATED AT 60.0'						
65												
70												
75												
80												
85												
90												

T NO.: 10942-001-02
NO.: 115929
A-2.8

SHEET: 1 of 2
RANGE:

ARTED: 4/4/00
SHED: 4/4/00
Y: UES - ORLANDO
AMPLING: ASTM D-1586

RBERG IITS	K (FT./DAY)	ORG. CONT. (%)
PI		

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-001-02
REPORT NO.: 115929
PAGE: A-2.11

OJECT: BORROW PIT 91
KEENE ROAD LANDFILL
APOPKA, FLORIDA

BORING DESIGNATION: B-16
SECTION:
TOWNSHIP:
SHEET: 2 of 2
RANGE:

NGV
53.

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./DAY)	ORG. CONT. (%)
									LL	PI		
45	☒	4-4-5	9									
	☒	6-8-20	28			Very stiff tan sandy CLAY, with some cementation (A-6) – very hard	44	44			4.84E-04 = 1.71x10^-7 cm/sec	
	☒	7-20-40	60									
						BORING TERMINATED AT 49.0'						
50												

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-001-02
REPORT NO.: 115929
PAGE: A-2.5

PROJECT: BORROW PIT 91
KEENE ROAD LANDFILL
APOPKA, FLORIDA

CLIENT: BUTTREY DEVELOPMENT LLC
LOCATION: BORING LOCATIONS SELECTED BY CLIENT
REMARKS:

BORING DESIGNATION: B-12
SHEET: 1 of 1
SECTION:
TOWNSHIP:
RANGE:
G.S. ELEVATION (ft): 78.10' NGVD
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):
DATE STARTED: 4/5/00
DATE FINISHED: 4/5/00
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./ DAY)	ORG. CONT. (%)
									LL	PI		
0						Loose light brown fine SAND [A-3]						
	☒	2-2-3	5			— light orange brown						
	☒	3-2-3	5									
5	☒	3-3-3	6			— very loose						
	☒	3-2-2	4			— loose; very light brown						
	☒	2-2-3	5									
10	☒	3-2-3	6									
NGVD						Proposed Bottom Landfill						
63.10' 15	☒	3-5-8	13			— medium dense; very light brown to white						
20	☒	4-5-7	12									
						Medium dense light brown fine SAND with silt [A-2-4]						
25	☒	8-8-15	23									
						Medium stiff very light gray CLAY with lenses of fine sand [A-7-6]						
48.10' 30	☒	2-3-4	7									
						Very loose light gray to white clayey fine SAND [A-2-6]						
35	☒	1-1-2	3									
						— light orange/brown						
40	☒	0-0-1	1			BORING TERMINATED AT 40.0'						
45												

02867

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-001-02
REPORT NO.: 115929
PAGE: A-2.17

JECT: BORROW PIT 91
KEENE ROAD LANDFILL
APOPKA, FLORIDA

CLIENT: BUTTREY DEVELOPMENT LLC
LOCATION: BORING LOCATIONS SELECTED BY CLIENT
REMARKS:

BORING DESIGNATION: B-16
SHEET: 1 of 2
SECTION:
TOWNSHIP:
RANGE:
G.S. ELEVATION (ft): 86.90' NGVD
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):
DATE STARTED: 4/3/00
DATE FINISHED: 4/3/00
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./ DAY)	ORG. CONT. (%)
									LL	PI		
0						Loose orange/brown fine SAND [A-3]						
	☒	3-4-5	9									
	☒	3-3-3	6			— very loose; orange						
5	☒	2-2-1	3			— loose						
	☒	3-2-3	5			— very loose						
	☒	2-2-2	4			— loose						
10	☒	3-3-3	6									

	4-7-7	14	→ Top; proposed		
25	6-11-12	23	-- light brown	2	19
	11-14-13	27	-- dense		
	15-19-20	39	-- medium dense		
30	4-7-11	18	-- dense		
	7-14-20	34			
	16-16-20	36	-- very dense		
35	12-23-32	55			
	35-50-75	125	-- dense		
	15-21-27	48			
40	24-20-23	43			

NGVD
45.10'

02313

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-091-02
REPORT NO.: 115929
PAGE: A-2.8

BORING DESIGNATION: B-14
SHEET: 1 of 2
SECTION:
TOWNSHIP:
RANGE:

PROJECT: BORROW PIT 91
KEENE ROAD LANDFILL
APOPKA, FLORIDA

CLIENT: BUTTREY DEVELOPMENT LLC
LOCATION: BORING LOCATIONS SELECTED BY CLIENT
REMARKS:

G.S. ELEVATION (ft): 98.10' NGVD
WATER TABLE (ft): 22.5
DATE OF READING: 4/4/00
EST. W.S.W.T. (ft):
DATE STARTED: 4/4/00
DATE FINISHED: 4/4/00
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	PI	K (FT./ DAY)	ORG. CONT. (%)
0						Very loose light brown fine SAND with large root pieces [A-3]						
	☒	2-2-2	4									
	☒	3-2-3	6			Medium-dense orange/brown mottled clayey fine SAND [A-2-6]						
5	☒	4-8-10	18			-- dense						
	☒	11-18-18	36									
	☒	17-21-18	39									
	☒	20-16-18	34									
10						Medium dense light gray to white fine SAND [A-3]						
15	☒	6-10-12	22									
						-- dense; mottled with orange						
20	☒	8-16-21	37									
				▼		-- medium dense; no mottling						
25	☒	0-10-11	21									
						Soft light brown silty CLAY with sand lenses [A-7-5]					5.2x10^-9 cm/sec	
30	☒	2-1-2	3	SIO								
						Loose light brown clayey fine SAND with silt [A-2-6]						
35	☒	0-4-5	9			← Proposed Bottom Landfill						
40	☒	2-2-3	6									
45	☒	2-3-5	8									

NGVD
58.10'

02867

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65	24-34-35	69	
	21-25-28	63	
	20-33-45	78	
	16-34-43	77	
70	37-80-55	135	
	29-77-50	127	
	60-71-58	129	
75			BORING TERMINATED AT 75.0'
80			

02213

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-001-02
REPORT NO.: 115929
PAGE: A-2.9

PROJECT: BORROW PIT 91
KEENE ROAD LANDFILL
APOPKA, FLORIDA

BORING DESIGNATION: B-14
SECTION:
TOWNSHIP:
SHEET: 2 of 2
RANGE:

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./DAY)	ORG. CONT. (%)
NGVD 53.10' 45												
						Medium stiff light gray sandy SILT [A-6]						
		2-3-4	7									
		2-4-6	10			Stiff tan CLAY with fine sand [A-7-6]						
50												
						Medium dense gray clayey fine SAND with a trace of phosphate nodules [A-2-6]						
		4-5-9	14									
55							28	31			3.48E-03 = 1.24×10^{-6} cm/sec	
						Hard tan sandy CLAY, well-cemented [A-7-5]						
		8-22-10	32			BORING TERMINATED AT 58.5'						
60												
65												
70												
75												
80												
85												
90												

02263

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION
40	☒	8-8-11	19		░	
45	☒	7-11-15	26		░	

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-001-02
REPORT NO.: 115979
PAGE: A-2.10

BORING DESIGNATION: B-15
SHEET: 1 of 2
SECTION:
TOWNSHIP:
RANGE:

PROJECT: BORROW PIT 81
KEENS ROAD LANDFILL
APOPKA, FLORIDA

CLIENT: BUTTREY DEVELOPMENT LLC
LOCATION: BORING LOCATIONS SELECTED BY CLIENT
REMARKS:

G.S. ELEVATION (ft): 87.02' NGVD
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):

DATE STARTED: 4/3/00
DATE FINISHED: 4/3/00
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D-1586

	DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./ DAY)	ORG. CONT. (%)
										LL	PI		
	0					░	Medium dense orange/brown fine SAND (A-3)						
		☒	4-5-6	11		░	-- loose; orange						
		☒	5-4-4	8		░							
	5	☒	2-3-3	6		░	-- light brown						
		☒	2-3-2	5		░	-- very loose						
		☒	2-2-2	4		░							
	10	☒	3-3-3	6		░							
						░	-- loose; light gray/brown						
	15	☒	2-3-4	7		░							
NGVD						░	-- medium dense; light gray						
67.02'	20	☒	4-4-8	12		░							
						░	Proposed Bottom Landfill						
		☒	6-8-12	20		▨	Medium dense light gray to off-white clayey fine SAND (A-2-4)						
	25	☒	13-9-7	16		▨							
		☒	5-4-3	7		▨	Medium stiff light gray sandy CLAY (A-6)						
		☒	4-6-4	10		▨	Loose light gray to white clayey fine SAND (A-2-4)						
	30	☒	5-5-9	14		▨	-- medium dense; with orange mottling						
		☒	3-5-4	9		▨	-- loose						
		☒	3-2-3	5		▨	-- orange						
	35	☒	3-2-3	5		▨							
52.02'		☒	0-1-3	4		▨	Soft dark orange sandy CLAY (A-6) -- medium stiff						
		☒	2-2-3	5		▨	Very loose orange clayey fine SAND (A-2-6)						
		☒	1-1-2	3		▨	-- loose						
	40	☒	3-3-3	6		▨	-- brown/orange						
		☒	2-3-4	7		▨	-- with fragmented limestone & phosphate nodules						
		☒	2-3-2	5		▨							
	45												

912-001-02
15929
-2.10
1 of 2

4/3/00
4/3/00
UES - ORLANDO
ASTM D-1586

K (FT./DAY)	ORG. CONT. (%)

DEPTH (FT.)
80
85
90

02857

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-001-02
REPORT NO.: 115929
PAGE: A-2.11

OJECT: BORROW PIT 91
KEENE ROAD LANDFILL
APOPKA, FLORIDA

BORING DESIGNATION: B-15
SECTION:
TOWNSHIP:
SHEET: 2 of 2
RANGE:

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./ DAY)	ORG. CONT. (%)
45	☒	4-4-5	9		▨							
	☒	8-8-20	28		▨	Very stiff tan sandy CLAY, with some cementation [A-8] -- very hard	44	44			4.84E-04 = 1.71 x 10⁻⁷ cm/sec	
	☒	7-20-40	60		▨							
						BORING TERMINATED AT 49.0'						
50												
55												
60												
65												
70												
75												
80												
85												
90												

02857

						~ light orange/brown
40	☒	0-0-1	1			BORING TERMINATED AT 40.0'
45						

02887

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-001-02
REPORT NO.: 115929
PAGE: A-2.17

PROJECT: BORROW PIT 81
KEENE ROAD LANDFILL
APOPKA, FLORIDA

CLIENT: BUTTREY DEVELOPMENT LLC

LOCATION: BORING LOCATIONS SELECTED BY CLIENT

REMARKS:

BORING DESIGNATION: B-16
SHEET: 1 of 2
SECTION:
TOWNSHIP:
RANGE:

G.S. ELEVATION (ft): 86.90' NGVD
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):

DATE STARTED: 4/3/00
DATE FINISHED: 4/3/00
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	PI	K (FT./ DAY)	ORG. CONT. (%)
0						Loose orange/brown fine SAND (A-3)						
	☒	3-4-5	9									
	☒	3-3-3	6									
5	☒	2-2-1	3			~ very loose; orange						
	☒	3-2-3	5			~ loose						
	☒	2-2-2	4			~ very loose						
10	☒	3-3-3	6			~ loose						
15	☒	2-4-4	8			~ gray/brown						
20	☒	3-4-4	8			~ brown						
						Proposed Bottom Landfill						
25	☒	4-5-7	12			~ medium dense						
30	☒	5-7-10	17			Replace with compacted clay						
NGVD 51.90 35	☒	7-10-10	20			~ gray/brown						
						Top, proposed clay liner						
40	☒	3-5-6	11									
45	☒	4-6-7	13									

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UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-001-02
REPORT NO.: 115929
PAGE: A-2.13

ROJECT: BORROW PIT 91
KEENE ROAD LANDFILL
APOPKA, FLORIDA

BORING DESIGNATION: B-16
SECTION:
TOWNSHIP:
SHEET: 2 of 2
RANGE:

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./ DAY)	ORG. CONT. (%)
									LL	PI		
45												
50	☒	6-10-12	22									
						— light gray						
55	☒	5-7-9	16									
60	☒	8-12-12	24									
						— light gray/brown						
65	☒	7-9-13	22									
70	☒	8-11-14	25			BORING TERMINATED AT 70.0'						
75												
80												
85												
90												

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-001-02
REPORT NO.: 115929
PAGE: A-2.14

PROJECT: BORROW PIT 91
KEENE ROAD LANDFILL
APOPKA, FLORIDA
CLIENT: BUTTREY DEVELOPMENT LLC
LOCATION: BORING LOCATIONS SELECTED BY CLIENT
REMARKS:

BORING DESIGNATION: B-17
SHEET: 1 of 3
SECTION: TOWNSHIP: RANGE:
G.S. ELEVATION (ft): 58.80' NGVD
WATER TABLE (ft): 7.0
DATE OF READING: 3/31/00
EST. W.S.W.T. (ft):
DATE STARTED: 3/31/00
DATE FINISHED: 3/31/00
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	PI	K (FT./DAY)	ORG. CONT. (%)
0						Medium dense light brown fine SAND (A-3)						
	☒	5-6-8	14									
	☒	8-9-10	19									
5	☒	10-7-7	14			– loose						
	☒	4-4-4	8	▼								
	☒	2-3-3	6			Replace with compacted clay						
	☒	2-3-4	7									
10	☒	3-2-3	5			– medium dense						
	☒	4-8-8	16									
	☒	10-11-11	22			– light gray to white						
15	☒	2-4-6	10			– loose – medium dense						
	☒	8-9-11	20									
	☒	5-7-9	16			Top, proposed clay liner	2	23				
20	☒	4-8-9	17			– loose; light brown, with a trace of silt						
	☒	2-3-4	7			– medium dense						
	☒	2-4-7	11									
	☒	3-5-6	11									
25	☒	4-8-9	17									
	☒	4-7-11	18									
	☒	5-6-10	16			Loose light brown fine SAND with silt (A-3, A-2-4)						
30	☒	4-5-4	9									
	☒	4-5-7	12			Medium dense brown fine SAND (A-3)						
	☒	5-8-9	17									
35	☒	5-7-7	14			– light brown						
	☒	6-7-9	16			– light gray/brown						
	☒	4-7-8	15									
	☒	4-6-9	15									
40	☒	4-7-8	15									
	☒	3-8-9	17									
	☒	8-9-9	18									
45												

NGVD 48.80'

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UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	10642-001-02
REPORT NO.:	115929
PAGE:	A-2.15

PROJECT: BORROW PIT #1
KEENE ROAD LANDFILL
APOPKA, FLORIDA

BORING DESIGNATION: B-17
SECTION:
TOWNSHIP:
SHEET: 2 of 3
RANGE:

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	PI	K (FT./ DAY)	ORG. CONT. (%)
45	☒	8-14-16	30									
	☒	6-9-12	21									
	☒	5-9-9	18			~ light gray, fine to medium-grained	6	20				
50	☒	6-8-8	16									
	☒	8-12-12	24									
	☒	5-7-11	18									
55	☒	5-5-10	15									
	☒	8-10-11	21									
	☒	6-7-8	15									
	☒	6-8-10	18									
60	☒	4-6-6	12									
65	☒	4-6-8	14									
70	☒	6-8-9	17									
75	☒	6-8-9	17			~ with blue-gray streaks						
80	☒	6-10-10	20									
85	☒	8-11-12	23									
90	☒	7-9-12	21									

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-001-02
REPORT NO.: 115929
PAGE: A-2.16

PROJECT: BORROW PIT #1
KEENE ROAD LANDFILL
APOPKA, FLORIDA

BORING DESIGNATION: B-17
SECTION:
TOWNSHIP:
SHEET: 3 of 3
RANGE:

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./ DAY)	ORG. CONT. (%)
									LL	PI		
90						BORING TERMINATED AT 90.0'						
95												
100												
105												
110												
115												
120												
125												
130												
135												

02867

PROJECT:

CLIENT:
LOCATION:
REMARKS:

DEPTH (FT.)
0
5
10
15
20
25
30
35
40

NGVD
69.90'
49.90'

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-001-02
REPORT NO.: 115929
PAGE: A-2.17

PROJECT: BORROW PIT 81
KEENE ROAD LANDFILL
APOPKA, FLORIDA

CLIENT: BUTTREY DEVELOPMENT LLC

LOCATION: BORING LOCATIONS SELECTED BY CLIENT

REMARKS:

BORING DESIGNATION: B-18
SECTION: -
TOWNSHIP:
SHEET: 1 of 2
RANGE:

G.S. ELEVATION (ft): 94.90' NGVD
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):

DATE STARTED: 4/5/00
DATE FINISHED: 4/5/00
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D-1586

	DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./DAY)	ORG. CONT. (%)
										LL	PI		
	0						Loose light brown fine SAND with a trace of small roots [A-3]						
		☒	4-4-5	9									
		☒	3-3-4	7			— light brown						
	5	☒	2-3-3	6									
		☒	2-1-2	3			— very loose						
		☒	2-2-3	5			— loose; light orange/brown						
		☒	2-3-3	6									
	10												
							Medium dense light grey/orange clayey fine SAND [A-2-6]						
	15	☒	6-8-20	28									
							— dense; fine to medium-grained						
	20	☒	7-14-21	35									
NGVD							Proposed Bottom Landfill — medium dense; orange, fine-grained						
69.90'	25	☒	2-5-6	11									
							— loose						
	30	☒	2-3-5	8									
							Medium stiff orange/brown mottled sandy CLAY [A-6]					3.45 E-7 cm/sec	
	35	☒	1-2-3	5	511								
							Loose orange clayey fine SAND [A-2-6]						
	40	☒	0-2-3	5									
							Soft brown sandy CLAY with some limestone fragments [A-6]						
49.90'	45	☒	0-0-4	4									

BISHOP & BUTTREY, INC.

EB Clancy

NOT VALID WITHOUT RAISED SEAL

III LANDFILL

O, L.L.C.

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-001-02
REPORT NO.: 115929
PAGE: A-2.18

ROJECT: BORROW PIT #1
KEENE ROAD LANDFILL
APOPKA, FLORIDA

BORING DESIGNATION: B-18
SECTION:
TOWNSHIP:
SHEET: 2 of 2
RANGE:

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./ DAY)	ORG. CONT. (%)
									LL	PI		
45					▨							
	☒	40-100	100/6"		▨	– very hard, well-cemented						
50						BORING TERMINATED AT 50.0'						
55												
60												
65												
70												
75												
80												
85												
90												

02867

45

BORING DESIGNATION: B-19
SECTION:
TOWNSHIP:
SHEET: 1 of 1
RANGE:

PROJECT: BORROW PIT #1
KEENE ROAD LANDFILL
APOPKA, FLORIDA

CLIENT: BUTTREY DEVELOPMENT LLC
LOCATION: BORING LOCATIONS SELECTED BY CLIENT
REMARKS:

G.S. ELEVATION (ft): 106.10' NGVD
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):

DATE STARTED: 4/6/00
DATE FINISHED: 4/6/00
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	PI	K (FT./ DAY)	ORG. CONT. (%)
0						Very loose light brown fine SAND [A-3]						
	☒	3-2-2	4									
	☒	3-2-2	4			– with small root piece						
5	☒	2-1-2	3			– loose						
	☒	2-2-3	5									
	☒	3-3-4	7									
	☒	5-5-4	9									
10		<										
						Medium dense light brown clayey fine SAND [A-2-6]						
						→ Proposed Bottom Landfill						
	☒	5-6-8	14									
15						– light orange/brown, mottled						
	☒	7-8-4	12									
20												
						Medium dense light brown fine SAND with clay [A-2-4]						
	☒	5-7-8	15									
25						Soft light orange/brown sandy CLAY [A-6]						
	☒	0-0-3	3									
30						Very loose light orange/brown clayey fine SAND [A-2-6]						
	☒	2-2-2	4									
35						– medium dense; gray/brown						
	☒	5-7-11	18									
40												
	☒	5-7-9	16									
45						– dense; with abundant shell fragments	14	29			6.32E-03 = 2.2 x 10^-6 cm/sec	
	☒	7-14-20	34									
50						– very dense, few shell fragments, well-cemented						
	☒	100	100/3.5"			BORING TERMINATED AT 54'						
55												

02867

45

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	10942-001-02
REPORT NO.:	115929
PAGE:	A-2.22

PROJECT: BORROW PIT 91
KEENE ROAD LANDFILL
APOPKA, FLORIDA
CLIENT: BUTTREY DEVELOPMENT LLC
LOCATION: BORING LOCATIONS SELECTED BY CLIENT
REMARKS:

BORING DESIGNATION: B-21
SHEET: 1 of 1
SECTION:
TOWNSHIP:
RANGE:

G.S. ELEVATION (ft): 89.10' NGVD
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):

DATE STARTED: 4/3/00
DATE FINISHED: 4/3/00
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./DAY)	ORG. CONT. (%)
0						Loose light gray/brown fine SAND [A-3]						
	☒	2-2-3	5									
	☒	3-2-2	4			— very loose						
5	☒	2-2-2	4			— with a small root piece						
	☒	2-2-2	4			— no roots						
	☒	3-4-4	8			— loose; very light gray to white						
	☒	4-4-4	8									
10						Loose light orange/brown clayey fine SAND [A-2-6]						
						Dense light gray fine SAND [A-3]						
15	☒	6-16-20	36									
20	☒	4-5-9	14			Medium dense very light gray to white clayey fine SAND [A-2-6]						
	☒	5-7-8	15									
	☒	4-4-5	9			— loose						
NGVD 64.0' 25	☒	3-4-5	9			← Proposed Bottom landfill						
	☒	4-5-8	11			— medium dense						
	☒	2-2-4	6			— loose; mottled with orange						
	☒	1-2-3	6			Medium stiff light gray mottled with orange sandy CLAY [A-7-6]						
30	☒	3-3-3	6	515							5.22 x 10-9 cm/sec	
	☒	0-2-4	6									
	☒	1-2-4	6									
						Loose light gray clayey fine SAND mottled with orange [A-2-6]						
35	☒	0-1-2	3									
	☒	2-3-4	7			— loose						
	☒	0-1-1	2									
	☒	0-0-3	3	521		Very soft orange/brown sandy CLAY with cemented fine SAND [A-6]					3.45E-7 cm/sec	
40						~~— soft; with some phosphate nodules~~						
	☒	7-8-16	24			— very stiff						
	☒	8-10-24	34			— hard	48	42				
	☒	8-20-22	42			— light gray, with some weathered limestone fragments					1.47E-04 = 5.18 x 10-8 cm/sec	
45	☒	8-18-30	48									
	☒	8-100-100	100/5" 00/.25'			— very hard						
						BORING TERMINATED AT 47.5'						
50												

02867

RECEIVED
JAN - 9 2001
ORANGE COUNTY ENVIRONMENTAL PROTECTION DIVISION

KEENE

JOB NO.
DATE
SCALE
DRAWN BY
CHKD BY

1	REVISIO
2	RECEI
3	
4	MAR 23 20
5	
6	ORANGE COUNTY ENVIRO PROTECTION DIVISI
7	

C:\R14\DESIGN\PIT91L

DRAWING DESCRIPTIO
SUMMARY OF
LANDFILL SO
BORINGS

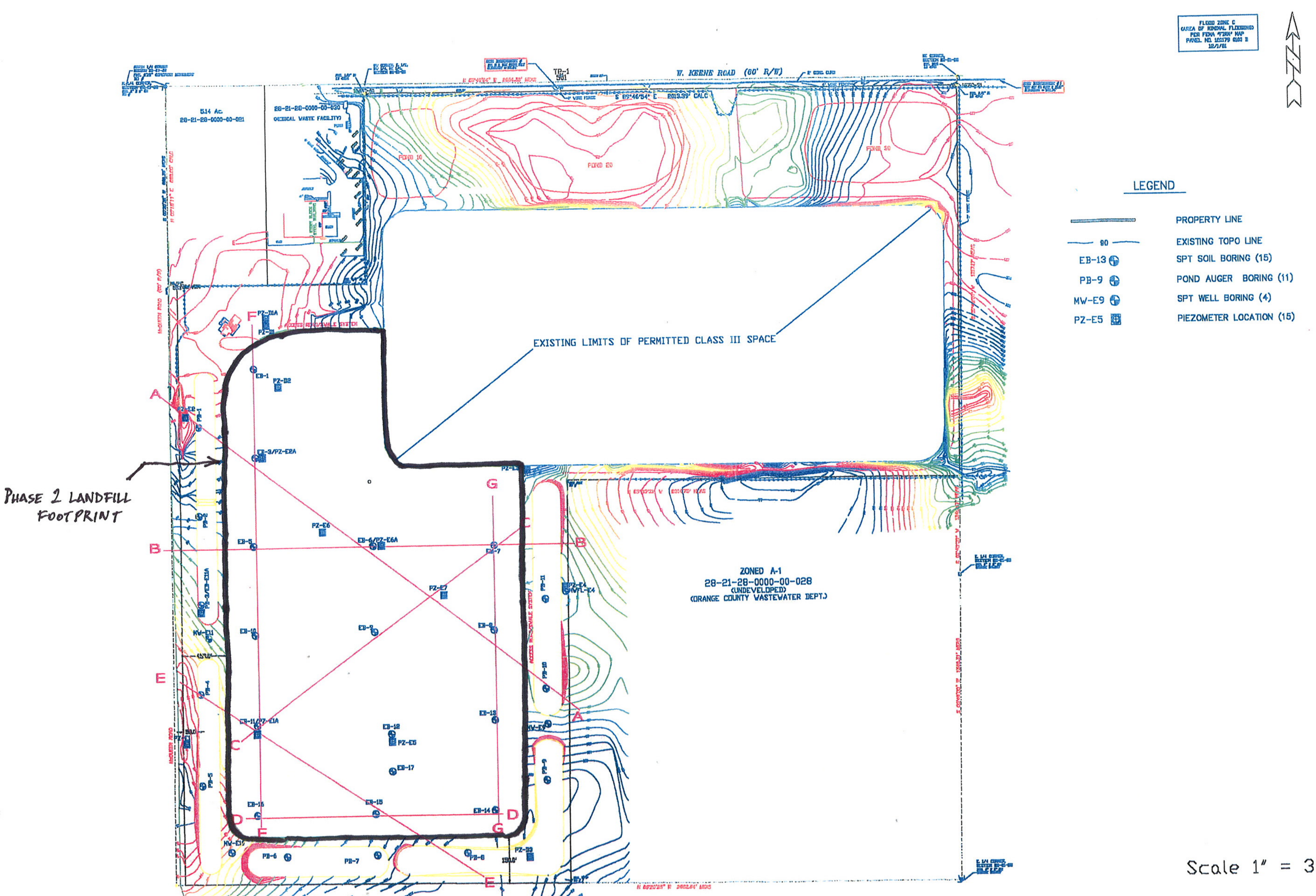
DRAWING NO.
SHEET 2 OF 2

PHASE 1

SOIL BORINGS INFORMATION

PHASE 2

SOIL BORINGS INFORMATION



BISHOP &
BUTTREY,
INC.

NOT VALID WITHOUT RAISED SEAL

BUTTREY DEVELOPMENT THREE, L.L.C.
KEENE ROAD DISPOSAL CLASS III LANDFILL EXPANSION

JOB NO.
DATE
SCALE
DRAWN BY EC
CHKD BY EC

REVISIONS
1 10/25/02
2 03/18/03
3
4
5
6

DRAWING DESCRIPTION
SOIL BORING
LOCATION MAP

Scale 1" = 300'

DRAWING NO.
FIGURE 2

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-002-01
REPORT NO.:
PAGE: B-2.2

T: BORROW PIT NO. 125 - KEENE ROAD
LANDFILL EXPANSION
ORANGE COUNTY, FLORIDA

CLIENT: BUTTREY DEVELOPMENT TWO L.L.C.
LOCATION:
REMARKS:

BORING DESIGNATION: **EB-1** SHEET: **1 of 2**
SECTION: TOWNSHIP: RANGE:
G.S. ELEVATION (ft): 108.9
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):
DATE STARTED: 10/23/01
DATE FINISHED: 10/23/01
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./ DAY)	ORG. CONT. (%)
0						Loose light tan fine SAND [A-3]						
	☒	1-2-2	4									
	☒	2-2-3	5									
5	☒	2-2-2	4									
	☒	2-2-3	5									
	☒	2-2-3	5									
	☒	3-3-3	6				2	3			18.2	
10												
						Medium dense orange brown SAND with clay [A-3, A-2-4]						
	☒	6-8-12	20									
15												
						Very dense gray & yellow brown SAND [A-3]						
	☒	10-21-40	61									
	☒	12-23-24	47			-- dense						
25												
						Stiff gray & yellow brown CLAY [A-7]						
	☒	2-5-7	12									
30												
						-- 2" layer of LIMESTONE						
	☒	2-3-5	8			-- medium stiff						
35												
						Medium dense gray SILT [A-4, A-5]						
	☒	4-6-6	12									
40												
						Loose tan LIMESILT with limestone [A-4]						
	☒	2-2-3	5									
45												
	☒	2-2-3	5									
50												
	☒	3-4-4	8									
55												
						Tan weathered LIMESTONE with phosphates						
	☒	50	50/5"									
60												
	☒	86	86/6"									
65												

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BORING LOG

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T: BORROW PIT NO. 125 - KEENE ROAD
LANDFILL EXPANSION
ORANGE COUNTY, FLORIDA

BORING DESIGNATION: EB-1 SHEET: 2 of 2
SECTION: TOWNSHIP: RANGE:

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./ DAY)	ORG. CONT. (%)
									LL	PI		
65					▦							
	☒	23-40-50	90/11"		▦	-- dark gray						
70					▦							
	☒	50	50/1"		▦							
75					▦							
						BORING TERMINATED AT 78.0 FEET						
80												
90												
95												
100												
105												
110												
115												
120												
125												
130												

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BORING LOG

PROJECT NO.: 10942-002-01
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PAGE: B-2.1

ECT: BORROW PIT NO. 125 - KEENE ROAD
LANDFILL EXPANSION
ORANGE COUNTY, FLORIDA

BORING DESIGNATION: **EB-3**
SHEET: **1 of 1**
SECTION:
TOWNSHIP:
RANGE:

CLIENT: BUTTREY DEVELOPMENT TWO L.L.C.
LOCATION:
REMARKS:

G.S. ELEVATION (ft): 101.5
WATER TABLE (ft): N.E.
DATE OF READING: 06/28/01
EST. W.S.W.T. (ft):

DATE STARTED: 6/28/01
DATE FINISHED: 6/28/01
DRILLED BY: UES-ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./ DAY)	ORG. CONT. (%)
									LL	PI		
0						Very loose, orange-brown fine SAND [A-3]						
	☒	3-2-2	4									
	☒	3-2-3	5			---Loose						
5	☒	1-1-1	2									
	☒	2-2-2	4			---Very loose						
	☒	2-2-3	5			---Loose						
	☒	2-2-3	5				2	4				
10												
	☒	4-8-7	15									
15						---Medium dense, little lighter						
0	☒	7-8-12	20			---Light brown						
						---Very dense, light gray						
25	☒	13-27-28	55				3	11				
						Dense, light gray silty fine SAND [A-2-4]						
30	☒	16-28-20	48				12	16				
35	☒	11-14-14	28				3	21				
						Medium dense, light gray fine SAND [A-3]						
						Medium dense, light gray fine SAND; with silt [A-3]						
40	☒	12-12-12	24				9	20				
						Very loose, orange clayey fine SAND [A-2-4]						
45	☒	1-2-2	4									
50	☒	5-6-9	15			---Medium dense, light brown	9	17			5.94E-01 $2.10 X 10^{-4}$ cm/sec	
						Medium dense, orange-brown and gray sandy silty CLAY [A-6, A-7]						
55	☒	5-7-7	14			BORING TERMINATED AT 55 FEET						
60												
65												

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

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T: BORROW PIT NO. 125 - KEENE ROAD
LANDFILL EXPANSION
ORANGE COUNTY, FLORIDA

CLIENT: BUTTREY DEVELOPMENT TWO L.L.C.
LOCATION:
REMARKS:

BORING DESIGNATION: EB-5
SHEET: 1 of 1
SECTION:
TOWNSHIP:
RANGE:
G.S. ELEVATION (ft): 99.1
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):
DATE STARTED: 10/24/01
DATE FINISHED: 10/24/01
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./ DAY)	ORG. CONT. (%)
									LL	PI		
0						Loose gray fine SAND [A-3] -- light brown						
	☒	2-2-3	5									
	☒	2-2-3	5									
5	☒	2-2-2	4									
	☒	2-3-2	5									
	☒	2-2-2	4									
	☒	2-3-4	7				2	2			23.0	
10												
	☒	5-7-8	15			-- medium dense; gray brown						
15												
	☒	4-6-7	13			Stiff orange brown CLAY [A-7]						
	☒	8-12-13	25			Medium dense light gray fine SAND [A-3]						
25												
						Medium dense light gray & yellow brown SAND with yellow brown sandy clay [A-2-4]						
	☒	4-6-11	17									
30						Light orange brown & gray sandy CLAY [A-6]						
	☒	2-1-2	3			-- soft						
35												
	☒	2-2-2	4									
40												
	■					-- SHELBY TUBE TAKEN FROM 43.0 FEET TO 45.0 FEET	80	53			1.15E-03	
45	☒	2-3	5			-- medium stiff					4.06×10^{-7} cm/sec	
	☒	2-3-3	6									
50												
	☒	5-50	50/3"			Very dense light gray consolidated LIMESILT [A-4]						
						BORING TERMINATED AT 52.0 FEET						
55												
60												
65												

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

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CT: BORROW PIT NO. 125 - KEENE ROAD
LANDFILL EXPANSION
ORANGE COUNTY, FLORIDA

CLIENT: BUTTREY DEVELOPMENT TWO L.L.C.
LOCATION:
REMARKS:

BORING DESIGNATION: **EB-6**
SHEET: **1 of 1**
SECTION:
TOWNSHIP:
RANGE:
G.S. ELEVATION (ft): 98.5
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):
DATE STARTED: 10/24/01
DATE FINISHED: 10/24/01
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./ DAY)	ORG. CONT. (%)
									LL	PI		
0					⁘	Very loose gray fine SAND [A-3]						
	☒	1-1-2	3			-- light tan						
	☒	2-1-2	3									
5	☒	1-2-2	4									
	☒	2-2-2	4									
	☒	2-3-4	7									
					▨	Loose to medium dense orange brown clayey SAND [A-2-4, A-2-6]						
	☒	4-5-6	11									
10												
	☒	12-22-31	53			-- very dense						
15												
					▩	Very hard orange & gray sandy CLAY [A-6]						
	☒	10-13-20	33									
					⁘	Very dense light gray & yellow brown SAND [A-3						
	☒	18-30-30	60									
25												
	☒	46-20-29	49			-- dense						
30												
	☒	13-12-17	29									
35												
					▩	Stiff light orange brown & gray sandy CLAY [A-6]						
	☒	6-6-5	11									
40												
	☒	4-4-5	9			-- medium stiff						
45												
	☒	2-2-3	5									
50												
					▥	Loose gray & yellow brown SILT [A-4]						
	☒	2-3-4	7									
55						BORING TERMINATED AT 55.0 FEET						
60												
65												

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BORING LOG

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.CT: BORROW PIT NO. 125 - KEENE ROAD
LANDFILL EXPANSION
ORANGE COUNTY, FLORIDA

CLIENT: BUTTREY DEVELOPMENT TWO L.L.C.
LOCATION:
REMARKS:

BORING DESIGNATION: EB-7
SHEET: 1 of 1
SECTION:
TOWNSHIP:
RANGE:
G.S. ELEVATION (ft): 95.7
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):
DATE STARTED: 10/25/01
DATE FINISHED: 10/25/01
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./ DAY)	ORG. CONT. (%)
									LL	PI		
0						Very loose gray fine SAND [A-3] -- light brown						
	☒	1-1-2	3									
	☒	1-2-3	5			Medium dense orange clayey SAND [A-2-4, A-2-6]						
5	☒	6-8-11	19									
	☒	8-9-10	19			Medium dense light tan brown SAND [A-3]						
	☒	8-8-9	17									
	☒	9-10-10	20									
10												
						-- light gray						
	☒	8-15-19	34									
15												
	☒	9-13-18	31									
						Medium stiff gray & orange brown CLAY [A-7]						
	☒	3-4-6	10									
25												
						Stiff orange brown & Gray silty CLAY [A-6]						
	☒	3-4-6	10									
30												
						-- orange brown, with limestone						
	☒	3-4-6	10									
35												
						Very loose orange gray LIMESILT [A-4]						
	☒	3-2-3	5									
40												
	■					-- SHELBY TUBE TAKEN FROM 44.0 FEET TO 46.0 FEET						
45							32	32			1.57E-02 5.52×10^{-6} cm/sec	
	☒	5-6-12	18			-- with phosphates						
						BORING TERMINATED AT 47.5 FEET						
50												
55												
60												
65												

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-002-01
REPORT NO.:
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CT: BORROW PIT NO. 125 - KEENE ROAD
LANDFILL EXPANSION
ORANGE COUNTY, FLORIDA

BORING DESIGNATION: **EB-8** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

CLIENT: BUTTREY DEVELOPMENT TWO L.L.C.
LOCATION:
REMARKS:

G.S. ELEVATION (ft): 95.3
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):

DATE STARTED: 9/27/01
DATE FINISHED: 9/27/01
DRILLED BY: UES-ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./ DAY)	ORG. CONT. (%)
									LL	PI		
0						Loose, light brown fine SAND						
	☒	2-3-3	6									
	☒	2-1-1	2			---With roots						
5	☒	2-3-6	8			Loose, orange-brown, with gray mottling sandy CLAY						
	☒	6-10-10	20				78	26	56	30	4.79E-05	
	☒	8-10-12	22								1.69×10^{-8} cm/sec	
	☒	6-7-8	15			Medium dense, orange-brown clayey fine SAND						
10						Medium dense, light orange-brown fine SAND						
						---With clay						
	☒	14-17-24	41									
15												
	☒	18-15-18	33									
						Stiff, orange-brown CLAY						
25	☒	6-6-6	12									
						Medium dense, orange-brown silty fine SAND; with clay						
30	☒	6-7-8	15									
35	☒	2-2-3	5			---Loose						
						Loose, gray clayey fine SAND						
40	☒	4-4-4	8									
						Firm, orange-brown silty sandy CLAY						
45	☒	2-3-4	7									
50	☒	4-9-5	14			---Stiff	15	31			1.83E-03	
											6.47×10^{-7} cm/sec	
						Very dense, gray cemented SAND						
55	☒	100	100/1"									
						BORING TERMINATED AT 55 FEET						
60												
65												

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-002-01
REPORT NO.:
PAGE: B-2.2

.CT: BORROW PIT NO. 125 - KEENE ROAD
LANDFILL EXPANSION
ORANGE COUNTY, FLORIDA
CLIENT: BUTTREY DEVELOPMENT TWO L.L.C.
LOCATION:
REMARKS:

BORING DESIGNATION: **EB-9**
SHEET: 1 of 1
SECTION:
TOWNSHIP:
RANGE:

G.S. ELEVATION (ft): 98.5
WATER TABLE (ft): N.E.
DATE OF READING: 06/28/01
EST. W.S.W.T. (ft):
DATE STARTED: 6/28/01
DATE FINISHED: 6/28/01
DRILLED BY: UES-ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./ DAY)	ORG. CONT. (%)
0						Very loose, gray-brown fine SAND [A-3]						
	☒	2-2-2	4				2	4				
	☒	2-1-2	3			Medium dense, orange fine SAND; with trace of clay [A-3]						
5	☒	5-6-11	17									
	☒	11-12-16	28			Dense, light orange-brown clayey fine SAND [A-2-4]	19	10				
	☒	20-21-23	44									
	☒	14-16-17	33			---Gray and orange						
10												
						Very dense, light brown fine SAND [A-3]						
15	☒	14-23-27	50									
0	☒	21-26-29	55			---Light gray						
25	☒	17-21-25	46			---Light orange-brown	5	17				
						Stiff, orange-brown sandy CLAY [A-6, A-7]						
30	☒	4-6-8	14									
35	☒	2-3-4	7			---Firm, orange-gray	82	62			5.35E-03 1.88×10^{-6} cm/sec	
40	☒	3-4-4	8									
45	☒	4-7-7	14									
						Very stiff, green sandy silty CLAY [A-6, A-7]						
50	☒	11-13-17	30									
						Medium dense, dark greenish-gray silty fine SAND; with shells [A-2-4]						
55	☒	10-11-13	24			BORING TERMINATED AT 55 FEET						
60												
65												

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	10942-002-01
REPORT NO.:	
PAGE:	8-2.7

:CT: BORROW PIT NO. 125 - KEENE ROAD
LANDFILL EXPANSION
ORANGE COUNTY, FLORIDA

CLIENT: BUTTREY DEVELOPMENT TWO L.L.C.

LOCATION:

REMARKS:

BORING DESIGNATION: **EB-10** SHEET: 1 of 1

SECTION: TOWNSHIP: RANGE:

G.S. ELEVATION (ft): 95.1

WATER TABLE (ft):

DATE OF READING:

EST. W.S.W.T. (ft):

DATE STARTED: 10/24/01

DATE FINISHED: 10/24/01

DRILLED BY: UES - ORLANDO

TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./ DAY)	ORG. CONT. (%)
									LL	PI		
0						Loose gray fine SAND [A-3] -- light brown						
	☒	1-2-2	4									
	☒	1-1-2	3									
5	☒	1-2-2	4									
	☒	1-2-3	5			Loose orange brown clayey SAND [A-2-4, A-2-6]						
	☒	2-3-3	6									
	☒	3-3-4	7									
10												
						-- dense						
	☒	8-14-23	37									
15												
						Dense light tan SAND [A-3]						
	☒	14-16-21	37									
.0												
						Medium dense light tan SAND with silt [A-3, A-2-4]						
	☒	8-8-7	15									
25												
						Soft gray & orange brown sandy CLAY [A-6]						
	☒	1-2-2	4									
30												
						Soft orange brown silty CLAY [A-5, A-6]						
	☒	2-1-2	3									
35												
						-- medium stiff						
	☒	1-2-3	5									
40												
						Loose gray & orange SILT [A-4, A-5]						
	☒	2-3-3	6									
45												
						Gray weathered LIMESTONE with phosphates						
	☒	50	50/5"									
50						BORING TERMINATED AT 50.0 FEET						
55												
60												
65												

03412

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-002-01
REPORT NO.:
PAGE: B-2.8

ECT: BORROW PIT NO. 125 - KEENE ROAD
LANDFILL EXPANSION
ORANGE COUNTY, FLORIDA

CLIENT: BUTTREY DEVELOPMENT TWO L.L.C.
LOCATION:
REMARKS:

BORING DESIGNATION: EB-11
SHEET: 1 of 1
SECTION:
TOWNSHIP:
RANGE:

G.S. ELEVATION (ft): 93.4
WATER TABLE (ft): N.E.
DATE OF READING: 06/28/01
EST. W.S.W.T. (ft):

DATE STARTED: 6/28/01
DATE FINISHED: 6/28/01
DRILLED BY: UES-ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./ DAY)	ORG. CONT. (%)
0												
	☒	2-2-2	4		░	Very loose, light gray-brown fine SAND [A-3]						
	☒	2-1-2	3		░							
5	☒	1-2-2	4		░	---Shade lighter	1	2				
	☒	2-2-4	6		░							
	☒	5-6-9	15		▨	Medium dense, orange-brown clayey fine SAND [A-2-4]						
10	☒	7-9-10	19		▨							
	☒	8-10-16	26		▨	Very stiff, orange CLAY [A-6, A7]	90	34	82	39		
15					▨							
	☒	10-16-19	35		▨							
20					░	Dense, orange-brown fine SAND; with silt [A-3]	5	21				
	☒	16-14-8	22		░	---Loose, light gray	7	16				
25					░	---Very dense, light gray						
	☒	2-2-2	4		░							
30					▨	Firm, orange-gray silty CLAY [A-6, A-7]						
	☒	3-3-3	6		▨							
35					▨	---Light gray						
	☒	2-3-4	7		▨							
40					▨							
	☒	5-5-6	11		▨	Stiff, light brown silty CLAY; with limestone [A-6, A-7]						
45					▨							
	☒	27-24-17	41		▨							
50						BORING TERMINATED AT 50 FEE						
55												
60												
65												

03412

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-002-02
REPORT NO.:
PAGE: A-1.1

ROJECT: GEOTECHNICAL EXPLORATION
BISHOP & BUTTREY PIT NO. 125, KEENE ROAD
ORANGE COUNTY, FLORIDA

BORING DESIGNATION: **EB-12** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

CLIENT: BUTTREY DEVELOPMENT L.L.C.
LOCATION: SEE BORING LOCATION PLAN
REMARKS: GROUND SURFACE ELEVATION IS APPROXIMATE

G.S. ELEVATION (ft): 73.0
WATER TABLE (ft):
DATE OF READING: 3/18/03
EST. W.S.W.T. (ft):

DATE STARTED: 3/18/03
DATE FINISHED: 3/18/03
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./ DAY)	ORG. CONT. (%)
									LL	PI		
0						Medium dense orange silty SAND [A-2-4]						
		6-7-5	7									
		5-5-6	18			Medium dense orange clayey SAND [A-2-4, A-2-6]						
5		6-5-4	15			Loose orange fine SAND [A-3]						
		5-7-6	15			-- medium dense; light gray						
		5-3-3	10			Firm orange CLAY [A-6, A-7]						
10		5-4-7	7			Medium dense to loose orange clayey SAND [A-2-4, A-2-6]						
		3-4-4	9									
		4-4-4	7			Loose tan clayey SAND [A-2-4, A-2-6]						
		2-2-4	4									
15		3-3-3	6									
		2-2-2	11									
		2-3-4	15									
20		3-4-5	4									
		4-5-5	7			Stiff tan sandy CLAY [A-6]						
		5-5-5	9									
25		3-5-7	7									
		4-4-5	13			Loose orange clayey SAND [A-2-4, A-2-6]						
		4-4-5	9			Loose to medium dense tan silty SAND [A-2-4]						
		4-4-4	16									
30												
		4-6-6	14									
						BORING TERMINATED AT 32.0 FEET						
35												

W-04057.G

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-002-01
REPORT NO.:
PAGE: B-2.2

ECT: BORROW PIT NO. 125 - KEENE ROAD
LANDFILL EXPANSION
ORANGE COUNTY, FLORIDA

BORING DESIGNATION: **EB-13** SHEET: **1 of 2**
SECTION: TOWNSHIP: RANGE:

CLIENT: BUTTREY DEVELOPMENT TWO L.L.C.
LOCATION:
REMARKS:

G.S. ELEVATION (ft): 96.7
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):

DATE STARTED: 9/25/01
DATE FINISHED: 9/25/01
DRILLED BY: UES-ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./ DAY)	ORG. CONT. (%)
									LL	PI		
0						Loose, light brown fine SAND						
	☒	2-3-2	5									
	☒	1-2-1	3			---Very loose						
5	☒	1-1-1	2			---Shade lighter						
	☒	1-1-1	2									
	☒	1-2-1	3									
	☒	3-4-4	8			---Loose, orange-brown						
10						---Loose						
	☒	9-11-15	26			---Medium dense						
15												
						Medium dense, brown silty fine SAND, slightly clay						
	☒	10-12-18	30									
0												
	☒	10-12-12	24									
25												
	☒	12-13-13	26			---Shade lighter						
30												
	☒	11-14-17	31									
35												
	☒	14--14-20	34			---Dense, orange-brown						
40												
	☒	14-17-18	35									
45												
	☒	6-6-12	18			---Medium dense						
50												
	☒	10-10-12	22									
55												
	☒	5-4-4	8			---Loose, light orange-brown						
0												
	☒	4-6-8	14									
65												

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-002-01
REPORT NO.:
PAGE: B-2.3

CT: BORROW PIT NO. 125 - KEENE ROAD
LANDFILL EXPANSION
ORANGE COUNTY, FLORIDA

BORING DESIGNATION: **EB-13** SHEET: 2 of 2
SECTION: TOWNSHIP: RANGE:

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./ DAY)	ORG. CONT. (%)
65					▨	Stiff, gray silty CLAY						
	☒	1-1-2	3		▨	---Soft						
70					▨							
	☒	2-3-4	7		▨	---Firm	57	56			9.34E-04	
75						BORING TERMINATED AT 75 FEET					3.29x10^{7} cm/sec	
80												
5												
90												
95												
100												
105												
110												
115												
120												
25												
130												

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-002-01
REPORT NO.:
PAGE: B-2.8

CT: BORROW PIT NO. 125 - KEENE ROAD
LANDFILL EXPANSION
ORANGE COUNTY, FLORIDA

CLIENT: BUTTREY DEVELOPMENT TWO L.L.C.
LOCATION:
REMARKS:

BORING DESIGNATION: **EB-14**
SHEET: 1 of 1
SECTION:
TOWNSHIP:
RANGE:

G.S. ELEVATION (ft): 103.7
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):

DATE STARTED: 10/24/01
DATE FINISHED: 10/24/01
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./ DAY)	ORG. CONT. (%)
									LL	PI		
0												
	☒	1-2-2	4		∴	Gray fine SAND [A-3] -- light brown						
	☒	1-2-2	4		∴							
5	☒	1-2-1	5		∴							
	☒	14-18-22	40		▨	Dense orange brown clayey SAND [A-2-4, A-2-6] -- very dense						
	☒	25-31-37	68		▨							
	☒	34-40-41	81		▨							
10					▨							
					∴	Medium dense light gray SAND [A-3]						
15	☒	8-13-20	33		∴							
)	☒	12-22-31	53		∴	-- dense						
25	☒	11-17-21	38		∴	-- medium dense						
					▨	Soft gray & orange brown silty CLAY [A-6]						
30	☒	2-2-2	4		▨							
35	☒	3-4-5	9		×	Loose gray LIMESILT with limestone pieces [A-4]						
40	☒	4-6-7	13		×							
					▨	Hard dark green silty CLAY [A-6]						
45	☒	5-9-18	27		▨							
50	☒	8-8-14	22		▨	-- stiff						
55	■				▨	-- SHELBY TUBE ATTEMPTED FROM 53.0 FEET TO 55.0 FEET (8" RECOVERY)	26	38			1.58E-02 5.59×10^{-6} cm/sec	
					▨	Very hard dark green silty sandy CLAY with shell [A-6]						
60	☒	12-18-21	39		▨	BORING TERMINATED AT 60.0 FEET						
65												

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-002-01
REPORT NO.:
PAGE: B-2.4

ECT: BORROW PIT NO. 125 - KEENE ROAD
LANDFILL EXPANSION
ORANGE COUNTY, FLORIDA

BORING DESIGNATION: EB-15
SHEET: 1 of 1
SECTION:
TOWNSHIP:
RANGE:

CLIENT: BUTTREY DEVELOPMENT TWO L.L.C.
LOCATION:
REMARKS:

G.S. ELEVATION (ft): 95.8
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):

DATE STARTED: 9/27/01
DATE FINISHED: 9/27/01
DRILLED BY: UES-ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./ DAY)	ORG. CONT. (%)
0						Loose, brown fine SAND						
	☒	3-3-3	6									
	☒	3-2-3	5									
5	☒	3-4-6	10			Stiff, orange-brown and gray mottling sandy CLAY						
	☒	10-8-10	18									
	☒	12-12-13	25			---Medium dense	77	25	64	33		
	☒	7-8-10	18			Medium dense, orange-brown fine SAND						
10												
	☒	6-7-9	16			---Light brown						
15												
	☒	9-12-13	25									
20												
	☒	8-8-12	20									
25												
						Stiff, gray silty CLAY						
	☒	6-6-8	14									
30												
	☒	4-4-4	8			---Firm						
35												
	☒	4-5-6	11			---Stiff						
40												
	☒	6-6-6	12									
45												
	☒	6-6-9	15			---Gray						
50												
	☒	6-8-12	20			---Very stiff, gray						
55						BORING TERMINATED AT 55 FEET						
60												
65												

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-002-01
REPORT NO.:
PAGE: B-2.6

ECT: BORROW PIT NO. 125 - KEENE ROAD
LANDFILL EXPANSION
ORANGE COUNTY, FLORIDA

CLIENT: BUTTREY DEVELOPMENT TWO L.L.C.
LOCATION:
REMARKS:

BORING DESIGNATION: EB-16
SHEET: 1 of 1
SECTION:
TOWNSHIP:
RANGE:

G.S. ELEVATION (ft): 87.3
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):

DATE STARTED: 9/25/01
DATE FINISHED: 9/25/01
DRILLED BY: UES-ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./ DAY)	ORG. CONT. (%)
									LL	PI		
0						Loose, light brown fine SAND						
	☒	2-3-3	6									
	☒	2-2-2	4			---Very loose						
5	☒	1-1-1	2									
	☒	1-1-1	2									
	☒	2-1-2	3			---Orange-brown						
	☒	3-2-3	5									
10						Loose, orange-brown clayey fine SAND						
						Very stiff, light gray sandy CLAY						
	☒	8-10-10	20									
15						Medium dense, light tan SAND						
	☒	12-16-18	34									
20												
	☒	36-56-44	100									
25												
	☒	10-10-10	20			Medium dense, orange-brown fine SAND; with silt						
30												
						Loose, orange-brown silty fine SAND						
	☒	2-3-5	8									
35												
						Stiff, light orange-brown silty CLAY						
	☒	3-4-6	10									
40												
	☒	3-3-4	7				30	45			1.67E-03	
45											5.90×10^{-7} cm/sec	
	☒	3-4-4	8			Loose, brown silty fine SAND [SM]						
50						BORING TERMINATED AT 50 FEET						
55												
60												
65												

03412

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 10942-002-02
REPORT NO.:
PAGE: A-1.2

PROJECT: GEOTECHNICAL EXPLORATION
BISHOP & BUTTREY PIT NO. 125, KEENE ROAD
ORANGE COUNTY, FLORIDA

CLIENT: BUTTREY DEVELOPMENT L.L.C.
LOCATION: SEE BORING LOCATION PLAN
REMARKS: GROUND SURFACE ELEVATION IS APPROXIMATE

BORING DESIGNATION: EB-17
SHEET: 1 of 1
SECTION:
TOWNSHIP:
RANGE:

G.S. ELEVATION (ft): 75.0
WATER TABLE (ft):
DATE OF READING: 3/18/03
EST. W.S.W.T. (ft):

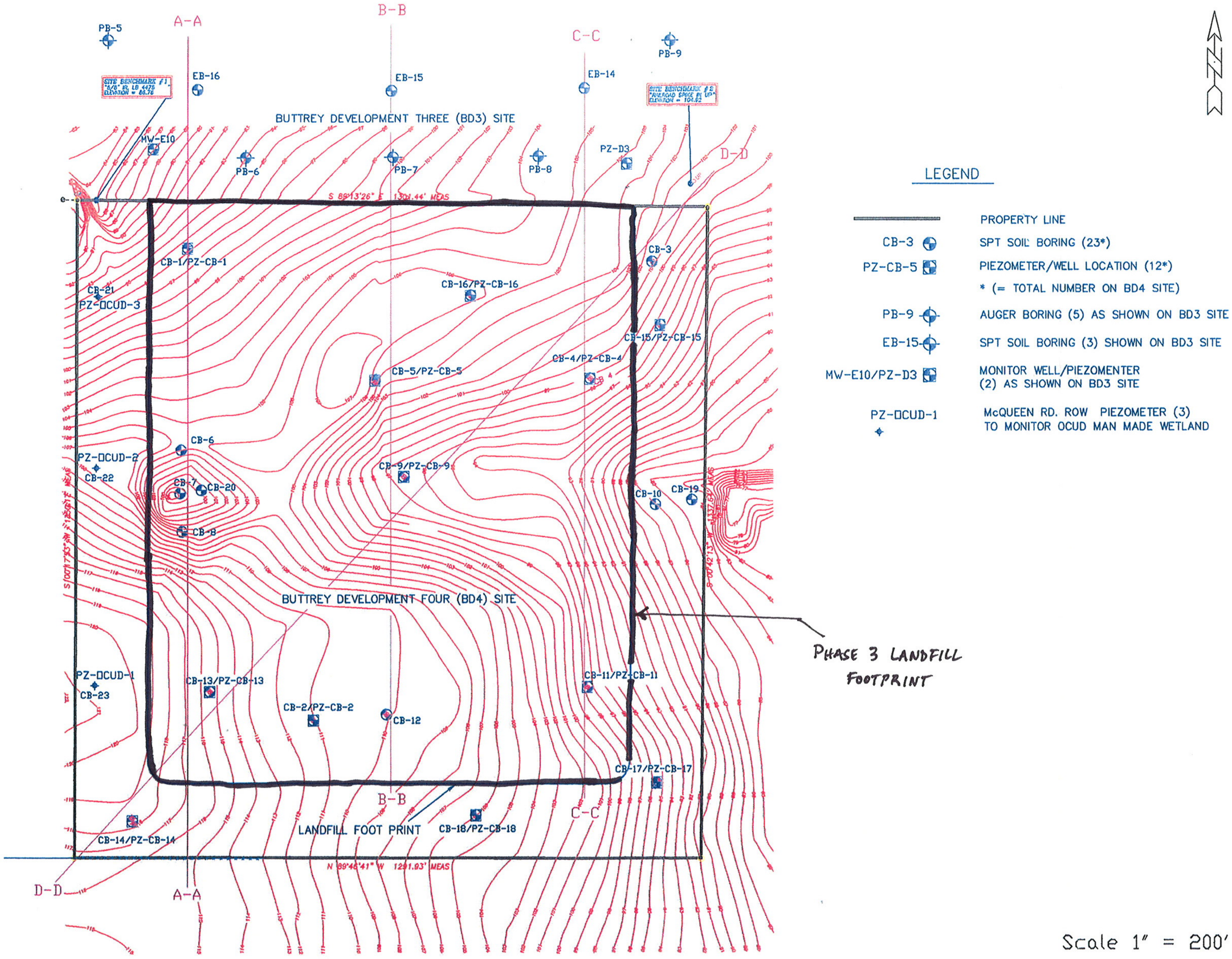
DATE STARTED: 3/18/03
DATE FINISHED: 3/18/03
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./ DAY)	ORG. CONT. (%)
									LL	PI		
0						Loose very light gray fine SAND [A-3						
		1-2-5	7									
		7-9-9	18			-- medium dense; very light gray, medium-grained						
5		8-7-8	15			-- light gray						
		8-7-8	15			Medium dense red orange fine SAND with silt [A-3, A-2-4]						
		5-5-5	10			-- medium dense; tan to light gray Loose mixed silty clayey SAND [A-2-4]						
10		4-3-4	7			Firm orange CLAY with sand. [A-6, A-7]						
		2-3-6	9									
		4-3-4	7			-- sandy						
		2-2-2	4			Loose tan SILT with phosphates and clay [A-4]						
15		2-3-3	6			-- no phosphates or clay						
		3-4-7	11									
		5-6-9	15									
20		2-2-2	4			-- loose; orange brown						
		3-3-4	7									
		4-4-5	9									
25		3-3-4	7			-- medium dense						
		5-6-7	13									
		4-4-5	9									
		6-8-8	16									
30												
		5-7-7	14			Medium dense orange silty clayey SAND [A-2-4, A-2-6]						
						BORING TERMINATED AT 32.0 FEET						
35												

W-0405"

PHASE 3

SOIL BORINGS INFORMATION



LEGEND

▬	PROPERTY LINE
CB-3	SPT SOIL BORING (23*)
PZ-CB-5	PIEZOMETER/WELL LOCATION (12*)
	* (= TOTAL NUMBER ON BD4 SITE)
PB-9	AUGER BORING (5) AS SHOWN ON BD3 SITE
EB-15	SPT SOIL BORING (3) SHOWN ON BD3 SITE
MW-E10/PZ-D3	MONITOR WELL/PIEZOMENTER (2) AS SHOWN ON BD3 SITE
PZ-DCUD-1	McQUEEN RD. ROW PIEZOMETER (3) TO MONITOR OCUD MAN MADE WETLAND

Scale 1" = 200'

BISHOP &
BUTTREY,
INC.
NOT VALID WITHOUT RAISED SEAL

BUTTREY DEVELOPMENT FOUR, L.L.C.
KEENE ROAD DISPOSAL CLASS III LANDFILL EXPANSION

JOB NO.
DATE JAN. 2004
SCALE
DRAWN BY EC
CHKD BY EC

REVISIONS
1 DEC. 2004
2
3
4
5
6

C:\R14\DESIGN\PIT15I\BORINGS
DRAWING DESCRIPTION
SOIL BORING
LOCATION MAP

DRAWING NO.
FIGURE 2

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 12474-001-01
REPORT NO.:
PAGE: B-2.1

OJECT: PIT NO. 151
ORANGE COUNTY, FLORIDA
CLIENT: BUTTREY DEVELOPMENT FOUR
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

BORING DESIGNATION: **CB-1**
SHEET: **1 of 2**
SECTION:
TOWNSHIP:
RANGE:

G.S. ELEVATION (ft): 95.6
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):
DATE STARTED: 5/30/03
DATE FINISHED: 5/30/03
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (cm/ sec)	ORG. CONT. (%)
									LL	PI		
0						Very loose orange brown fine SAND [A-3]						
	☒	2-2-2	4									
	☒	2-2-2	4									
5	☒	2-2-1	3			-- shade lighter, with roots						
	☒	2-2-3	5			-- loose; light orange brown, no roots						
	☒	3-2-3	5			-- shade lighter						
	☒	4-4-5	9			-- orange brown						
10												
	☒	3-4-6	10			-- gray						
15												
	☒	6-6-8	14			-- medium dense, light brown						
20												
	☒	9-10-14	24			-- orange brown, trace of clay						
25												
	☒	13-15-26	41			-- dense; light gray						
30												
	☒	10-13-14	27			Medium dense orange brown silty fine SAND [A-2-4]						
35												
						Orange sandy CLAY [A-6]						
						Medium dense orange brown fine SAND [A-3]						
	☒	10-12-14	26									
40												
	☒	10-11-24	35									
45												
						Firm orange brown silty sandy CLAY [A-6]						
	☒	3-4-3	7									
50												
	☒	3-4-4	8									
55												

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 12474-001-01
REPORT NO.:
PAGE: B-2.2

ROJECT: PIT NO. 151

ORANGE COUNTY, FLORIDA

BORING DESIGNATION: **CB-1**
SHEET: **2 of 2**
SECTION:
TOWNSHIP:
RANGE:

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (cm/ sec)	ORG. CONT. (%)
									LL	PI		
55					▨							
					▨	Soft orange brown CLAY [A-6, A-7]						
60	☒	2-2-2	4		▨							
65	☒	1-2-2	4		▨		64	39			2.6x10-8	
						BORING TERMINATED AT 65.0 FEET						
70												
75												
80												
85												
90												
95												
100												
105												
110												

W-04166.GPJ

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:
REPORT NO.:
PAGE: B-2.1

ROJECT: PIT # 51
BUTTREY DEVELOPMENT IV
ORANGE COUNTY, FLORIDA

BORING DESIGNATION: **PZ-CB-2** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

CLIENT:
LOCATION: SEE BORING LOCATION PLAN
REMARKS: SHGWT = SEASONAL HIGH GROUNDWATER TABLE, N.S. = NOT SURVEYED

G.S. ELEVATION (ft): 111.0
WATER TABLE (ft):
DATE OF READING: 1/10/04
EST. SHGWT (ft):

DATE STARTED: 1/10/04
DATE FINISHED: 1/10/04
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT/ DAY)	ORG. CONT. (%)
									LL	PI		
0												
	☒	2-2-3	5			Loose, light brown fine SAND [A-3]						
	☒	2-2-3	5			--Shade lighter						
5	☒	4-15-20	35			Medium dense, orange-brown clayey fine SAND [A-4]						
	☒	20-21-22	43			--Very dense						
	☒	13-15-18	33			--Dense, with seams of clay						
	☒	17-21-22	43			--Very dense						
10												
	☒	6-13-22	35			Very dense, orange-brown fine SAND [A-3]						
15												
	☒	14-22-45	67			--Very dense, shade lighter						
20												
	☒	19-14-16	30			--Medium dense, gray-brown						
25												
	☒	7-7-11	18			--Orange-brown						
30												
	☒	11-12-19	31									
35						--Dense, gray-brown						
						Loose, orange-brown SILT; with fine sand [A-5]						
	☒	2-3-4	7									
40												
	☒	2-1-1	2			--Very loose						
45												
						Very stiff, gray CLAY; with silt [A-7]						
	☒	4-7-11	18									
50						BORING TERMINATED AT 50 FEET						
55												

W-04426.GPJ

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	12474-001-01
REPORT NO.:	
PAGE:	B-2.3

ROJECT: PIT NO. 151

ORANGE COUNTY, FLORIDA

CLIENT: BUTTREY DEVELOPMENT FOUR

LOCATION: SEE BORING LOCATION PLAN

REMARKS:

BORING DESIGNATION: **CB-3**

SHEET: **1 of 1**

SECTION:

TOWNSHIP:

RANGE:

G.S. ELEVATION (ft): 101.2

DATE STARTED: 5/28/03

WATER TABLE (ft):

DATE FINISHED: 5/28/03

DATE OF READING:

DRILLED BY: UES - ORLANDO

EST. W.S.W.T. (ft):

TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (cm/ sec)	ORG. CONT. (%)
									LL	PI		
0						Very loose light orange brown fine SAND [A-3]						
	☒	1-2-2	4									
	☒	2-2-2	4									
5	☒	2-5-8	13			Stiff to very hard dark orange brown sandy CLAY [A-6]						
	☒	17-25-28	53									
	☒	34-20-30	50			-- with seams of gray						
10	☒	23-22-20	42									
						Dense light gray SAND [A-3]						
15	☒	13-18-25	43									
						-- very light gray						
20	☒	14-16-24	40									
						-- medium dense; light gray						
25	☒	9-9-10	19									
						Loose gray SILT [A-4]						
30	☒	2-3-4	7									
						-- orange brown						
35	☒	1-2-3	5									
						-- gray, with sand						
40	☒	1-3-5	8									
						Very stiff gray green silty CLAY [A-6]						
45	☒	9-14-14	28									
50	☒	10-16-22	38				53	32			1.4x10-7	
						BORING TERMINATED AT 50.0 FEET						
55												

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 12474-002-01
REPORT NO.:
PAGE: B-2.1

PROJECT: BORROW PIT #153
ORANGE COUNTY, FLORIDA
CLIENT: BUTTREY DEVELOPMENT FOUR
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

BORING DESIGNATION: CB-4
SHEET: 1 of 1
SECTION:
TOWNSHIP:
RANGE:

G.S. ELEVATION (ft): 98.60
WATER TABLE (ft):
DATE OF READING: 8/13/03
EST. W.S.W.T. (ft):
DATE STARTED: 8/13/03
DATE FINISHED: 8/13/03
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (cm/ sec)	ORG. CONT. (%)
									LL	PI		
0						Loose tan fine SAND [A-3]						
	☒	2-3-3	6									
	☒	1-2-3	5			Loose orange brown clayey SAND [A-2-4, A-2-6]						
5	☒	6-6-9	15			-- medium dense; mottled orange						
	☒	6-12-13	25									
	☒	12-12-12	24			Medium dense orange fine SAND [A-3]						
10	☒	8-10-11	21									
						-- dense; light gray to white						
15	☒	10-16-27	43									
						-- medium dense						
20	☒	8-12-14	26									
						Medium dense orange brown clayey SAND [A-2-4, A-2-6]						
25	☒	7-9-13	22									
						Medium dense orange brown fine SAND [A-3]						
30	☒	3-5-9	14									
						Medium dense tan silty fine SAND with cemented sand [A-2-4]						
35	☒	4-6-9	15									
						Medium dense gray clayey SAND [A-2-4, A-2-6]						
40	☒	7-12-14	26									
						Medium dense green clayey silty SAND [A-2-4]						
45	☒	9-12-12	24									
						-- dense	35	42			2.6x10-7	
50	☒	9-13-21	34			BORING TERMINATED AT 50.0 FEET						
55												

W-04247.SPJ

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 12474-001-01
REPORT NO.:
PAGE: B-2.4

ROJECT: PIT NO. 151

ORANGE COUNTY, FLORIDA

CLIENT: BUTTREY DEVELOPMENT FOUR
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

BORING DESIGNATION: **CB-5** SHEET: **1 of 2**
SECTION: TOWNSHIP: RANGE:

G.S. ELEVATION (ft): 104.2
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):
DATE STARTED: 5/29/03
DATE FINISHED: 5/28/03
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (cm/ sec)	ORG. CONT. (%)
									LL	PI		
0						Loose light brown fine SAND [A-3]						
	☒	3-2-3	5									
	☒	2-2-2	4			-- shade lighter						
5	☒	4-3-4	7									
	☒	5-7-14	21			Very stiff gray sandy CLAY, with seams of orange [A-6]						
	☒	12-14-21	35									
10	☒	14-13-18	31									
						Medium dense light gray fine SAND [A-3]						
15	☒	7-10-11	21									
20	☒	11-16-16	32			-- dense; light orange brown						
						Medium dense orange brown silty fine SAND, trace of clay [A-2-4]						
25	☒	11-11-8	19									
30	☒	11-9-8	17			-- shade lighter						
35	☒	8-5-3	8			-- loose						
						Very loose orange brown silty SAND [A-2-4, A-4]						
40	☒	2-2-2	4									
45	☒	3-4-5	9			-- loose; gray						
50	☒	2-2-2	4			-- very loose; light orange brown	40	48	46	22	3.4x10-8	
55	☒	3-3-4	7			-- loose; with sand						

W-04166.GPJ

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 12474-001-01
REPORT NO.:
PAGE: B-2.5

ROJECT: PIT NO. 151

ORANGE COUNTY, FLORIDA

BORING DESIGNATION: **CB-5**
SHEET: **2 of 2**
SECTION:
TOWNSHIP:
RANGE:

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (cm/ sec)	ORG. CONT. (%)
									LL	PI		
55												
60	☒	100	100/4"			Very dense gray consolidated SILT and sand with phosphates BORING TERMINATED AT 60.0 FEET						
65												
70												
75												
80												
85												
90												
95												
100												
105												
110												

W-04166.GPJ

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 12474-001-01
REPORT NO.:
PAGE: A-1.1

ROJECT: BORROW PIT 151
ORANGE COUNTY, FLORIDA
CLIENT: BUTTREY DEVELOPMENT IV
LOCATION:
REMARKS:

BORING DESIGNATION: **CB-6**
SHEET: **1 of 2**
SECTION:
TOWNSHIP:
RANGE:

G.S. ELEVATION (ft): 105.0
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):

DATE STARTED: 9/20/02
DATE FINISHED: 9/20/02
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS /FT)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (cm/sec)	ORG. CONT. (%)
									LL	PI		
0					░	Loose tan fine SAND [A-3]						
	☒	2-3-2	5		░							
					░	-- very loose						
	☒	1-2-2	4		░							
5	☒	2-2-1	3		░	-- very light tan						
	☒	1-1-1	2		░							
	☒	2-2-2	4		░							
					░	-- loose						
10	☒	2-3-2	5		░							
					░	Loose orange fine SAND with silt [A-3, A-2-4]						
15	☒	3-4-5	9		░							
					▨	Stiff mottled orange CLAY with sand [A-6]						
20	☒	4-6-8	14		▨							
					▨	Very stiff light gray sandy CLAY [A-5, A-6]						
25	☒	5-7-10	17		▨							
30	☒	5-8-9	17		░	Medium dense very light gray to white fine SAND [A-3]						
					░	-- very light orange, mottled						
35	☒	8-10-13	23		░							
					▥	Very loose orange brown clayey silty SAND [A-5]						
40	☒	2-2-2	4		▥		34	32			2.7E-07	

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UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 12474-001-01
REPORT NO.:
PAGE: A-1.2

ROJECT: BORROW PIT 151
ORANGE COUNTY, FLORIDA

BORING DESIGNATION: **CB-6**
SECTION:
TOWNSHIP:
SHEET: **2 of 2**
RANGE:

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS /FT)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (cm/ sec)	ORG. CONT. (%)
40												
						Loose light yellow to tan sandy SILT with clay [A-5]						
45	☒	2-3-3	6									
						Firm mottled tan sandy CLAY with silt [A-6]						
50	☒	3-2-3	5									
						Loose tan sandy SILT, trace of clay [A-4, A-5]						
55	☒	2-2-3	5									
						Very dense gray silty SAND [A-2-4, A-4]						
60	☒	4-8-100	100/3"			Very dense light gray cemented SAND [A-3]						
						BORING TERMINATED AT 60.0 FEET						
65												
70												
75												
80												

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UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 12474-001-01
REPORT NO.:
PAGE: A-1.3

PROJECT: BORROW PIT 151
ORANGE COUNTY, FLORIDA
CLIENT: BUTTREY DEVELOPMENT IV
LOCATION:
REMARKS:

BORING DESIGNATION: CB-7
SHEET: 1 of 2
SECTION:
TOWNSHIP:
RANGE:

G.S. ELEVATION (ft): 99.0
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):

DATE STARTED: 9/19/02
DATE FINISHED: 9/19/02
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS /FT)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (cm/ sec)	ORG. CONT. (%)
									LL	PI		
0						Very loose tan fine SAND [A-3]						
	☒	2-1-1	2									
	☒	0-1-0	1									
5	☒	1-1-1	2									
	☒	1-1-1	2			-- light tan						
	☒	1-2-1	3									
10	☒	0-1-0	1			-- mottled tan & orange						
						-- loose; orange brown						
15	☒	3-4-5	9									
						-- medium dense						
20	☒	3-5-7	12									
						-- mottled orange & gray						
25	☒	7-9-10	19									
						Medium dense orange fine SAND with silt [A-3, A-2-4]						
30	☒	4-7-7	14									
						-- light orange						
35	☒	8-9-10	19									
						Medium dense orange silty SAND [A-2-4, A-4]						
40	☒	8-9-10	19									

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UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 12474-001-01
REPORT NO.:
PAGE: A-1.4

JECT: BORROW PIT 151

ORANGE COUNTY, FLORIDA

BORING DESIGNATION: **CB-7**
SHEET: **2 of 2**
SECTION:
TOWNSHIP:
RANGE:

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K cm/sec	ORG. CONT. (%)
									LL	PI		
40												
45	☒	7-7-8	15			Medium dense orange fine SAND with silt [SP-SM]						
50	☒	4-4-4	8			-- loose; light tan						
55	☒	3-3-5	8		▨	Firm tan very sandy CLAY [A-6]	57	33			7.2x10-8	
60	☒	4-5-7	12			Medium dense orange silty fine SAND [A-2-4, A-4]						
65	☒	3-4-5	9		▨	Stiff orange CLAY with sand [A-6, A-7]						
70	☒	3-4-5	9			Loose orange brown SAND with silt [A-3, A-2-4]						
						BORING TERMINATED AT 70.0 FEET						
75												
80												

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UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 12474-001-01
REPORT NO.:
PAGE: A-1.5

ROJECT: BORROW PIT 151
ORANGE COUNTY, FLORIDA
CLIENT: BUTTREY DEVELOPMENT IV
LOCATION:
REMARKS:

BORING DESIGNATION: **CB-8**
SHEET: **1 of 2**
SECTION:
TOWNSHIP:
RANGE:

G.S. ELEVATION (ft): 106.0
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):
DATE STARTED: 9/19/02
DATE FINISHED: 9/19/02
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS /FT)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (cm/ sec)	ORG. CONT. (%)
									LL	PI		
0						Very loose gray brown fine SAND [A-3]						
	☒	1-0-1	1									
	☒	1-0-1	1			-- light brown						
5	☒	2-2-2	4									
	☒	2-1-2	3									
	☒	2-1-2	3			-- brown						
10	☒	2-2-2	4									
						-- medium dense; tan						
15	☒	5-7-9	16									
20	☒	6-7-10	17									
						-- light orange brown to tan						
25	☒	7-7-10	17									
30	☒	10-10-10	20									
						Stiff orange CLAY with sand [A-6, A-7]						
35	☒	12-13-15	28			Medium dense light gray to white fine SAND with silt [A-3, A-2-4]						
						Very loose orange brown sandy SILT [A-4, A-5]						
40	☒	1-0-1	1									

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 12474-001-01
REPORT NO.:
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PROJECT: BORROW PIT 151
ORANGE COUNTY, FLORIDA

BORING DESIGNATION: **CB-8**
SHEET: **2 of 2**
SECTION:
TOWNSHIP:
RANGE:

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS /FT)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (cm/ sec)	ORG. CONT. (%)
									LL	PI		
40					▥							
45	☒	1-1-1	2		▨	Very loose light orange slightly silty clayey SAND [A-2-4, A-2-6]						
50	☒	2-2-3	5		▨	-- loose						
55	☒	2-2-2	4		▨	Soft light gray to tan sandy CLAY [A-6]						
60	☒	2-2-3	5		▨	Loose mottled light orange brown clayey SAND [A-2-6]						
65	☒	3-4-4	8		▥	Loose mottled tan & orange brown SILT with sand [A4, A-5]						
70	☒	36-100	100/0.5'		▨	Very hard orange consolidated clayey SAND [A-2-6]	24	46			1.96E-07	
						BORING TERMINATED AT 70.0 FEET						
75												
80												

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UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 12474-001-01
REPORT NO.:
PAGE: A-1.7

JECT: BORROW PIT 151
ORANGE COUNTY, FLORIDA
CLIENT: BUTTREY DEVELOPMENT IV
LOCATION:
REMARKS:

BORING DESIGNATION: **CB-9**
SHEET: **1 of 2**
SECTION:
TOWNSHIP:
RANGE:
G.S. ELEVATION (ft): 95.60
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):
DATE STARTED: 9/20/02
DATE FINISHED: 9/20/02
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS /FT)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (cm/ sec)	ORG. CONT. (%)
									LL	PI		
0						Very loose light orange brown fine SAND [A-3]						
	☒	1-1-1	2									
	☒	1-0-1	1									
5	☒	1-2-2	4			Very loose orange clayey SAND [A-2-4, A-2-6]						
	☒	1-2-2	4			Very loose orange fine SAND with silt [A-3, A-2-4]						
	☒	2-3-3	6			Loose light orange brown fine SAND [A-3]						
	☒	4-4-3	7									
10												
						Stiff orange brown CLAY [A-6, A-7]						
15	☒	5-5-5	10									
						Medium dense mottled light gray to white & orange brown fine SAND [A-3]						
20	☒	5-8-12	20									
						Loose yellow brown to tan clayey fine SAND [SC]						
25	☒	3-3-4	7									
						-- very loose; trace of cemented sand						
30	☒	1-1-2	3									
						Stiff gray brown sandy CLAY [A-6]						
35	☒	5-6-9	15				60	52			7.2E-08	
						Stiff green gray sandy CLAY with shell [A-6]						
40	☒	4-5-7	12									

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UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 12474-001-01
REPORT NO.:
PAGE: A-1.8

ROJECT: BORROW PIT 151

ORANGE COUNTY, FLORIDA

BORING DESIGNATION: **CB-9**
SHEET: **2 of 2**
SECTION:
TOWNSHIP:
RANGE:

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS /FT)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (cm/ sec)	ORG. CONT. (%)
									LL	PI		
40					▨							
	☒	7-8-11	19		▨	-- very stiff						
45					▨							
	☒	100	100/0.5'		▨	-- very hard						
50						BORING TERMINATED AT 60.0 FEET						
55												
60												
65												
70												
75												
80												

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UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 12474-001-01
REPORT NO.:
PAGE: A-1.9

JECT: BORROW PIT 151

ORANGE COUNTY, FLORIDA

CLIENT: BUTTREY DEVELOPMENT IV
LOCATION:
REMARKS:

BORING DESIGNATION: **CB-10**
SHEET: **1 of 2**
SECTION:
TOWNSHIP:
RANGE:
G.S. ELEVATION (ft): 86.0
DATE STARTED: 9/23/02
WATER TABLE (ft):
DATE FINISHED: 9/23/02
DATE OF READING:
DRILLED BY: UES - ORLANDO
EST. W.S.W.T. (ft):
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS /FT)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (cm/ sec)	ORG. CONT. (%)
									LL	PI		
0						Very loose tan fine SAND (A-3)						
	☒	3-2-1	3									
	☒	1-1-1	2									
5	☒	1-1-1	2									
	☒	2-2-2	4			Loose orange brown fine SAND with clay (A-2-4)						
	☒	3-3-4	7			Loose tan fine SAND (A-3)						
	☒	4-4-4	8			-- mottled light orange & light brown						
10												
15	☒	4-8-16	24			Medium dense orange silty SAND (A-2-4, A-4)						
						Stiff light orange brown sandy CLAY (A-6)						
20	☒	4-5-7	12									
						Loose very light orange brown clayey fine SAND (A-2-4, A-2-6)						
25	☒	4-5-5	10									
30	☒	2-3-2	5									
						Stiff gray brown sandy CLAY (A-6)						
35	☒	4-5-7	12									
						-- very stiff; green gray, with shell						
40	☒	9-10-11	21									

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UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO. 12474-001-01
REPORT NO.:
PAGE: A-1.10

ROJECT: BORROW PIT 151
ORANGE COUNTY, FLORIDA

BORING DESIGNATION: **CB-10**
SHEET: **2 of 2**
SECTION:
TOWNSHIP:
RANGE:

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS /FT)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (cm/ sec)	ORG. CONT. (%)
									LL	PI		
40					▨							
45	☒	8-8-14	22		▨	Medium dense dark green clayey SAND with shell [A-2-4, A-2-6]						
50	☒	10-16-30	46		▨	Hard dark green CLAY with sand [A-6, A-7]						
55	☒	40-100	100/2"		▨	Very hard gray consolidated clayey SAND [A-2-6]	16	28			2.2E-07	
						BORING TERMINATED AT 55.0 FEET						
60												
65												
70												
75												
80												

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UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 12474-002-01
REPORT NO.:
PAGE: B-2.2

PROJECT: BORROW PIT #153
ORANGE COUNTY, FLORIDA
CLIENT: BUTTREY DEVELOPMENT FOUR
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

BORING DESIGNATION: **CB-11** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

G.S. ELEVATION (ft): 97.20
WATER TABLE (ft):
DATE OF READING: 8/14/03
EST. W.S.W.T. (ft):
DATE STARTED: 8/14/03
DATE FINISHED: 8/14/03
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (cm/ sec)	ORG. CONT. (%)
0						Loose yellow brown to tan fine SAND [A-3]						
	☒	3-3-3	6									
	☒	2-2-3	5			Firm orange CLAY [A-6] Loose yellow brown to tan fine SAND [A-3]						
5	☒	2-3-5	8									
	☒	5-10-11	21			Dense orange clayey SAND [A-2-6]						
	☒	16-18-26	44			-- mottled gray and orange						
10	☒	10-15-22	37									
						Dense light gray to white fine SAND, mottled with orange [A-3]						
15	☒	6-17-16	33									
						-- medium dense						
20	☒	7-13-11	24									
						Medium dense mottled orange clayey SAND [A-2-4, A-2-6]						
25	☒	5-8-8	16									
						-- light gray						
30	☒	3-6-8	14									
						-- loose; mottled orange and gray						
35	☒	3-5-5	10									
40	☒	3-5-4	9									
45	☒	3-4-4	8			-- more clay [A-2-6]	18	35			3.5x10-7	
						-- gray						
50	☒	3-5-5	10			BORING TERMINATED AT 50.0 FEET						
55												

W-04247.GPJ

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 12474-001-01
REPORT NO.:
PAGE: B-2.6

ROJECT: PIT NO. 151
ORANGE COUNTY, FLORIDA
CLIENT: BUTTREY DEVELOPMENT FOUR
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

BORING DESIGNATION: **CB-12** SHEET: **1 of 2**
SECTION: TOWNSHIP: RANGE:
G.S. ELEVATION (ft): 110.1 DATE STARTED: 5/29/03
WATER TABLE (ft): DATE FINISHED: 5/29/03
DATE OF READING: DRILLED BY: UES - ORLANDO
EST. W.S.W.T. (ft): TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (cm/ sec)	ORG. CONT. (%)
									LL	PI		
0						Very loose light brown fine SAND [A-3]						
	☒	2-2-2	4									
	☒	1-2-2	4									
5	☒	2-2-3	5			-- loose; shade of orange						
	☒	7-13-18	31			Dense dark orange brown clayey fine SAND [A-2-6]						
	☒	18-16-17	33									
10	☒	7-13-19	32			-- gray, with seams of orange						
15	☒	4-5-9	14									
						Dense light gray fine SAND [A-3]						
20	☒	11-14-21	35									
25	☒	12-12-11	23			-- medium dense						
30	☒	4-5-12	17			Medium dense orange brown silty fine SAND, slightly clayey [A-2-4, A-2-6]						
35	☒	5-3-2	5			-- more clay [A-2-6]						
40	☒	1-2-2	4			Very loose orange brown SILT [A-4]						
45	☒	4-2-3	5			-- loose; gray						
50	☒	6-10-9	19									
							53	59			4.6x10-8	
						Medium dense gray green silty clayey SAND with shell [A-2-4, A-2-6]						
55	☒	5-12-11	23									

W-04166.GPJ

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	12474-001-01
REPORT NO.:	
PAGE:	B-2.7

ROJECT: PIT NO. 151

ORANGE COUNTY, FLORIDA

BORING DESIGNATION: **CB-12**
SHEET: **2 of 2**
SECTION:
TOWNSHIP:
RANGE:

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (cm/ sec)	ORG. CONT. (%)
									LL	PI		
55					▨							
	☒	8-13-20	33		▨	-- dense						
60						BORING TERMINATED AT 60.0 FEET						
65												
70												
75												
80												
85												
90												
95												
100												
105												
110												

W-04166.GPJ

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 12474-002-01
REPORT NO.:
PAGE: B-2.3

PROJECT: BORROW PIT #153
ORANGE COUNTY, FLORIDA
CLIENT: BUTTREY DEVELOPMENT FOUR
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

BORING DESIGNATION: **CB-13**
SHEET: **1 of 2**
SECTION:
TOWNSHIP:
RANGE:

G.S. ELEVATION (ft): 115.0
WATER TABLE (ft):
DATE OF READING: 8/13/03
EST. W.S.W.T. (ft):

DATE STARTED: 8/13/03
DATE FINISHED: 8/13/03
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (cm/ sec)	ORG. CONT. (%)
									LL	PI		
0						Very loose yellow brown to tan fine SAND [A-3]						
	☒	2-2-2	4									
	☒	2-2-2	4									
5	☒	1-1-2	3			— very light tan						
	☒	1-2-3	5			— loose						
	☒	1-3-5	8			Loose orange brown clayey SAND [A-2-4, A-2-6]						
10	☒	4-5-8	13			— medium dense						
15	☒	9-10-11	21									
						Medium dense mottled orange, yellow & white fine SAND [A-3]						
20	☒	14-16-23	39									
25	☒	11-19-24	43									
						Dense orange brown clayey SAND [A-2-4, A-2-6]						
30	☒	6-10-23	33									
						Very dense light yellow fine SAND [A-3]						
35	☒	18-25-28	53									
						Very loose to loose orange brown to tan silty clayey SAND [A-2-4]						
40	☒	2-2-2	4									
45	☒	3-3-4	7									
						Very stiff very light gray calcareous CLAY with silt and cemented sand [A-6]						
50	☒	8-7-10	17									
						Very stiff gray CLAY [A-7]						
55	☒	7-7-10	17									

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 12474-002-01
REPORT NO.:
PAGE: B-2.4

PROJECT: BORROW PIT #153
ORANGE COUNTY, FLORIDA

BORING DESIGNATION: **CB-13**
SHEET: **2 of 2**
SECTION:
TOWNSHIP:
RANGE:

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (cm/ sec)	ORG. CONT. (%)
55												
60		5-6-13	19			Medium dense gray SILT with sand, clay and trace of shell [A-5]						
65		7-13-22	35			Dense dark green silty SAND with clay and shell [A-2-4]	16	33			7.5x10-7	
						BORING TERMINATED AT 65.0 FEET						
70												
75												
80												
85												
90												
95												
100												
105												
110												

W-0424T.GPJ

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 12474-001-01
REPORT NO.:
PAGE: B-2.8

ROJECT: PIT NO. 151
ORANGE COUNTY, FLORIDA
CLIENT: BUTTREY DEVELOPMENT FOUR
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

BORING DESIGNATION: **CB-14** SHEET: **1 of 2**
SECTION: TOWNSHIP: RANGE:
G.S. ELEVATION (ft): 118.5
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):
DATE STARTED: 5/29/03
DATE FINISHED: 5/29/03
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (cm/ sec)	ORG. CONT. (%)
									LL	PI		
0						Very loose light brown fine SAND [A-3]						
	☒	1-2-2	4									
	☒	1-1-1	2									
5	☒	1-1-2	3			-- shade lighter						
	☒	2-2-2	4									
	☒	2-2-3	5			-- loose						
10	☒	1-3-5	8			-- light orange brown						
15	☒	8-8-17	25			-- medium dense						
						-- dense; orange brown						
20	☒	12-15-17	32									
25	☒	10-10-12	22			Very stiff dark orange brown CLAY [A-6, A-7]						
						Medium dense orange brown fine SAND [A-3]						
30	☒	10-12-15	27									
35	☒	14-15-21	36			-- dense; light orange brown						
40	☒	5-5-6	11			Medium dense light gray silty fien SAND [A-2-4]						
45	☒	1-1-2	3			Very loose orange brown SILT [A-4]						
50	☒	2-4-3	7			-- loose						
						-- gray						
55	☒	4-5-7	12									

W-04166.GPJ

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 12474-001-01
REPORT NO.:
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ROJECT: PIT NO. 151

ORANGE COUNTY, FLORIDA

BORING DESIGNATION: **CB-14**
SHEET: **2 of 2**
SECTION:
TOWNSHIP:
RANGE:

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (cm/ sec)	ORG. CONT. (%)
									LL	PI		
55												
60	☒	7-6-7	13			-- medium dense						
65	☒	7-7-12	19				52	47	49	26	9.9x10-8	
						Very dense gray consolidated SILT with phosphates						
70	☒	100	100/1"									
						BORING TERMINATED AT 70.0 FEET						
75												
80												
85												
90												
95												
100												
105												
110												

W-04166.GPJ

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:
REPORT NO.:
PAGE: B-2.2

ROJECT: PIT # 51
BUTTREY DEVELOPMENT IV
ORANGE COUNTY, FLORIDA

CLIENT:
LOCATION: SEE BORING LOCATION PLAN
REMARKS: SHGWT = SEASONAL HIGH GROUNDWATER TABLE, N.S. = NOT SURVEYED

BORING DESIGNATION: **PZ-CB-15** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

G.S. ELEVATION (ft): 98.2
WATER TABLE (ft):
DATE OF READING: 1/8/04
EST. SHGWT (ft):

DATE STARTED: 1/8/04
DATE FINISHED: 1/8/04
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT/ DAY)	ORG. CONT. (%)
									LL	PI		
0						Very loose, light brown fine SAND [A-3]						
	☒	2-1-1	2									
	☒	2-1-2	3									
5	☒	4-8-12	20			Medium dense, orange-brown clayey fine SAND [A-4]						
	☒	12-14-17	31			--Dense						
	☒	23-20-20	40									
	☒	13-18-15	33			Dense, orange-brown fine SAND [A-3]						
10												
15	☒	13-20-21	41			--Very light gray						
20	☒	12-12-7	19			Medium dense, orange-brown clayey fine SAND [A-4]						
						Loose, orange silty, or clayey fine SAND; with shade of clay [A-4]						
25	☒	3-6-4	10									
						Firm, orange-brown CLAY; with silt [A-7]						
30	☒	2-3-4	7									
35	☒	4-5-7	12									
						Medium dense, gray SILT; with shell [A-4]						
						Very stiff, gray-green CLAY; with silt [A-5]						
40	☒	6-8-12	20			BORING TERMINATED AT 40 FEET						
45												
50												
55												

W-04426.GPJ

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:
REPORT NO.:
PAGE: B-2.3

PROJECT: PIT # 51
BUTTREY DEVELOPMENT IV
ORANGE COUNTY, FLORIDA

BORING DESIGNATION: **PZ-CB-16** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

CLIENT:
LOCATION: SEE BORING LOCATION PLAN
REMARKS: SHGWT = SEASONAL HIGH GROUNDWATER TABLE, N.S. = NOT SURVEYED

G.S. ELEVATION (ft): 104.9
WATER TABLE (ft):
DATE OF READING: 1/9/04
EST. SHGWT (ft):

DATE STARTED: 1/9/04
DATE FINISHED: 1/9/04
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT/ DAY)	ORG. CONT. (%)
									LL	PI		
0						Very loose, light brown fine SAND [A-3]						
	☒	2-2-2	4									
	☒	2-1-2	3									
5	☒	2-2-1	3			--Loose, shade lighter						
	☒	2-2-3	5									
	☒	9-8-13	21			Medium dense, orange-brown clayey fine SAND [A-4]						
10	☒	15-20-21	41			--Dense						
	☒	5-9-17	26			--Medium dense, orange-brown						
15												
	☒	13-16-18	34			Dense, light orange-brown fine SAND [A-3]						
20												
	☒	7-8-15	23			--Medium dense, very light gray						
25												
	☒	6-7-10	17			Medium dense, orange-brown silty fine SAND [A-4]						
30												
						Stiff, orange-brown CLAY; with silt [A-5]						
	☒	4-5-7	12									
35												
						Loose, gray SILT; with sand [A-4]						
	☒	3-3-4	7									
40												
	☒	3-4-7	11			--Medium dense						
45						BORING TERMINATED AT 45 FEET						
50												
55												

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 12474-001-01
REPORT NO.:
PAGE: B-2.10

ROJECT: PIT NO. 151

ORANGE COUNTY, FLORIDA

CLIENT: BUTTREY DEVELOPMENT FOUR
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

BORING DESIGNATION: **CB-17**
SHEET: **1 of 2**
SECTION:
TOWNSHIP:
RANGE:

G.S. ELEVATION (ft): 95.6
WATER TABLE (ft):
DATE OF READING:
EST. W.S.W.T. (ft):

DATE STARTED: 5/28/03
DATE FINISHED: 5/28/03
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (cm/ sec)	ORG. CONT. (%)
									LL	PI		
0						Very loose light brown fine SAND [A-3]						
	☒	1-2-2	4									
	☒	2-1-2	3									
5	☒	2-2-4	6			-- loose						
	☒	7-12-15	27			Very stiff to hard orange brown sandy CLAY [A-6]						
	☒	25-19-21	40									
10	☒	13-17-19	36			-- gray with seams of orange						
						Dense gray fine SAND [A-3]						
15	☒	14-16-23	39									
						-- very light gray						
20	☒	15-20-22	42									
						Medium dense gray silty fine SAND [A-2-4]						
25	☒	14-13-13	26									
						Medium dense orange brown SILT with sand [A-4]						
30	☒	6-6-9	15									
35	☒	2-4-6	10									
40	☒	2-4-8	12			Loose to medium dense orange brown silty SAND [A-2-4]						
45	☒	4-5-7	12									
50	☒	3-5-6	11									
55	☒	3-3-7	10				23	41	NP	NP	7.1x10-7	

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UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	12474-001-01
REPORT NO.:	
PAGE:	B-2.11

ROJECT: PIT NO. 151

ORANGE COUNTY, FLORIDA

BORING DESIGNATION: **CB-17** SHEET: **2 of 2**
SECTION: TOWNSHIP: RANGE:

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (cm/ sec)	ORG. CONT. (%)
									LL	PI		
55												
						Very loose gray and orange sandy SILT, with consolidated silt and shell [A-4, A-5]						
60	☒	0-0-0	WOR									
						-- dense, more shell						
65	☒	23-13-28	41				37	55			6.0x10-7	
						BORING TERMINATED AT 65.0 FEET						
70												
75												
80												
85												
90												
95												
100												
105												
110												

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:
REPORT NO.:
PAGE: B-2.4

ROJECT: PIT # 51
BUTTREY DEVELOPMENT IV
ORANGE COUNTY, FLORIDA

BORING DESIGNATION: **PZ-CB-18** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

CLIENT:
LOCATION: SEE BORING LOCATION PLAN
REMARKS: SHGWT = SEASONAL HIGH GROUNDWATER TABLE, N.S. = NOT SURVEYED

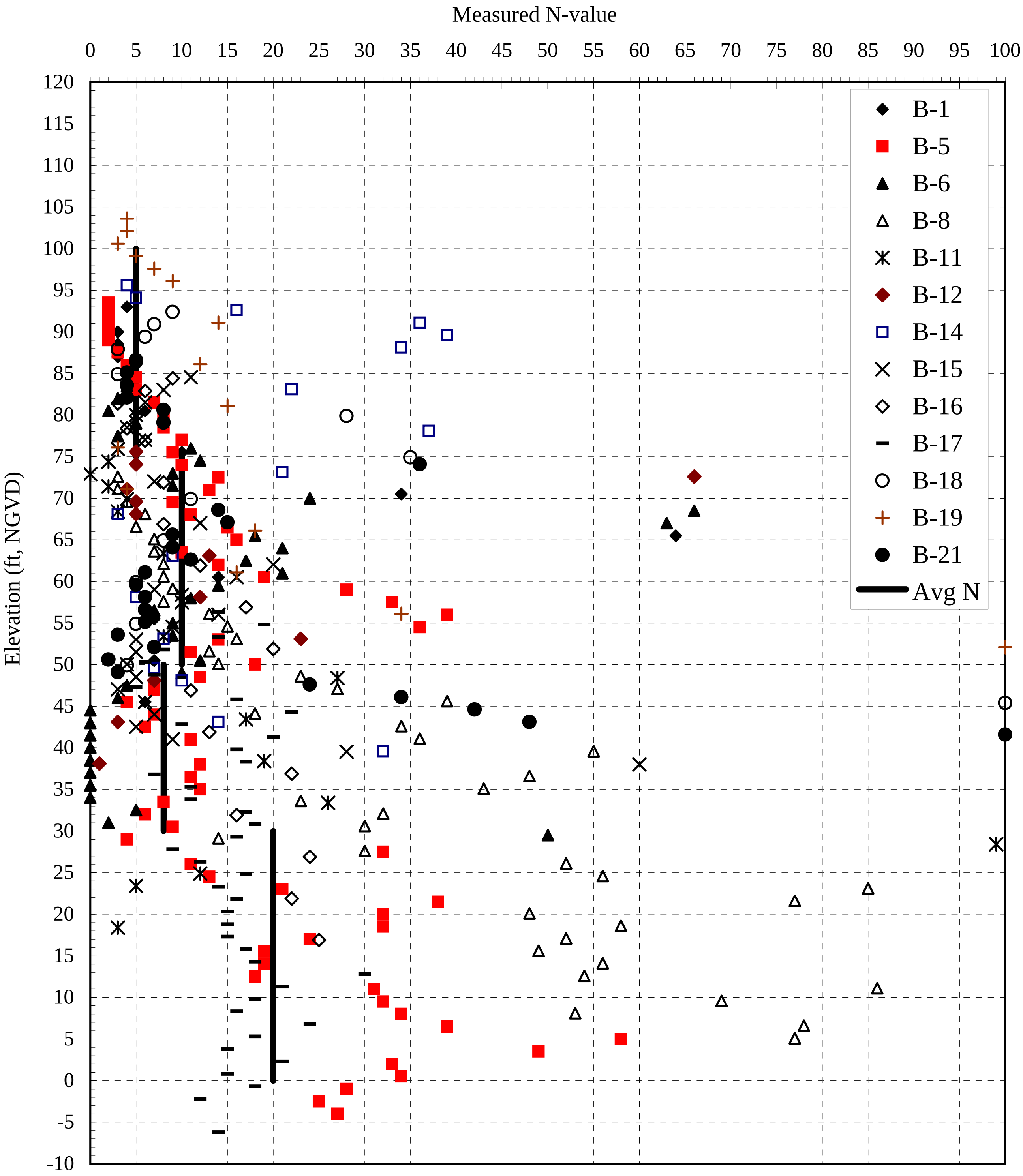
G.S. ELEVATION (ft): 105.5
WATER TABLE (ft):
DATE OF READING: 1/10/04
EST. SHGWT (ft):

DATE STARTED: 1/10/04
DATE FINISHED: 1/10/04
DRILLED BY: UES - ORLANDO
TYPE OF SAMPLING: ASTM D 1586

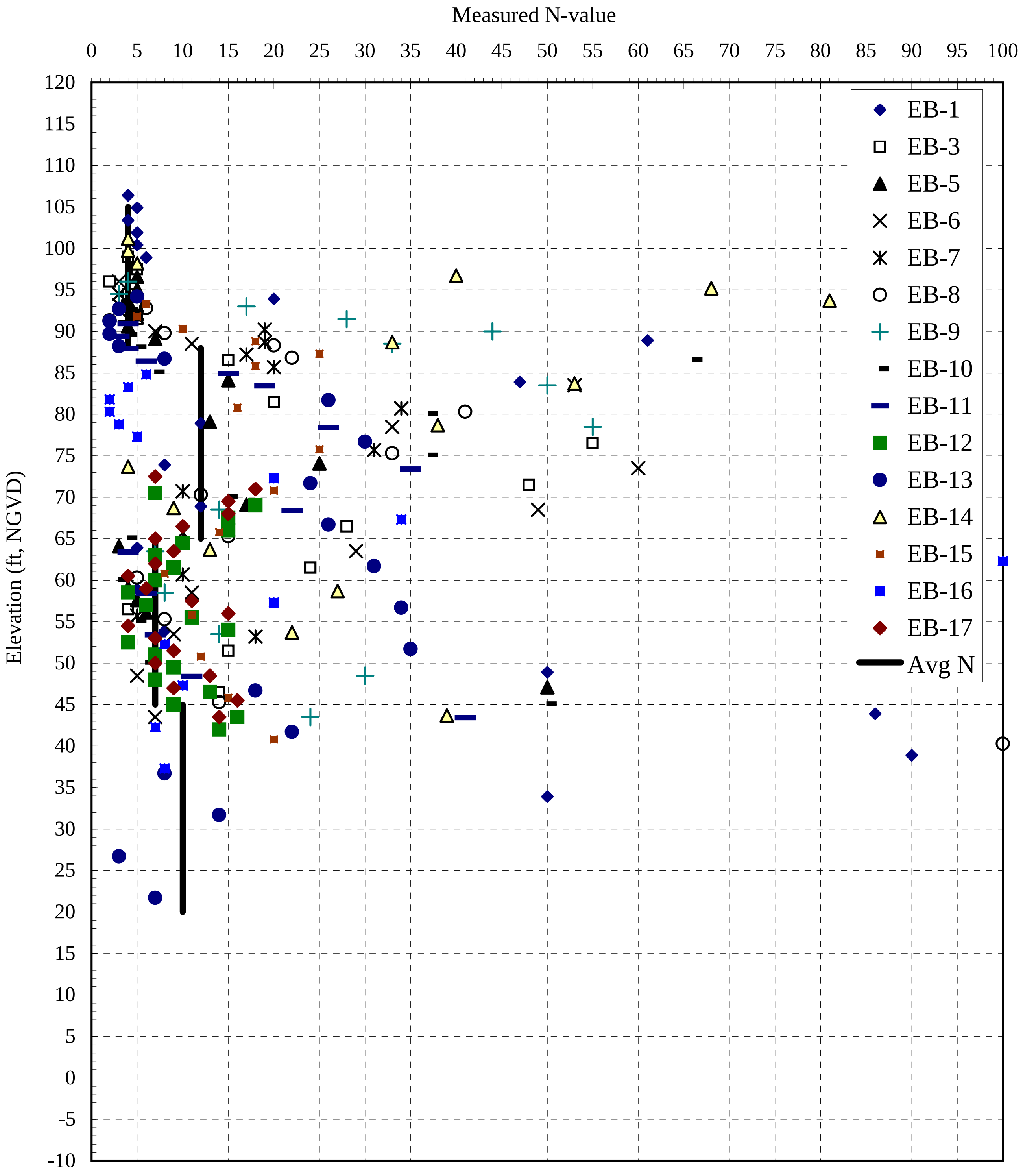
DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT/ DAY)	ORG. CONT. (%)
									LL	PI		
0						Very loose, light brown fine SAND [A-3]						
	☒	2-1-2	3									
	☒	2-2-2	4									
5	☒	3-3-4	7			--Very loose, shade lighter						
	☒	6-15-23	37			Dense, orange-brown clayey fine SAND [A-4]						
	☒	25-30-38	68			--Very dense						
10	☒	27-31-3	64									
						Dense, light gray-brown fine SAND [A-3]						
15	☒	8-15-28	43									
20	☒	20-20-26	46									
25	☒	10-10-9	19			--Medium dense, light gray						
						Loose, orange-brown silty fine SAND [A-4]						
30	☒	2-3-3	6									
						Loose, gray SILT; with sand [A-5]						
35	☒	2-2-4	6									
40	☒	2-2-3	5									
45	☒	3-5-9	14			--Medium dense						
						BORING TERMINATED AT 45 FEET						
50												
55												

ATTACHMENT 2

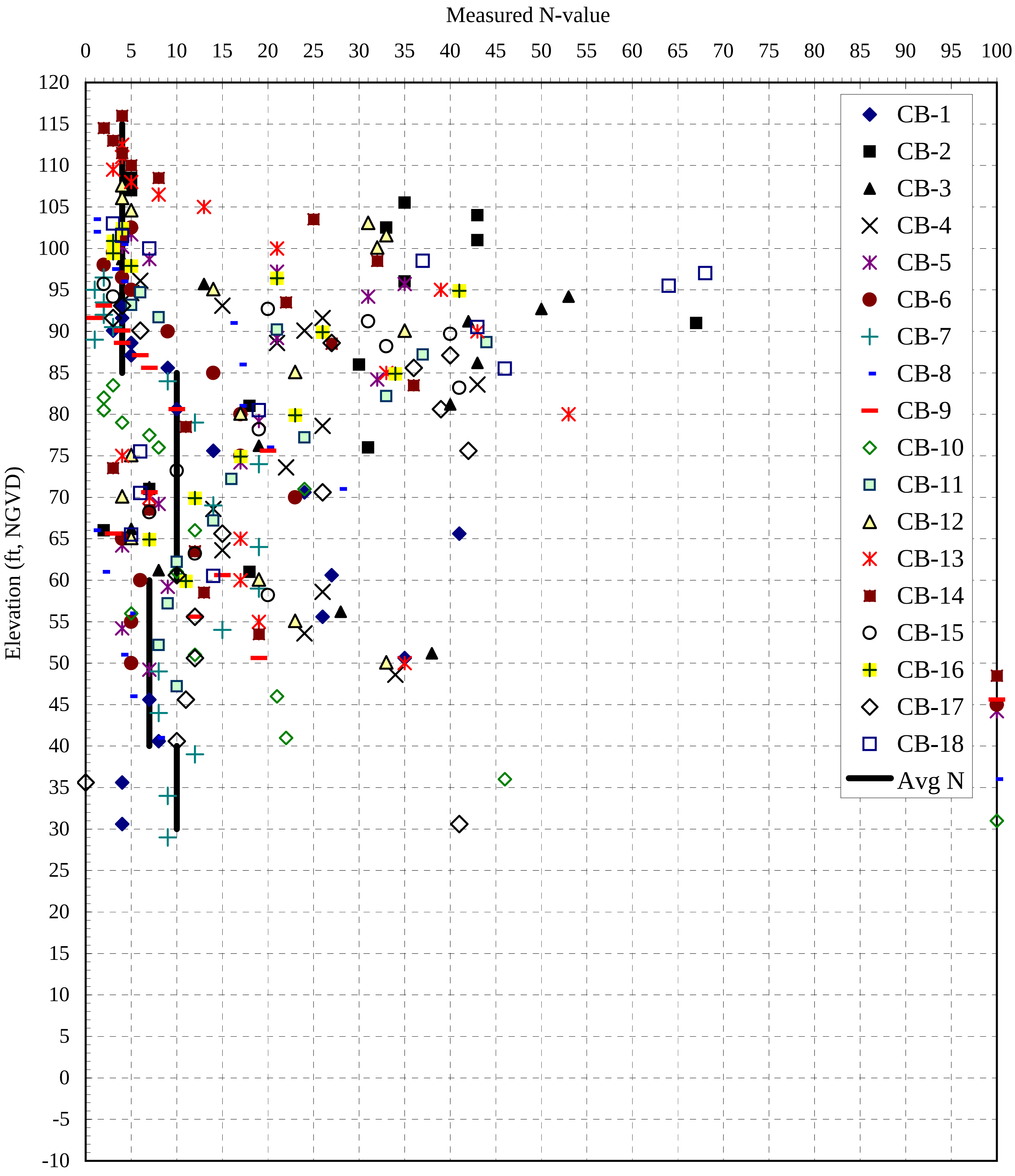
Phase 1: Measured N-value vs. Depth
Vista Class III Landfill
Apopka, Florida



Phase 2: Measured N-value vs. Depth
Vista Class III Landfill
Apopka, Florida



Phase 3: Measured N-value vs. Depth
Vista Class III Landfill
Apopka, Florida



Geosyntec
consultants

COMPUTATION COVER SHEET

Client: **Vista LF, LLC** Project: **Vista Landfill – Substantial Permit Mod** Project No.: **FL1229**

Phase No.:

Title of Computations **FOUNDATION STABILITY ANALYSIS**

Computations by:
Signature
Printed Name Wade Tyner, E.I.T.
Title Staff Engineer
25 June 2007
Date

Assumptions and Procedures Checked by:
(peer reviewer)
Signature Juan D. Quiroz
Printed Name Juan D. Quiroz, Ph.D., P.E.
Title Project Engineer
27 June 2007
Date

Computations Checked by:
Signature Sangho Eun
Printed Name Sangho "Jay" Eun, E.I.T.
Title Senior Staff Engineer
27 June 2007
Date

Computations Backchecked by:
(originator)
Signature
Printed Name Wade Tyner, E.I.T.
Title Staff Engineer
26 July 2007
Date

Approved by:
(pm or designate)
Signature Juan D. Quiroz
Printed Name Juan D. Quiroz, Ph.D., P.E.
Title Project Engineer
27 July 2007
Date

Approval notes:

Revisions (number and initial all revisions)

No.	Sheet	Date	By	Checked by	Approval

Written by: **W. Tyner** Date: **06/25/07** Reviewed by: **J. Quiroz** Date: **06/27/07**

Client: **Vista LF, LLC** Project: **Vista LF – Substantial** Project No.: **FL1229** Phase No.:

FOUNDATION STABILITY ANALYSIS
VISTA CLASS III LANDFILL
APOPKA, FLORIDA

INTRODUCTION

The purpose of this calculation package is to present the foundation stability analyses associated with the Vista Class III Landfill facility located in Apopka, Florida. The analyses were performed to evaluate the impact of the waste fill on the foundation soils beneath the landfill. The analyses were performed with respect to the following conditions: (i) the post-closure (long-term) configuration; and (ii) the construction (short-term) condition during waste filling activities.

The subsequent sections present several aspects of the foundation stability analyses and include the following items:

- Input parameters and assumptions used analysis;
- Methodology utilized to evaluate foundation stability; and
- Results of the stability analyses for the critical cross-sections analyzed.

INPUT PARAMETERS AND ASSUMPTIONS

Landfill Configuration

Figure 1 present the typical post-closure configuration (cell floor grades and final cover grades) for the proposed landfill construction. The maximum landfill elevation will be approximately EL. 156 ft, NGVD with side slopes and top slopes inclined at 3H:1V and 4%, respectively. The typical leachate collection system (LCS) slope is 1% with leachate sumps located at EL. 56, NGVD.

Figure 2 presents the representative construction (cell floor grades and interim waste grades) condition for the proposed landfill construction. The typical interim, construction configuration corresponds to a section perpendicular to that shown in

Figure 1. The maximum inclination of the interim waste slopes during landfilling activities is 3H:1V. The cross-slopes along the cell floor, which convey leachate to the collection header pipe located at the center of each cell, were assumed to be 2%. Note that this cross section accounts for the maximum height at EL. 156 ft, NGVD, and thereby the maximum driving force relative to slope stability.

A final cover system and liner system approximately 2-ft thick was incorporated in the cross sections. The final cover system and liner system were assumed to have a unit weight of 110 pcf, a cohesion value of 30 psf, and an internal friction angle (ϕ) of 30°.

Subsurface Profile and Material Properties

Foundation soils were modeled in accordance with the site's subsurface model which was developed in a separate calculation package as part of this permit application. Attachment 1 presents the subsurface model and corresponding material properties for the foundation soils beneath the selected cross-sections. The foundations soils, from top to bottom, beneath the landfill footprint generally consist of loose to medium dense sandy deposits underlain by approximately 20 ft of silty and sandy clay, and underlain by medium dense sandy and silty soil depsoits. Below the soil layers, the geological formation consists of bedrock categorized as limestone.

As presented in Attachment 1, the soil deposits were separated into distinct layers and corresponding shear strength parameters (i.e., angle of internal friction and cohesion) were based on measured Standard Penetration Test (SPT) N-values. For the foundation slope stability analyses presented in this calculation package, angle of internal friction (ϕ) values between 28° to 33° were utilized for the sandy soil deposits beneath the landfill, and a cohesion of 700 psf was utilized for the clayey soil. The unit weights for the sand and clayey soil deposits utilized for the slope stability analyses was 110 pcf and 120 pcf, respectively. The ground water elevation for the representative critical cross sections was assumed to be at EL. 54, NGVD.

Waste Properties

Disposed waste for the proposed landfill construction will be compacted Class III waste. At present, limited published data is available on the material properties of Class

III waste. As such, the assumed shear strength envelope exhibits and internal friction angle (ϕ) of 33° and zero cohesion. The unit weight of the compacted Class III waste including weekly and intermediate cover soils was assumed to be 70 pcf.

METHOD OF ANALYSIS

The established critical representative cross sections were evaluated using the slope stability software SLIDE (Rocscience, 2004). This program performed automatic search routines using Spencer's method of slices (Spencer, 1973) for finding the critical failure surface and minimum factor of safety. Both circular and truncated circular failure surfaces were analyzed to calculate the minimum factor of safety for the established critical cross-section. The minimum regulatory factor of safety requirement for post-closure (long-term) foundation slope stability is 1.5. A minimum factor of safety of 1.3 was utilized for construction (short-term) foundation slope stability.

FOUNDATION SLOPE STABILITY RESULTS

Post-Closure (Long-Term) Stability

The results of the post-closure (long-term) foundation slope stability analyses for the representative critical cross section presented in Figure 1 are included in Attachment 2. Based on the proposed landfill configuration and input parameters mentioned above, a minimum calculated factor of safety of 2.00 was obtained for a failure surface that primarily passes through the waste. For comparative purposes, a failure surface that passes through the foundation soils with a corresponding factor of safety of 2.84 is also shown in the graphical output. These minimum calculated factor of safety values exceed the regulatory minimum, long-term foundation stability factor of safety of 1.5.

Construction (Short-Term) Stability

The results of the construction (short-term) foundation slope stability analyses for the representative critical cross section presented in Figure 2 is included in Attachment 3. Based on the proposed landfill configuration and the input parameters mentioned above, a minimum calculated factor of safety of 1.35 was obtained. This minimum calculated factor of safety value exceeds the established minimum, short-term foundation stability factor of safety of 1.3.

CONCLUSIONS

The results of the foundation slope stability analyses indicate that the subsurface soils beneath the proposed landfill footprint provide adequate foundation support. The calculated foundation slope stability factor of safety values for long-term and short-term foundation slope stability exceeded the minimum requirements of 1.5 and 1.3, respectively.

Written by: **W. Tyner** Date: **06/25/07** Reviewed by: **J. Quiroz** Date: **06/27/07**

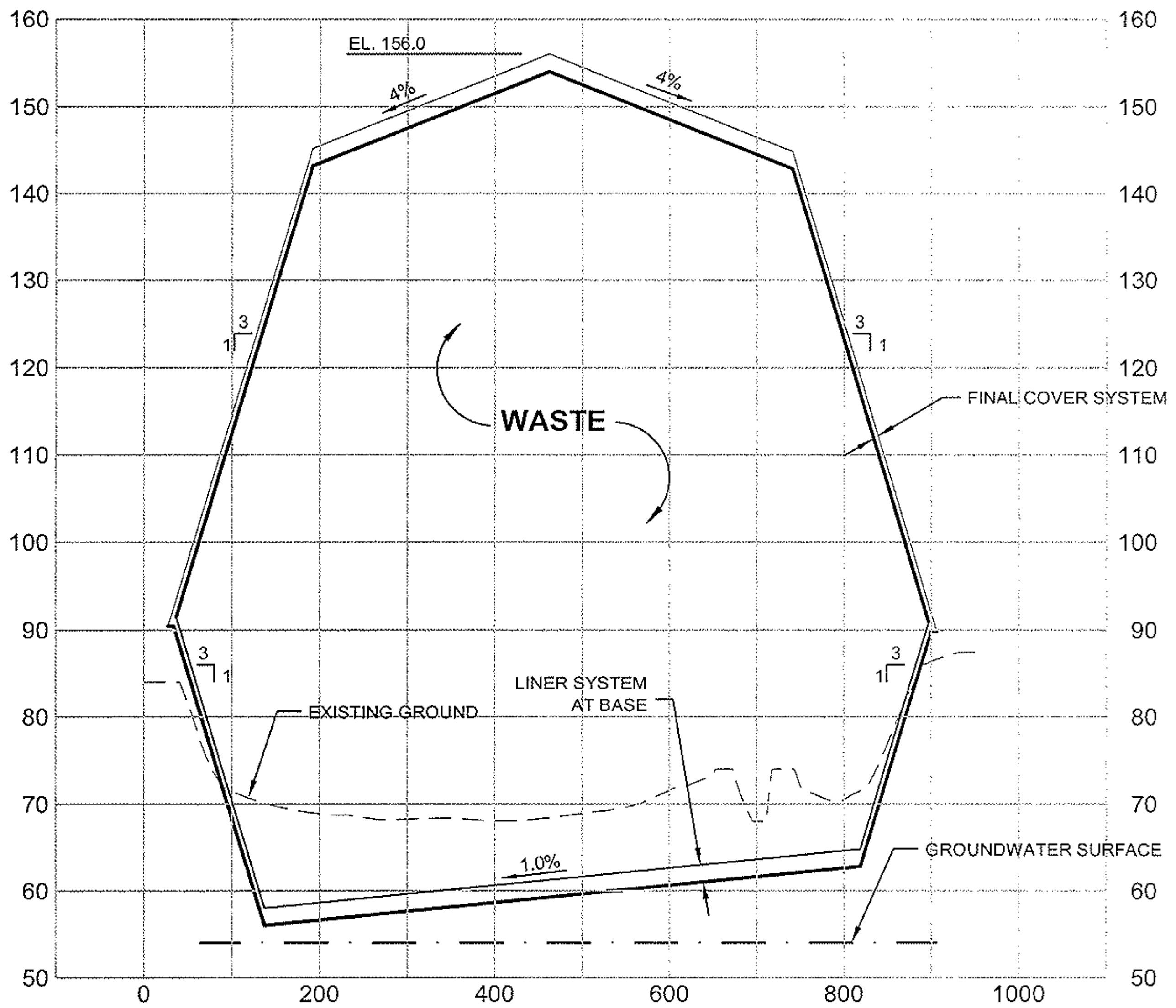
Client: **Vista LF, LLC** Project: **Vista LF – Substantial** Project No.: **FL1229** Phase No.:

REFERENCES

Rocscience, *"SLIDE – 2-D Limit Equilibrium Slope Stability for Soil and Rock Slopes,"* User's Guide, Rocscience Software, Inc., Toronto, Ontario, Canada, 2004.

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

FIGURES



LANDFILL CROSS SECTION CELL 2
NORTH-SOUTH
SCALE: 1" = 200'H, 1" = 20' V

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TAMPA, FL

DATE:	JULY 2007	FILE NO.	FL1229.02F013
PROJECT NO.	FL1229.02	FIGURE NO.	1

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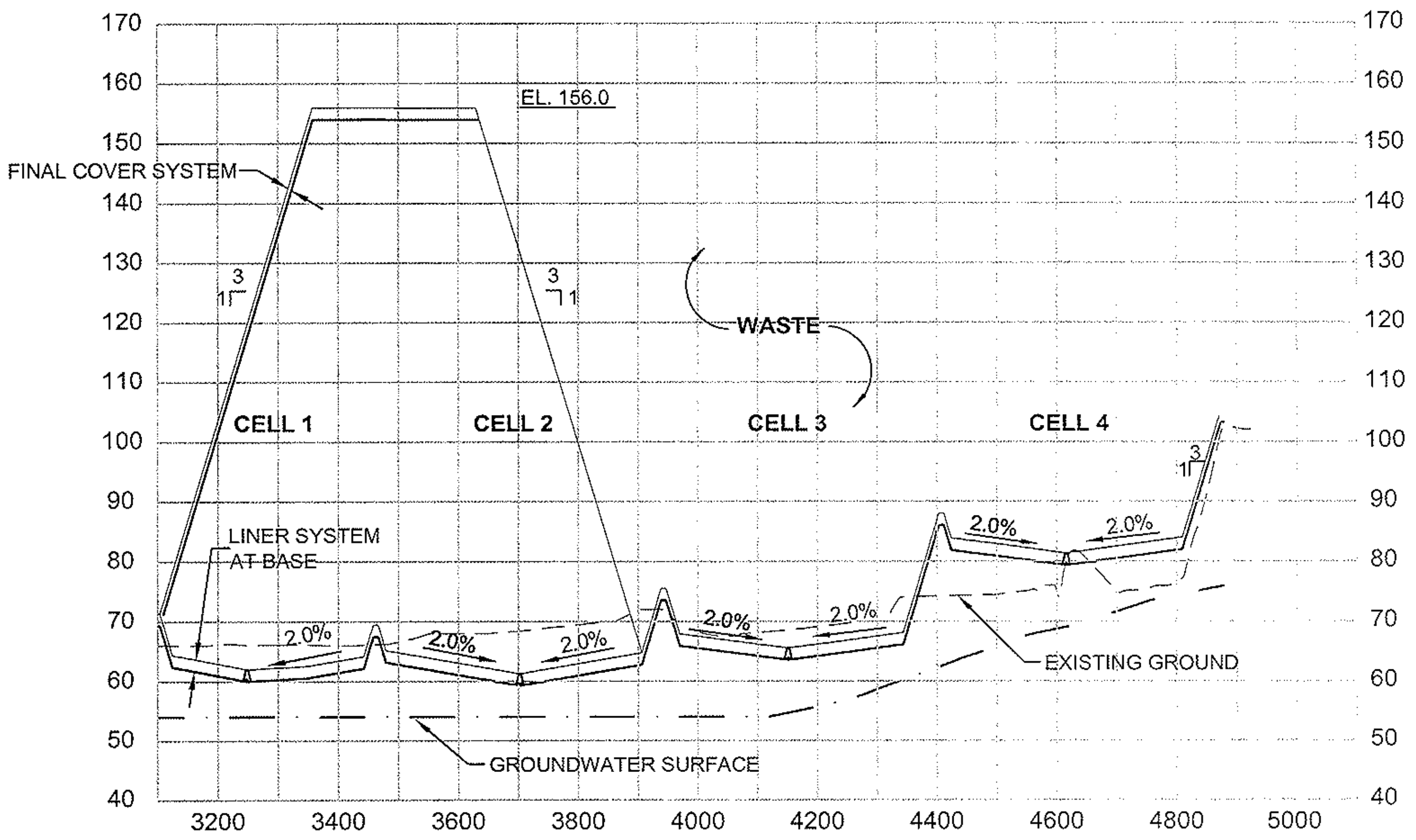

LANDFILL CROSS SECTION PHASE 1
WEST - EAST
SCALE: 1" = 300'H, 1" = 30' V

Geosyntec consultants

TAMPA, FL

DATE:	JULY 2007	FILE NO.	FL1229.02F013
PROJECT NO.	FL1229.02	FIGURE NO.	2

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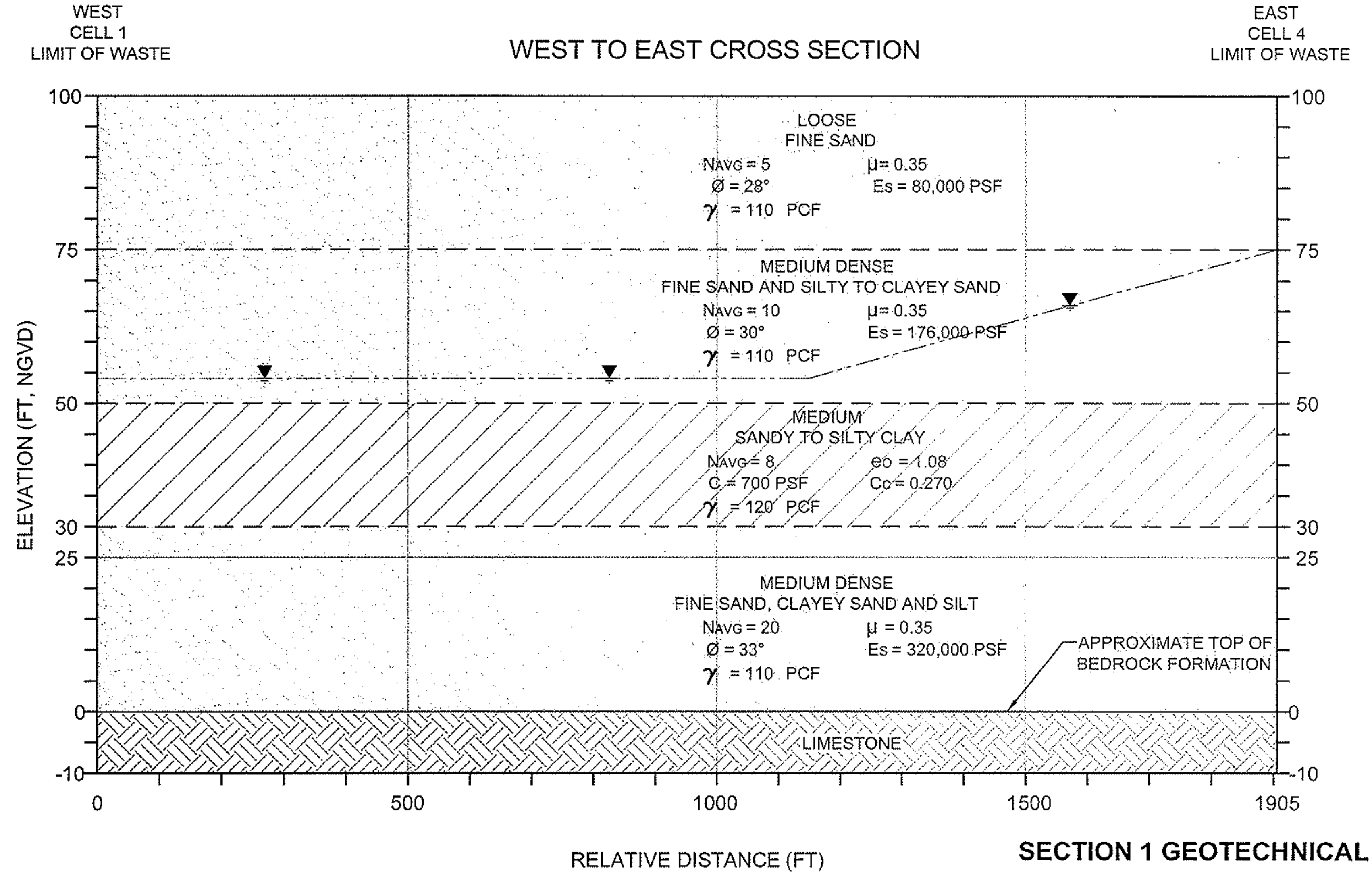
ATTACHMENT 1

WEST TO EAST CROSS SECTION



0 25'
VERTICAL SCALE: 1"=25'

0 250'
HORIZONTAL SCALE: 1"=250'

SECTION 1 GEOTECHNICAL SUBSURFACE SOIL MODEL

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DATE:	JULY2007	FILE NO.	FL1229.02F004
PROJECT NO.	FL1229.02	FIGURE NO.	1

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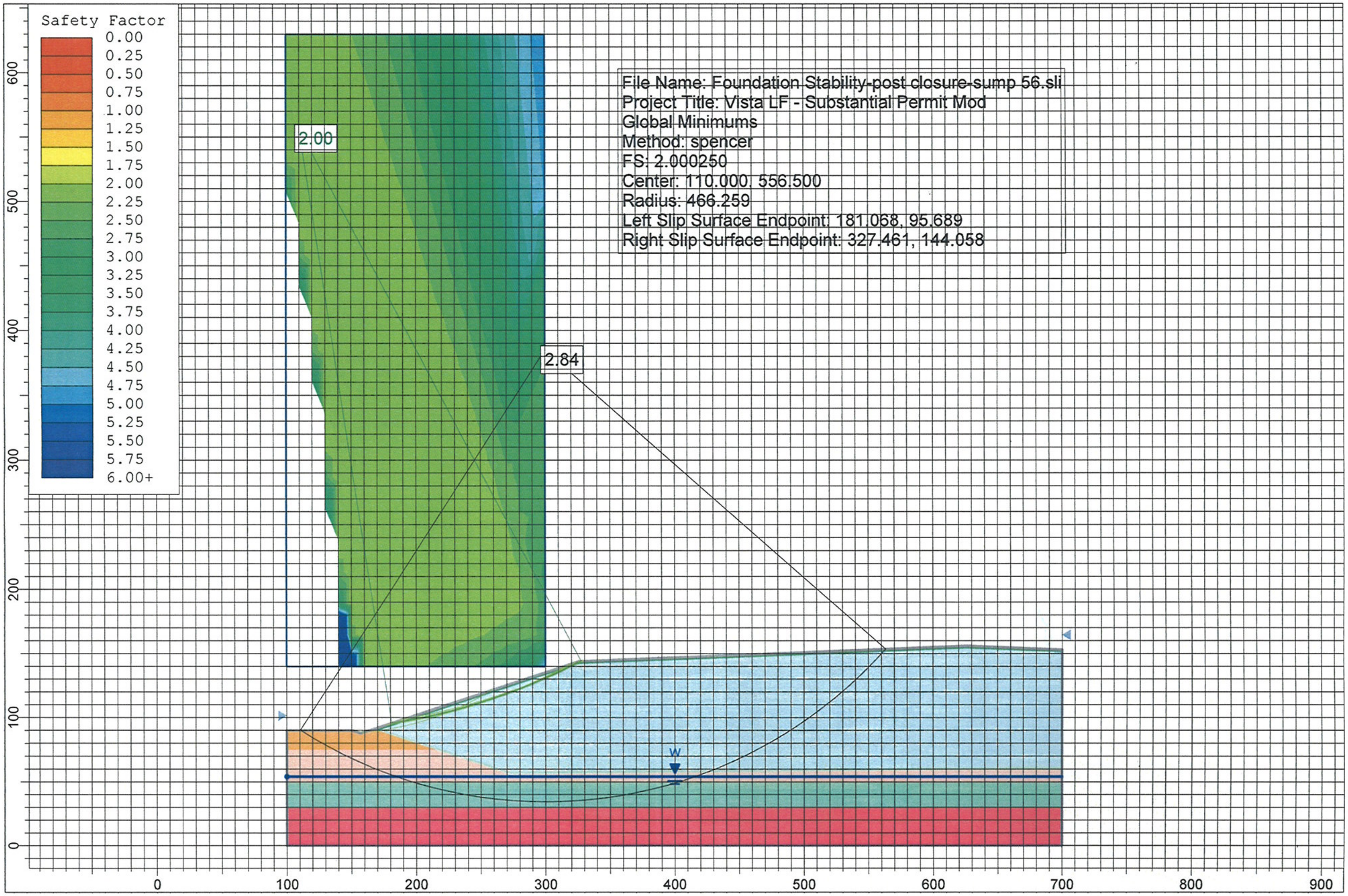
ATTACHMENT 2



File Name: Foundation Stability-post closure-sump 56.sli
Project Title: Vista LF - Substantial Permit Mod
Global Minimums
Method: spencer
FS: 2.000250
Center: 110.000, 556.500
Radius: 466.259
Left Slip Surface Endpoint: 181.068, 95.689
Right Slip Surface Endpoint: 327.461, 144.058

Slide Analysis Information

Document Name

File Name: Foundation Stability-post closure-sump 56.sli

Project Settings

Project Title: Vista LF - Substantial Permit Mod
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 20
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Loose Fine Sand
Strength Type: Mohr-Coulomb
Unit Weight: 110 lb/ft3
Cohesion: 0 psf
Friction Angle: 28 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Liner System
Strength Type: Mohr-Coulomb
Unit Weight: 110 lb/ft3
Cohesion: 30 psf
Friction Angle: 30 degrees
Water Surface: Water Table

Custom Hu value: 1

Material: Cover System
Strength Type: Mohr-Coulomb
Unit Weight: 110 lb/ft3
Cohesion: 30 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Class III Waste
Strength Type: Mohr-Coulomb
Unit Weight: 70 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Medium Dense Fine Sand
Strength Type: Mohr-Coulomb
Unit Weight: 110 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Sandy Clay
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Constant
Cohesion: 700 psf
Water Surface: None

Material: Medium Dense Sand and Silt
Strength Type: Mohr-Coulomb
Unit Weight: 110 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: spencer
FS: 2.000250
Center: 110.000, 556.500
Radius: 466.259
Left Slip Surface Endpoint: 181.068, 95.689
Right Slip Surface Endpoint: 327.461, 144.058
Resisting Moment=1.73907e+007 lb-ft
Driving Moment=8.69424e+006 lb-ft
Resisting Horizontal Force=35388 lb
Driving Horizontal Force=17691.8 lb

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 8279
Number of Invalid Surfaces: 982
Error Codes:
Error Code -106 reported for 1 surface
Error Code -107 reported for 96 surfaces
Error Code -108 reported for 510 surfaces
Error Code -111 reported for 13 surfaces
Error Code -112 reported for 47 surfaces
Error Code -1000 reported for 315 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.

-107 = Total driving moment or
total driving force is negative. This will occur
if the wrong failure direction is specified,
or if high external or anchor loads are applied
against the failure direction.

-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.

-1000 = No valid slip surfaces are generated
at a grid center. Unable to draw a surface.

List of All Coordinates

Search Grid

100.0	140.0
300.0	140.0
300.0	630.0
100.0	630.0

Material Boundary

164.0	90.0
170.3	90.0

Material Boundary

170.3	90.0
173.3	91.0
326.0	142.0
626.0	154.0
700.0	151.0

Material Boundary

272.3	58.0
700.0	62.3

Material Boundary

173.3	91.0
272.3	58.0

Material Boundary

170.3	90.0
215.3	75.0
272.3	56.0
700.0	60.3

Material Boundary

100.0	75.0
215.3	75.0

Material Boundary

100.0	50.0
700.0	50.0

Material Boundary

100.0	30.0
700.0	30.0

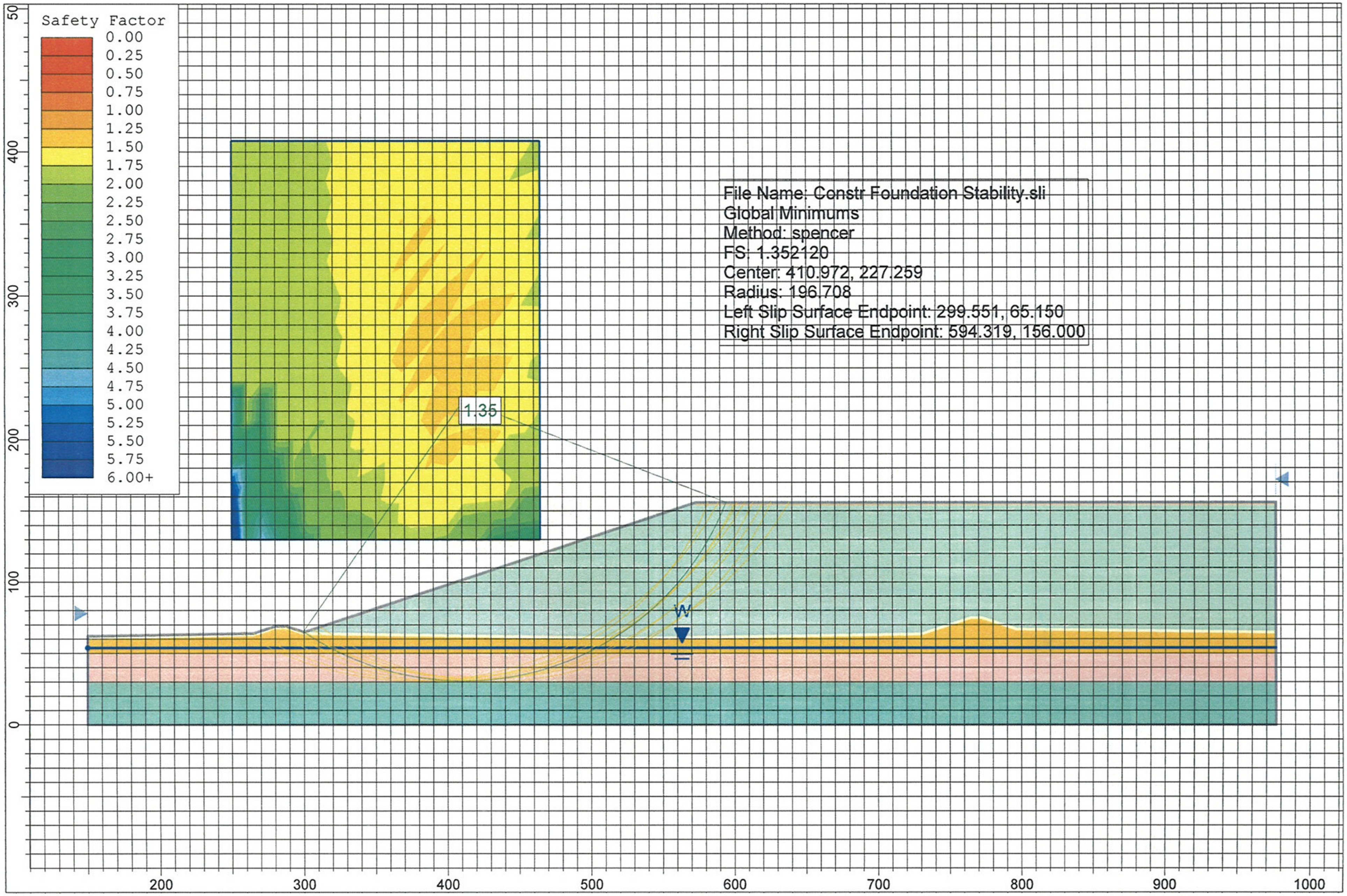
External Boundary

100.0	0.0
272.3	0.0
700.0	0.0
700.0	30.0
700.0	50.0
700.0	60.3
700.0	62.3
700.0	151.0
700.0	153.0
626.0	156.0
326.0	144.0
164.0	90.0
157.0	88.0
150.0	90.0
100.0	90.0
100.0	75.0
100.0	50.0
100.0	30.0

Water Table

100.0	54.0
700.0	54.0

ATTACHMENT 3



File Name: Constr Foundation Stability.sli
Global Minimums
Method: spencer
FS: 1.352120
Center: 410.972, 227.259
Radius: 196.708
Left Slip Surface Endpoint: 299.551, 65.150
Right Slip Surface Endpoint: 594.319, 156.000

Slide Analysis Information

Document Name

File Name: Constr Foundation Stability.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 20
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Liner
Strength Type: Mohr-Coulomb
Unit Weight: 110 lb/ft3
Cohesion: 30 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste
Strength Type: Mohr-Coulomb
Unit Weight: 70 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table

Custom Hu value: 1

Material: Cover
Strength Type: Mohr-Coulomb
Unit Weight: 110 lb/ft3
Cohesion: 30 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Medium Dense Fine Sand
Strength Type: Mohr-Coulomb
Unit Weight: 110 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Sandy Clay
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Constant
Cohesion: 700 psf
Water Surface: None

Material: Medium Dense Sand and Silt
Strength Type: Mohr-Coulomb
Unit Weight: 110 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: spencer
FS: 1.352120
Center: 410.972, 227.259
Radius: 196.708
Left Slip Surface Endpoint: 299.551, 65.150
Right Slip Surface Endpoint: 594.319, 156.000
Resisting Moment=7.46961e+007 lb-ft
Driving Moment=5.52437e+007 lb-ft
Resisting Horizontal Force=316145 lb
Driving Horizontal Force=233814 lb

Valid / Invalid Surfaces

Method: spencer
Number of Valid Surfaces: 9173
Number of Invalid Surfaces: 88
Error Codes:
Error Code -102 reported for 2 surfaces
Error Code -108 reported for 2 surfaces
Error Code -109 reported for 1 surface
Error Code -111 reported for 4 surfaces
Error Code -112 reported for 79 surfaces

Error Codes

The following errors were encountered during the computation:

-102 = Two surface / slope intersections,
but resulting arc is actually outside soil 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).

-109 = Soiltype for slice base not
located. This error should occur very rarely,
if at all. It may occur if a very low number of
slices is combined with certain soil geometries,
such that the midpoint of a slice base is
actually outside the soil region,even though
the slip surface is wholly within the soil region.

-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 All Coordinates

Search Grid

250.0	130.0
464.6	130.0
464.6	407.9
250.0	407.9

Material Boundary

300.0	65.0
526.0	61.5
730.0	64.5
764.5	76.0
772.5	76.0
796.5	68.0
976.5	65.7

Material Boundary

573.0	156.0
573.0	154.0
976.5	154.0

Material Boundary

150.0	60.0
265.0	62.0
280.0	67.0

288.0	67.0
300.0	63.0
526.0	59.5
730.0	62.5
764.5	74.0
772.0	74.0
796.5	66.0
976.5	63.7

Material Boundary

150.0	50.0
976.5	50.0

Material Boundary

150.0	30.0
976.5	30.0

External Boundary

150.0	0.0
265.0	0.0
280.0	0.0
288.0	0.0
300.0	0.0
526.0	0.0
730.0	0.0
764.5	0.0
772.5	0.0
796.5	0.0
976.5	0.0
976.5	30.0
976.5	50.0
976.5	63.7
976.5	65.7
976.5	154.0
976.5	156.0
573.0	156.0
300.0	65.0
288.0	69.0
280.0	69.0
265.0	64.0
150.0	62.3
150.0	60.0
150.0	50.0
150.0	30.0

Water Table

150.0	54.0
976.5	54.0

Geosyntec
consultants

COMPUTATION COVER SHEET

Client: **Vista LF, LLC** Project: **Vista Landfill – Substantial Permit Mod** Project No.: **FL1229**

Phase No.: ______

Title of Computations **LINER-WASTE BLOCK SLOPE STABILITY**

Computations by:
Signature
Printed Name Wade Tyner, E.I.T.
Title Staff Engineer
Date 20 June 2007

Assumptions and Procedures Checked by: (peer reviewer)
Signature Juan D. Quiroz
Printed Name Juan D. Quiroz, Ph.D., P.E.
Title Project Engineer
Date 22 June 2007

Computations Checked by:
Signature
Printed Name Sangho "Jay" Eun, E.I.T.
Title Senior Staff Engineer
Date 22 June 2007

Computations Backchecked by: (originator)
Signature
Printed Name Wade Tyner, E.I.T.
Title Staff Engineer
Date 25 July 2007

Approved by: (pm or designate)
Signature Juan D. Quiroz
Printed Name Juan D. Quiroz, Ph.D., P.E.
Title Project Engineer
Date 27 July 2007

Approval notes: ______

Revisions (number and initial all revisions)

No.	Sheet	Date	By	Checked by	Approval

Written by: **W. Tyner** Date: **06/20/07** Reviewed by: **J. Quiroz** Date: **06/22/07**

Client: **Vista LF, LLC** Project: **Vista LF – Substantial** Project No.: **FL1229** Phase No.:

LINER-WASTE BLOCK SLOPE STABILITY
VISTA CLASS III LANDFILL
APOPKA, FLORIDA

INTRODUCTION

The purpose of this calculation package is to present the liner-waste block slope stability analyses associated with the Vista Class III Landfill facility located in Apopka, Florida. The stability analyses were performed to evaluate the impact of the landfill construction on the proposed liner system configuration. The analyses were performed with respect to the following conditions: (i) the post-closure (long-term) configuration; and (ii) the construction (short-term) condition during waste filling activities.

The subsequent sections present several aspects of the liner-waste block slope stability analyses and include the following items:

- Input parameters and assumptions used for the stability analyses;
- Methodology utilized to evaluate liner-waste block stability; and
- Results of the stability analyses for the critical cross-sections analyzed.

INPUT PARAMETERS AND ASSUMPTIONS

Landfill Configuration

Figure 1 presents the typical post-closure configuration (cell floor grades and final cover grades) for the proposed landfill construction. The maximum landfill elevation will be approximately EL. 156 ft, NGVD with side slopes and top slopes inclined at 3H:1V and 4%, respectively. The typical leachate collection system (LCS) slope is 1% with leachate sumps located at EL. 56, NGVD. It is noted that a few of the cells within the landfill footprint contain leachate sumps at elevations higher than EL. 56 ft, NGVD.

Figure 2 presents the typical construction (cell floor grades and interim waste grades) for the proposed landfill construction. The typical construction configuration corresponds to a section perpendicular to that shown in Figure 1. The maximum inclination of the interim waste slopes during landfilling activities is 3H:1V. The cross-slopes along the cell floor, which convey leachate to the collection header pipe located at the center of each cell, were assumed to be approximately 2%.

A final cover system approximately 2-ft thick was incorporated in the cross sections. The final cover system was assumed to have a unit weight of 110 pcf, a cohesion value of 30 psf, and an internal friction angle (ϕ) of 30°.

Liner System Details and Material Properties

A detailed description of the liner system (from top to bottom) underlying the proposed landfill construction is provided below.

- 2-ft thick liner protective layer;
- Double-sided geocomposite drainage layer;
- 60-mil thick textured high density polyethylene (HDPE) geomembrane; and
- Subgrade.

Sliding within the liner system is governed by the interface friction angle (δ) of the weakest interface which can occur at soil-geosynthetic and/or geosynthetic-geosynthetic interfaces. The interface friction values for the liner system described above were varied to achieve the minimum regulatory factor of safety requirement.

The unit weight of the liner system consisting of geosynthetics and soil was assumed to be 80 pcf. Note that the assumed unit weight of the liner system has a negligible effect on the calculated slope stability factor of safety.

Waste Properties

Disposed waste for the proposed landfill construction will be compacted Class III waste. At present, limited published data is available on the material properties of Class III waste. As such, the assumed shear strength envelope exhibits an internal friction angle (ϕ) of 33° and zero cohesion. The unit weight of the compacted Class III waste including weekly and intermediate cover soils was assumed to be 70 pcf.

Written by: **W. Tyner** Date: **06/20/07** Reviewed by: **J. Quiroz** Date: **06/22/07**

Client: **Vista LF, LLC** Project: **Vista LF – Substantial** Project No.: **FL1229** Phase No.:

METHOD OF ANALYSIS

The established critical representative cross sections were evaluated using the slope stability software SLIDE (Rocscience, 2004). This program performed automatic search routines using Spencer's method of slices (Spencer, 1973) for finding the critical failure surface and minimum factor of safety. Since the assumed failure surface is expected to occur along a defined path (i.e., within the liner system), sliding block failure analyses were used to calculate the minimum factor of safety for each critical cross-section. The regulatory minimum slope stability factor of safety requirement for post-closure (i.e., long-term) conditions is 1.5. A minimum slope stability factor of safety requirement of 1.3 was used for construction (i.e., short-term) conditions.

As previously mentioned, some of the cells within the landfill footprint contain leachate sumps at elevations higher than EL. 56 ft, NGVD. This condition essentially reduces the resisting forces at the downstream (i.e., passive) side along the assumed failure surface. As such, an additional analysis was performed for the post-closure (long-term) condition which considers a higher sump elevation. A differential elevation of 5 ft between the sump and the landfill footprint perimeter was conservatively selected as a worse-case scenario. For the representative cross section presented in Figure 1, this corresponds to a sump elevation of about 85 ft, NGVD.

For each landfill configuration analyzed, a parametric or sensitivity analysis was performed to establish the minimum liner system interface friction angle (δ) such that the calculated liner-waste block slope stability factor of safety is equal to or greater than the minimum requirement for slope stability as identified above. The sensitivity analysis was performed by calculating the liner-waste block slope stability factor of safety for various values of interface friction angle.

LINER-WASTE BLOCK SLOPE STABILITY RESULTS

Post-Closure Stability

The results of the post-closure liner-waste block slope stability analyses for the representative critical cross section presented in Figure 1, and that developed to account for a higher leachate sump elevation are included in Attachment 1. Based on the sensitivity analyses for sliding along the liner system for each representative cross section, a minimum interface friction angle of 12.4° is required to meet a factor of safety of 1.5, the minimum regulatory requirement for long-term stability.

Construction Stability

The results of the construction liner-waste block slope stability analyses for the representative critical cross section presented in Figure 2 is included in Attachment 2. Based the sensitivity analyses for sliding along the liner system for the representative cross section, a minimum interface friction angle of 9.6° is required to meet a factor of safety of 1.3, the established minimum requirement for short-term stability.

CONCLUSIONS

A minimum interface friction angle of 12.4° is required to achieve a liner-waste block slope stability factor of safety equal to or greater than 1.5 for long-term conditions and 1.3 for short-term conditions. 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; Long et al., 1993; Williams and Houlihan, 1986). A summary of typical interface friction angles is provided in Attachment 3.

Prior to construction, the interface friction angles between the actual soil and geosynthetic materials will be verified by performing site-specific interface shear strength testing.

REFERENCES

Koerner, R.M., Designing with Geosynthetics. 4th Ed. Prentice Hall, New Jersey, 1999.

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.

Long, J. H., Daly, J. and Gilbert, R., "Structural Integrity of Geosynthetic Liner and Cover Systems for Solid Waste Landfills, Appendices A-K", Office of Solid Waste Research, Institute for Environmental Studies, University of Illinois at Urbana-Champaign, May, 1993.

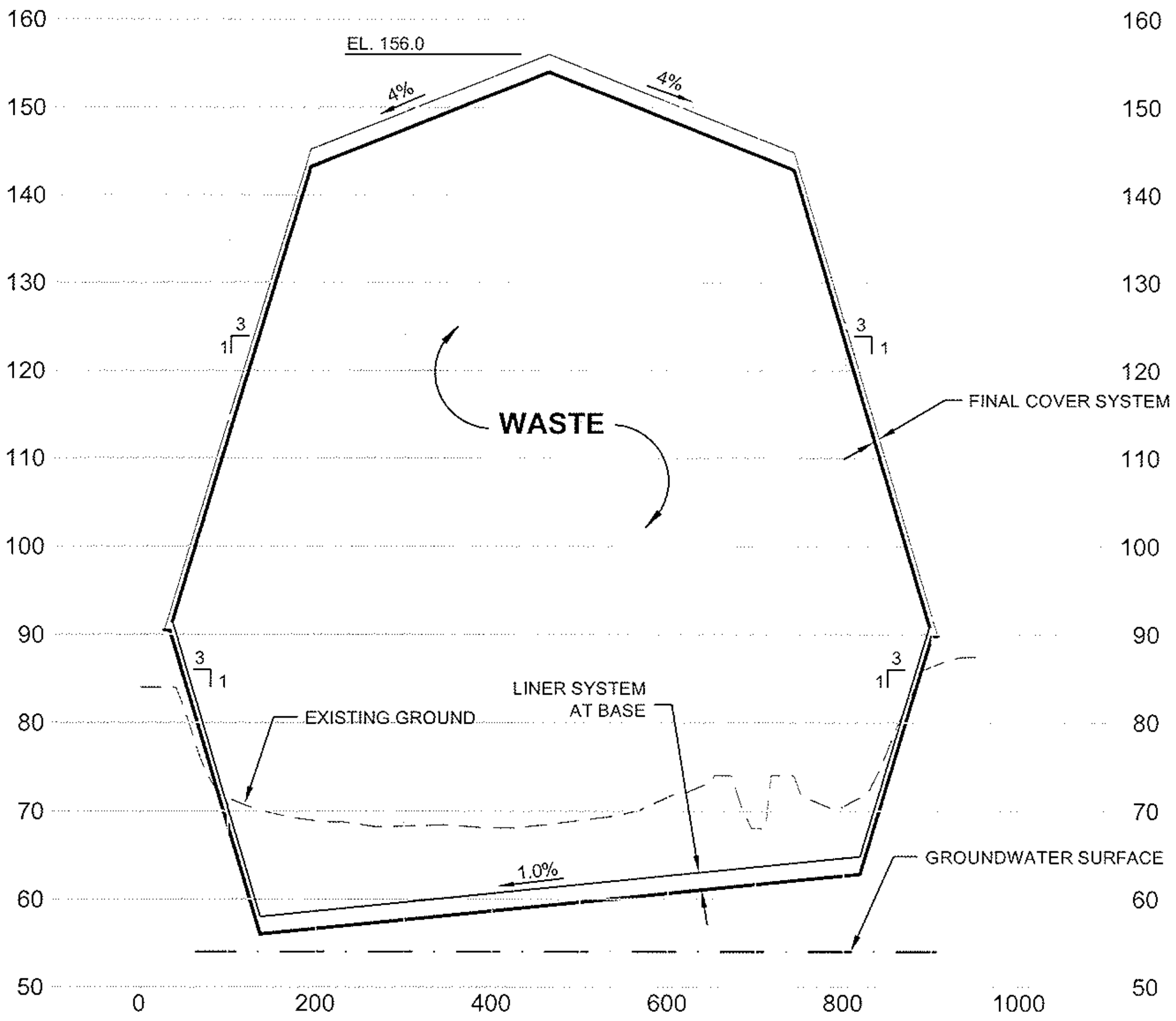
Martin, J.P., Koerner, R.M., and Whitty, J.E., "Experimental Friction Evaluation of Slippage Between Geomembranes and Geotextiles," Proceedings of the International Conference on Geomembranes, Denver, Colorado, pp. 191-196, 1984.

Rocscience, *"SLIDE – 2-D Limit Equilibrium Slope Stability for Soil and Rock Slopes,"* User's Guide, Rocscience Software, Inc., Toronto, Ontario, Canada, 2004.

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

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.

FIGURES



LANDFILL CROSS SECTION CELL 2
NORTH-SOUTH
SCALE: 1" = 200'H, 1" = 20'V

Geosyntec consultants

TAMPA, FL

DATE:	JULY 2007	FILE NO.	FL1229.02F013
PROJECT NO.	FL1229.02	FIGURE NO.	1

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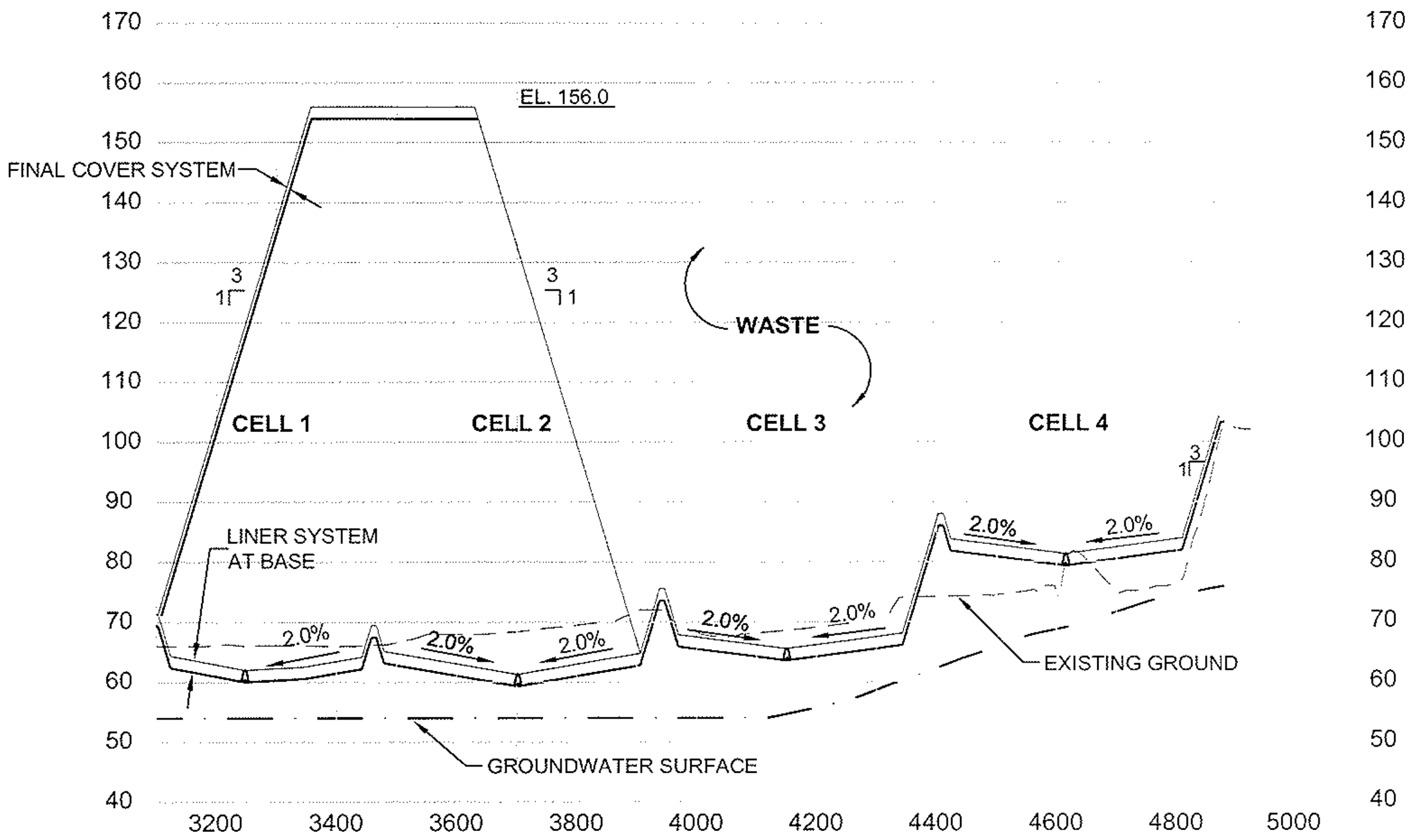


LANDFILL CROSS SECTION PHASE 1
WEST - EAST
SCALE: 1" = 300'H, 1" = 30'V

Geosyntec consultants

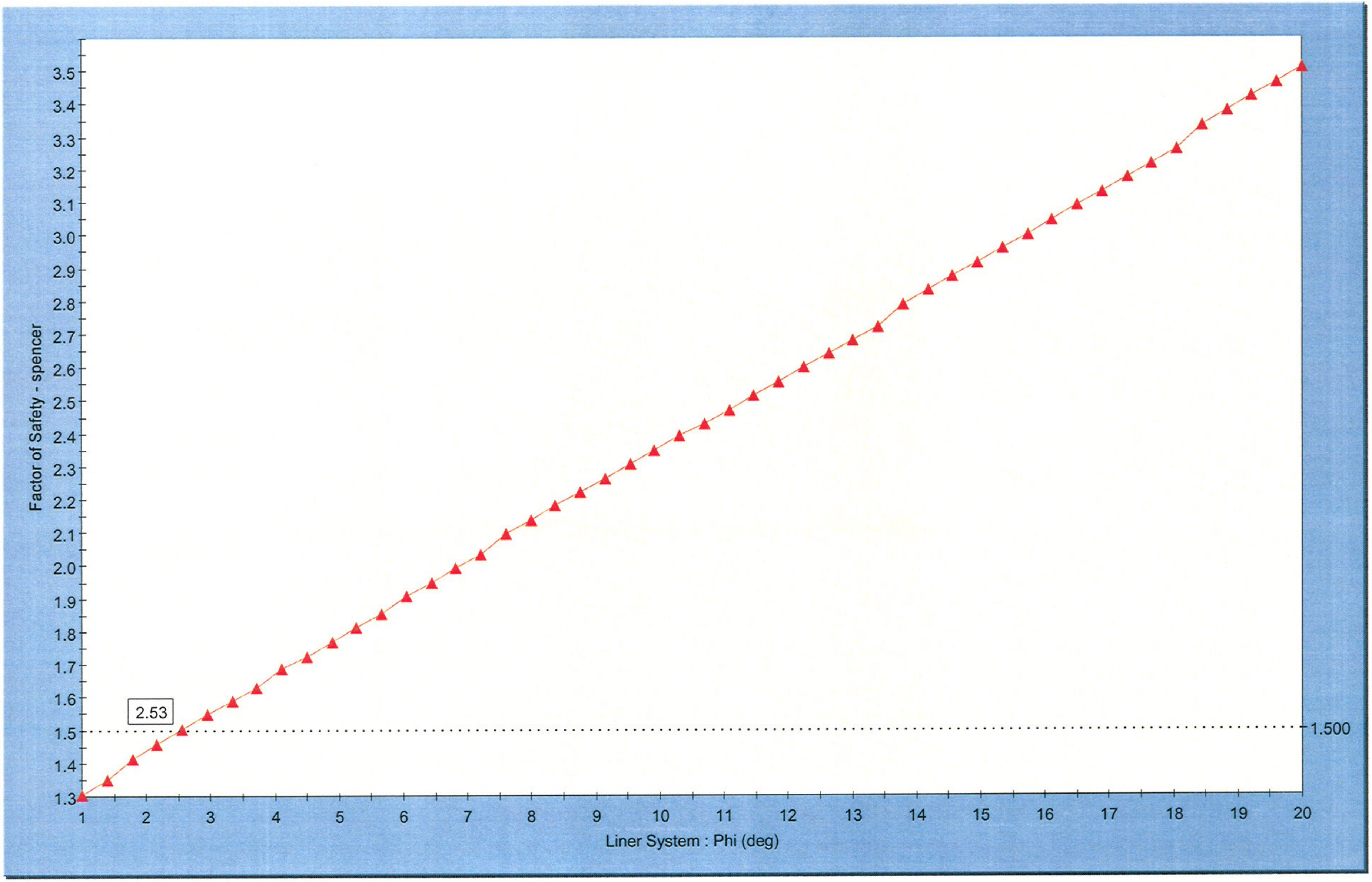
TAMPA, FL

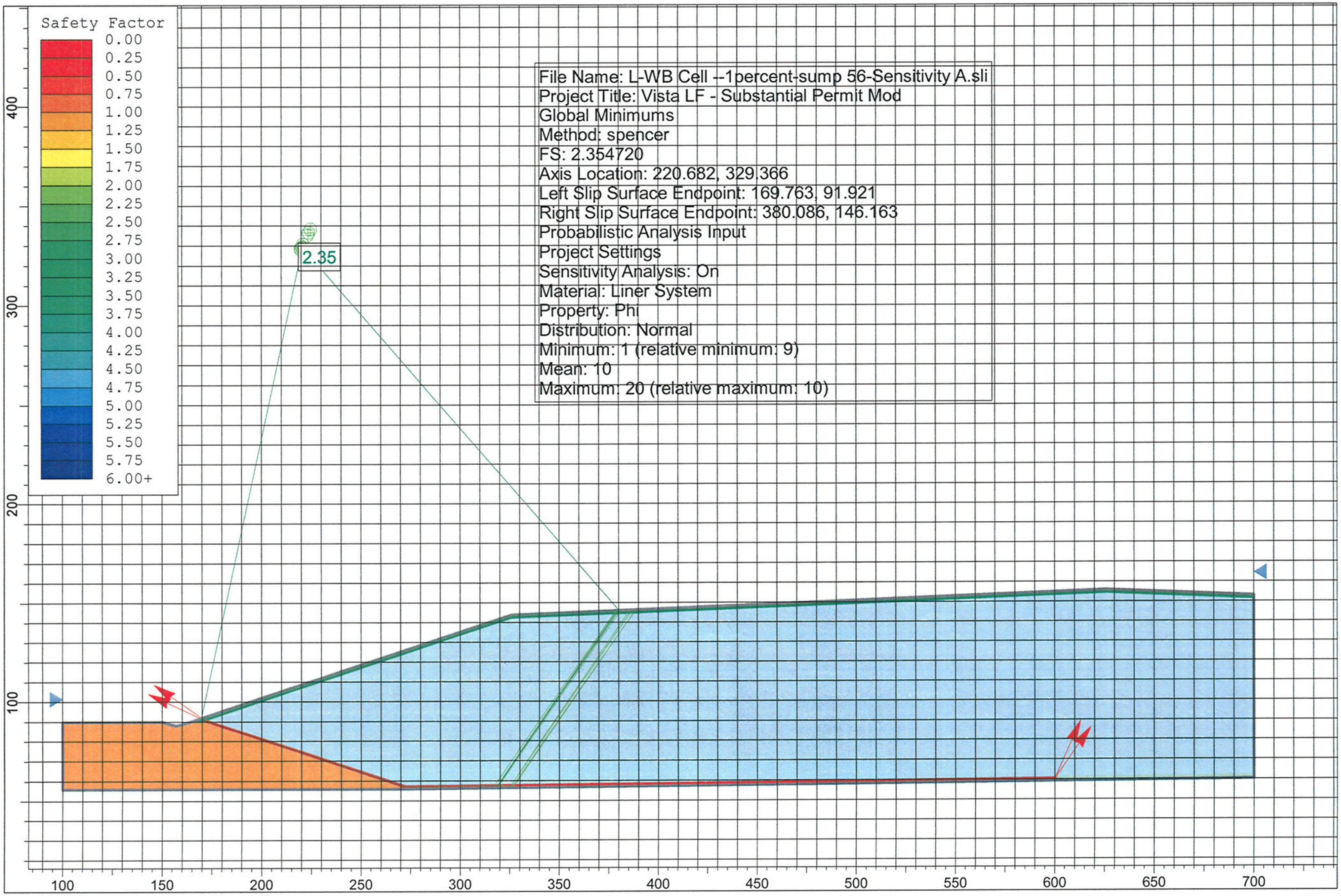
DATE:	JULY 2007	FILE NO.	FL1229.02F013
PROJECT NO.	FL1229.02	FIGURE NO.	2

I:\FL1229\FL1229.02\FIGURES\FL1229.02F013.DWG (5 December 2006) cvickers

ATTACHMENT 1

Sensitivity Plot: L-WB Cell --1percent-sump 56-Sensitivity A.sli





File Name: L-WB Cell --1percent-sump 56-Sensitivity A.sli
Project Title: Vista LF - Substantial Permit Mod
Global Minimums
Method: spencer
FS: 2.354720
Axis Location: 220.682, 329.366
Left Slip Surface Endpoint: 169.763, 91.921
Right Slip Surface Endpoint: 380.086, 146.163
Probabilistic Analysis Input
Project Settings
Sensitivity Analysis: On
Material: Liner System
Property: Phi
Distribution: Normal
Minimum: 1 (relative minimum: 9)
Mean: 10
Maximum: 20 (relative maximum: 10)

Slide Analysis Information

Document Name

File Name: L-WB Cell --1percent-sump 56-Sensitivity A.sli

Project Settings

Project Title: Vista LF - Substantial Permit Mod
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50

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): 145
Left Projection Angle (End Angle): 155
Right Projection Angle (Start Angle): 55
Right Projection Angle (End Angle): 66
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Existing Soil
Strength Type: Mohr-Coulomb
Unit Weight: 110 lb/ft3
Cohesion: 0 psf
Friction Angle: 28 degrees

Water Surface: None

Material: Liner System
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 10 degrees
Water Surface: None

Material: Cover System
Strength Type: Mohr-Coulomb
Unit Weight: 110 lb/ft3
Cohesion: 30 psf
Friction Angle: 30 degrees
Water Surface: None

Material: Class III Waste
Strength Type: Mohr-Coulomb
Unit Weight: 70 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: None

Global Minimums

Method: spencer
FS: 2.354720
Axis Location: 220.682, 329.366
Left Slip Surface Endpoint: 169.763, 91.921
Right Slip Surface Endpoint: 380.086, 146.163
Resisting Moment=5.60832e+007 lb-ft
Driving Moment=2.38173e+007 lb-ft
Resisting Horizontal Force=170864 lb
Driving Horizontal Force=72562.2 lb

Valid / Invalid Surfaces

Method: spencer
Number of Valid Surfaces: 3580
Number of Invalid Surfaces: 1420
Error Codes:
Error Code -108 reported for 516 surfaces
Error Code -111 reported for 904 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

Probabilistic Analysis Input

Project Settings
Sensitivity Analysis: On
Probabilistic Analysis: Off

Material: Liner System
Property: Phi
Distribution: Normal
Minimum: 1 (relative minimum: 9)
Mean: 10
Maximum: 20 (relative maximum: 10)

List of All Coordinates

Block Search Polyline

171.8	90.5
272.3	57.0
600.0	60.3

Material Boundary

164.0	90.0
170.3	90.0

Material Boundary

170.3	90.0
173.3	91.0
326.0	142.0
626.0	154.0
700.0	151.0

Material Boundary

272.3	58.0
700.0	62.3

Material Boundary

173.3	91.0
272.3	58.0

Material Boundary

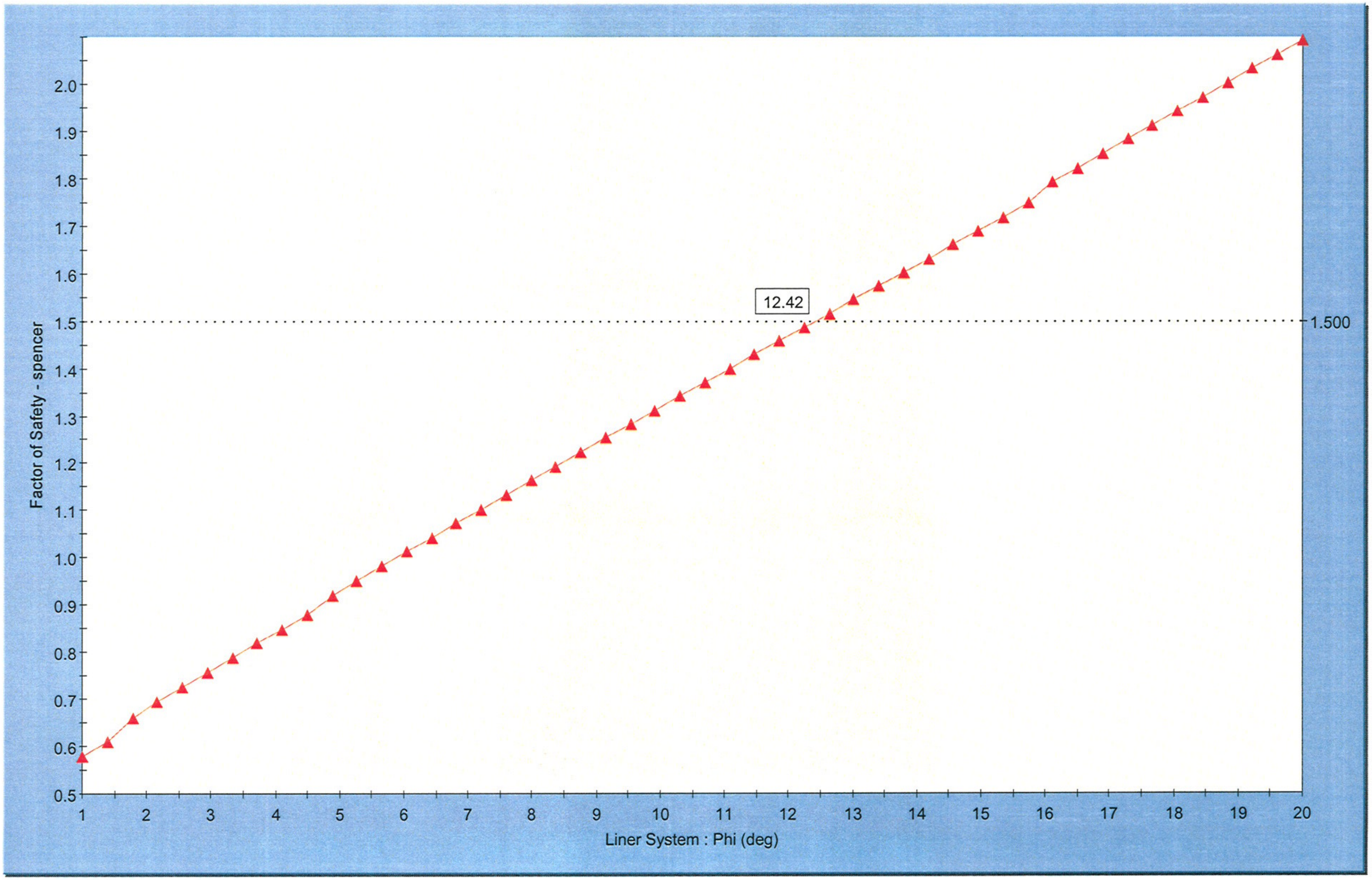
170.3	90.0
272.3	56.0

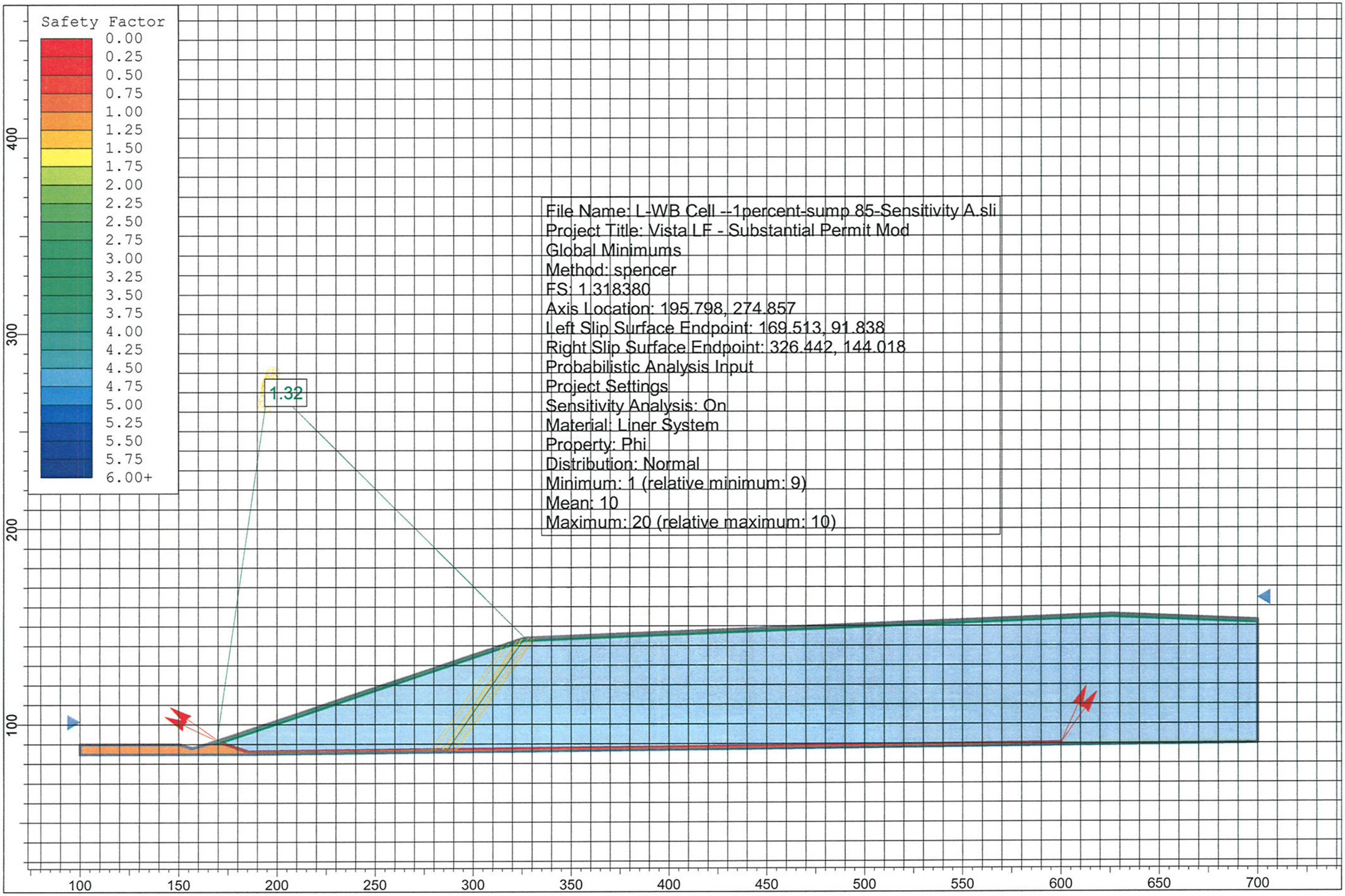
External Boundary

100.0	56.0

272.3	56.0
700.0	60.3
700.0	62.3
700.0	151.0
700.0	153.0
626.0	156.0
326.0	144.0
164.0	90.0
157.0	88.0
150.0	90.0
100.0	90.0

Sensitivity Plot: L-WB Cell --1percent-sump 85-Sensitivity A.sli





File Name: L-WB Cell --1percent-sump 85-Sensitivity A.sli
Project Title: Vista LF - Substantial Permit Mod
Global Minimums
Method: spencer
FS: 1.318380
Axis Location: 195.798, 274.857
Left Slip Surface Endpoint: 169.513, 91.838
Right Slip Surface Endpoint: 326.442, 144.018
Probabilistic Analysis Input
Project Settings
Sensitivity Analysis: On
Material: Liner System
Property: Phi
Distribution: Normal
Minimum: 1 (relative minimum: 9)
Mean: 10
Maximum: 20 (relative maximum: 10)

Slide Analysis Information

Document Name

File Name: L-WB Cell --1percent-sump 85-Sensitivity A.sli

Project Settings

Project Title: Vista LF - Substantial Permit Mod
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50

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): 145
Left Projection Angle (End Angle): 155
Right Projection Angle (Start Angle): 55
Right Projection Angle (End Angle): 66
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Existing Soil
Strength Type: Mohr-Coulomb
Unit Weight: 110 lb/ft3
Cohesion: 0 psf
Friction Angle: 28 degrees

Water Surface: None

Material: Liner System
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 10 degrees
Water Surface: None

Material: Cover System
Strength Type: Mohr-Coulomb
Unit Weight: 110 lb/ft3
Cohesion: 30 psf
Friction Angle: 30 degrees
Water Surface: None

Material: Class III Waste
Strength Type: Mohr-Coulomb
Unit Weight: 70 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: None

Global Minimums

Method: spencer
FS: 1.318380
Axis Location: 195.798, 274.857
Left Slip Surface Endpoint: 169.513, 91.838
Right Slip Surface Endpoint: 326.442, 144.018
Resisting Moment=1.40314e+007 lb-ft
Driving Moment=1.06429e+007 lb-ft
Resisting Horizontal Force=60064.4 lb
Driving Horizontal Force=45559.2 lb

Valid / Invalid Surfaces

Method: spencer
Number of Valid Surfaces: 4795
Number of Invalid Surfaces: 205
Error Codes:
Error Code -108 reported for 96 surfaces
Error Code -111 reported for 109 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

Probabilistic Analysis Input

Project Settings
Sensitivity Analysis: On
Probabilistic Analysis: Off

Material: Liner System
Property: Phi
Distribution: Normal
Minimum: 1 (relative minimum: 9)
Mean: 10
Maximum: 20 (relative maximum: 10)

List of All Coordinates

Block Search Polyline

171.8	90.5
185.3	86.0
600.0	90.1

Material Boundary

164.0	90.0
170.3	90.0

Material Boundary

170.3	90.0
173.3	91.0
326.0	142.0
626.0	154.0
700.0	151.0

Material Boundary

185.3	87.0
700.0	92.2

Material Boundary

173.3	91.0
185.3	87.0

Material Boundary

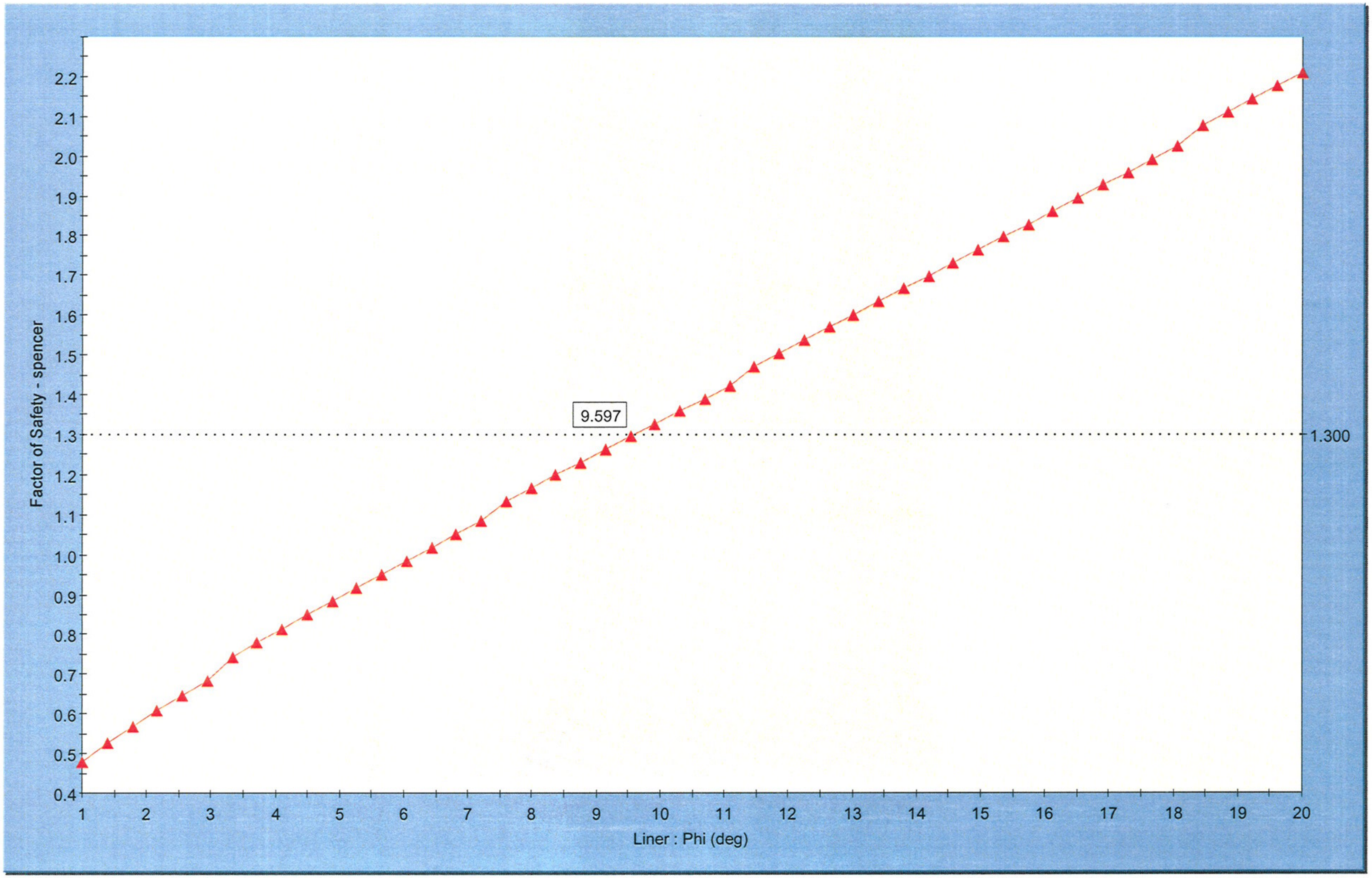
170.3	90.0
185.3	85.0

External Boundary

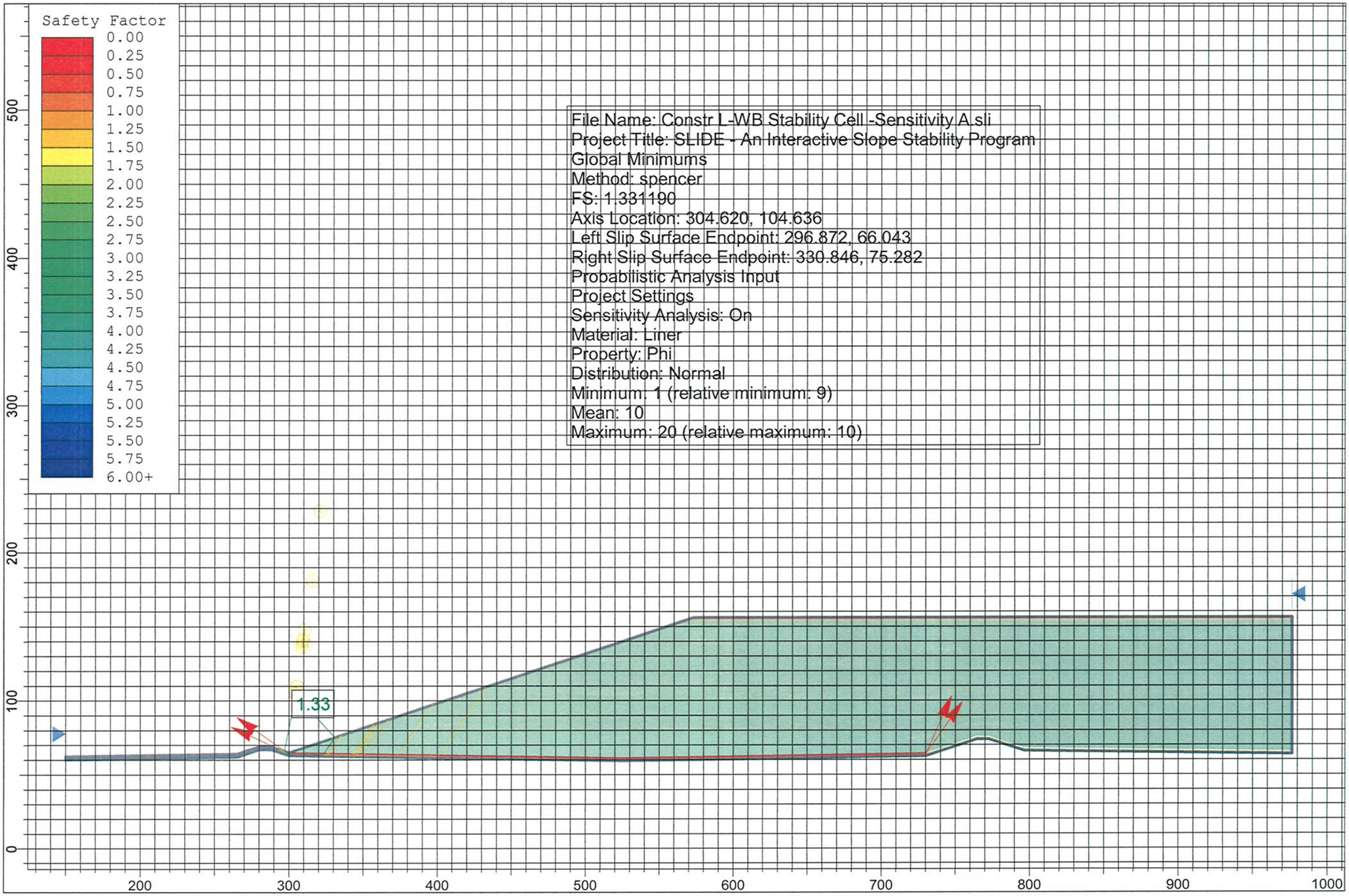
100.0	85.0

185.3	85.0
700.0	90.2
700.0	92.2
700.0	151.0
700.0	153.0
626.0	156.0
326.0	144.0
164.0	90.0
157.0	88.0
150.0	90.0
100.0	90.0

ATTACHMENT 2



Sensitivity Plot: Constr L-WB Stability Cell -Sensitivity A.sli



File Name: Constr L-WB Stability Cell -Sensitivity A.sli
Project Title: SLIDE - An Interactive Slope Stability Program
Global Minimums
Method: spencer
FS: 1.331190
Axis Location: 304.620, 104.636
Left Slip Surface Endpoint: 296.872, 66.043
Right Slip Surface Endpoint: 330.846, 75.282
Probabilistic Analysis Input
Project Settings
Sensitivity Analysis: On
Material: Liner
Property: Phi
Distribution: Normal
Minimum: 1 (relative minimum: 9)
Mean: 10
Maximum: 20 (relative maximum: 10)

Slide Analysis Information

Document Name

File Name: Constr L-WB Stability Cell -Sensitivity A.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 145
Left Projection Angle (End Angle): 155
Right Projection Angle (Start Angle): 55
Right Projection Angle (End Angle): 66
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Liner

Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 10 degrees

Water Surface: None

Material: Waste
Strength Type: Mohr-Coulomb
Unit Weight: 70 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: None

Material: Cover
Strength Type: Mohr-Coulomb
Unit Weight: 110 lb/ft3
Cohesion: 30 psf
Friction Angle: 30 degrees
Water Surface: None

Global Minimums

Method: spencer
FS: 1.331190
Axis Location: 304.620, 104.636
Left Slip Surface Endpoint: 296.872, 66.043
Right Slip Surface Endpoint: 330.846, 75.282
Resisting Moment=112724 lb-ft
Driving Moment=84679.2 lb-ft
Resisting Horizontal Force=2283.32 lb
Driving Horizontal Force=1715.25 lb

Valid / Invalid Surfaces

Method: spencer
Number of Valid Surfaces: 4979
Number of Invalid Surfaces: 21
Error Codes:
Error Code -107 reported for 9 surfaces
Error Code -108 reported for 12 surfaces

Error Codes

The following errors were encountered during the computation:

-107 = Total driving moment or
total driving force is negative. This will occur
if the wrong failure direction is specified,
or if high external or anchor loads are applied
against the failure direction.

-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).

Probabilistic Analysis Input

Project Settings
Sensitivity Analysis: On
Probabilistic Analysis: Off

Material: Liner
Property: Phi
Distribution: Normal
Minimum: 1 (relative minimum: 9)
Mean: 10
Maximum: 20 (relative maximum: 10)

List of All Coordinates

Block Search Polyline

300.0	64.0
526.0	60.5
730.0	63.5

Material Boundary

300.0	65.0
526.0	61.5
730.0	64.5
764.5	76.0
772.5	76.0
796.5	68.0
976.5	65.7

Material Boundary

573.0	156.0
573.0	154.0
976.5	154.0

External Boundary

150.0	60.3
265.0	62.0
280.0	67.0
288.0	67.0
300.0	63.0
526.0	59.5
730.0	62.5
764.5	74.0
772.5	74.0
796.5	66.0
976.5	63.7
976.5	65.7
976.5	154.0

976.5	156.0
573.0	156.0
300.0	65.0
288.0	69.0
280.0	69.0
265.0	64.0
150.0	62.3

ATTACHMENT 3

Summary of Documented Interface Friction Values
Vista Class III Landfill
Apopka, Florida

Geosynthetic / Geosynthetic	δ (°)
Textured HDPE Geomembrane / Nonwoven Geotextile	15 to 35
Textured HDPE Geomembrane / Geocomposite Drainage Layer	17 to 29
Geonet / Nonwoven Geotextile	14 to 22
Geosynthetic / Soil	**tan δ / tan ϕ**
Textured HDPE / Sand	0.7 to 0.8
Textured HDPE / Clay	0.8 to 0.9
Needle-punched Geotextile / Sand	0.8 to 1.0
Needle-punched Geotextile / Angular Gravel	0.7 to 0.9
Needle-punched Geotextile / Rounded Gravel	0.6 to 0.8
Needle-punched Geotextile / Silty Sands	0.96

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), Long et al. (1993), Koerner (1999), manufacturers literature, and unpublished results from Geosyntec Consultants.

Geosyntec
consultants

COMPUTATION COVER SHEET

Client: **Vista LF, LLC** Project: **Vista Landfill – Substantial Permit Mod** Project No.: **FL1229**

Phase No.: ________

Title of Computations **SUBGRADE SETTLEMENT ANALYSIS**

Computations by: Signature ________ Date: 9 June 2007
Printed Name: Wade Tyner, E.I.T.
Title: Staff Engineer

Assumptions and Procedures Checked by: (peer reviewer) Signature: Juan D. Quiroz Date: 11 June 2007
Printed Name: Juan D. Quiroz, Ph.D., P.E.
Title: Project Engineer

Computations Checked by: Signature ________ Date: 11 June 2007
Printed Name: Sangho "Jay" Eun, E.I.T.
Title: Senior Staff Engineer

Computations backchecked by: (originator) Signature ________ Date: 25 July 2007
Printed Name: Wade Tyner, E.I.T.
Title: Staff Engineer

Approved by: (pm or designate) Signature: Juan D. Quiroz Date: 27 July 2007
Printed Name: Juan D. Quiroz, Ph.D., P.E.
Title: Project Engineer

Approval notes: ________

Revisions (number and initial all revisions)

No.	Sheet	Date	By	Checked by	Approval

Written by: **W. Tyner** Date: **06/09/07** Reviewed by: **J. Quiroz** Date: **06/11/07**

Client: **Vista LF** Project: **Vista LF – Substantial** Project No.: **FL1229** Phase No.:

SUBGRADE SETTLEMENT ANALYSIS
VISTA CLASS III LANDFILL
APOPKA, FLORIDA

INTRODUCTION

The purpose of this calculation package is to evaluate the subgrade settlement and its impact on the leachate collection system (LCS) for the Vista Class III Landfill facility located in Apopka, Florida. Total settlement and differential settlement were evaluated at selected locations along the leachate corridor (i.e., leachate collection header pipe) to confirm that the leachate will continue to drain towards the leachate sumps located along the outer perimeter of the proposed landfill area.

Two representative cross sections are presented in Figures 1 and 2, which correspond to Cells 2 and 7 of the proposed landfill development (see Permit Drawings). The maximum height of the landfill is at approximately EL. 156 ft, NGVD with top slopes of 4 percent and side slopes inclined at 3H:1V. The minimum leachate corridor / cell floor slope is 1% with leachate sumps typically located at EL. 56 ft, NGVD.

The subsequent sections present several aspects of the settlement analysis and include the following items:

- Methodologies utilized to evaluate settlement;
- Input parameters and assumptions used for the settlement analysis; and
- Results of the total and differential settlement analysis

METHODOLOGY

Total settlement was calculated for each cross-section and below the following three points: (i) the sump; (ii) the maximum waste height elevation; and (iii) the opposite, high end of the leachate collection header pipe. In addition, two settlement methodologies were utilized to account for the total settlement of the sandy and clayey soils below the landfill footprint. Elastic settlement was evaluated for the sandy soil layers, while consolidation settlement was evaluated for the clayey soils. Furthermore, since the thickness of the underlying, compressible soils is thin relative to the width of the landfill (i.e., approximately 65 ft versus 850 ft), one-dimensional settlement calculation methodologies were utilized.

The settlement of the sandy soil layers (Δs_{sand}) was estimated using the following one-dimensional stress-strain relationship [Lambe and Whitman, 1969]:

$$\Delta s_{sand} = \sum \Delta l \frac{\Delta\sigma}{D}$$

where:

Δl = layer thickness;

$\Delta\sigma$ = incremental vertical stress;

D = constrained modulus of elasticity $= \dfrac{E(1-\mu)}{(1+\mu)(1-2\mu)}$;

E = modulus of elasticity = 8*N based on Schmertmann [1970] where N is the standard penetration test (SPT) N-value; and

μ = Poisson's ratio (varies from 0.3 to 0.45 for sands).

The settlement of the clay layer (Δs_{clay}) was estimated utilizing conventional one-dimensional consolidation theory assuming a normally consolidated soil [Holtz and Kovacs, 1981]:

$$\Delta s_{clay} = C_c \frac{H_o}{1+e_o} \log \frac{\sigma' + \Delta\sigma}{\sigma'}$$

where:

C_c = compression index = 0.009*(LL-10) based on Terzaghi and Peck [1967] where LL is the Liquid Limit of the soil;

H_o = thickness of consolidating layer;

e_o = initial void ratio of the soil;

σ' = effective vertical stress at the mid-point of the consolidating layer; and

$\Delta\sigma$ = vertical stress increment.

INPUT PARAMETERS AND ASSUMPTIONS

The representative cross sections presented in Figures 1 and 2 were selected to evaluate subgrade settlement. As previously mentioned, the maximum elevation of the landfill is at approximately EL. 156 ft, NGVD with top slopes of 4 percent and side slopes inclined at 3H:1V. The minimum leachate corridor / cell floor slope is 1% with leachate sumps typically located at EL. 56 ft, NGVD.

The two generalized (subsurface) geotechnical models that were developed for the site are provided in Attachment 1. [Note: The site geotechnical models were developed in a separate calculation package titled "Site Geotechnical Model," and included as part of this permit application.] Section 1 is an east-west subsurface cross section that includes Cells 1 through 4 of Phase 1 landfill development; and Section 2 is a north-south subsurface cross section that includes Cells 5 through 12 of landfill development Phases 2 and 3. For the given the representative cross section shown in Figures 1 and 2, settlement was evaluated using the geotechnical models presented in Sections 1 and 2, respectively.

Since considerable overburden must be excavated to establish the base grades for the landfill, a pre-loading effect was considered in the settlement analyses for the sandy and clayey soils. The net vertical load (i.e., $\Delta\sigma$) experienced by the underlying compressible soils below the proposed landfill was calculated by subtracting the excavated soil overburden pressure from the waste load overburden pressure above the landfill base grades. It is noted that the existing grade prior to excavation was conservatively assumed to be at EL. 90 ft, NGVD.

The following geometric parameters, material properties and assumptions were established with respect to the subsurface settlement of the sandy soil and clay layers below the landfill footprint.

Analysis	Parameter	Value	Description
One-Dimensional Stress-Strain (sandy soils)	γ_{waste}	70 pcf	Assumed unit weight of overfill waste.
	H_{waste}	Variable	Height of overfill waste.
	$\Delta\sigma$	Variable	Incremental vertical stress (i.e., $\Delta\sigma = \gamma_{waste} \times H_{waste} - \gamma_{soil} \times H_{excavation}$), see Attachment 2.
	μ	0.35	Assumed value for Poisson's ratio.
	E	Variable	Modulus of elasticity based on SPT N-value, see Attachment 1.

Analysis	Parameter	Value	Description
One-Dimensional Consolidation Theory (clays)	γ_{waste}	70 pcf	Assumed unit weight of overfill waste.
	γ_{soil}	110 pcf 120 pcf	Assumed total unit weight of sandy soil. Assumed total unit weight of clay soil.
	H_o	20 ft	Clay layer thickness.
	C_c	0.270	Compression index of clay based on 0.009*(LL-10) as presented in Terzaghi and Peck (1967), see Attachment 1.
	e_o	1.08	Calculated initial void ratio based on $G\omega = Se$, see Attachment 1.
	σ'	Variable	Calculated initial effective vertical stress at the center of the clay layer for each geotechnical subsurface model, see Attachment 2.
	$\Delta\sigma$	Variable	Vertical stress increment (i.e., $\Delta\sigma = \gamma_{waste} \times H_{waste} - \gamma_{soil} \times H_{excavation}$), see Attachment 2.

Written by: **W. Tyner** Date: **06/09/07** Reviewed by: **J. Quiroz** Date: **06/11/07**

Client: **Vista LF** Project: **Vista LF – Substantial** Project No.: **FL1229** Phase No.:

RESULTS

Total Settlement

Attachment 2 presents the subgrade settlement calculations for the Vista Landfill facility, and Attachment 3 presents a summary of total estimated settlements for each cross section analyzed. For the Cell 2 landfill configuration and Section 1 geotechnical subsurface model, the estimated settlement of the subsurface soils due to the proposed landfill loading is 5 inches below the sump, 11.1 inches below maximum waste height, and 3.9 inches below the high end of the leachate collection header pipe. For Cell 7 and Section 2 geotechnical subsurface model, the estimated settlement of the subsurface soils due to the proposed landfill loading is 5.5 inches below the sump, 13.9 inches below maximum waste height, and 8.5 inches below the high end of the leachate collection header pipe.

Differential Settlement and Slope of LCS Pipes

The differential settlement and resulting slope of the LCS pipes was calculated to assess the adequacy of leachate conveyance from the high end of the leachate collection pipe towards the leachate sumps located along the outer perimeter of the proposed landfill. The typical initial LCS slope is 1%. Calculation of differential settlement was based on the settlement values presented above, and a summary of post-settlement LCS slopes is presented in Attachment 3.

The following sign convention was utilized: (i) a positive slope (+S%) indicates leachate conveyance towards the leachate sump; and (ii) a negative slope (-S%) indicates grade reversal. The slope of the LCS pipe was calculated in two segments with respect to the point below the maximum waste height. For Cell 2, the LCS pipe slope varied from +0.85% to +1.18% with an effective slope of +1.01%. For Cell 7, the LCS pipe slope varied from +0.83% to +1.11% with an effective slope of +0.97%. There was no calculated grade reversal along the length of the LCS pipes in Cells 2 and 7.

Written by: **W. Tyner** Date: **06/09/07** Reviewed by: **J. Quiroz** Date: **06/11/07**

Client: **Vista LF** Project: **Vista LF – Substantial** Project No.: **FL1229** Phase No.:

CONCLUSIONS

The results of the subgrade settlement analyses indicate that the maximum total settlement is about 14 inches or less and corresponds to a point below the maximum waste height. In addition, the overall effective post-settlement slope of the LCS pipes was calculated to be +1.01% for Cell 2 and +0.97% for Cell 7, with no grade reversals along the length of the pipes. Therefore, the LCS pipes will adequately convey leachate to the sumps located at the ends of the leachate collection pipes.

REFERENCES

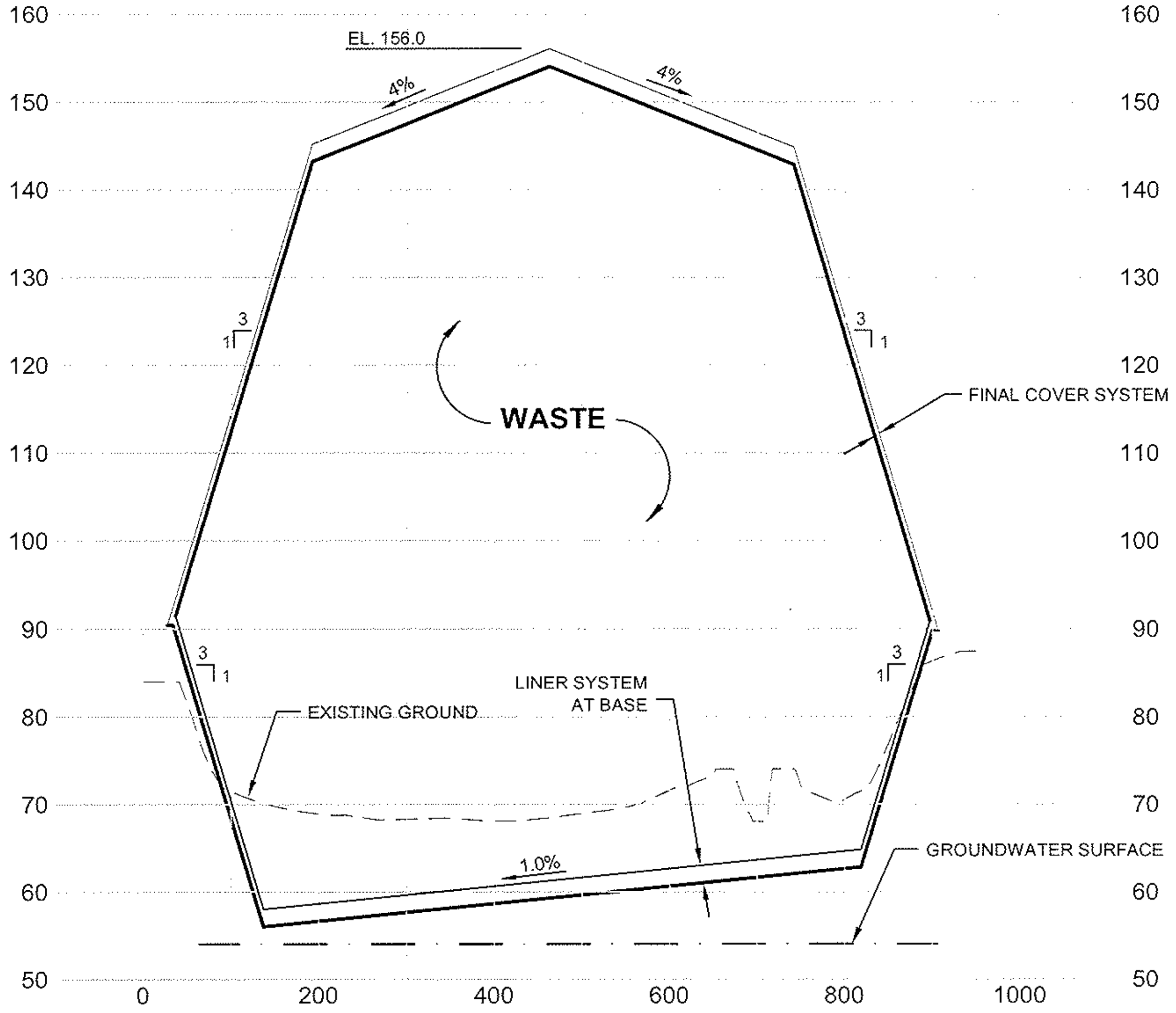
Holtz, R.D., Kovacs, W.D., "An Introduction to Geotechnical Engineering," Prentice-Hall, Inc., 1981.

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

Schmertmann, J.H., "Static Cone to Compute Settlement Over Sand," Journal of the Soil Mechanics and Foundations Division, ASCE, Vol. 96, No. SM3, pp. 1011-1043, 1970.

Terzaghi, K., and Peck, R.B., "Soil Mechanics in Engineering Practice," 2nd Ed. John Wiley and Sons, New York, 1967.

FIGURES



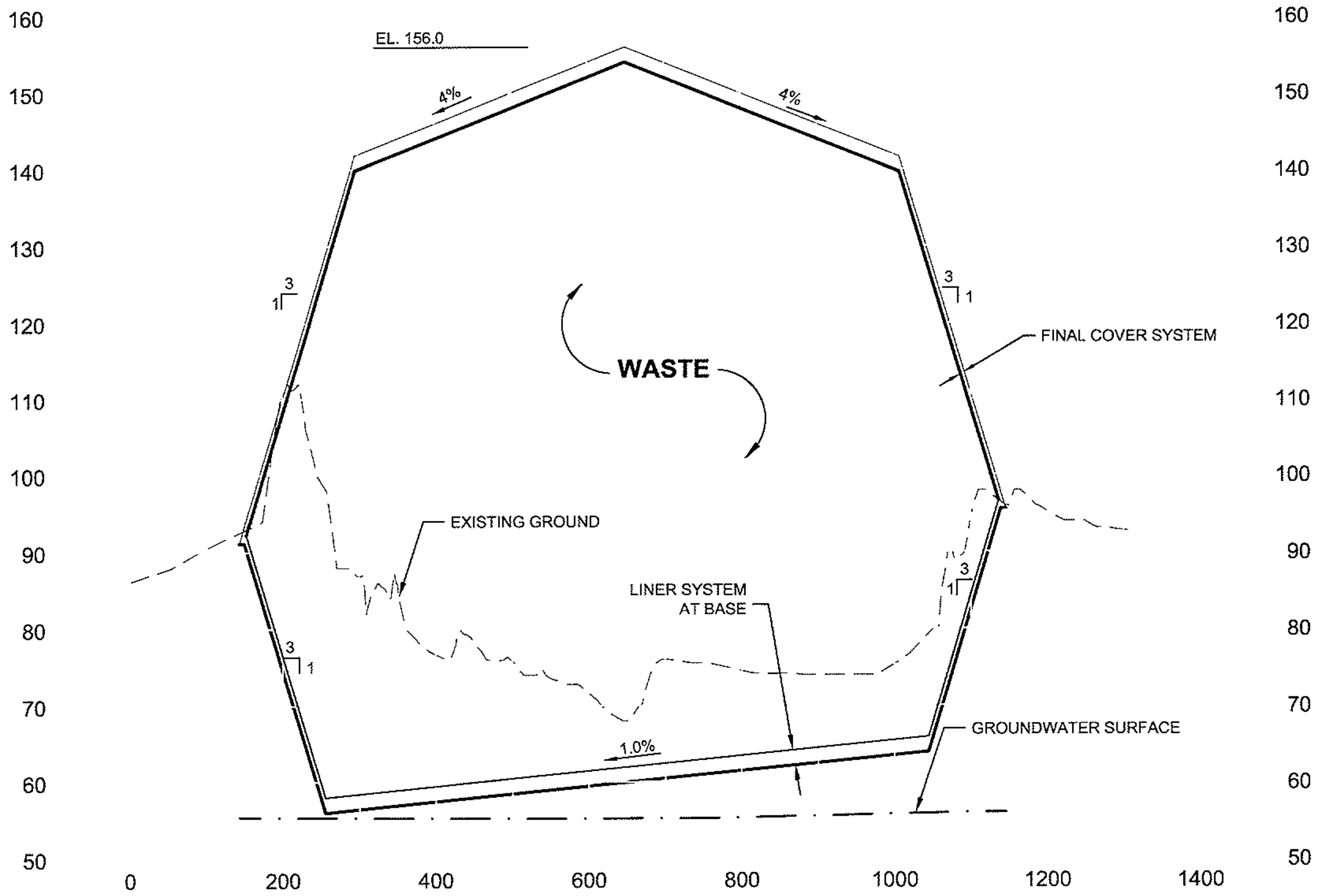
LANDFILL CROSS SECTION CELL 2
NORTH-SOUTH
SCALE: 1" = 200'H, 1" = 20'V

Geosyntec consultants

TAMPA, FL

DATE:	JULY 2007	FILE NO.	FL1229.02F013
PROJECT NO.	FL1229.02	FIGURE NO.	1

I:\FL1229\FL1229.02\FIGURES\FL1229.02F013.DWG (5 December 2006) cvickers



LANDFILL CROSS SECTION CELL 7
EAST-WEST
SCALE: 1" = 200'H, 1" = 20' V

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DATE:	JUNE 2007	FILE NO.	FL122902F006
PROJECT NO.	FL1229.02	FIGURE NO.	2

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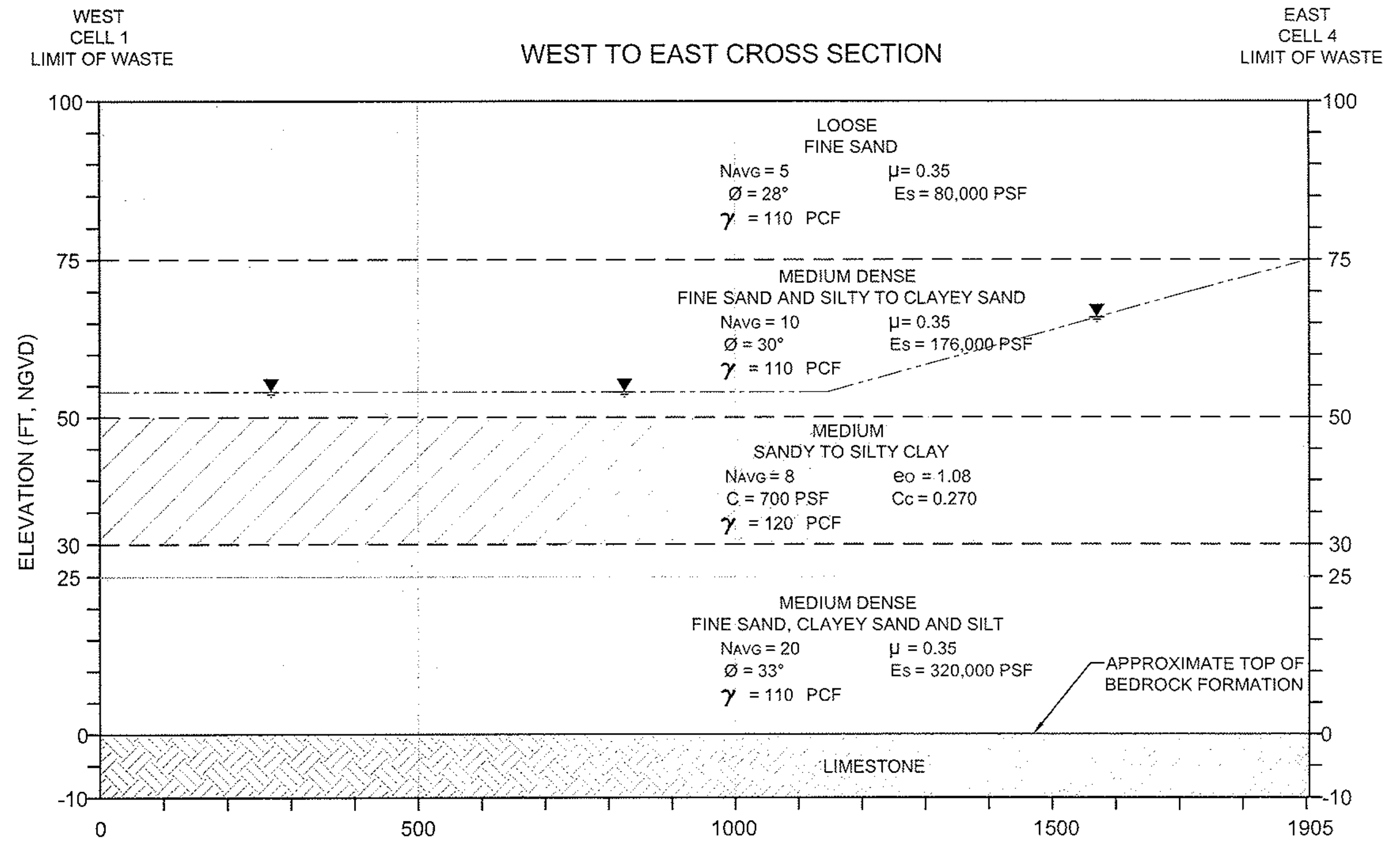
ATTACHMENT 1



SECTION 1 GEOTECHNICAL SUBSURFACE SOIL MODEL

0 25'
VERTICAL SCALE: 1"=25'

0 250'
HORIZONTAL SCALE: 1"=250'

Geosyntec consultants

TAMPA, FL

DATE:	JULY2007	FILE NO.	FL1229.02F004
PROJECT NO.	FL1229.02	FIGURE NO.	1

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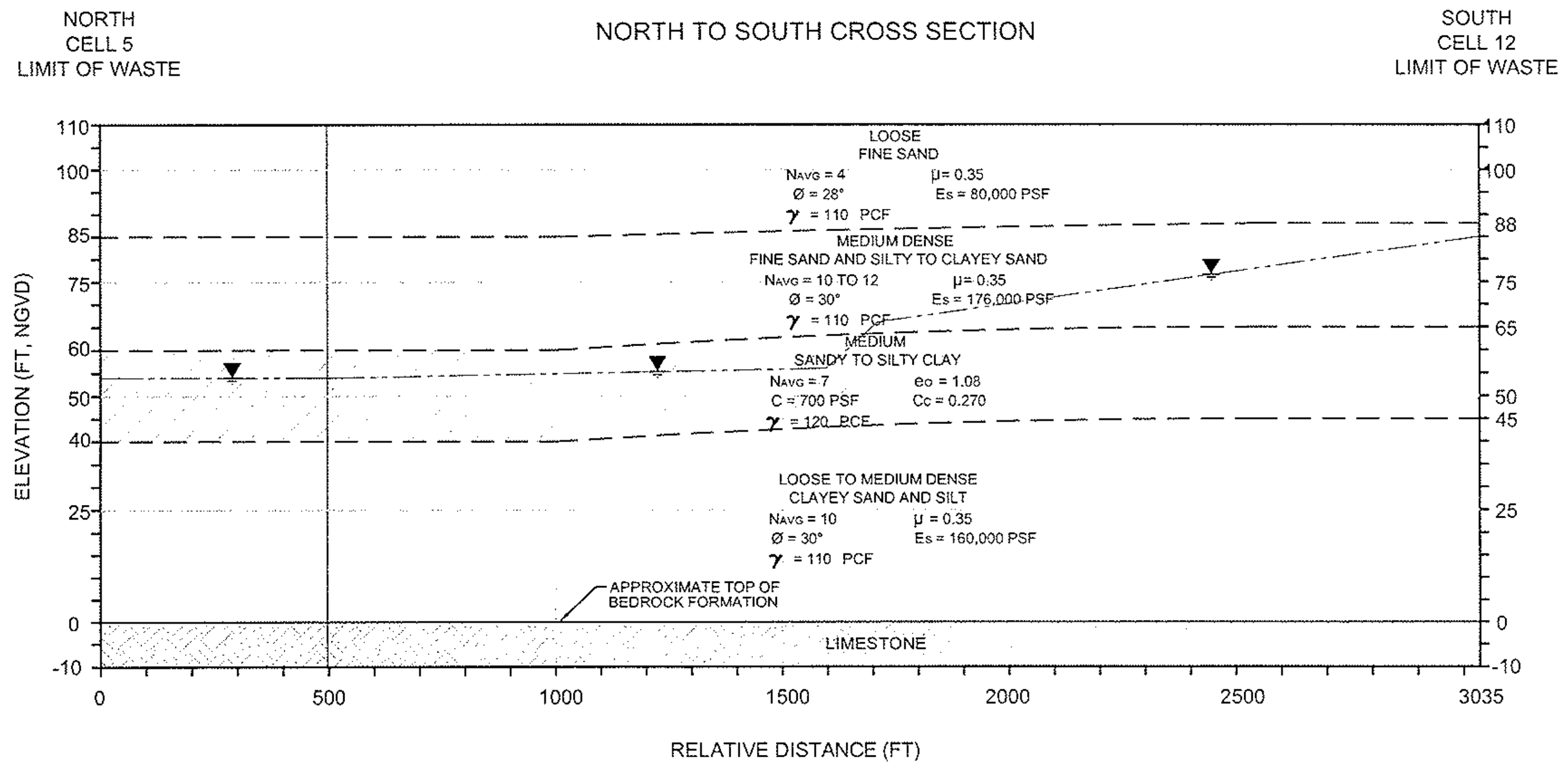


0 30'

VERTICAL SCALE: 1"=30'

0 300'

HORIZONTAL SCALE: 1"=300'

SECTION 2 GEOTECHNICAL SUBSURFACE SOIL MODEL

Geosyntec consultants

TAMPA, FL

DATE:	JULY 2007	FILE NO.	FL1229.02F005
PROJECT NO.	FL1229.02	FIGURE NO.	2

I:\FL1229\FL1229.02\FIGURES\FL1229.02F005.DWG (5 December 2006) ecsordas

ATTACHMENT 2

CELL 2 SETTLEMENT CALCULATIONS

Calculation of Sand Foundation Settlement Due to Waste Fill in Cell 2
Vista Class III Landfill - Substantial Permit Modification
Vista Landfill - Apopka, Florida

Below Sump

Layer No.	Soil Type	Top of Layer (ft)	Bottom of Layer (ft)	Δl Layer Thickness (ft)	$\Delta\sigma^{(3)}$ Vertical Stress Increment (psf)	$E^{(1)}$ Modulus of Elasticity (psf)	D Constrained Modulus of Elasticity (psf)	ΔSettlement (ft)	ΔSettlement (in)
1	fine sand and silty/clayey sand	0	6	6	1440	176000	282469	0.031	0.37
$2^{(2)}$	sandy/silty clay	6	26	20	1440	---	---	---	---
3	fine sand, clayey sand and silt	26	56	30	1440	320000	513580	0.084	1.01
							Total =	**0.115**	**1.38**

Below Maximum Waste Height

Layer No.	Soil Type	Top of Layer (ft)	Bottom of Layer (ft)	Δl Layer Thickness (ft)	$\Delta\sigma^{(3)}$ Vertical Stress Increment (psf)	$E^{(1)}$ Modulus of Elasticity (psf)	D Constrained Modulus of Elasticity (psf)	ΔSettlement (ft)	ΔSettlement (in)
1	fine sand and silty/clayey sand	0	9.5	9.5	3400	176000	282469	0.114	1.37
$2^{(2)}$	sandy/silty clay	9.5	29.5	20	3400	---	---	---	---
3	fine sand, clayey sand and silt	29.5	59.5	30	3400	320000	513580	0.199	2.38
							Total =	**0.313**	**3.76**

Below High End of Leachate Header Pipe

Layer No.	Soil Type	Top of Layer (ft)	Bottom of Layer (ft)	Δl Layer Thickness (ft)	$\Delta\sigma^{(3)}$ Vertical Stress Increment (psf)	$E^{(1)}$ Modulus of Elasticity (psf)	D Constrained Modulus of Elasticity (psf)	ΔSettlement (ft)	ΔSettlement (in)
1	fine sand and silty/clayey sand	0	12.8	12.8	1012	176000	282469	0.046	0.55
$2^{(2)}$	sandy/silty clay	12.8	32.8	20	1012	---	---	---	---
3	fine sand, clayey sand and silt	32.8	62.8	30	1012	320000	513580	0.059	0.71
							Total =	**0.105**	**1.26**

Notes: (1) The geotechnical parameter was obtained from the generalized geotechnical models for the site, i.e., Sections 1 and 2, as presented in Attachment 1.

(2) Layer 2 is a clay layer, therefore the calculated settlement within this layer is based on conventional one-dimensional consolidation theory.

(3) See attached calculation sheet for vertical stress increment ($\Delta\sigma$).

(4) The calculations are based on the following input parameters:

Poisson Ratio (μ) =	0.35	
Unit Weight of Waste (γ_{waste}) =	70	pcf
Unit Weight of Sand (γ_{sand}) =	110	pcf
Unit Weight of Clay (γ_{clay}) =	120	pcf

Calculation of Clay Foundation Consolidation Due to Waste Fill in Cell 2
Vista Class III Landfill - Substantial Permit Modification
Vista Landfill - Apopka, Florida

Below Sump

Layer No.	Soil Type	Top of Layer (ft)	Bottom of Layer (ft)	Δl Layer Thickness (ft)	Mid-Depth Below Grade (ft)	$\Delta\sigma^{(4)}$ Vertical Stress Increment (psf)	Initial Vertical Stress @ Midpoint of Layer$^{(2)}$ (psf)	e_o Void Ratio$^{(1)}$	Cc$^{(1)}$ Compression Index	ΔSettlement	
										(ft)	(in)
1	fine sand and silty/clayey sand	0	6	6	3.0	1440	---	---	---	---	---
2$^{(3)}$	sandy/silty clay	6	26	20	16.0	1440	4726	1.08	0.27	0.30	3.60
3	fine sand, clayey sand and silt	26	56	30	41.0	1440	---	---	---	---	---
									Total =	0.30	3.60

Below Maximum Waste Height

Layer No.	Soil Type	Top of Layer (ft)	Bottom of Layer (ft)	Δl Layer Thickness (ft)	Mid-Depth Below Grade (ft)	$\Delta\sigma^{(2)}$ Vertical Stress Increment (psf)	Initial Vertical Stress @ Midpoint of Layer$^{(2)}$ (psf)	e_o Void Ratio$^{(1)}$	Cc$^{(1)}$ Compression Index	ΔSettlement	
										(ft)	(in)
1	fine sand and silty/clayey sand	0	9.5	9.5	4.8	3400	---	---	---	---	---
2$^{(3)}$	sandy/silty clay	9.5	29.5	20	19.5	3400	4726	1.08	0.27	0.61	7.33
3	fine sand, clayey sand and silt	29.5	59.5	30	44.5	3400	---	---	---	---	---
									Total =	0.61	7.33

Below High End of Leachate Header Pipe

Layer No.	Soil Type	Top of Layer (ft)	Bottom of Layer (ft)	Δl Layer Thickness (ft)	Mid-Depth Below Grade (ft)	$\Delta\sigma^{(2)}$ Vertical Stress Increment (psf)	Initial Vertical Stress @ Midpoint of Layer$^{(2)}$ (psf)	e_o Void Ratio$^{(1)}$	Cc$^{(1)}$ Compression Index	ΔSettlement	
										(ft)	(in)
1	fine sand and silty/clayey sand	0	12.8	12.8	6.4	1012	---	---	---	---	---
2$^{(3)}$	sandy/silty clay	12.8	32.8	20	22.8	1012	4726	1.08	0.27	0.22	2.63
3	fine sand, clayey sand and silt	32.8	62.8	30	47.8	1012	---	---	---	---	---
									Total =	0.22	2.63

Notes: (1) The geotechnical parameter was obtained from the generalized geotechnical models for the site, i.e., Sections 1 and 2, as presented in Attachment 1.
(2) See attached calculation sheet for initial vertical stress at midpoint of layer.
(3) Layer 2 is a clay layer, therefore the calculated settlement within this layer is based on conventional one-dimensional consolidation theory.
(4) See attached calculation sheet for vertical stress increment (Δσ).
(5) The calculations are based on the following input parameters:

Unit Weight of Waste (γ_{waste}) =	70	pcf
Unit Weight of Sand (γ_{sand}) =	110	pcf
Unit Weight of Clay (γ_{clay}) =	120	pcf

Geosyntec consultants

Written by: JUAN QUIROZ Date: 27/06/07 (DD MM YY) Reviewed by: ____________ Date: __/__/__ (DD MM YY)

Client: VISTA LF, LLC Project: VISTA LF-MAJOR Project/Proposal No. FL1229 Task No. ______

NET $\Delta\sigma$ CALCULATIONS FOR CELL 2

BELOW SUMP: WASTE LOAD = σ_{WASTE} = (EL 130 - EL 56)(70 PCF) = 5,180 PSF

EXISTING PRE-LOAD = σ_{PL} = (EL 90 - EL 56)(110 PCF) = 3,740 PSF

$\Delta\sigma$ = 1,440 PSF

BELOW MAX. WASTE HEIGHT: σ_{WASTE} = (EL 156 - EL 59.5)(70 PCF) = 6,755 PSF

σ_{PL} = (EL 90 - EL 59.5)(110 PCF) = 3,355 PSF

$\Delta\sigma$ = 3,400 PSF

BELOW HIGH END OF LEACHATE PIPE: σ_{WASTE} = (EL 120 - EL 62.8)(70 PCF) = 4,004 PSF

σ_{PL} = (EL 90 - EL 62.8)(110 PCF) = 2,992 PSF

$\Delta\sigma$ = 1,012 PSF

Page _____ of _____

Geosyntec consultants

Written by: Juan Quiroz Date: 27/06/07 Reviewed by: __________ Date: ___/___/___

Client: Vista LF, LLC Project: Vista LF-Major Project/Proposal No. FL1229 Task No. __________

INITIAL VERTICAL STRESS AT MID-POINT OF CLAY LAYER CALCULATION

SECTION 1

INITIAL VERTICAL STRESS = σ'_{vo}

TOP OF CLAY

$\sigma'_{vo_1} = (EL\,90 - EL\,54)(110\text{ PCF}) + (EL\,54 - EL\,50)(110\text{ PCF} - 62.4\text{ PCF}) +$

ASSUMED TOP OF EXISTING GROUND PRIOR TO EXCAV.

TOP OF ASSUMED GWT

$+ (EL\,50 - EL\,40)(120\text{ PCF} - 62.4\text{ PCF}) =$

MIDPOINT OF CLAY

$\underline{\underline{4{,}726.4\text{ PSF}}}$

SECTION 2

TOP OF ASSUMED GWT

MIDPOINT OF CLAY

$\sigma'_{vo_2} = (EL\,90 - EL\,63)(110\text{ PCF}) + (EL\,63 - EL\,55)(120\text{ PCF}) + (EL\,55 - EL\,53)(120\text{ PCF} - 62.4\text{ PCF}) =$

TOP OF CLAY

$\underline{\underline{4{,}045.2\text{ PSF}}}$

CELL 7 SETTLEMENT CALCULATIONS

Calculation of Sand Foundation Settlement Due to Waste Fill in Cell 7
Vista Class III Landfill - Substantial Permit Modification
Vista Landfill - Apopka, Florida

Below Sump

Layer No.	Soil Type	Top of Layer	Bottom of Layer	Δl Layer Thickness	Δσ[3] Vertical Stress Increment	E[1] Modulus of Elasticity	D Constrained Modulus of Elasticity	ΔSettlement	
		(ft)	(ft)	(ft)	(psf)	(psf)	(psf)	(ft)	(in)
1	fine sand and silty/clayey sand	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2[2]	sandy/silty clay	0	13	13	1440	---	---	---	---
3	fine sand, clayey sand and silt	13	56	43	1440	160000	256790	0.241	2.89
							Total =	0.241	2.89

Below Maximum Waste Height

Layer No.	Soil Type	Top of Layer	Bottom of Layer	Δl Layer Thickness	Δσ[3] Vertical Stress Increment	E[1] Modulus of Elasticity	D Constrained Modulus of Elasticity	ΔSettlement	
		(ft)	(ft)	(ft)	(psf)	(psf)	(psf)	(ft)	(in)
1	fine sand and silty/clayey sand	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2[2]	sandy/silty clay	0	17	17	3420	---	---	---	---
3	fine sand, clayey sand and silt	17	60	43	3420	160000	256790	0.573	6.87
							Total =	0.573	6.87

Below High End of Leachate Header Pipe

Layer No.	Soil Type	Top of Layer	Bottom of Layer	Δl Layer Thickness	Δσ[3] Vertical Stress Increment	E[1] Modulus of Elasticity	D Constrained Modulus of Elasticity	ΔSettlement	
		(ft)	(ft)	(ft)	(psf)	(psf)	(psf)	(ft)	(in)
1	fine sand and silty/clayey sand	0	1	1	1760	176000	282469	0.006	0.07
2[2]	sandy/silty clay	1	21	20	1760	---	---	---	---
3	fine sand, clayey sand and silt	21	64	43	1760	160000	256790	0.295	3.54
							Total =	0.301	3.61

Notes: (1) The geotechnical parameter was obtained from the generalized geotechnical models for the site, i.e., Sections 1 and 2, as presented in Attachment 1.

(2) Layer 2 is a clay layer, therefore the calculated settlement within this layer is based on conventional one-dimensional consolidation theory.

(3) See attached calculation sheet for vertical stress increment ($\Delta\sigma$).

(4) The calculations are based on the following input parameters:

Poisson Ratio (μ) =	0.35	
Unit Weight of Waste (γ_{waste}) =	70	pcf
Unit Weight of Sand (γ_{sand}) =	110	pcf
Unit Weight of Clay (γ_{clay}) =	120	pcf

Calculation of Clay Foundation Consolidation Due to Waste Fill in Cell 7
Vista Class III Landfill - Substantial Permit Modification
Vista Landfill - Apopka, Florida

Below Sump

Layer No.	Soil Type	Top of Layer (ft)	Bottom of Layer (ft)	Δl Layer Thickness (ft)	Mid-Depth Below Grade (ft)	Δσ(4) Vertical Stress Increment (psf)	Initial Vertical Stress @ Midpoint of Layer(2) (psf)	e_o Void Ratio(1)	Cc(1) Compression Index	ΔSettlement (ft)	ΔSettlement (in)
1	fine sand and silty/clayey sand										
2(3)	sandy/silty clay	0	13	13	6.5	1440	4045	1.08	0.27	0.22	2.68
3	fine sand, clayey sand and silt	13	56	43	34.5	1440	---	---	---	---	---
										0.22	2.68

Below Maximum Waste Height

Layer No.	Soil Type	Top of Layer (ft)	Bottom of Layer (ft)	Δl Layer Thickness (ft)	Mid-Depth Below Grade (ft)	Δσ(2) Vertical Stress Increment (psf)	Initial Vertical Stress @ Midpoint of Layer(2) (psf)	e_o Void Ratio(1)	Cc(1) Compression Index	ΔSettlement (ft)	ΔSettlement (in)
1	fine sand and silty/clayey sand										
2(3)	sandy/silty clay	0	17	17	8.5	3420	4045	1.08	0.27	0.59	7.05
3	fine sand, clayey sand and silt	17	60	43	38.5	3420	---	---	---	---	---
										0.59	7.05

Below High End of Leachate Header Pipe

Layer No.	Soil Type	Top of Layer (ft)	Bottom of Layer (ft)	Δl Layer Thickness (ft)	Mid-Depth Below Grade (ft)	Δσ(2) Vertical Stress Increment (psf)	Initial Vertical Stress @ Midpoint of Layer(2) (psf)	e_o Void Ratio(1)	Cc(1) Compression Index	ΔSettlement (ft)	ΔSettlement (in)
1	fine sand and silty/clayey sand	0	1	1	0.5	1760	---	---	---	---	---
2(3)	sandy/silty clay	1	21	20	11.0	1760	4045	1.08	0.27	0.41	4.89
3	fine sand, clayey sand and silt	21	64	43	42.5	1760	---	---	---	---	---
										0.41	4.89

Notes: (1) The geotechnical parameter was obtained from the generalized geotechnical models for the site, i.e., Sections 1 and 2, as presented in Attachment 1.
(2) See attached calculation sheet for initial vertical stress at midpoint of layer.
(3) Layer 2 is a clay layer, therefore the calculated settlement within this layer is based on conventional one-dimensional consolidation theory.
(4) See attached calculation sheet for vertical stress increment (Δσ).
(5) The calculations are based on the following input parameters:

Unit Weight of Waste (γ_{waste}) =	70	pcf
Unit Weight of Sand (γ_{sand}) =	110	pcf
Unit Weight of Clay (γ_{clay}) =	120	pcf

Written by: JUAN QUIROZ Date: 27 / 06 / 07 (DD MM YY) Reviewed by: ______________ Date: ___/___/___ (DD MM YY)

Client: VISTA LF, LLC Project: VISTA LF - MAJOR Project/Proposal No. FL1229 Task No. ______________

NET Δσ CALCULATIONS FOR CELL 7

SEE FIG 1 FOR ELEV'S

BELOW SUMP: WASTE LOAD = σ_{WASTE} = (EL 130 - EL 56)(70 PCF) = 5,180 PSF

EXISTING PRE-LOAD = σ_{PL} = (EL 90 - EL 56)(110 PCF) = 3,740 PSF

ASSUMED TOP OF EXISTING GROUND PRIOR TO EXCAV.

$\Delta\sigma$ = 1,440 PSF

BELOW MAX. WASTE HEIGHT: σ_{WASTE} = (EL 156 - EL 60)(70 PCF) = 6,720 PSF

σ_{PL} = (EL 90 - EL 60)(110 PCF) = 3,300 PSF

$\Delta\sigma$ = 3,420 PSF

BELOW HIGH END OF LEACHATE PIPE: σ_{WASTE} = (EL 130 - EL 64)(70 PCF) = 4,620 PSF

σ_{PL} = (EL 90 - EL 64)(110 PCF) = 2,860 PSF

$\Delta\sigma$ = 1,760 PSF

Written by: JUAN QUIROZ Date: 27/06/07 (DD MM YY) Reviewed by: ____________ Date: ___/___/___ (DD MM YY)

Client: VISTA LF, LLC Project: VISTA LF-MAJOR Project/Proposal No. FL1229 Task No. ____________

INITIAL VERTICAL STRESS AT MID-POINT OF CLAY LAYER CALCULATION

SECTION 1

INITIAL VERTICAL STRESS = σ'_{VO}

TOP OF CLAY

$$\sigma'_{VO_1} = (EL\ 90 - EL\ 54)(110\ PCF) + (EL\ 54 - EL\ 50)(110\ PCF - 62.4\ PCF) +$$

ASSUMED TOP OF EXISTING GROUND PRIOR TO EXCAV.

TOP OF ASSUMED GWT

$$+ (EL\ 50 - EL\ 40)(120\ PCF - 62.4\ PCF) =$$

MIDPOINT OF CLAY

$$\underline{\underline{4{,}726.4\ psF}}$$

SECTION 2

TOP OF ASSUMED GWT

MIDPOINT OF CLAY

$$\sigma'_{VO_2} = (EL\ 90 - EL\ 63)(110\ PCF) + (EL\ 63 - EL\ 55)(120\ PCF) + (EL\ 55 - EL\ 53)(120\ PCF - 62.4\ PCF) =$$

TOP OF CLAY

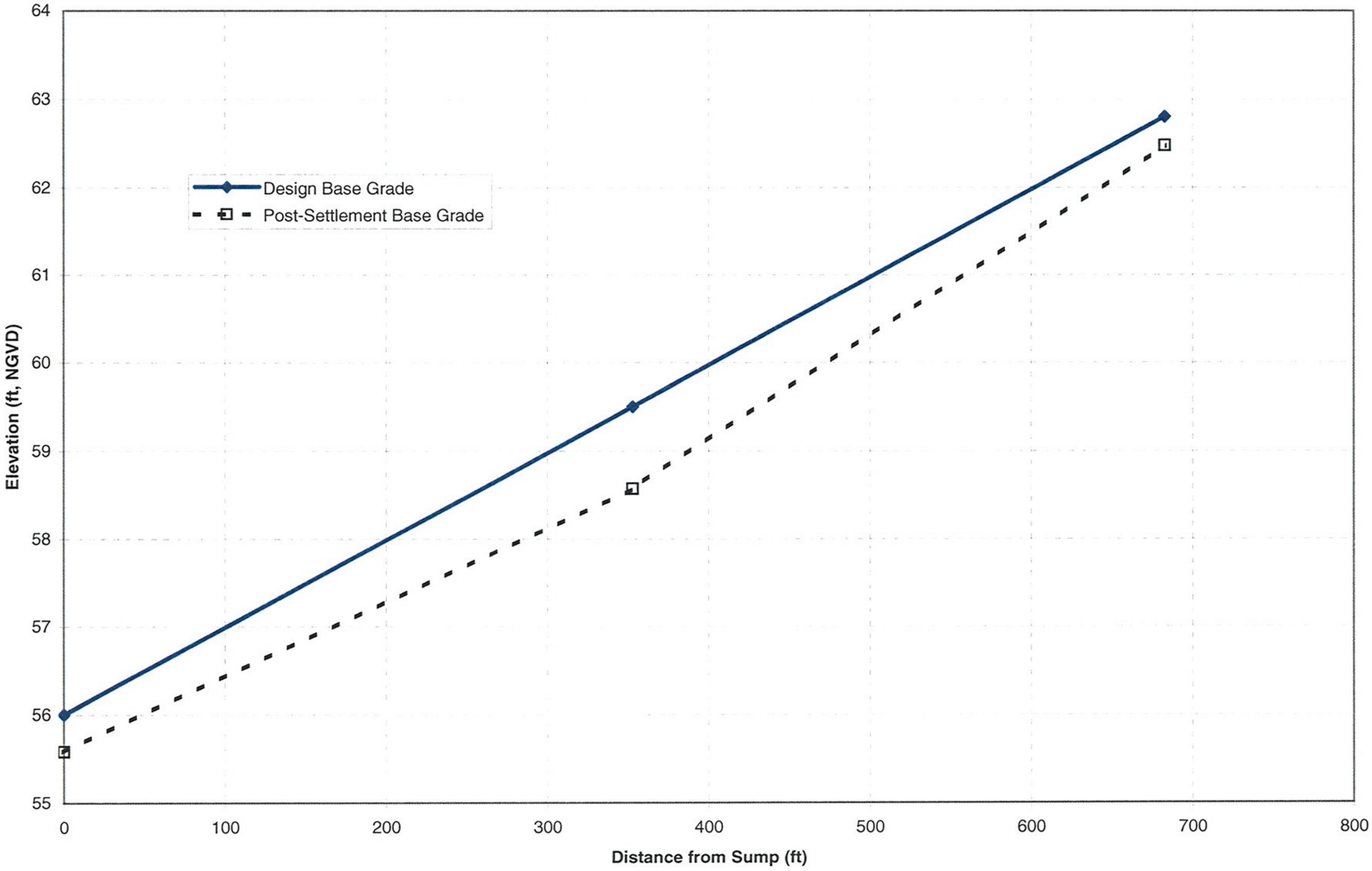
$$\underline{\underline{4{,}045.2\ psF}}$$

ATTACHMENT 3

Summary of Settlement Due to Waste Fill in Cell 2
Vista Class III Landfill - Substantial Permit Modification
Vista Landfill - Apopka, Florida

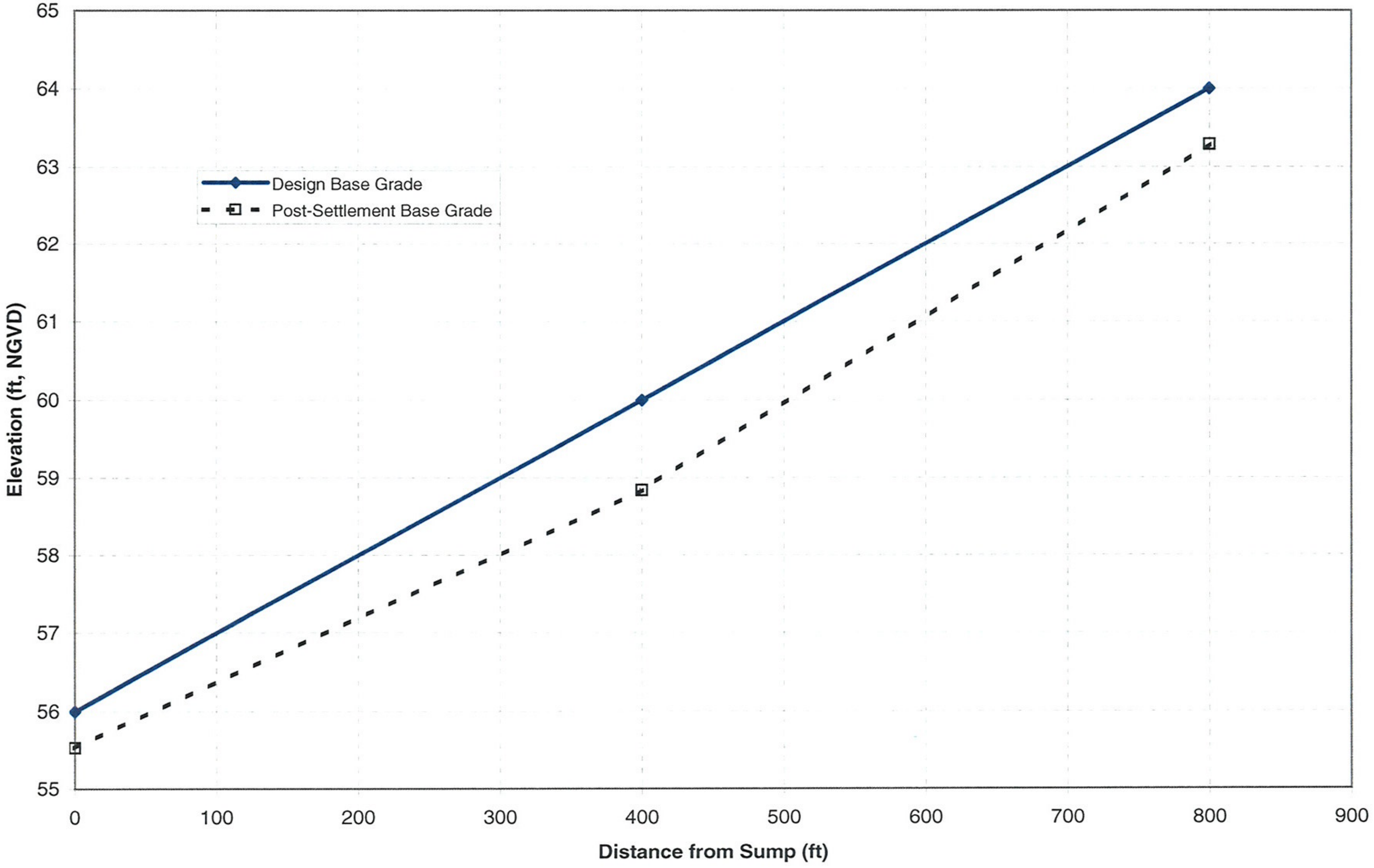
Settlement Location	Distance from Sump (ft)	Total Settlement (ft)	Total Settlement (inches)	Original Elevation (ft, NGVD)	Final Elevation (ft, NGVD)	Post-Settlement Slope (%)	Effective Slope (%)
Sump	0	0.41	4.97	56	55.6	0.85%	
Max. Waste Height	353	0.92	11.09	59.5	58.6	1.18%	1.01%
High End of Leachate Header Pipe	683	0.32	3.88	62.8	62.5		

Comparison of Design and Post-Settlement Base Grades in Cell 2



Summary of Settlement Due to Waste Fill in Cell 7
Vista Class III Landfill - Substantial Permit Modification
Vista Landfill - Apopka, Florida

Settlement Location	Distance from Sump (ft)	Total Settlement		Original Elevation (ft, NGVD)	Final Elevation (ft, NGVD)	Post-Settlement Slope (%)	Effective Slope (%)
		(ft)	(inches)				
Sump	0	0.46	5.57	56	55.5	0.83%	0.97%
Max. Waste Height	400	1.16	13.92	60	58.8	1.11%	
High End of Leachate Header Pipe	800	0.71	8.50	64	63.3		



Comparison of Design and Post-Settlement Base Grades in Cell 7

Geosyntec
consultants

COMPUTATION COVER SHEET

Client: **Vista LF, LLC** Project: **Vista Landfill – Substantial Permit Mod** Project No.: **FL1229**

Phase No.:

Title of Computations **LEACHATE COLLECTION SYSTEM ANALYSIS**

Computations by:
Signature
Date: 25 June 2007
Printed Name: Jay Eun, E.I.T.
Title: Senior Staff Engineer

Assumptions and Procedures Checked by:
(peer reviewer)
Signature
Date:
Printed Name: Ayushman Gupta, P.E.
Title: Senior Engineer

Computations Checked by:
Signature: Juan D. Quiroz
Date: 18 July 2007
Printed Name: Juan D. Quiroz, Ph.D., P.E.
Title: Project Engineer

Computations Backchecked by:
(originator)
Signature
Date: 25 July 2007
Printed Name: Jay Eun, E.I.T.
Title: Senior Staff Engineer

Approved by:
(pm or designate)
Signature: Juan D. Quiroz
Date: 27 July 2007
Printed Name: Juan D. Quiroz, Ph.D., P.E.
Title: Project Engineer

Approval notes:

Revisions (number and initial all revisions)

No.	Sheet	Date	By	Checked by	Approval

Written by: **Jay Eun** Date: **06/25/07** Reviewed by: **A. Gupta** Date: **07/10/07**

Client: **Vista LF, LLC** Project: **Vista LF – Substantial** Project No.: **FL1229** Phase No.:

LEACHATE COLLECTION SYSTEM ANALYSIS
VISTA CLASS III LANDFILL
APOPKA, FLORIDA

1. INTRODUCTION

The purpose of this calculation package is to perform engineering design and evaluate the performance of the proposed leachate collection system that will be constructed at the Vista Landfill, a Class III facility in Apopka, Florida. This calculation package is being submitted as part of a substantial permit modification application. The existing permit is being modified to permit a bottom liner system for the Vista Landfill.

The proposed leachate collection system consists of a geocomposite drainage layer (on top of a geomembrane) designed to collect the leachate that percolates vertically through the waste and convey it to a sump for removal from the cell. For each cell, the leachate collection system components include a geocomposite drainage layer, leachate collection pipes, and a leachate collection sump. Each sump will have a sump pump to remove the leachate and transfer it via a leachate transmission line to a municipal forcemain that is connected to a local wastewater treatment plant. The adequacy of the leachate management system proposed for the Vista Landfill was evaluated based on the leachate generation rates and heads on the liner estimated by the analyses presented herein.

2. VISTA LANDFILL CONFIGURATION

The layout of the leachate collection system proposed for the Vista Landfill is indicated on Sheet 6 of the Permit Drawings. Vista Landfill will consist of 12 cells (Cells 1 through 12) that will be constructed in three phases (Phases 1 through 3). Vista Landfill footprint is approximately 102 acres.

The floor of all cells are graded in a “herringbone” pattern with a leachate collection pipe (perforated HDPE collection pipe surrounded by high-permeability gravel wrapped in a geotextile) installed in the valley of the “herringbone” bottom grades along the center of each cell. The cell floor slopes at a 2 percent grade towards the leachate collection pipe, and the leachate collection pipe slopes toward the sump at 1.0 percent in each cell. This compound slope configuration yields a maximum cell floor slope (perpendicular to the bottom grade contours) of 2.0 percent and a maximum drainage path (i.e., maximum distance leachate travels to reach the collection pipe) of 315 ft.

The maximum height of waste is approximately 90 ft and corresponds to a maximum elevation of approximately 156 ft (NGVD). The design side slope and top slop of the Vista Landfill are 33 percent (3H:1V) and 4 percent (25H:1V), respectively. An average subgrade elevation of 66 ft (NGVD) was assumed in the analyses which corresponds to the approximate average subgrade elevations for Cells 1 though 12 (which ranged from 62 to 82 ft, NGVD). It is noted that this is the expected average subgrade elevation after excavation of the borrow materials. An average bottom elevation of 68 ft (NGVD) was assumed for waste considering 2 ft of protective cover on top of the bottom liner system.

3. DESCRIPTION OF RELEVANT SYSTEMS AND OPERATIONS

3.1 Bottom Liner System

The components of the bottom liner system that will be installed on a prepared subgrade include (from top to bottom):

- 24-inch thick liner protective layer;
- geocomposite drainage layer (HDPE geonet with non-woven geotextile heat-bonded on both sides); and
- 60-mil HDPE geomembrane.

Properties of the liner protective layer, manufacturing and installation defects for the geomembrane liner, and transmissivity data for the geocomposite used in the analyses are discussed in Section 4 below. The minimum hydraulic conductivity of the liner protective layer shall be $1x10^{-4}$ centimeters per second (cm/s).

3.2 Leachate Collection Pipe and Sump

The leachate collection pipe consists of a 6-inch diameter SDR 11 perforated HDPE pipe surrounded by drainage gravel wrapped in a non-woven geotextile filter fabric. The leachate collection system is located in the valley of the “herringbone” pattern base grade, typically along the centerline of each cell. The collection pipe slopes at 1.0

percent toward the sump. The sumps are located at the interior toe of the perimeter landfill side slope.

3.3 Final Cover System

The final cover system consists of the following components from top to bottom:

- 6-inch thick vegetative soil layer (erosion layer);
- 18-inch thick cap protective layer;
- geocomposite drainage layer (HDPE geonet with non-woven geotextile heat-bonded on both sides on side slopes only);
- 40-mil polyethylene (PE) geomembrane; and
- 6-inch thick intermediate soil cover.

4. HELP MODEL ANALYSES

4.1 Purpose

The Hydrogeologic Evaluation of Landfill Performance (HELP) model, Version 3.07 [Schroeder, et. al., EPA/600/R-94/168a and EPA/600/R-94/168b, 1994] was used to estimate leachate generation rates, leakage through geomembranes, and head on geomembranes for the proposed leachate collection system for the cells at the Vista Landfill. The HELP model is a quasi-two dimensional water balance computer program used to evaluate the vertical 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 configurations.

The estimated leachate generation rates and other information obtained from the HELP model were used to evaluate the performance of the proposed leachate collection systems. The leachate generation rates were also used to design the leachate transmission system and auxiliary storage system for the landfill.

Landfill Development Conditions Analyzed

To estimate leachate generation rates for different landfill development conditions, four waste configurations were analyzed assuming a unit area of 1 acre. The leachate generation rate for each configuration was conservatively evaluated using only the final top slope of 4 percent. Analysis was not performed for the final side slope of 33.3 percent as it results in lower leachate generation rates (due to relatively higher runoff) in comparison to the final top slope of 4 percent.

The leachate generation rates, leakage through the geomembranes, and the maximum head on the geomembranes were estimated for the cases described below:

- Case 1 Startup condition with 10 ft of waste;
- Case 2 Intermediate development condition with 50 ft of waste
- Case 3 Intermediate development condition with 90 ft of waste (before construction of the final cover system); and
- Case 4 Post-Closure condition (after construction of the final cover system,90 ft of waste)

Case 1

This scenario considered the initial conditions of operation in a cell after the placement of a start-up lift and additional lifts of waste for a total of 10 ft of waste. No runoff, and no surface vegetation was assumed for this case.

Case 2

This scenario considered intermediate condition with 50 ft of waste. For this case, runoff from the intermediate cover surfaces was allowed and bare ground surface without vegetation was assumed.

Case 3

This scenario considered with the maximum waste height of 90 ft before construction of the final cover. For this case, runoff from the intermediate cover surfaces was allowed and surface vegetation was assumed.

Case 4

This scenario considered post-closure condition with 90 ft of waste and the final cover installed. This case represents the lowest potential for leachate generation, leakage, and head in the primary and secondary leachate collection systems as the final cover system over the waste minimizes percolation of rainfall through the waste.

4.3 Overburden Stresses Applied to Each Case

Class III waste will be disposed at the Vista landfill. For the leachate management system analyses, an average unit weight of 70 pcf was used to estimate the overburden stresses for each case. The overburden stresses for each case due to class III waste are summarized in the table below.

Case	Waste Height (ft)	Overburden Stress (psf)
Case 1	10	700
Case 2	50	3,500
Case 3	90	6,300
Case 4	90	6,300

4.4 Geocomposite Properties

The geocomposite properties used in the calculation of heads, leachate generation rate, and leakage for the Vista Landfill are based on properties of commercially available geocomposites. It is not the objective of this section to identify specific geocomposites for use in the construction of future cells. However, it was ensured that the performance of commercially available materials meets the minimum requirements of the proposed design for the leachate collection system.

4.5 Reduction Factors

The reduction factors used to predict the long-term performance of the drainage geocomposite in the liner system are discussed in this section. The following discussion provides details of the method for 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 typically 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 $\theta_{req'd}$:

$$FS = \frac{\theta_{LTIS}}{\theta_{req'd}} \qquad \text{Equation 1}$$

where:

$$\theta_{LTIS} = \frac{\theta_{measured}}{\Pi(RF)} = \frac{\theta_{measured}}{RF_{in} * RF_{cr} * RF_{cc} * RF_{bc}} \qquad \text{Equation 2}$$

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;
$\theta_{measured}$ =	the transmissivity measured in a geosynthetics testing laboratory;
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.

Holtz et al. (1997) recommend a seating time of 100 or 300 hours for geocomposite transmissivity testing to allow a significant amount of creep to occur. The RF_{cr} and

RF_{in} for 100 or 300 hours geocomposite transmissivity tests are significantly less than the RF_{cr} and RF_{in} for tests with shorter seating time.

There are also other reduction factors including 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_{cr}	RF_{cc}	RF_{bc}
Facility cover drainage layer Low retaining wall drainage	Low	Water	1.0-1.2	1.1-1.4	1.0-1.2	1.2-1.5

Facility leachate collection layer; Facility and Leachate Pond leakage collection and detection layer	High	Leachate	1.0-1.2	1.4-2.0	1.5-2.0	1.5-2.0

The GSE Drainage Design Manual (2004) provides the following reduction factors for creep deformation (RF_{cr}) for GSE products. These reduction factors for creep deformation (RF_{cr}) were used in the analyses.

Pressure (psf)	Creep Reduction Factor (RF_{cr})
1000	1.1
5000	1.2
10000	1.3
15000	1.6

The waste height varies from about 10 feet at toe to a maximum height of approximately 90 ft. The vertical stress corresponding to these waste heights ranges from 700 psf at the toe to 6,300 psf under the maximum height of waste. Based on the reduction factors suggested by Richardson et. al. (2000) and GSE drainage design manual (2004), the reduction factors used in the analysis for the geocomposite drainage layer are summarized in the table below.

Case	Stress (psf)	RF_{in}	RF_{cr}	RF_{cc}	RF_{bc}	$\Pi(RF)$
1 (10 ft of waste)	560	1.0	1.1	1.5	1.5	2.48
2 (50 ft of waste)	3,100	1.1	1.15	1.75	1.75	4.04
3 (90 ft of waste)	6,300	1.1	1.25	1.75	1.75	4.21
4 (Long-Term Care)	6,300	1.2	1.6	2.0	2.0	7.68

4.6 Transmissivity Values Used in HELP Model Analyses

The minimum required transmissivity values ($\theta_{req'd}$) for the candidate geocomposite were evaluated such that the head on the bottom liner system is almost (but less than) 12 inches (Note: There is no regulatory requirement for maximum head on the bottom liner system for Class III landfills. The regulatory requirement for Class I landfills was used as the design criterion). The measured transmissivity values ($\theta_{measured}$) were then computed by applying the cumulative reduction factors (RF) and the assumed factor of safety (FS) of 2. It is noted that the measured transmissivity values represent transmissivity values for 100-hour seating time at 0.02 gradient (corresponding to the initial 2 percent slope of the liner system) under normal loads of approximately 600 psf to 6,500 psf (i.e., stress range applicable to Vista Landfill) and with the same boundary conditions as in the field (i.e., geocomposite drainage layer sandwiched between liner protective cover soils and a texture geomembrane). The minimum required transmissivity values ($\theta_{req'd}$) evaluated using the HELP model analyses and the corresponding measured transmissivity values ($\theta_{measured}$) are presented in Table 1.

4.7 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 for the Vista Landfill was 30 years.

4.7.1 Weather Data Description

The HELP model provides default and synthetically generated precipitation data for specific cities in the United States. Precipitation data for Orlando is not available in the HELP Model Version 3.07. However, there is an option in the HELP model that generates daily precipitation data using the mean monthly precipitation values for a specific location in the event a particular location is not included in the HELP model database. This option was used to generate daily precipitation data for Orlando using the mean monthly precipitation data for Orlando obtained from a weather database website (www.weatherbase.com). A print out for the mean monthly precipitation data for Orlando is included in Attachment 1. As shown in the Attachment 1, the average annual rainfall for Orlando for last 26 years is 50.6 inches.

4.7.2 Soil and Design Data

Subsections 4.7.2.1 through 4.7.2.4 describe the parameters considered for the input data required for the soil and design data in the cases analyzed for the Vista Landfill.

4.7.2.1 Model Plan Area

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

4.7.2.2 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	20
3	50
4	50

4.7.2.3 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.

4.7.2.4 Layer Data

Layer data was selected based on Geosyntec's experience, knowledge with local soils and site conditions, and the HELP model recommendation. The HELP model provides default parameters based on the USCS (Unified Soil Classification System) soil classification 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) a soil barrier layer designed to restrict vertical leakage or percolation through which a saturated vertical flow is allowed; and iv) geomembrane liners.

Attachment 2 shows the input properties of each layer for the four cases analyzed using the HELP model. Other information used in the HELP model analyses is presented in the following section.

4.7.3 Miscellaneous Input

4.7.3.1 Geomembrane Liner

- Pinhole density corresponds to the number of assumed defects in a given area 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 correspond to the assumed number of defects in a given area with a hole diameter larger than the geomembrane thickness. 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 program.

4.7.3.2 Liner System and Final Cover Drainage Path Lengths

The longest drainage path for the proposed leachate collection system in each cell varied from 250 ft to 315 ft, see Sheet 6 of the Permit Drawings. The HELP model analysis was performed using a 315-ft long drainage path.

4.7.3.3 Surface Soil Texture

The surface soil texture for waste was used for Cases 1, 2, and 3. Case 4 used the vegetated soil layer properties for the cover system.

4.7.3.4 Surface Vegetation

The surface vegetation of each case used the following values.

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

5. HELP Model Analyses

HELP model analyses were performed for the four cases (Cases 1 through 4) to evaluate the minimum required transmissivity values ($\theta_{req'd}$). The minimum required transmissivity ($\theta_{req'd}$) was iteratively evaluated for each case such that the head on the geomembrane liner was almost (but less than) 12 inches in compliance with the established design criterion. The minimum required transmissivity ($\theta_{req'd}$) evaluated using the HELP model analyses was then used to compute the measured transmissivity values ($\theta_{measured}$) using the cumulative reduction factors (RF) and the assumed factor of safety (FS) of 2. A final check was made to ensure that the computed measured transmissivity values ($\theta_{measured}$) are within the range of the transmissivity values for the commercially available geocomposites when tested under the conditions discussed above.

The head on the bottom liner system were computed using a method presented by Giroud, et. al. (2004). Giroud, et. al. (2004) developed a method 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 rate of liquid supply, the hydraulic conductivities of the two layers, the length of the drainage path, and the slope. The rate of liquid supply, q_h, (used in Giroud's method) was obtained from the HELP model analyses performed for each case. The peak monthly average lateral drainage in the geocomposite drainage layer (obtained from the HELP analysis for each case) was used as rate of liquid supply (q_h).

The head on the geomembrane liner computed by the HELP model was not used because the HELP model uses McEnroe's equation. 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). Further, McEnroe's equations are mathematically sensitive under certain ranges of drainage layer slope and hydraulic conductivity and may produce incorrect results. Giroud, et. al. (2004) presented an alternative solution (based on simplified assumptions and numerical methods) that was used to compute heads on the geomembrane liner.

The results of the HELP model analyses are summarized in Table 1. A summary of the input data used in the HELP model analysis is presented in Attachment 2 of this calculation package. Output files from the HELP model for each case are included in Attachment 3. The parameters used to compute the heads using Giroud's method are presented in the spreadsheets included in Attachment 4 of this calculation package.

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6. HELP Model Results

Table 1 presents a summary of the lateral drainage and head for each case for the proposed leachate collection system for the Vista Landfill. The properties of the geocomposite drainage layer used in analyses are also presented in Table 1. The performance evaluation for the leachate collection system assumed an initial minimum liner system slope of 2 percent (Case 1); a slope of 1.8 percent for the intermediate stage of construction with 50 ft of waste (Case 2); and a minimum liner system slope of 1.65 percent for the intermediate stage with 90 ft of waste (Case 3) and the post-closure stage (Case 4), as noted in the Table 1.

7. LEACHATE STORAGE CAPACITY

Each leachate collection sump will have a sump pump to remove the leachate and transfer it (via leachate transmission pipeline) to a forcemain that is connected to a local wastewater treatment plant. A leachate storage container will be constructed and used as back-up (auxiliary) storage when leachate transmission pipe line needs repairs or in any other emergency situation. The design storage capacity for the proposed leachate storage container at the Vista Landfill was selected to provide storage for leachate generated for a period of 7 days at the peak monthly average leachate generation rate.

A peak monthly average leachate generation rate of approximately 66,000 gallons per month per acre (= 2,200 gal/day/ac) was obtained from the HELP model analysis (for 10 ft of waste or Case 1). The area of largest cell that will be developed at Vista Landfill is approximately 10 acres. Therefore, the leachate generated in 7 days at the peak monthly average leachate generation rate for a 10-acre cell is approximately 154,000 gallons.

The leachate storage containers for the Vista Landfill were designed with a storage capacity of 160,000 gallons in order to meet the established design criterion.

8. LEACHATE COLLECTION SYSTEM PIPE DESIGN

This section evaluates the performance of the proposed leachate collection system for the Vista Landfill. The performance requirements of the leachate collection system include the peak leachate flow, pipe perforation sizing, and structural stability of the pipe used in the cells and sumps.

8.1 Peak Leachate Flow

The leachate collection pipes proposed for the cells and sumps are 6-inch diameter perforated HDPE, with a standard dimension ratio (SDR) of 11. The maximum leachate amount (peak leachate flow) that could flow into a leachate collection pipe and sump was obtained from the peak daily leachate generation rate of 4,256 gallons per day per acre (gal/day/ac) corresponding to 10 ft of waste (HELP model, Case 1). Therefore, the peak leachate flow for any cell would be 4,256 gal/day/ac times the area of the largest cell (approximately 10 acres) which corresponds to 30 gallons per minute (gpm).

8.2 Pipe Flow Capacity

The pipe flow capacity is calculated using Manning's equation as follows:

$$Q_p = \frac{1.486 R_h^{0.66} i_p^{0.5} A_p}{n} \qquad \text{Equation 1}$$

where:

Q_p= pipe flow capacity, cfs;

R_h= $B_i/4$, hydraulic radius where B_i= pipe inner diameter;

i_p= hydraulic gradient (i.e., slope of the pipe);

A_p= cross-sectional area of the pipe, ft^2; and

n= Manning's roughness coefficient (0.011).

For a circular pipe flowing full, Manning's equation assumes steady uniform turbulent conditions.

8.2.1 Leachate Collection Pipes

The flow capacities for a 6-inch diameter HDPE pipe (SDR 11) were obtained for various slopes and the following input data:

B_i	5.349 in
R_h	1.34 in
i_p	1.0% to 0.5%
A_p	22.47 in^2
n	0.011

Equation 1 yields the following flow capacities:

Pipe Slope %	Flow gpm
1.0	222
0.75	193
0.5	157

It is noted that the leachate collection pipe has initial slopes of 1.0 percent with an assumed minimum slope after settlement of 0.5 percent. As presented above, the flow capacity at an assumed minimum slope of 0.5 percent is approximately five times larger than the maximum expected flow in a cell (i.e., 30 gallons per minute).

8.3 Pipe Perforation Sizing

The maximum allowable perforation diameter in the leachate collection pipes and leachate sump pipes that will prevent gravel from passing through may be determined as follows (USEPA, 1983):

$$d_{h\max} = \frac{d_{85}}{F} \qquad \text{Equation 2}$$

where:

d_{hmax}= maximum perforation diameter to provide particle retention (inches);

d_{85}= particle size of the pipe bedding material for which 85 percent by weight of the particles are finer (inches); and

F= factor varying from 1.2 to 2.0.

The Vista Landfill will use No. 57 stone for the leachate collection pipes and No. 4 stone for the leachate sump pipes. The pipe perforation sizing proposed is 1/2 inch for the leachate collection pipes and 5/8 inch for the leachate sump pipes. Assuming a factor, F, of 1.5 and using the particle size of the pipe bedding material for 85 percent of finer particles (ASTM D 448, Attachment 3) results in the following:

Pipes in cells	Pipes in sumps
Stone No. 57	Stone No. 4
F= 1.5	F= 1.5
d_{85}= 3/4 in	d_{85}= 1 in
d_{hmax}= 1/2 in (= 1/2 in)	d_{hmax}=2/3 in (> 5/8 in)

8.4 Pipe Structural Stability

Calculations are performed to evaluate the ability of the pipes in cells to withstand the applied load. The potential failure mechanisms that are checked in these analyses are: (i) wall crushing; (ii) wall buckling; (iii) excessive ring deflection; and (iv) excessive bending strain. Stresses applied on the pipes are considered for two conditions: (i) initial condition and (ii) the post-closure condition.

8.4.1 Calculation of Applied Stresses

Initial Condition

The initial condition considers the pipes with 2 ft of cover material and the stresses due to traffic applied by a 35 ton truck with a wheel load of 20,000 lb. Therefore, the total stress on the pipe can be calculated as described by ASCE (1979) as follows:

$$\sigma_{ic} = \gamma_p D_p + C_s \frac{PF_{ic}}{L_{ic} D_{od}} \qquad \text{Equation 3}$$

where:

γ_p= average unit weight of the overburden materials, pcf;

D_p= thickness of the overburden materials (assumed 1 ft for critical conditions);

D_{od}= pipe outer diameter, ft;

C_s= load coefficient from Attachment 5 (Chevron, 1994);

P= concentrated load, lb;

F_{ic}= impact factor accounting for dynamic loads (Chevron, 1994);

L_{ic}= effective length of pipe equal to 3 if the pipe is longer than 3 ft or equal to the actual pipe length if the pipe is shorter than 3 ft (ASCE, 1979); and

σ_{ic}= stress on the pipe, psf.

The table below shows a summary of the parameters used and the applied stresses calculated for the initial condition for a 6 inch pipe:

Data	6 inch Pipe
γ_p	120 pcf
D_p	1 ft
D_{od}	6.625
Cs	0.324
P	20,000 lb
F_{ic}	2
L_{ic}	3
σ_{ic}	7,945 psf (55 psi)

Post-Closure Condition

During the post-closure condition, the stress applied to the pipes in cells and sumps is due to the overburden materials above the pipe. The stress is calculated with Equation 4.

$$\sigma_p = \gamma_p D_p$$

Equation 4

For the leachate collection pipes, overburden depth was assumed to be approximately 90 ft of waste with a density of 70 pcf plus approximately 3 ft of soil cover with a density of 120 pcf.

For the leachate sump pipes the overburden was assumed to be approximately 20 ft of general fill (same as the height of berm) with an assumed density of 120 pcf. The following table summarizes the parameters used and the applied stresses calculated for the post-closure condition:

Data	6 inch Pipe

γ_p	70 pcf (waste), 120 pcf (cover soil)
D_p	90 ft of waste and 3 ft of cover soil
σ_p	6,700 psf = 46 psi

Additional calculation was performed to account for loads on perforated pipe. There is no standard procedure for estimating the effect of loads on perforated pipes. A conservative method is suggested by the Washington State Department of Ecology (1987) as described in Sharma and Lewis (1994). This method increases the load in proportion to the reduction effective length of the pipe using the following equation:

$$DesignLoad = AcualLoad \times \frac{L}{(L - L_P)} \qquad \text{Equation 5}$$

Where L is the unit length of the pipe and L_p is the cumulative length of perforations per unit length of pipe. The parameters used and the results calculated by Equation 5 for initial and post closure conditions are:

Data	6 inch Pipe
L	12 in (1 ft)
L_p	2 in
$L/(L - L_p)$	1.2
σ_p (initial)	66 psi
σ_p (post closure)	55 psi

From the above calculations, the critical stress used to check the leachate collection pipe structural stability was 66 psi.

8.4.2 Wall Crushing

Wall crushing occurs when the stress in the pipe wall due to external pressures exceeds the compressive strength of the pipe material. The maximum applied stress which may be withstood by the pipe can be calculated by Equation 6:

$$\sigma_{crush} = \frac{2\sigma_y}{(SDR - 1)} \qquad \text{Equation 6}$$

Where σ_y is the compressive strength of the pipe material, based on PE 3408 pipe. σ_{crush} is the maximum applied stress that can be withstood by the pipe. The parameters used and the results calculated by Equation 6 are:

Data	6 inch Pipe
σ_y	1500 psi
SDR	11
σ_{crush}	300 psi > 66 psi

Based on these calculations, the compressive strength of the 6 inch pipe is greater than the applied stresses calculated in Section 8.4.1.

8.4.3 Wall Buckling

Wall buckling occurs when the external vertical pressure exceeds the critical buckling pressure of the pipe/bedding aggregate system. The maximum applied stress that may be withstood by the pipe can be calculated by Equation 7:

$$\sigma_{buckle} = 1.2\left[\frac{E'E}{SDR^3}\right]^{1/2} \qquad \text{Equation 7}$$

Where E is the modulus of elasticity of the pipe material, E' is the modulus of soil reaction for the pipe bedding material, SDR is the standard dimension ratio of the pipe, and σ_{buckle} is the maximum applied stress that can be withstood by the pipe.

Since HDPE exhibits a tensile creep characteristic, the value of E is dependent upon the applied tensile stress and the time of application as shown in Attachment 5 (Phillips, 1991). Using the overburden stress, the tensile stress intensity can be estimated using the following equation:

$$S_A = \frac{(SDR-1)\sigma_{vo}}{2} \qquad \text{Equation 8}$$

Where SDR is the pipe standard dimension ratio, σ_{vo} is the maximum stress due to overburden, and S_A is the estimated tensile stress.

The modulus of soil reaction (E') is calculated using Young's modulus (E_s), Poisson's ratio (ν) and an empirical factor (k) with may vary from 0.7 to 2.3. The Young's modulus and Poisson ratio were taken from data presented by Selig (1990) for soils at various overburden stress levels. Equations 9 and 10 were used to obtain the modulus of soil reaction:

$$M_s = \frac{E_s(1-\nu)}{(1+\nu)(1-2\nu)} \qquad \text{Equation 9}$$

$$E' = k * M_s \qquad \text{Equation 10}$$

where:

M_s= constrained modulus, psi;

E_s= Young's modulus, psi;

ν = Poisson's ratio;

E’= Modulus of soil reaction, psi; and

k= Empirical factor

The following table presents the parameters used and the results calculated by the above Equations:

Data	6 inch Pipe
SDR	11
σ_{vo}	66 psi
S_A	330 psi
E	24,000 psi
Es	2,800 psi
ν	0.35
Ms	4,494 psi
k	1.5
E’	6741 psi
σ_{buckle}	425 psi > 66 psi

Based on these results, the 6 inch pipe is capable of resisting the maximum applied stresses.

8.4.4 Ring Deflection

Excessive ring deflection is a horizontal over-deflection of the pipe causing a reversal of curvature in the pipe wall. This can occur if large external vertical pressures are applied to the pipe/bedding system. Excessive ring deflection can also lead to a substantial loss in flow capacity. Ring deflection is calculated using the Modified Iowa Equation:

$$\Delta X = \frac{D_L K W_c}{\frac{EI}{r^3} + \left(0.061E'\right)}$$

Equation 11

Where:

D_L=	deflection lag factor which varies from 1 to 1.5 (Koerner, 1998);
K=	bedding constant with values from 0.083 to 0.11 (Wilson-Fahmy and Koerner, 1994, Attachment 5);
W_c=	Martson prism load per unit length (overburden stress times the pipe outside diameter);
E=	modulus of elasticity of the pipe material;
E'=	modulus of soil reaction for the bedding material;
I=	moment of inertia of the pipe wall;
r=	mean radius of the pipe $((D_{od}-t)/2)$; and
ΔX=	horizontal deflection. The ring deflection is calculated from the horizontal deflection divided by the pipe outside diameter.

The allowable ring deflection for HDPE pipe is 3.0 percent (Koerner, 1998). The table below shows the parameters used and the results obtained by for this calculation.

Data	6 inch Pipe
D_L	1.25
K	0.11
W_c	437 lb/in
E	24,000 psi
I	0.018 in^3
r	3.01 in
E'	6741 psi
ΔX	0.14
Ring Deflection	2.1% < 3.0%

Based on these calculations the calculated ring deflection for the 6-inch pipe under maximum stress is below the 3 percent limit recommended by Koerner (1998).

8.4.5 Bending Strain

When a pipe deflects under load, bending strains are induced in the pipe wall. Bending strain occurs in the pipe wall as external pressures are applied to the pipe/bedding aggregate system. Bending strain is calculated using the following equation (Mosher, 1990):

$$\varepsilon_b = f_d \frac{t\Delta_y}{D^2}$$

Equation 12

where:

ε_b= bending strain, percent;
f_d= deformation shape factor (Chevron, 1994);
t= minimum wall thickness, in;
Δ_y= vertical deflection, in; and
D= inside pipe diameter, in.

The following are recommendations for allowable bending strain from the literature and manufacturers:

- An allowable bending strain of 5 percent is recommended in Wilson-Fahmy and Koerner (1994) based on ASHTO guidelines for long-term use of smooth polyethylene pipes.

- An allowable bending strain of 4.2 percent is recommended as conservative in Chevron (1994). It is noted that strains up to 8 percent are reported in literature as acceptable for a design period of 50 years.

The following table presents the parameters used and the results of the bending strain calculations:

Data	6 inch Pipe
f_d	6

t	0.602 in
Δ_y	0.14
D	5.349 in
ε_b	1.8 % < 4.2 %

Based on these parameters, the calculated strains are less than published allowable values.

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TABLES

TABLE 1

HEADS ON GEOMEMBRANE LINER
COMPUTED USING GIROUD'S METHOD
VISTA CLASS III LANDFILL
APOPKA, FLORIDA

					Primary Geocomposite Drainage Layer					HELP Model Results		Heads Computed using Giroud's Method		
Case Developed	Waste Height (ft)	Vertical Stress (psf)	Drainage Length (ft)	Liner System Slope (%)	$\theta_{measured}$ [1] (m^2/sec)	RF*FS	$\theta_{req'd}$ [2] (m^2/sec)	Geonet Thickness (in)	Permeability k (cm/s)	Lateral Drainage (Peak Daily) (gal/ac/day)	Lateral Drainage (Peak Monthly Avg.) (gal/ac/mon)	Impingement Rate [3] (Peak Monthly Avg.) (in/ac/month)	(ft^3/ac/day)	Head on Geomembrane Liner [4] (in)
Case 1	10	700	315	2.0	5.10E-04	4.95	1.03E-04	0.250	1.62	4,256	60,686	2.24	270	10.2
Case 2	50	3,500	315	1.8	6.23E-04	8.09	7.70E-05	0.250	1.21	2,708	41,000	1.51	183	11.3
Case 3	90	6,300	315	1.65	7.07E-04	8.42	8.40E-05	0.250	1.32	2,670	41,000	1.51	183	11.4
Case 4	90	6,300	315	1.65	9.00E-04	15.36	5.86E-05	0.250	0.92	0.0	0.0	0.0	0.0	0.0

NoteS:

[1] Measured transmissivity during laboratory testing

[2] Transmissivity used in HELP model analysis

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

[4] Anlaysis performed iteratively by changing the geocomposite transmissivity to obtain a maximum head of almost (but less than) 12 inches on the geomembrane liner.

Attachment 1

MEAN MONTHLY PRECIPITATION DATA FOR ORLANDO

weatherbase SEARCH • VACATION FINDER • REFERENCE • GLOSSARY • ABOUT

Summary All Data °F °C

Orlando, Florida

Elevation: 118 feet Latitude: 28 33N Longitude: 081 20W

Average Temperature

Years on Record: 26

	YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
°F	73	61	62	67	72	78	81	83	83	81	75	67	62

Average High Temperature

Years on Record: 26

	YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
°F	83	72	73	77	83	88	91	92	92	89	84	77	73

Average Low Temperature

Years on Record: 26

	YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
°F	62	50	51	55	61	67	71	73	73	72	66	56	51

Highest Recorded Temperature

Years on Record: 26

	YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
°F	100	87	90	92	96	100	100	100	99	97	95	89	90

Lowest Recorded Temperature

Years on Record: 26

	YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
°F	20	24	28	31	40	52	60	67	64	56	43	29	20

Average Precipitation

Years on Record: 26

	YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
in.	50.6	2.1	3.1	3.5	2.6	3	6.5	8.1	7.2	6.8	3.9	1.7	2.1

Average Number of Clear Days

Years on Record: 45

	YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Days	90	9	8	9	10	9	4	3	3	4	10	10	10

Average Number of Cloudy Days

Years on Record: 45

	YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Days	128	12	11	12	9	9	12	11	11	11	10	10	12

Average Number of Partly Cloudy Days

Years on Record: 45

	YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.

Attachment 2

SUMMARY OF HELP MODEL INPUT DATA

CASE 1
SUMMARY OF INPUT DATA
10 FT OF WASTE WITH 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	Orlando
State	Florida
Years for data generation	30

C. Temperature

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

Normal mean monthly temperature (°F)

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	480	ft
Surface Slope	4	%
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	Lateral drainage	24	10	0.398	0.244	0.136	0.0001		
6	2	Lateral drainage	0.250		0.850	0.010	0.005	1.62	315	2.0
7	4	Geomembrane liner	0.060	35				2E-13		
9	1	Vertical percolation	24	10	0.398	0.244	0.136	0.0001		

CASE 2
SUMMARY OF INPUT DATA
50 FT OF WASTE WITH 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	Orlando
State	Florida
Years for data generation	30

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		20	%
Surface Length		360	ft
Surface Slope		4	%
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	600	18	0.671	0.292	0.077	0.001		
2	1	Lateral drainage	24	10	0.398	0.244	0.136	0.0001		
6	2	Lateral drainage	0.250		0.850	0.010	0.005	1.21	315	1.80
7	4	Geomembrane liner	0.060	35				2E-13		
9	1	Vertical percolation	24	10	0.398	0.244	0.136	0.0001		

CASE 3
SUMMARY OF INPUT DATA
90 FT OF WASTE WITH 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	Orlando
State	Florida
Years for data generation	30

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		240	ft
Surface Slope		4	%
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	1080	18	0.671	0.292	0.077	0.001		
2	1	Lateral drainage	24	10	0.398	0.244	0.136	0.0001		
6	2	Lateral drainage	0.250		0.850	0.010	0.005	1.32	315	1.65
7	4	Geomembrane liner	0.060	35				2E-13		
9	1	Vertical percolation	24	10	0.398	0.244	0.136	0.0001		

CASE 4
SUMMARY OF INPUT DATA
90 FT OF WASTE WITH FINAL COVER SYSTEM

WEATHER DATA AND SOIL LAYERS PROPERTIES

A. Evapotranspiration data

Data	Value	Units
Nearby city	Orlando	
State	Florida	
Latitude	27.8	
Evaporative zone depth	22	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	Orlando
State	Florida
Years for data generation	30

C. Temperature

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

Normal mean monthly temperature (°F)

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	240	ft
Surface Slope	4	%
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	6	10	0.398	0.244	0.136	0.00012		
2	1	Vertical percolation	18		0.398	0.244	0.136	0.0001		
3	2	Lateral drainage	0.250		0.85	0.01	0.005	2.15	150	33.3
4	4	Geomembrane liner	0.040	35				2E-13		
5	1	Vertical percolation	12		0.398	0.244	0.136	0.001		
6	1	Vertical percolation	1080	18	0.671	0.292	0.077	0.001		
7	1	Lateral drainage	24		0.398	0.244	0.136	0.0001		
8	2	Lateral drainage	0.250		0.850	0.010	0.005	0.92	315	1.65
9	4	Geomembrane liner	0.060	35				2E-13		
10	1	Vertical percolation	24	10	0.398	0.244	0.136	0.0001		

Attachment 3

HELP MODEL OUTPUT FILES

CASE 1

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              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:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\VISTA.D4
TEMPERATURE DATA FILE:       C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\CASE1.D7
SOLAR RADIATION DATA FILE:   C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\CASE1.D13
EVAPOTRANSPIRATION DATA:     C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\CASE1.D11
SOIL AND DESIGN DATA FILE:   C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\CASE1RB.D10
OUTPUT DATA FILE:            C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\CASE1RB.OUT


TIME:  14: 0     DATE:   6/29/2007


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

     TITLE:  Oak Hammock Disposal 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  =      0.2918 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC
```

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

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                   =     24.00   INCHES
POROSITY                    =      0.3980 VOL/VOL
FIELD CAPACITY              =      0.2440 VOL/VOL
WILTING POINT               =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.2492 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-04 CM/SEC


                        LAYER  3
                        --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                   =      0.25   INCHES
POROSITY                    =      0.8500 VOL/VOL
FIELD CAPACITY              =      0.0100 VOL/VOL
WILTING POINT               =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0454 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =   1.62000000000     CM/SEC
SLOPE                       =      2.00   PERCENT
DRAINAGE LENGTH             =    315.0    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 1 - VERTICAL PERCOLATION LAYER
```

```
                MATERIAL TEXTURE NUMBER   0
  THICKNESS                    =      24.00    INCHES
  POROSITY                     =       0.3980 VOL/VOL
  FIELD CAPACITY               =       0.2440 VOL/VOL
  WILTING POINT                =       0.1360 VOL/VOL
  INITIAL SOIL WATER CONTENT   =       0.2438 VOL/VOL
  EFFECTIVE SAT. HYD. COND.    =   0.999999975000E-04 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  4.% AND
         A SLOPE LENGTH OF  480. FEET.

SCS RUNOFF CURVE NUMBER             =     79.70
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   =      2.158  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    =     46.860  INCHES
TOTAL INITIAL WATER                 =     46.860  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 WAS SYNTHETICALLY GENERATED USING
         COEFFICIENTS FOR    TAMPA                 FLORIDA
```

```
                 NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

      JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
      -------     -------     -------     -------     -------     -------
        2.10        3.10        3.50        2.60        3.00        6.50
        8.10        7.20        6.80        3.90        1.70        2.10


          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    1 THROUGH   30
------------------------------------------------------------------------------

                         JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                         -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                 2.04     2.84     2.82     2.30     2.52     6.14
                           8.04     6.97     6.59     5.05     1.71     2.08

    STD. DEVIATIONS        1.28     1.69     1.83     1.80     1.68     3.45
                           3.56     2.28     2.82     2.76     1.12     1.10

  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                 1.952    2.130    2.490    2.176    2.186    4.056
                           5.115    5.280    4.337    3.663    1.950    1.751
```

```
  STD. DEVIATIONS          0.866    0.827    0.851    1.154    1.361    1.421
                           1.387    0.977    1.064    0.764    0.872    0.851

 LATERAL DRAINAGE COLLECTED FROM LAYER  3
 ----------------------------------------
  TOTALS                   0.3031   0.1833   0.4605   0.4821   0.3768   0.3124
                           1.4923   2.1170   1.6988   2.2352   1.7185   0.5988

  STD. DEVIATIONS          0.3771   0.1815   0.5201   0.6261   0.4609   0.3775
                           1.4335   1.4159   1.3407   1.3612   1.2600   0.6891

 PERCOLATION/LEAKAGE THROUGH LAYER  4
 ------------------------------------
  TOTALS                   0.0003   0.0002   0.0005   0.0010   0.0007   0.0006
                           0.0084   0.0141   0.0106   0.0191   0.0121   0.0021

  STD. DEVIATIONS          0.0003   0.0002   0.0005   0.0026   0.0022   0.0013
                           0.0173   0.0276   0.0224   0.0314   0.0258   0.0082

 PERCOLATION/LEAKAGE THROUGH LAYER  5
 ------------------------------------
  TOTALS                   0.0016   0.0001   0.0005   0.0012   0.0010   0.0009
                           0.0100   0.0145   0.0111   0.0183   0.0083   0.0025

  STD. DEVIATIONS          0.0066   0.0004   0.0006   0.0038   0.0034   0.0019
                           0.0173   0.0216   0.0177   0.0217   0.0140   0.0109


-------------------------------------------------------------------------------
               AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


 DAILY AVERAGE HEAD ON TOP OF LAYER  4
 -------------------------------------
  AVERAGES                 0.0168   0.0112   0.0283   0.1201   0.0817   0.0696
                           1.4393   2.5234   1.9366   3.5226   2.2484   0.3194

  STD. DEVIATIONS          0.0209   0.0111   0.0349   0.4438   0.3538   0.2238
                           3.3024   5.5124   4.6082   6.3490   5.3233   1.5569

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


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

   AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH   30
-------------------------------------------------------------------------------
                                      INCHES            CU. FEET      PERCENT
                              -------------------    -------------   ---------
 PRECIPITATION                  49.08     (   7.630)    178170.1      100.00

 RUNOFF                          0.000    (  0.0000)         0.00       0.000

 EVAPOTRANSPIRATION             37.086    (  4.3016)    134621.16      75.558
```

```
 LATERAL DRAINAGE COLLECTED    11.97868 (  4.06377)    43482.605  24.40511
   FROM LAYER  3

 PERCOLATION/LEAKAGE THROUGH    0.06959 (  0.08086)      252.630    0.14179
   LAYER  4

 AVERAGE HEAD ON TOP            1.026 (    1.358)
   OF LAYER  4

 PERCOLATION/LEAKAGE THROUGH    0.07013 (  0.06803)      254.559    0.14287
   LAYER  5

 CHANGE IN WATER STORAGE       -0.052    (  1.0397)     -188.26    -0.106

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

               PEAK DAILY VALUES FOR YEARS    1 THROUGH   30
   ------------------------------------------------------------------------
                                                  (INCHES)      (CU. FT.)
                                                 ----------    -------------
     PRECIPITATION                                  4.85         17605.500

     RUNOFF                                         0.000            0.0000

     DRAINAGE COLLECTED FROM LAYER  3               0.15674        568.96307

     PERCOLATION/LEAKAGE THROUGH LAYER  4           0.004478        16.25632

     AVERAGE HEAD ON TOP OF LAYER  4               28.452

     MAXIMUM HEAD ON TOP OF LAYER  4               34.875

     LOCATION OF MAXIMUM HEAD IN LAYER  3
           (DISTANCE FROM DRAIN)                  132.5 FEET

     PERCOLATION/LEAKAGE THROUGH LAYER  5           0.006729        24.42485

     SNOW WATER                                     0.00             0.0000


     MAXIMUM VEG. SOIL WATER (VOL/VOL)                       0.6235

     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   30
    ----------------------------------------------------------------------
                    LAYER        (INCHES)       (VOL/VOL)
                    -----        --------       ---------
                      1          33.3788          0.2782

                      2           6.0733          0.2531

                      3           0.0179          0.0716

                      4           0.0000          0.0000

                      5           5.8344          0.2431

                  SNOW WATER      0.000

******************************************************************************
******************************************************************************
```

CASE 2

```
******************************************************************************
 ******************************************************************************
 **                                                                          **
 **                                                                          **
 **              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:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\VISTA.D4
 TEMPERATURE DATA FILE:       C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\CASE2.D7
 SOLAR RADIATION DATA FILE:   C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\CASE2.D13
 EVAPOTRANSPIRATION DATA:     C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\CASE2.D11
 SOIL AND DESIGN DATA FILE:   C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\CASE2RC.D10
 OUTPUT DATA FILE:            C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\CASE2RC.OUT


 TIME:  15: 0     DATE:   6/29/2007


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

      TITLE:  Oak Hammock Disposal 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                  =    600.00   INCHES
            POROSITY                   =      0.6710 VOL/VOL
            FIELD CAPACITY             =      0.2920 VOL/VOL
            WILTING POINT              =      0.0770 VOL/VOL
            INITIAL SOIL WATER CONTENT =      0.2914 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                       =      0.3980 VOL/VOL
FIELD CAPACITY                 =      0.2440 VOL/VOL
WILTING POINT                  =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT     =      0.2476 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =  0.999999975000E-04 CM/SEC



                            LAYER  3
                            --------

                TYPE 2 - LATERAL DRAINAGE LAYER
                 MATERIAL TEXTURE NUMBER   0
THICKNESS                      =      0.25   INCHES
POROSITY                       =      0.8500 VOL/VOL
FIELD CAPACITY                 =      0.0100 VOL/VOL
WILTING POINT                  =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT     =      0.0610 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =   1.21000004000     CM/SEC
SLOPE                          =      1.80   PERCENT
DRAINAGE LENGTH                =    315.0    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 1 - VERTICAL PERCOLATION LAYER
                 MATERIAL TEXTURE NUMBER   0
   THICKNESS                 =     24.00   INCHES
   POROSITY                  =      0.3980 VOL/VOL
   FIELD CAPACITY            =      0.2440 VOL/VOL
   WILTING POINT             =      0.1360 VOL/VOL
   INITIAL SOIL WATER CONTENT  =      0.2422 VOL/VOL
   EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-04 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  4.% AND
           A SLOPE LENGTH OF  360. FEET.

 SCS RUNOFF CURVE NUMBER              =     80.00
 FRACTION OF AREA ALLOWING RUNOFF     =     20.0     PERCENT
 AREA PROJECTED ON HORIZONTAL PLANE   =      1.000   ACRES
 EVAPORATIVE ZONE DEPTH               =     12.0     INCHES
 INITIAL WATER IN EVAPORATIVE ZONE    =      2.747   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     =    186.638   INCHES
 TOTAL INITIAL WATER                  =    186.638   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 WAS SYNTHETICALLY GENERATED USING
```

```
                    COEFFICIENTS FOR    TAMPA              FLORIDA

                    NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

           JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
           -------     -------     -------     -------     -------     -------
             2.10        3.10        3.50        2.60        3.00        6.50
             8.10        7.20        6.80        3.90        1.70        2.10


           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    1 THROUGH   30
-------------------------------------------------------------------------------

                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                  2.04     2.84     2.82     2.30     2.52     6.14
                            8.04     6.97     6.59     5.05     1.71     2.08

    STD. DEVIATIONS         1.28     1.69     1.83     1.80     1.68     3.45
                            3.56     2.28     2.82     2.76     1.12     1.10

  RUNOFF
  ------
    TOTALS                 0.004    0.006    0.010    0.010    0.009    0.053
                           0.042    0.017    0.042    0.033    0.004    0.000

    STD. DEVIATIONS        0.010    0.014    0.021    0.028    0.023    0.085
                           0.057    0.027    0.071    0.076    0.018    0.002

  EVAPOTRANSPIRATION
  ------------------
```

```
    TOTALS                        1.921     2.420     2.864     2.449     2.360     4.561
                                  5.651     5.682     4.675     3.993     2.132     1.731

    STD. DEVIATIONS               0.772     0.811     1.066     1.353     1.469     1.615
                                  1.515     0.943     1.042     0.678     0.936     0.774

  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  ----------------------------------------
    TOTALS                        0.4897    0.2288    0.2859    0.2579    0.2669    0.1110
                                  0.5704    1.1248    1.1194    1.4068    1.5089    1.0419

    STD. DEVIATIONS               0.7437    0.3780    0.3663    0.3481    0.5543    0.2022
                                  0.6577    0.8157    1.0042    0.9447    1.0318    1.0588

  PERCOLATION/LEAKAGE THROUGH LAYER  4
  ------------------------------------
    TOTALS                        0.0027    0.0007    0.0006    0.0006    0.0012    0.0002
                                  0.0021    0.0056    0.0077    0.0118    0.0137    0.0097

    STD. DEVIATIONS               0.0084    0.0017    0.0012    0.0012    0.0042    0.0003
                                  0.0036    0.0075    0.0130    0.0170    0.0164    0.0171

  PERCOLATION/LEAKAGE THROUGH LAYER  5
  ------------------------------------
    TOTALS                        0.0028    0.0009    0.0008    0.0007    0.0016    0.0002
                                  0.0026    0.0075    0.0093    0.0125    0.0151    0.0096

    STD. DEVIATIONS               0.0082    0.0022    0.0017    0.0016    0.0064    0.0004
                                  0.0046    0.0100    0.0154    0.0157    0.0173    0.0167


-------------------------------------------------------------------------------
              AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


  DAILY AVERAGE HEAD ON TOP OF LAYER  4
  -------------------------------------
    AVERAGES                      0.4116    0.0856    0.0608    0.0627    0.1580    0.0094
                                  0.2955    0.8346    1.2723    1.9672    2.3309    1.6356

    STD. DEVIATIONS               1.4604    0.2796    0.1640    0.1763    0.6784    0.0172
                                  0.5558    1.2505    2.3933    3.1428    2.9669    3.0540

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


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

    AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH   30
-------------------------------------------------------------------------------
                                         INCHES            CU. FEET      PERCENT
                                   -------------------   -------------  ---------
 PRECIPITATION                       49.08    (   7.630)    178170.1     100.00

 RUNOFF                               0.230   (  0.1195)       835.80      0.469
```

```
EVAPOTRANSPIRATION              40.440    (  4.7598)     146795.67     82.391

LATERAL DRAINAGE COLLECTED       8.41234 (  3.58578)     30536.801   17.13913
  FROM LAYER  3

PERCOLATION/LEAKAGE THROUGH      0.05654 (  0.05268)       205.231     0.11519
  LAYER  4

AVERAGE HEAD ON TOP              0.760 (     0.805)
  OF LAYER  4

PERCOLATION/LEAKAGE THROUGH      0.06357 (  0.05353)       230.741     0.12951
  LAYER  5

CHANGE IN WATER STORAGE         -0.063    (  2.1812)       -228.92     -0.128

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

              PEAK DAILY VALUES FOR YEARS    1 THROUGH   30
   ----------------------------------------------------------------------
                                                (INCHES)     (CU. FT.)
                                               ----------   -------------
     PRECIPITATION                                4.85        17605.500

     RUNOFF                                       0.294        1067.7887

     DRAINAGE COLLECTED FROM LAYER  3             0.09965       361.72702

     PERCOLATION/LEAKAGE THROUGH LAYER  4         0.002984       10.83100

     AVERAGE HEAD ON TOP OF LAYER  4             18.212

     MAXIMUM HEAD ON TOP OF LAYER  4             23.345

     LOCATION OF MAXIMUM HEAD IN LAYER  3
           (DISTANCE FROM DRAIN)                115.3 FEET

     PERCOLATION/LEAKAGE THROUGH LAYER  5         0.002723        9.88281

     SNOW WATER                                   0.00            0.0000


     MAXIMUM VEG. SOIL WATER (VOL/VOL)                    0.5331

     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   30
    ----------------------------------------------------------------------
               LAYER         (INCHES)       (VOL/VOL)
               -----         --------       ---------
                 1           173.0575         0.2884

                 2             6.0572         0.2524

                 3             0.0292         0.1169

                 4             0.0000         0.0000

                 5             5.6025         0.2334

              SNOW WATER       0.000

*******************************************************************************
*******************************************************************************
```

CASE 3

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              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:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\VISTA.D4
TEMPERATURE DATA FILE:       C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\CASE3.D7
SOLAR RADIATION DATA FILE:   C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\CASE3.D13
EVAPOTRANSPIRATION DATA:     C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\CASE3.D11
SOIL AND DESIGN DATA FILE:   C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\CASE3RD.D10
OUTPUT DATA FILE:            C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\CASE3RD.OUT


TIME:  15:10     DATE:   6/29/2007


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

     TITLE:  Oak Hammock Disposal 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                  =   1080.00    INCHES
          POROSITY                   =      0.6710 VOL/VOL
          FIELD CAPACITY             =      0.2920 VOL/VOL
          WILTING POINT              =      0.0770 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.2917 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                   =      0.3980 VOL/VOL
          FIELD CAPACITY             =      0.2440 VOL/VOL
          WILTING POINT              =      0.1360 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.2476 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.999999975000E-04 CM/SEC



                                 LAYER  3
                                 --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                     MATERIAL TEXTURE NUMBER   0
          THICKNESS                  =      0.25   INCHES
          POROSITY                   =      0.8500 VOL/VOL
          FIELD CAPACITY             =      0.0100 VOL/VOL
          WILTING POINT              =      0.0050 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.0609 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =   1.32000005000      CM/SEC
          SLOPE                      =      1.65   PERCENT
          DRAINAGE LENGTH            =    315.0    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 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER   0
     THICKNESS                    =     24.00   INCHES
     POROSITY                     =      0.3980 VOL/VOL
     FIELD CAPACITY               =      0.2440 VOL/VOL
     WILTING POINT                =      0.1360 VOL/VOL
     INITIAL SOIL WATER CONTENT   =      0.2432 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-04 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  4.%
             AND A SLOPE LENGTH OF  240. FEET.

   SCS RUNOFF CURVE NUMBER             =     73.30
   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   =      2.747  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    =    326.822  INCHES
   TOTAL INITIAL WATER                 =    326.822  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 WAS SYNTHETICALLY GENERATED USING
```

```
              COEFFICIENTS FOR    TAMPA              FLORIDA

              NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

   JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
   -------     -------     -------     -------     -------     -------
     2.10        3.10        3.50        2.60        3.00        6.50
     8.10        7.20        6.80        3.90        1.70        2.10


         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    1 THROUGH   30
-------------------------------------------------------------------------------

                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                  2.04     2.84     2.82     2.30     2.52     6.14
                            8.04     6.97     6.59     5.05     1.71     2.08

    STD. DEVIATIONS         1.28     1.69     1.83     1.80     1.68     3.45
                            3.56     2.28     2.82     2.76     1.12     1.10

  RUNOFF
  ------
    TOTALS                 0.001    0.002    0.005    0.006    0.006    0.053
                           0.029    0.008    0.033    0.030    0.003    0.000

    STD. DEVIATIONS        0.004    0.008    0.019    0.026    0.019    0.110
                           0.059    0.016    0.081    0.101    0.016    0.000

  EVAPOTRANSPIRATION
  ------------------
```

```
    TOTALS                      1.916     2.423     2.865     2.456     2.365     4.564
                                5.647     5.681     4.675     3.992     2.137     1.732

    STD. DEVIATIONS             0.771     0.809     1.069     1.350     1.476     1.612
                                1.513     0.939     1.045     0.679     0.933     0.777

  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  ----------------------------------------
    TOTALS                      0.5455    0.2777    0.3031    0.2587    0.2710    0.1108
                                0.5422    1.1019    1.0988    1.3718    1.5063    1.0759

    STD. DEVIATIONS             0.7874    0.5125    0.3760    0.3371    0.5516    0.2070
                                0.6222    0.7830    0.9788    0.8871    0.9901    1.0681

  PERCOLATION/LEAKAGE THROUGH LAYER  4
  ------------------------------------
    TOTALS                      0.0026    0.0009    0.0006    0.0006    0.0010    0.0002
                                0.0018    0.0045    0.0056    0.0085    0.0107    0.0082

    STD. DEVIATIONS             0.0062    0.0025    0.0011    0.0011    0.0034    0.0003
                                0.0030    0.0056    0.0095    0.0112    0.0116    0.0138

  PERCOLATION/LEAKAGE THROUGH LAYER  5
  ------------------------------------
    TOTALS                      0.0030    0.0010    0.0008    0.0006    0.0013    0.0002
                                0.0020    0.0059    0.0071    0.0102    0.0127    0.0098

    STD. DEVIATIONS             0.0074    0.0029    0.0014    0.0014    0.0048    0.0004
                                0.0034    0.0074    0.0136    0.0142    0.0139    0.0171


-------------------------------------------------------------------------------
              AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


  DAILY AVERAGE HEAD ON TOP OF LAYER  4
  -------------------------------------
    AVERAGES                    0.3739    0.1216    0.0607    0.0597    0.1320    0.0094
                                0.2386    0.6408    0.8676    1.3249    1.7392    1.3184

    STD. DEVIATIONS             1.0187    0.4240    0.1583    0.1643    0.5424    0.0176
                                0.4637    0.9000    1.6673    1.9193    2.0068    2.3595

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


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

     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH   30
-------------------------------------------------------------------------------
                                    INCHES             CU. FEET       PERCENT
                              -------------------   -------------   ---------
 PRECIPITATION                  49.08    (   7.630)     178170.1     100.00

 RUNOFF                          0.176   (  0.1480)        638.52      0.358
```

```
EVAPOTRANSPIRATION               40.454    (  4.7805)     146846.75     82.419

LATERAL DRAINAGE COLLECTED        8.46377 (  3.56460)     30723.484   17.24391
  FROM LAYER  3

PERCOLATION/LEAKAGE THROUGH       0.04517 (  0.03719)       163.957     0.09202
  LAYER  4

AVERAGE HEAD ON TOP               0.574 (     0.534)
  OF LAYER  4

PERCOLATION/LEAKAGE THROUGH       0.05467 (  0.05047)       198.444     0.11138
  LAYER  5

CHANGE IN WATER STORAGE          -0.065    (  2.4437)       -237.10     -0.133

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

                PEAK DAILY VALUES FOR YEARS    1 THROUGH   30
   ------------------------------------------------------------------------
                                                 (INCHES)      (CU. FT.)
                                                ----------    -------------
     PRECIPITATION                                 4.85        17605.500

     RUNOFF                                        0.442        1604.7616

     DRAINAGE COLLECTED FROM LAYER  3              0.09824       356.59567

     PERCOLATION/LEAKAGE THROUGH LAYER  4          0.001666        6.04607

     AVERAGE HEAD ON TOP OF LAYER  4               9.217

     MAXIMUM HEAD ON TOP OF LAYER  4              13.178

     LOCATION OF MAXIMUM HEAD IN LAYER  3
           (DISTANCE FROM DRAIN)                  89.8 FEET

     PERCOLATION/LEAKAGE THROUGH LAYER  5          0.002729        9.90799

     SNOW WATER                                    0.00            0.0000


     MAXIMUM VEG. SOIL WATER (VOL/VOL)                      0.5251

     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   30
     ----------------------------------------------------------------------
                 LAYER          (INCHES)          (VOL/VOL)
                 -----          --------          ---------
                   1            313.2174            0.2900

                   2              6.0643            0.2527

                   3              0.0284            0.1136

                   4              0.0000            0.0000

                   5              5.5523            0.2313

                SNOW WATER        0.000

******************************************************************************
******************************************************************************
```

CASE 4

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              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:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\VISTA.D4
TEMPERATURE DATA FILE:      C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\CASE4.D7
SOLAR RADIATION DATA FILE:  C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\CASE4.D13
EVAPOTRANSPIRATION DATA:    C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\CASE4.D11
SOIL AND DESIGN DATA FILE:  C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\CASE4R.D10
OUTPUT DATA FILE:           C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\CASE4R.OUT


TIME:  10: 6     DATE:   7/20/2007


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

     TITLE:  Oak Hammock Disposal 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  10
           THICKNESS                 =      6.00   INCHES
           POROSITY                  =      0.3980 VOL/VOL
           FIELD CAPACITY            =      0.2440 VOL/VOL
           WILTING POINT             =      0.1360 VOL/VOL
           INITIAL SOIL WATER CONTENT =     0.2014 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.119999997000E-03 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                   =     18.00   INCHES
POROSITY                    =      0.3980 VOL/VOL
FIELD CAPACITY              =      0.2440 VOL/VOL
WILTING POINT               =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.2745 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-04 CM/SEC



                              LAYER  3
                              --------

                  TYPE 2 - LATERAL DRAINAGE LAYER
                    MATERIAL TEXTURE NUMBER   0
THICKNESS                   =      0.25   INCHES
POROSITY                    =      0.8500 VOL/VOL
FIELD CAPACITY              =      0.0100 VOL/VOL
WILTING POINT               =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0100 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =    1.64999998000      CM/SEC
SLOPE                       =     33.30   PERCENT
DRAINAGE LENGTH             =    150.0    FEET



                              LAYER  4
                              --------

                  TYPE 4 - FLEXIBLE MEMBRANE LINER
                    MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.04   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 1 - VERTICAL PERCOLATION LAYER
                  MATERIAL TEXTURE NUMBER   0
THICKNESS                  =     12.00    INCHES
POROSITY                   =      0.3980 VOL/VOL
FIELD CAPACITY             =      0.2440 VOL/VOL
WILTING POINT              =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.  =  0.999999975000E-04 CM/SEC


                           LAYER  6
                           --------

              TYPE 1 - VERTICAL PERCOLATION LAYER
                  MATERIAL TEXTURE NUMBER  18
THICKNESS                  =   1080.00    INCHES
POROSITY                   =      0.6710 VOL/VOL
FIELD CAPACITY             =      0.2920 VOL/VOL
WILTING POINT              =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT =      0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC


                           LAYER  7
                           --------

              TYPE 1 - VERTICAL PERCOLATION LAYER
                  MATERIAL TEXTURE NUMBER   0
THICKNESS                  =     24.00    INCHES
POROSITY                   =      0.3980 VOL/VOL
FIELD CAPACITY             =      0.2440 VOL/VOL
WILTING POINT              =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.  =  0.999999975000E-04 CM/SEC


                           LAYER  8
                           --------

                TYPE 2 - LATERAL DRAINAGE LAYER
                  MATERIAL TEXTURE NUMBER   0
THICKNESS                  =      0.25    INCHES
POROSITY                   =      0.8500 VOL/VOL
FIELD CAPACITY             =      0.0100 VOL/VOL
WILTING POINT              =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT =      0.0100 VOL/VOL
EFFECTIVE SAT. HYD. COND.  =  0.920000017000      CM/SEC
SLOPE                      =      1.65    PERCENT
DRAINAGE LENGTH            =    315.0     FEET
```

```
                           LAYER  9
                           --------

               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 10
                           --------

             TYPE 1 - VERTICAL PERCOLATION LAYER
                 MATERIAL TEXTURE NUMBER   0
   THICKNESS                   =     24.00   INCHES
   POROSITY                    =      0.3980 VOL/VOL
   FIELD CAPACITY              =      0.2440 VOL/VOL
   WILTING POINT               =      0.1360 VOL/VOL
   INITIAL SOIL WATER CONTENT  =      0.2439 VOL/VOL
   EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-04 CM/SEC


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

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
          SOIL DATA BASE USING SOIL TEXTURE #10 WITH A
          FAIR STAND OF GRASS, A SURFACE SLOPE OF  4.%
          AND A SLOPE LENGTH OF  240. FEET.

SCS RUNOFF CURVE NUMBER             =     86.10
FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
EVAPORATIVE ZONE DEPTH              =     22.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE   =      5.599  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE  =      8.756  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE  =      2.992  INCHES
INITIAL SNOW WATER                  =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS    =    336.152  INCHES
TOTAL INITIAL WATER                 =    336.152  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                 =  22.0  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 WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR    TAMPA               FLORIDA

                  NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

     JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
     -------     -------     -------     -------     -------     -------
       2.10        3.10        3.50        2.60        3.00        6.50
       8.10        7.20        6.80        3.90        1.70        2.10


         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    1 THROUGH   30
-------------------------------------------------------------------------------

                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                  2.04     2.84     2.82     2.30     2.52     6.14
                            8.04     6.97     6.59     5.05     1.71     2.08

    STD. DEVIATIONS         1.28     1.69     1.83     1.80     1.68     3.45
                            3.56     2.28     2.82     2.76     1.12     1.10

  RUNOFF
  ------
    TOTALS                  0.098    0.129    0.186    0.165    0.139    0.735
                            0.822    0.435    0.759    0.554    0.060    0.038

    STD. DEVIATIONS         0.150    0.193    0.285    0.388    0.268    0.913
                            0.800    0.529    0.905    0.921    0.182    0.061

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                  1.836    2.696    2.910    2.420    2.352    4.544
                            5.753    5.806    4.734    4.150    2.273    1.697

    STD. DEVIATIONS         0.644    0.768    1.177    1.356    1.445    1.638
                            1.528    0.910    1.090    0.604    0.977    0.624

  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  ----------------------------------------
    TOTALS                  0.0939   0.1076   0.1220   0.0758   0.0003   0.2509
                            0.6575   0.6135   0.8795   0.7286   0.2193   0.1144

    STD. DEVIATIONS         0.2388   0.2826   0.3232   0.2336   0.0009   0.5791
                            0.9294   0.9125   1.2552   0.9953   0.3800   0.3440

  PERCOLATION/LEAKAGE THROUGH LAYER  4
  ------------------------------------
    TOTALS                  0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                            0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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

  LATERAL DRAINAGE COLLECTED FROM 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   0.0001   0.0000   0.0000   0.0000

  PERCOLATION/LEAKAGE THROUGH LAYER  9
  ------------------------------------
    TOTALS                  0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                            0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
```

```
    STD. DEVIATIONS          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                             0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

  PERCOLATION/LEAKAGE THROUGH LAYER 10
  ------------------------------------
    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                 0.0002   0.0002   0.0002   0.0001   0.0000   0.0004
                             0.0011   0.0011   0.0016   0.0013   0.0004   0.0002

    STD. DEVIATIONS          0.0004   0.0005   0.0006   0.0004   0.0000   0.0010
                             0.0016   0.0016   0.0022   0.0017   0.0007   0.0006

  DAILY AVERAGE HEAD ON TOP OF LAYER  9
  -------------------------------------
    AVERAGES                 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

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



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

     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH   30
-------------------------------------------------------------------------------
                                      INCHES            CU. FEET      PERCENT
                                 -------------------  -------------  ---------
 PRECIPITATION                  49.08     (   7.630)    178170.1     100.00

 RUNOFF                          4.121    (  1.5885)     14958.76      8.396

 EVAPOTRANSPIRATION             41.173    (  4.6771)    149458.28     83.885

 LATERAL DRAINAGE COLLECTED      3.86336 (  2.63016)     14024.004    7.87113
   FROM LAYER  3

 PERCOLATION/LEAKAGE THROUGH     0.00021 (  0.00013)         0.767    0.00043
   LAYER  4

 AVERAGE HEAD ON TOP             0.001 (    0.000)
```

```
    OF LAYER  4

  LATERAL DRAINAGE COLLECTED      0.00021 (  0.00013)        0.751    0.00042
    FROM LAYER  8

  PERCOLATION/LEAKAGE THROUGH     0.00000 (  0.00000)        0.016     0.00001
    LAYER  9

  AVERAGE HEAD ON TOP             0.000 (    0.000)
    OF LAYER  9

  PERCOLATION/LEAKAGE THROUGH     0.00000 (  0.00000)        0.000     0.00000
    LAYER 10

  CHANGE IN WATER STORAGE        -0.075    (  1.0444)      -271.70    -0.152

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

             PEAK DAILY VALUES FOR YEARS     1 THROUGH   30
   ------------------------------------------------------------------------
                                                     (INCHES)      (CU. FT.)
                                                    ----------    -------------
       PRECIPITATION                                  4.85        17605.500

       RUNOFF                                         2.628        9541.0586

       DRAINAGE COLLECTED FROM LAYER  3               0.98634      3580.42432

       PERCOLATION/LEAKAGE THROUGH LAYER  4           0.000029        0.10389

       AVERAGE HEAD ON TOP OF LAYER  4                0.053

       MAXIMUM HEAD ON TOP OF LAYER  4                0.127

       LOCATION OF MAXIMUM HEAD IN LAYER  3
             (DISTANCE FROM DRAIN)                    0.0 FEET

       DRAINAGE COLLECTED FROM LAYER  8               0.00002         0.05581

       PERCOLATION/LEAKAGE THROUGH LAYER  9           0.000000        0.00063

       AVERAGE HEAD ON TOP OF LAYER  9                0.000

       MAXIMUM HEAD ON TOP OF LAYER  9                0.007

       LOCATION OF MAXIMUM HEAD IN LAYER  8
             (DISTANCE FROM DRAIN)                    0.0 FEET

       PERCOLATION/LEAKAGE THROUGH LAYER 10           0.000000        0.00000

       SNOW WATER                                     0.00            0.0000


       MAXIMUM VEG. SOIL WATER (VOL/VOL)                      0.3549

       MINIMUM VEG. SOIL WATER (VOL/VOL)                      0.1360
```

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

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

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                FINAL WATER STORAGE AT END OF YEAR   30
    ----------------------------------------------------------------------
                 LAYER        (INCHES)       (VOL/VOL)
                 -----        --------       ---------
                   1            1.1862         0.1977

                   2            2.7171         0.1510

                   3            0.0020         0.0100

                   4            0.0000         0.0000

                   5            2.9280         0.2440

                   6          315.3599         0.2920

                   7            5.8560         0.2440

                   8            0.0025         0.0100

                   9            0.0000         0.0000

                  10            5.8549         0.2440

               SNOW WATER       0.000

******************************************************************************
******************************************************************************
```

Attachment 4

SPREADSHEETS FOR VERIFICATION OF HEADS USING GIROUD'S METHOD

Case 1

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.
(The indicated equation numbers correspond to the equation number in this paper)

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.

Manually input numbers in RED

For "Top Drainage Layer" using subscript "t" (same as "2" in the paper)
For "Bottom Drainage Layer" using subscript "b" (same as "1" in the paper)

Geocomposite Permeability (k1) = (kb) = 0.053 ft/sec Geocomposite Transmissivity (θ1) = (θb) = 1.03E-04 m^2/sec 0.0011 ft^2/sec
Geocomposite Thickness (t1) = (tb) = 0.250 inches
Sand Permeability (k2) = (kt) = 3.3E-06 ft/sec 0.0001 cm/sec Check k1 or kb > k2 or kt
Slope angle = β = 1.146 degrees 0.020 radians Slope (%) = 2.0 Check = 0.020

Drainage Length = L = 315 ft
Liquid Impingement Rate = qh = 7.17E-08 ft/sec 270 ft^3/ac/day Check qh < k2 or kt < k1 or kb

Length of Upstream Section = Lu = 308.9 ft (Eqn 18)
Characteristic Parameter = λ1 = λb 0.003 (Eqn 7)
Characteristic Parameter = λ2 = λt 54.666 (Eqn 17)
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

Conservative Approach:

Is applicable when λ < 0.01; Is an acceptable approximation when t max < one tenth the height of the drainage layer; and
Is rarely valid for granular drainage layers on a relatively flat slope.

For bottom drainage layer:		For top drainage layer:		
t maxb = (qh x L)/(kb x sinβ) =	N/A inches	t maxt = qh (L-Lu)/(kt x sinβ) =	80.53 inches	(Eqns 20 & 29)
h maxb = (t maxb) cosβ =	N/A inches	h maxt = (t maxt) cosβ =	80.52 inches	(Eqn 14)

Rigorous Approach:

Modifying Factor = j2 = jt =	0.972	(Eqn 26)
t max (top) = t max2 =	9.900 inches	(Eqn 25)

For Lu > L, flow is in the bottom drainage layer (geocomposite) only and the conservative approach is applicable.

Is conservative approach applicable	Yes	Therefore,	t max = t maxb =	**N/A** inches	(Eqn 20)
for the bottom drainage layer?		and	h max = (t max)cosβ =	**N/A** inches	(Eqn 14)

For Lu < L and λt < 0.01, flow is in both the drainage layers and the conservative approach is applicable.

Is conservative approach applicable	No	Therefore,	t max = tb + t maxt =	**N/A** inches	(Eqn 32)
for the top drainage layer?		and	h max = (t max)cosβ =	**N/A** inches	(Eqn 14)

For Lu < L and λt > 0.01, flow is in both the drainage layers and the rigorous approach is applicable.

Is rigorous approach applicable	Yes	Therefore,	t max = tb + t max2 =	**10.15** inches	(Eqn 32)
for the top drainage layer?		and	h max = (t max)cosβ =	**10.15** inches	(Eqn 14)

Case 2

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.
(The indicated equation numbers correspond to the equation number in this paper)

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.

Manually input numbers in RED

For "Top Drainage Layer" using subscript "t" (same as "2" in the paper)
For "Bottom Drainage Layer" using subscript "b" (same as "1" in the paper)

Geocomposite Permeability (k1) = (kb) =		0.040 ft/sec		Geocomposite Transmissivity (θ1) = (θb) =	7.70E-05 m^2/sec	0.0008 ft^2/sec
Geocomposite Thickness (t1) = (tb) =		0.250 inches				
Sand Permeability (k2) = (kt) =		3.3E-06 ft/sec	0.0001 cm/sec	Check k1 or kb > k2 or kt		
Slope angle = β =	1.031	0.018	Slope (%) = 1.8	Check = 0.018		
	degrees	radians				
Drainage Length = L =		315 ft				
Liquid Impingement Rate = qh =		4.86E-08 ft/sec	183 ft^3/ac/day	Check qh < k2 or kt < k1 or kb		
Length of Upstream Section = Lu =		306.6 ft	(Eqn 18)			
Characteristic Parameter = λ1 = λb		0.004	(Eqn 7)			
Characteristic Parameter = λ2 = λt		45.742	(Eqn 17)			

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

Conservative Approach:

Is applicable when λ < 0.01; is an acceptable approximation when t max < one tenth the height of the drainage layer; and
Is rarely valid for granular drainage layers on a relatively flat slope.

For bottom drainage layer:		For top drainage layer:		
t maxb = (qh x L)/(kb x sinβ) =	N/A inches	t maxt = qh (L-Lu)/(kt x sinβ) =	82.88 inches	(Eqns 20 & 29)
h maxb = (t maxb) cosβ =	N/A inches	h maxt = (t maxt) cosβ =	82.86 inches	(Eqn 14)

Rigorous Approach:

Modifying Factor = j2 = jt =	0.969	(Eqn 26)
t max (top) = t max2 =	11.030 inches	(Eqn 25)

For Lu > L, flow is in the bottom drainage layer (geocomposite) only and the conservative approach is applicable.

Is conservative approach applicable	Yes	Therefore,	t max = t maxb =	**N/A** inches	(Eqn 20)
for the bottom drainage layer?		and	h max = (t max)cosβ =	**N/A** inches	(Eqn 14)

For Lu < L and λt < 0.01, flow is in both the drainage layers and the conservative approach is applicable.

Is conservative approach applicable	No	Therefore,	t max = tb + t maxt =	**N/A** inches	(Eqn 32)
for the top drainage layer?		and	h max = (t max)cosβ =	**N/A** inches	(Eqn 14)

For Lu < L and λt > 0.01, flow is in both the drainage layers and the rigorous approach is applicable.

Is rigorous approach applicable	Yes	Therefore,	t max = tb + t max2 =	**11.28** inches	(Eqn 32)
for the top drainage layer?		and	h max = (t max)cosβ =	**11.28** inches	(Eqn 14)

Case 3

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.
(The indicated equation numbers correspond to the equation number in this paper)

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.

Manually input numbers in RED

For "Top Drainage Layer" using subscript "t" (same as "2" in the paper)
For "Bottom Drainage Layer" using subscript "b" (same as "1" in the paper)

Geocomposite Permeability (k1) = (kb) =		0.043 ft/sec		Geocomposite Transmissivity (θ1) = (θb) =	8.40E-05 m^2/sec	0.0009 ft^2/sec
Geocomposite Thickness (t1) = (tb) =		0.250 inches				
Sand Permeability (k2) = (kt) =		3.3E-06 ft/sec	0.0001 cm/sec	Check k1 or kb > k2 or kt		
Slope angle = β =	0.945 degrees	0.016 radians	Slope (%) = 1.65	Check = 0.017		
Drainage Length = L =		315 ft				
Liquid Impingement Rate = qh =		4.86E-08 ft/sec	183 ft^3/ac/day	Check qh < k2 or kt < k1 or kb		

Length of Upstream Section = Lu =	306.6 ft	(Eqn 18)
Characteristic Parameter = λ1 = λb	0.004	(Eqn 7)
Characteristic Parameter = λ2 = λt	54.437	(Eqn 17)

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

Conservative Approach:

Is applicable when λ < 0.01; Is an acceptable approximation when t max < one tenth the height of the drainage layer; and Is rarely valid for granular drainage layers on a relatively flat slope.

For bottom drainage layer:		For top drainage layer:		
t maxb = (qh x L)/(kb x sinβ) =	N/A inches	t maxt = qh (L-Lu)/(kt x sinβ) =	90.32 inches	(Eqns 20 & 29)
h maxb = (t maxb) cosβ =	N/A inches	h maxt = (t maxt) cosβ =	90.31 inches	(Eqn 14)

Rigorous Approach:

Modifying Factor = j2 = jt =	0.972	(Eqn 26)
t max (top) = t max2 =	11.125 inches	(Eqn 25)

For Lu > L, flow is in the bottom drainage layer (geocomposite) only and the conservative approach is applicable.

Is conservative approach applicable for the bottom drainage layer?	Yes	Therefore,	t max = t maxb =	**N/A** inches	(Eqn 20)
		and	h max = (t max)cosβ =	**N/A** inches	(Eqn 14)

For Lu < L and λt < 0.01, flow is in both the drainage layers and the conservative approach is applicable.

Is conservative approach applicable for the top drainage layer?	No	Therefore,	t max = tb + t maxt =	**N/A** inches	(Eqn 32)
		and	h max = (t max)cosβ =	**N/A** inches	(Eqn 14)

For Lu < L and λt > 0.01, flow is in both the drainage layers and the rigorous approach is applicable.

Is rigorous approach applicable for the top drainage layer?	Yes	Therefore,	t max = tb + t max2 =	**11.37** inches	(Eqn 32)
		and	h max = (t max)cosβ =	**11.37** inches	(Eqn 14)

Case 1

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.
(The indicated equation numbers correspond to the equation number in this paper)

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.

Manually input numbers in RED

For "Top Drainage Layer" using subscript "t" (same as "2" in the paper)
For "Bottom Drainage Layer" using subscript "b" (same as "1" in the paper)

Geocomposite Permeability (k1) = (kb) = 0.053 ft/sec   Geocomposite Transmissivity (θ1) = (θb) = 1.03E-04 m^2/sec   0.0011 ft^2/sec
Geocomposite Thickness (t1) = (tb) = 0.250 inches
Sand Permeability (k2) = (kt) = 3.3E-06 ft/sec   0.0001 cm/sec   Check k1 or kb > k2 or kt
Slope angle = β = 1.146 degrees   0.020 radians   Slope (%) = 2.0   Check = 0.020

Drainage Length = L = 315 ft
Liquid Impingement Rate = qh = 7.17E-08 ft/sec   270 ft^3/ac/day   Check qh < k2 or kt < k1 or kb

Length of Upstream Section = Lu = 308.9 ft (Eqn 18)
Characteristic Parameter = λ1 = λb 0.003 (Eqn 7)
Characteristic Parameter = λ2 = λt 54.666 (Eqn 17)
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

Conservative Approach:

Is applicable when λ < 0.01; Is an acceptable approximation when t max < one tenth the height of the drainage layer; and
Is rarely valid for granular drainage layers on a relatively flat slope.

For bottom drainage layer:		For top drainage layer:		
t maxb = (qh x L)/(kb x sinβ) =	N/A inches	t maxt = qh (L-Lu)/(kt x sinβ) =	80.53 inches	(Eqns 20 & 29)
h maxb = (t maxb) cosβ =	N/A inches	h maxt = (t maxt) cosβ =	80.52 inches	(Eqn 14)

Rigorous Approach:

Modifying Factor = j2 = jt =	0.972	(Eqn 26)
t max (top) = t max2 =	9.900 inches	(Eqn 25)

For Lu > L, flow is in the bottom drainage layer (geocomposite) only and the conservative approach is applicable.

Is conservative approach applicable	No	Therefore,	t max = t maxb =	**N/A** inches	(Eqn 20)
for the bottom drainage layer?		and	h max = (t max)cosβ =	**N/A** inches	(Eqn 14)

For Lu < L and λt < 0.01, flow is in both the drainage layers and the conservative approach is applicable.

Is conservative approach applicable	No	Therefore,	t max = tb + t maxt =	**N/A** inches	(Eqn 32)
for the top drainage layer?		and	h max = (t max)cosβ =	**N/A** inches	(Eqn 14)

For Lu < L and λt > 0.01, flow is in both the drainage layers and the rigorous approach is applicable.

Is rigorous approach applicable	Yes	Therefore,	t max = tb + t max2 =	**10.15** inches	(Eqn 32)
for the top drainage layer?		and	h max = (t max)cosβ =	**10.15** inches	(Eqn 14)

Case 2

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.
(The indicated equation numbers correspond to the equation number in this paper)

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.

Manually input numbers in RED

For "Top Drainage Layer" using subscript "t" (same as "2" in the paper)
For "Bottom Drainage Layer" using subscript "b" (same as "1" in the paper)

Geocomposite Permeability (k1) = (kb) = 0.040 ft/sec Geocomposite Transmissivity (θ1) = (θb) = 7.70E-05 m^2/sec 0.0008 ft^2/sec
Geocomposite Thickness (t1) = (tb) = 0.250 inches
Sand Permeability (k2) = (kt) = 3.3E-06 ft/sec 0.0001 cm/sec Check k1 or kb > k2 or kt
Slope angle = β = 1.031 degrees 0.018 radians Slope (%) = 1.8 Check = 0.018

Drainage Length = L = 315 ft
Liquid Impingement Rate = qh = 4.86E-08 ft/sec 183 ft^3/ac/day Check qh < k2 or kt < k1 or kb

Length of Upstream Section = Lu = 306.6 ft (Eqn 18)
Characteristic Parameter = λ1 = λb 0.004 (Eqn 7)
Characteristic Parameter = λ2 = λt 45.742 (Eqn 17)
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

Conservative Approach:

Is applicable when λ < 0.01; Is an acceptable approximation when t max < one tenth the height of the drainage layer; and
Is rarely valid for granular drainage layers on a relatively flat slope.

For bottom drainage layer:		For top drainage layer:		
t maxb = (qh x L)/(kb x sinβ) =	N/A inches	t maxt = qh (L-Lu)/(kt x sinβ) =	82.88 inches	(Eqns 20 & 29)
h maxb = (t maxb) cosβ =	N/A inches	h maxt = (t maxt) cosβ =	82.86 inches	(Eqn 14)

Rigorous Approach:

Modifying Factor = j2 = jt =	0.969	(Eqn 26)
t max (top) = t max2 =	11.030 inches	(Eqn 25)

For Lu > L, flow is in the bottom drainage layer (geocomposite) only and the conservative approach is applicable.

Is conservative approach applicable	No	Therefore,	t max = t maxb =	**N/A** inches	(Eqn 20)
for the bottom drainage layer?		and	h max = (t max)cosβ =	**N/A** inches	(Eqn 14)

For Lu < L and λt < 0.01, flow is in both the drainage layers and the conservative approach is applicable.

Is conservative approach applicable	No	Therefore,	t max = tb + t maxt =	**N/A** inches	(Eqn 32)
for the top drainage layer?		and	h max = (t max)cosβ =	**N/A** inches	(Eqn 14)

For Lu < L and λt > 0.01, flow is in both the drainage layers and the rigorous approach is applicable.

Is rigorous approach applicable	Yes	Therefore,	t max = tb + t max2 =	**11.28** inches	(Eqn 32)
for the top drainage layer?		and	h max = (t max)cosβ =	**11.28** inches	(Eqn 14)

Case 3

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.
(The indicated equation numbers correspond to the equation number in this paper)

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.

Manually input numbers in RED

For "Top Drainage Layer" using subscript "t" (same as "2" in the paper)
For "Bottom Drainage Layer" using subscript "b" (same as "1" in the paper)

Geocomposite Permeability (k1) = (kb) =		0.043 ft/sec	Geocomposite Transmissivity (θ1) = (θb) =	8.40E-05 m^2/sec			0.0009 ft^2/sec
Geocomposite Thickness (t1) = (tb) =		0.250 inches					
Sand Permeability (k2) = (kt) =		3.3E-06 ft/sec		0.0001 cm/sec	Check k1 or kb > k2 or kt		
Slope angle = β =	0.945	0.016	Slope (%) =	1.65	Check =	0.017	
	degrees	radians					
Drainage Length = L =		315 ft					
Liquid Impingement Rate = qh =		4.86E-08 ft/sec		183 ft^3/ac/day	Check qh < k2 or kt < k1 or kb		

Length of Upstream Section = Lu =	306.6 ft	(Eqn 18)
Characteristic Parameter = λ1 = λb	0.004	(Eqn 7)
Characteristic Parameter = λ2 = λt	54.437	(Eqn 17)

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

Conservative Approach:

Is applicable when $\lambda < 0.01$; Is an acceptable approximation when t max < one tenth the height of the drainage layer; and
Is rarely valid for granular drainage layers on a relatively flat slope.

For bottom drainage layer:		For top drainage layer:		
$t_{maxb} = (q_h \times L)/(k_b \times \sin\beta) =$	N/A inches	$t_{maxt} = q_h (L-L_u)/(k_t \times \sin\beta) =$	90.32 inches	(Eqns 20 & 29)
$h_{maxb} = (t_{maxb}) \cos\beta =$	N/A inches	$h_{maxt} = (t_{maxt}) \cos\beta =$	90.31 inches	(Eqn 14)

Rigorous Approach:

Modifying Factor = j2 = jt = 0.972 (Eqn 26)
t max (top) = t max2 = 11.125 inches (Eqn 25)

For Lu > L, flow is in the bottom drainage layer (geocomposite) only and the conservative approach is applicable.

Is conservative approach applicable	No	Therefore,	$t_{max} = t_{maxb} =$	**N/A** inches	(Eqn 20)
for the bottom drainage layer?		and	$h_{max} = (t_{max})\cos\beta =$	**N/A** inches	(Eqn 14)

For Lu < L and $\lambda t < 0.01$, flow is in both the drainage layers and the conservative approach is applicable.

Is conservative approach applicable	No	Therefore,	$t_{max} = t_b + t_{maxt} =$	**N/A** inches	(Eqn 32)
for the top drainage layer?		and	$h_{max} = (t_{max})\cos\beta =$	**N/A** inches	(Eqn 14)

For Lu < L and $\lambda t > 0.01$, flow is in both the drainage layers and the rigorous approach is applicable.

Is rigorous approach applicable	Yes	Therefore,	$t_{max} = t_b + t_{max2} =$	**11.37** inches	(Eqn 32)
for the top drainage layer?		and	$h_{max} = (t_{max})\cos\beta =$	**11.37** inches	(Eqn 14)

Case 4

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.
(The indicated equation numbers correspond to the equation number in this paper)

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.

Manually input numbers in RED

For "Top Drainage Layer" using subscript "t" (same as "2" in the paper)
For "Bottom Drainage Layer" using subscript "b" (same as "1" in the paper)

Geocomposite Permeability (k1) = (kb) = 0.030 ft/sec   Geocomposite Transmissivity (θ1) = (θb) = 5.86E-05 m^2/sec   0.0006 ft^2/sec
Geocomposite Thickness (t1) = (tb) = 0.250 inches
Sand Permeability (k2) = (kt) = 3.3E-06 ft/sec   0.0001 cm/sec   Check k1 or kb > k2 or kt
Slope angle = β = 0.945 degrees   0.016 radians   Slope (%) = 1.65   Check = 0.017

Drainage Length = L = 315 ft
Liquid Impingement Rate = qh = 2.92E-11 ft/sec   0 ft^3/ac/day   Check qh < k2 or kt < k1 or kb

Length of Upstream Section = Lu = 355,859.9 ft (Eqn 18)
Characteristic Parameter = λ1 = λb 0.000 (Eqn 7)
Characteristic Parameter = λ2 = λt 0.033 (Eqn 17)
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

Conservative Approach:

Is applicable when λ < 0.01; Is an acceptable approximation when t max < one tenth the height of the drainage layer; and
Is rarely valid for granular drainage layers on a relatively flat slope.

For bottom drainage layer:		For top drainage layer:		
t maxb = (qh x L)/(kb x sinβ) =	0.00 inches	t maxt = qh (L-Lu)/(kt x sinβ) =	N/A inches	(Eqns 20 & 29)
h maxb = (t maxb) cosβ =	0.00 inches	h maxt = (t maxt) cosβ =	N/A inches	(Eqn 14)

Rigorous Approach:

Modifying Factor = j2 = jt =	0.937	(Eqn 26)
t max (top) = t max2 =	N/A inches	(Eqn 25)

For Lu > L, flow is in the bottom drainage layer (geocomposite) only and the conservative approach is applicable.

Is conservative approach applicable	Yes	Therefore,	t max = t maxb =	**0.00** inches	(Eqn 20)
for the bottom drainage layer?		and	h max = (t max)cosβ =	**0.00** inches	(Eqn 14)

For Lu < L and λt < 0.01, flow is in both the drainage layers and the conservative approach is applicable.

Is conservative approach applicable	No	Therefore,	t max = tb + t maxt =	**N/A** inches	(Eqn 32)
for the top drainage layer?		and	h max = (t max)cosβ =	**N/A** inches	(Eqn 14)

For Lu < L and λt > 0.01, flow is in both the drainage layers and the rigorous approach is applicable.

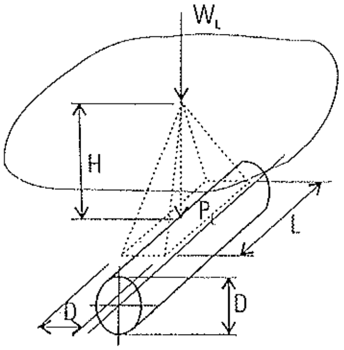
Is rigorous approach applicable	No	Therefore,	t max = tb + t max2 =	**N/A** inches	(Eqn 32)
for the top drainage layer?		and	h max = (t max)cosβ =	**N/A** inches	(Eqn 14)

Attachment 5

DATA FOR LEACHATE COLLECTION SYSTEM PIPE DESIGN

$\boxed{C_s = \text{LOAD COEFFICIENT}}$

Table 7-4 Load Coefficient, C_H, for Holl's Integration of Boussineq's Equation



6 in HDPE pipe :

$$\left\{ \begin{array}{l} \dfrac{D}{2H} = \dfrac{6.625''}{2(1 \times 12'')} = 0.28 \\ \dfrac{L}{2H} = \dfrac{3'}{2(1')} = 1.5 \end{array} \right.$$

$\longrightarrow C_s = \underline{0.324}$ (interpolated from table)

D/2H	L/2H													
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.5	2.0	20.0
0.1	0.019	0.037	0.053	0.067	0.079	0.089	0.097	0.103	0.108	0.112	0.117	0.121	0.124	0.127
0.2	0.037	0.072	0.103	0.131	0.155	0.174	0.189	0.202	0.211	0.219	0.229	0.238	0.244	0.248
0.3	0.053	0.103	0.149	0.190	0.224	0.252	0.274	0.292	0.306	0.318	0.333	0.346	0.355	0.361
0.4	0.067	0.131	0.190	0.241	0.284	0.320	0.349	0.373	0.391	0.405	0.425	0.442	0.454	0.462
0.5	0.079	0.155	0.224	0.284	0.336	0.379	0.414	0.441	0.463	0.481	0.505	0.525	0.540	0.550
0.6	0.089	0.174	0.252	0.320	0.379	0.428	0.467	0.499	0.524	0.544	0.572	0.596	0.613	0.625
0.7	0.097	0.189	0.274	0.349	0.414	0.467	0.511	0.546	0.574	0.597	0.628	0.655	0.674	0.688
0.8	0.103	0.202	0.292	0.373	0.441	0.499	0.546	0.584	0.615	0.639	0.674	0.703	0.725	0.740
0.9	0.108	0.211	0.306	0.391	0.463	0.524	0.574	0.615	0.647	0.673	0.711	0.743	0.766	0.783
1.0	0.112	0.219	0.318	0.405	0.481	0.544	0.597	0.639	0.673	0.701	0.740	0.775	0.800	0.818
1.2	0.117	0.229	0.333	0.425	0.505	0.572	0.628	0.674	0.711	0.740	0.783	0.821	0.849	0.871
1.5	0.121	0.238	0.346	0.442	0.525	0.596	0.655	0.703	0.743	0.775	0.821	0.863	0.895	0.920
2.0	0.124	0.244	0.355	0.454	0.540	0.613	0.674	0.725	0.766	0.800	0.849	0.895	0.930	0.960
20.0	0.127	0.248	0.361	0.462	0.550	0.625	0.688	0.740	0.783	0.818	0.871	0.920	0.960	1.000

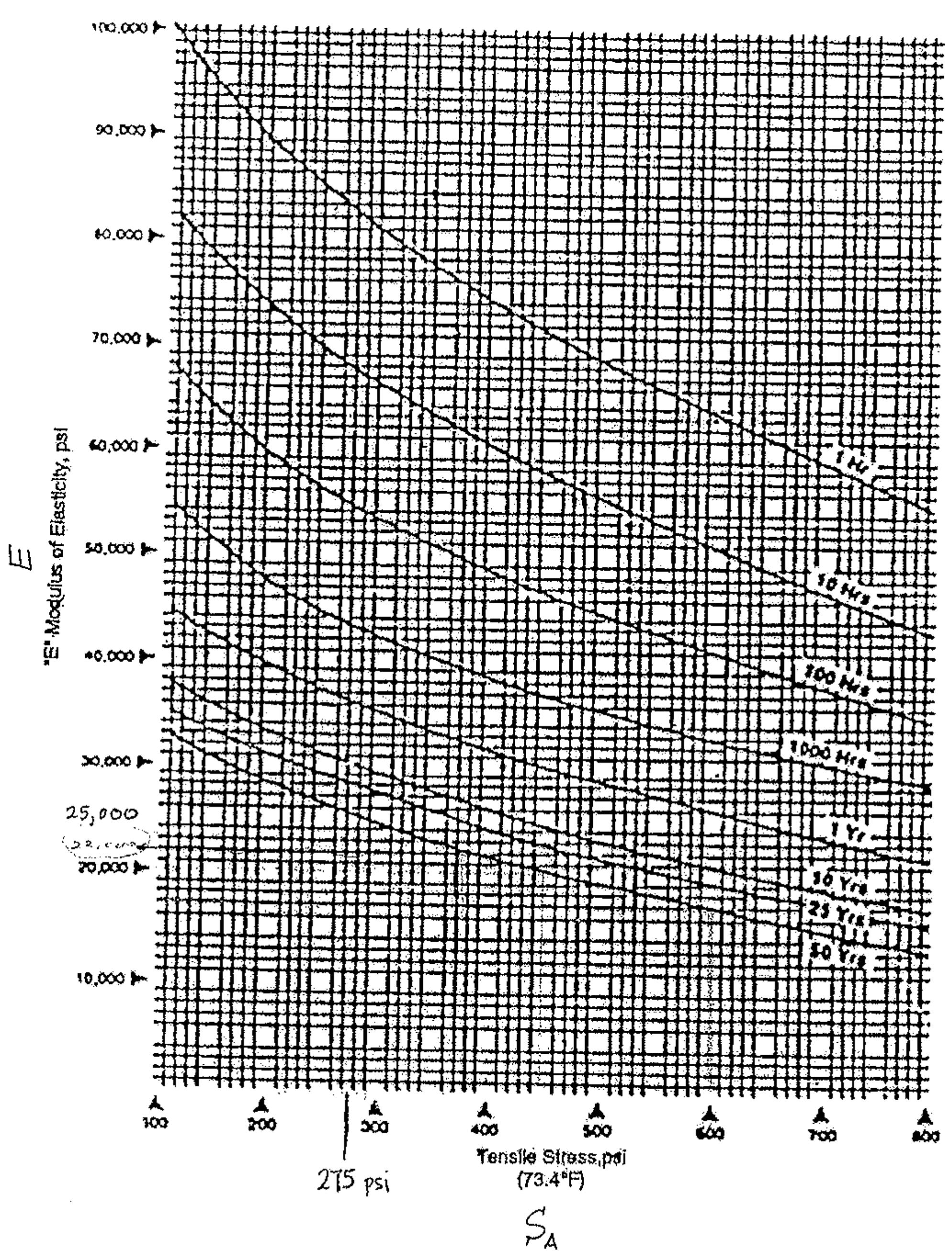
REF: "Plexco/Spirolite Eng. Manual, 2. System Design", Chevron Chemical Company, 1994.

Information on this page rev. 8/92— supersedes all previous issues.

E= MODULUS OF ELASTICITY FOR HDPE PIPE

Figure 4

MODULUS OF ELASTICITY (E) FOR HDPE PIPE
(Plastic Pipe Institute Handbook of Polyethylene Pipe, 1993)



6" HDPE Pipe

$$S_A = \frac{(SDR-1)\,\sigma_{vo}}{2}$$

$$= \frac{(11-1) \times 66\ psi}{2}$$

$$= 330\ psi$$

$\Longrightarrow$ E = 24,000 psi

E' = MODULUS OF SOIL REACTION

Modulus of Soil Reaction (E') for Pipe Bedding Material.
(from Selig, 1990)

SOIL TYPE = SM
$\sigma_V = 66$ psi

$1000 \text{ psi} < E_s < 4{,}700 \text{ psi}$
$0.28 < \nu_s < 0.41$

$\Rightarrow$ ASSUME For 6" pipe
$E' = 2800$ psi
$\nu_s = 0.35$

Soil Type: SW, SP, GW, GP

σ_V = Stress level	95% D698			85% D698		
psi (kPa)	E_s	B	ν_s	E_s	B	ν_s
1 (7)	1600 (11)	2800 (19)	0.40	1300 (9)	900 (6)	0.26
5 (34)	4100 (28)	3300 (23)	0.29	2100 (14)	1200 (8)	0.21
10 (70)	6000 (41)	3900 (27)	0.24	2600 (18)	1400 (10)	0.19
20 (140)	8600 (59)	5300 (37)	0.23	3300 (23)	1800 (12)	0.19
40 (280)	13000 (90)	8700 (60)	0.25	4100 (28)	2500 (17)	0.23
60 (410)	16000 (110)	13000 (90)	0.29	4700 (32)	3500 (24)	0.28

Soil Type: GM, SM, ML, and GC, SC with < 20% fines

Stress level	95% D698			85% D698		
psi (kPa)	E_s	B	ν_s	E_s	B	ν_s
1 (7)	1800 (12)	1900 (13)	0.34	600 (4)	400 (3)	0.25
5 (34)	2500 (17)	2000 (14)	0.29	700 (5)	450 (3)	0.24
10 (70)	2900 (20)	2100 (14)	0.27	800 (6)	500 (3)	0.23
20 (140)	3200 (22)	2500 (17)	0.29	850 (6)	700 (5)	0.30
40 (280)	3700 (25)	3400 (23)	0.32	900 (6)	1200 (8)	0.38
60 (410)	4100 (28)	4500 (31)	0.35	1000 (7)	1800 (12)	0.41

Soil Type: CL, MH, GC, SC

Stress level	95% D698			85% D698		
psi (kPa)	E_s psi	B psi	ν_s	E_s	B	ν_s
1 (7)	400 (3)	800 (6)	0.42	100 (1)	100 (1)	0.33
5 (34)	800 (6)	900 (6)	0.35	250 (2)	200 (1)	0.29
10 (70)	1100 (8)	1000 (7)	0.32	400 (3)	300 (2)	0.28
20 (140)	1300 (9)	1100 (8)	0.30	600 (4)	400 (3)	0.25
40 (280)	1400 (10)	1600 (11)	0.35	700 (5)	800 (6)	0.35
60 (410)	1500 (10)	2100 (14)	0.38	800 (6)	1300 (9)	0.40

Note: Units of E_s and B are psi (MPa).

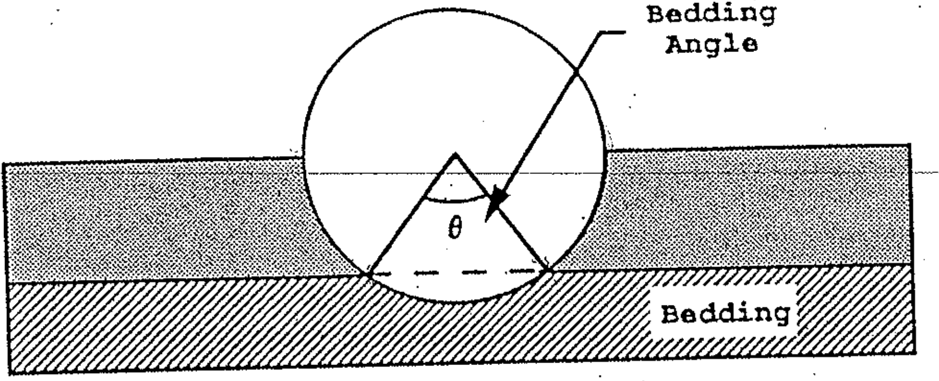
Deflections of buried flexible pipe are commonly calculated using the Iowa formula [1] which uses the modulus of soil reaction (E') as the parameter representing soil stiffness. Since E' is not a directly measureable soil parameter, but must be determined by back-calculation using observed pipe deflections, studies have been carried out to seek a correlation between E' and soil stiffness parameters such as Young's modulus (E_s) and constrained modulus (M_s), where E_s and M_s are related

REF: SELIG, E.T., "SOIL PROPERTIES FOR PLASTIC PIPE INSTALLATIONS," BURIED PLASTIC PIPE TECHNOLOGY, ASTM STP 1093, BUZZCALA AND CASSIDY, EDS., 1990.

K= BEDDING CONSTANT

Values of Bedding Constant

Bedding Angle (degrees)	K
* 0	0.110 *
30	0.108
45	0.105
60	0.102
90	0.096
120	0.090
180	0.083



(from Wilson-Fahmy and Koerner, 1994)

Geosyntec
consultants

COMPUTATION COVER SHEET

Client: **Vista LF, LLC** Project: **Vista Landfill – Substantial Permit Mod** Project No.: **FL1229**

Phase No.:

Title of Computations **Leachate Pumps and Conveyance System Design**

Computations by: Signature

Printed Name Erik J. Nelson, P.E. Date

Title Sr. Engineer

Assumptions and Procedures Checked by: (peer reviewer) Signature

Printed Name Juan D. Quiroz, Ph.D., P.E. Date

Title Project Engineer

Computations Checked by: Signature

Printed Name Sangho "Jay" Eun, E.I.T. Date

Title Senior Staff Engineer

Computations backchecked by: (originator) Signature

Printed Name Erik J. Nelson, P.E. Date

Title Sr. Engineer

Approved by: (pm or designate) Signature

Printed Name Juan D. Quiroz, Ph.D., P.E. Date

Title Project Engineer

Approval notes:

Revisions (number and initial all revisions)

No.	Sheet	Date	By	Checked by	Approval

Written by:	**E. Nelson**	Date:	**07/20/07**	Reviewed by:	**J. Quiroz**	Date:	**07/20/07**
Client:	**Vista LF LLC**	Project:	**Vista Landfill**	Project No.:	**FL1229**	Phase No.:	**02**

LEACHATE PUMPS AND CONVEYANCE SYSTEM DESIGN
CLASS III VISTA LANDFILL
APOPKA, FLORIDA

PURPOSE

The purpose of this calculation package is to describe the methodologies and assumptions used to select a pump and piping system that is capable of conveying collected leachate from the leachate sumps to the leachate storage area. The leachate sump pumps were designed to pump leachate directly from each leachate sump to the leachate storage tanks located near Cells 1 and 5 as shown on Sheet 6 of the Permit Drawings.

Each cell will be equipped with one submersible pump installed inside of the side slope riser. Each pump will be automatically controlled by a level transducer installed along with the pump (Attachment 1). The level transducer will transmit a signal to the level controller located inside the control panel at the top of the side slope riser. The level controller will be programmed with three set points, low level (pump off), high level (pump on) and high high level (alarm condition). The alarm condition is used to indicate that a problem has occurred where the leachate level has exceeded a pre-set depth inside the sump.

The following discussion describes the method of selection for the leachate pumps and the criteria used to select the pumps and size the leachate transmission pipeline.

PROCEDURE

Pump selection is a function of required pumping capacity and total head. To be effective a leachate sump needs to be capable of removing leachate from the cell quickly to prevent excessive head to build up on the liner. Ideally, a leachate sump pump would be capable of pumping the maximum instantaneous leachate generation rate. However, this would result in a leachate pump with significantly higher pumping capacity than is necessary for most applications. Therefore, pump selection was based on removing the peak daily leachate volume generated within a 24 hour period.

Written by: **E. Nelson** Date: **07/20/07** Reviewed by: **J. Quiroz** Date: **07/20/07**

Client: **Vista LF LLC** Project: **Vista Landfill** Project No.: **FL1229** Phase No.: **02**

Based on the results of the HELP model run for this site (see Appendix F of this permit application package), the maximum peak daily leachate generation rate was 4,256 gallons per acre per day. Multiplying this value by the largest cell foot print of 9.2 acres, results in a maximum daily leachate volume of 39,155 gallons. Further dividing this volume by the number of minutes in a day, 1440 minutes per day, results in a flow rate of 27.2 gallons per minute (gpm). Assuming a factor of safety of 2 would then yield a design flow rate of 54.4 gpm.

Pumping head is a combination of head losses resulting from pipe length, pipe diameter, pipe material, elevation differential and total flow rate in the pipe. For design purposes it was assumed that more than one sump pump may be operating at one time, resulting in a flow rate higher than the individual pumping rate. For purposes of this evaluation it was assumed that up to four pumps may be operating at once. This would require the leachate transmission pipeline to carry 218 gpm, the combined flow of 4 sump pumps running simultaneously. Therefore, the minimum flow rate used in selecting the pipe size for the leachate transmission line was based on this value.

The longest pipe length was used in performing the head loss calculations. The distance from the sump at Cell 3 to the leachate storage area is approximately 4,200 ft. This was the value used in calculating the head loss.

Elevation head was calculated as the maximum elevation differential between the lowest landfill sump bottom and the top of the leachate storage tanks. The elevation change between the sump elevation in Cell 3 and the top of the leachate storage tanks was approximately 75 feet. The elevation head is added to the head losses due to pipe friction to calculate the total pumping head.

Head loss in the pipe and pumping rate of the pumps are both dependant on each other. This results in an iterative process of pump selection. Pump selection is made from a pump curve that shows the pumping rate in relation to the pumping head (Figure 1). The calculated pumping head is compared to the pump curve to identify a new pumping rate which is used to calculate a new pumping head. This process is continued until a stable pumping rate and pumping head value is reached.

Based on the assumptions presented above, a Sligo Systems Series 3 Model 3-7.5-3 (Attachment 2) will provide 64 gpm of pumping capacity under 110 feet of head (Figure 1). At a flow rate of 64 gpm (multiplies by 4 pumps running simultaneously), approximately 15.24 psi (35.2 ft) of head loss would be generated for a 6 inch diameter, SDR17 HDPE pipe (Figure 2). The resulting pumping rate from this combination of pump and pipe size will result in an individual pumping capacity of 64 gpm which exceeds the 54.4 gpm minimum design rate.

Head calculations were also conducted for both 4 inch and 8 inch diameter leachate transmission lines. Head losses and fluid velocities were very high in the 4 inch pipe, requiring a much larger pump. Head losses in the 8 inch diameter pipe were not low enough to justify the selection of a smaller pump. There for a 6 inch diameter SDR 17 pipe was selected for this application.

REFERENCES

Chevron Chemical Company, (1990), "PLEXCALC™", *Calculation software for the Equations from Plexco/Spirolite Engineering Manual Vol. 2: System Design, Rev. 6/99.*

FIGURE 1

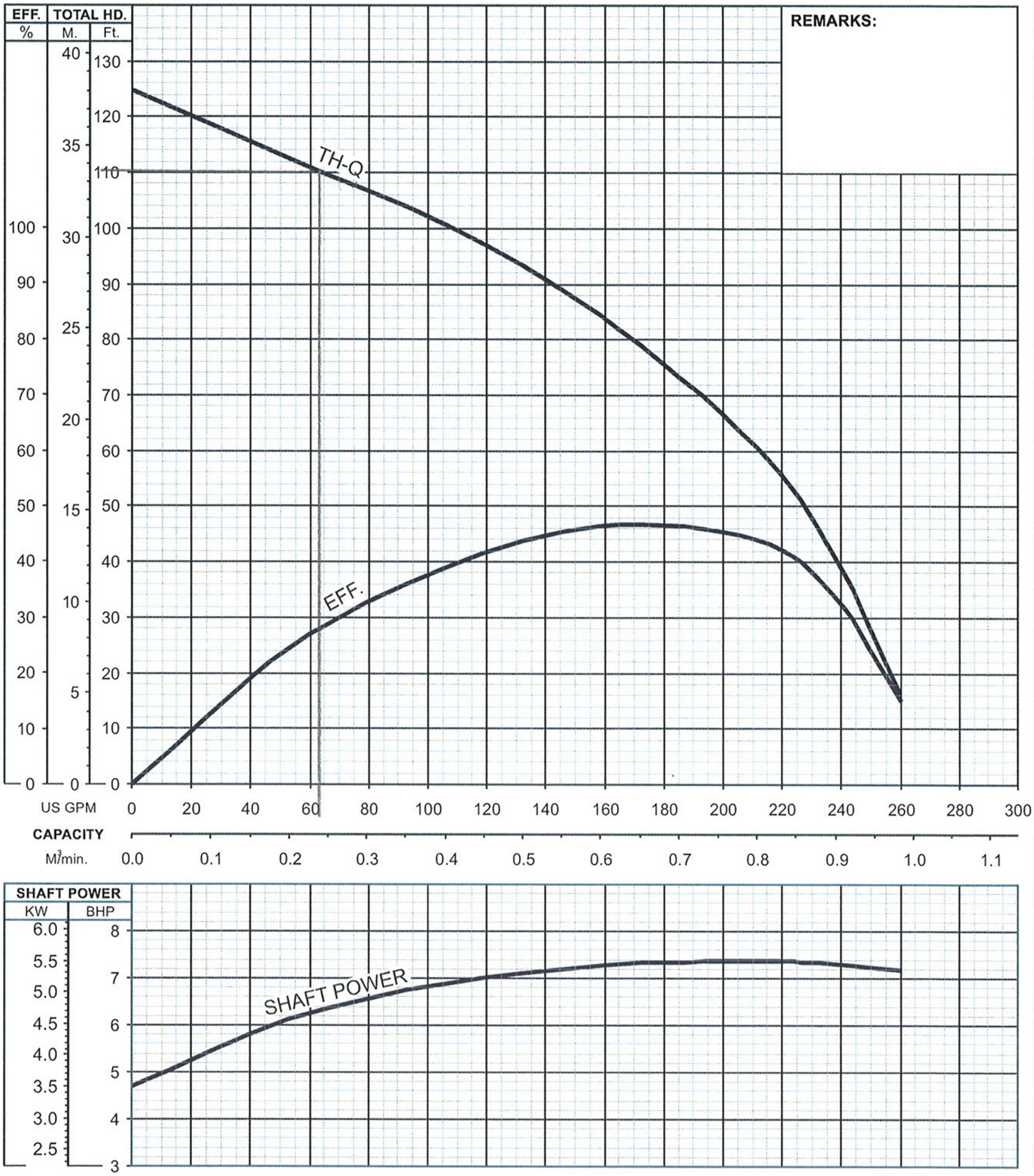
SLIGO SYSTEMS	SERIES 3 PUMPS PERFORMANCE CURVE	3-7.5-3

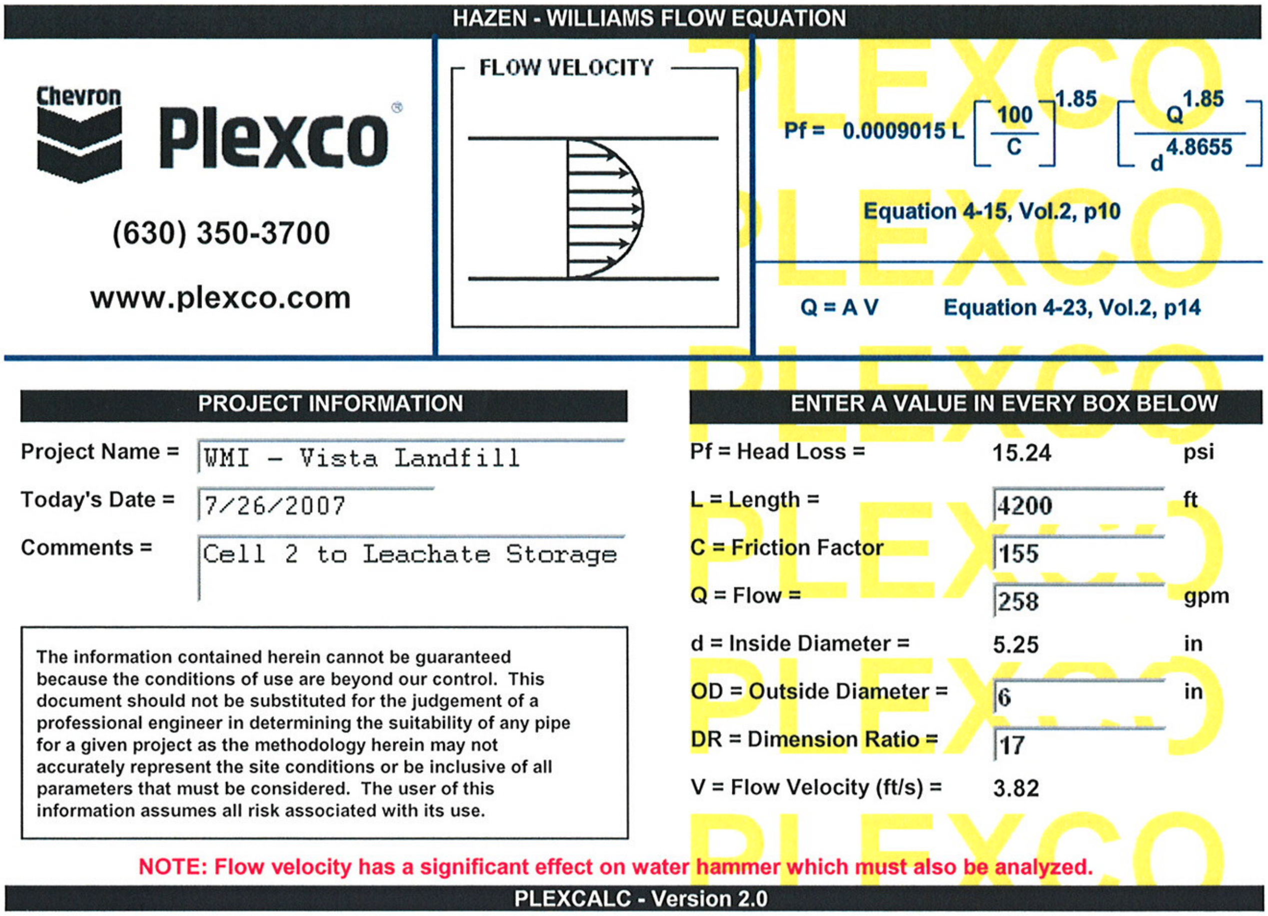
MODEL	BORE	HP	KW	RPM	SOLIDS DIA	LIQUID	SG.	VISCOSITY	TEMP.
3-7.5-3	3"/80mm	7.5	5.5	3430	0.334"/8.5mm	Water	1.0	1.81 CST	60°F

PUMP TYPE	PHASE	VOLTAGE	AMPERAGE	HZ	STARTING METHOD	INS. CLASS
Leachate Pump	3	208/230/460/575	21.0 / 19.0 / 9.5 / 7.3	60	Direct On Line	E

CURVE No.	DATE	PHASE	VOLTAGE	AMPERAGE	HZ	STARTING METHOD	INS. CLASS
-	-	-	-	-	-	-	-

REMARKS:





HAZEN - WILLIAMS FLOW EQUATION

Chevron
Plexco®

(630) 350-3700

www.plexco.com

$$P_f = 0.0009015\,L\left[\frac{100}{C}\right]^{1.85}\left[\frac{Q^{1.85}}{d^{4.8655}}\right]$$

Equation 4-15, Vol.2, p10

$Q = A\,V$ Equation 4-23, Vol.2, p14

PROJECT INFORMATION

Project Name = WMI – Vista Landfill

Today's Date = 7/26/2007

Comments = Cell 2 to Leachate Storage

The information contained herein cannot be guaranteed because the conditions of use are beyond our control. This document should not be substituted for the judgement of a professional engineer in determining the suitability of any pipe for a given project as the methodology herein may not accurately represent the site conditions or be inclusive of all parameters that must be considered. The user of this information assumes all risk associated with its use.

ENTER A VALUE IN EVERY BOX BELOW

Pf = Head Loss =	15.24	psi
L = Length =	4200	ft
C = Friction Factor	155	
Q = Flow =	258	gpm
d = Inside Diameter =	5.25	in
OD = Outside Diameter =	6	in
DR = Dimension Ratio =	17	
V = Flow Velocity (ft/s) =	3.82	

NOTE: Flow velocity has a significant effect on water hammer which must also be analyzed.

PLEXCALC - Version 2.0

FIGURE 2

Attachment 1

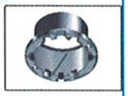
SLIGO SYSTEMS | SERIES 3 PUMPS | SPECIFICATIONS

■ FEATURES

1. Semi-open, high chrome iron impeller with ductile iron wear plate increases wear resistance when pumpage contains abrasive particles.
2. Double inside mechanical seals with silicon carbide faces, running in an oil filled chamber and further protected by a lip seal running against a replaceable, 420 stainless steel shaft sleeve and impeller hub provides for the most durable seal design available.
3. Highly efficient, continuous duty air filled, copper wound motor with class E or B insulation, minimizes the cost of operation.
4. Optional thermal & amperage sensing, protector prevents motor failure due to single phasing, overloading or accidental run - dry conditions.
5. Double shielded, permanently lubricated, high temperature C3 ball bearings rated for a B-10 life of 60,000 hours, extend operational life.
6. Top discharge, flow-thru design enables operation at low water levels for extended periods.

■ APPLICATIONS

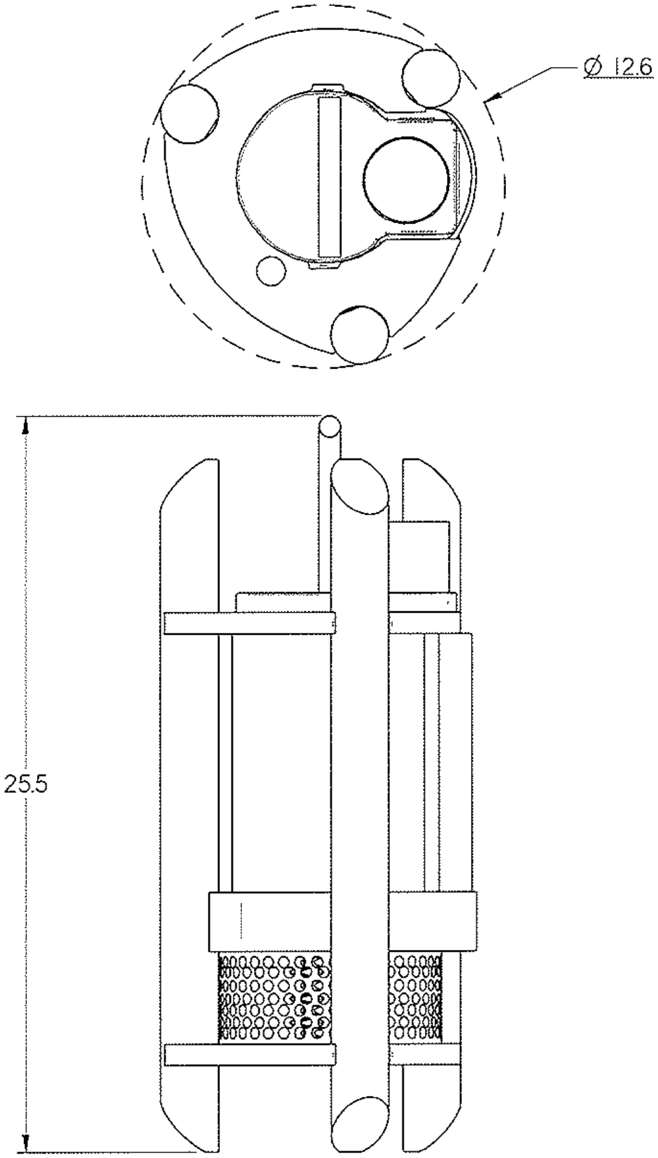
1. Commercial, industrial wastewater and construction site drainage.
2. Effluent transfer.
3. Leachate
4. Raw water supply from rivers or lakes.

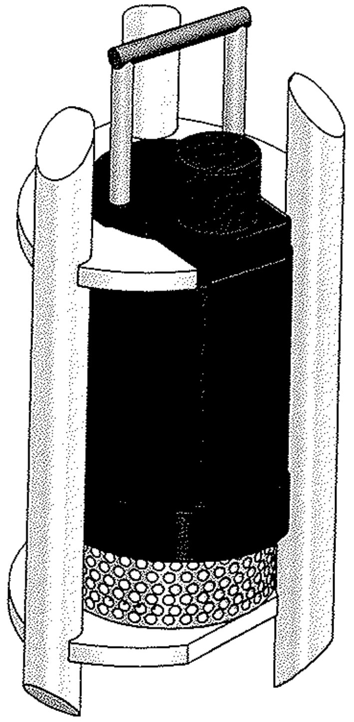


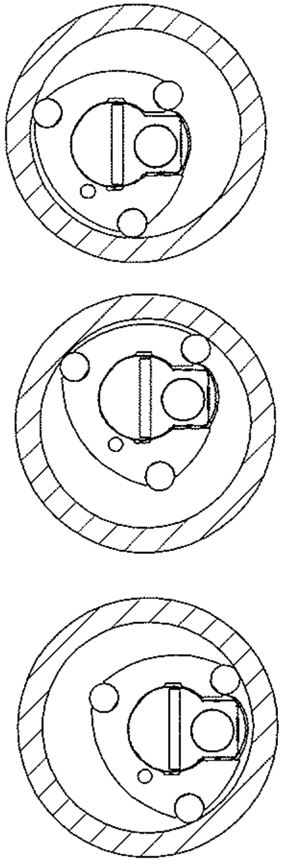
OILLIFTER

■ SPECIFICATIONS	■ STANDARD OPTIONS	■
Discharge Size	2" ~ 6" Npt (50 ~ 150 mm)	
Horsepower Range	2 ~ 15 Hp. (1.5 ~ 11 kW)	
Performance Range Capacity	25 ~ 650 Gpm. (.09 ~ 2.46 m^3/min)	
Head	5 Ft. ~ 150 Ft. (1.5 ~ 45.7 m)	
Maximum Water Temperature	104 F. (40 C.)	
Materials of Construction		
Casing	Cast Iron	
Impeller	High Chrome Iron Casting	
Shaft	420 Stainless Steel	
Motor Frame	Cast Iron	
Fasteners	304 Stainless Steel	
Mechanical Seal	with Seal Pressure Relief Ports (10 ~ 15 HP)	
Upper Seal	Silicon Carbide/Silicon Carbide (2 ~ 3 Hp.) Silicon Carbide/Carbon (5 ~ 15 Hp.)	
Lower Seal	Silicon Carbide/Silicon Carbide	
Elastomers	NBR (Nitrile Rubber)	
Impeller Type	Semi-open	
Solids Handling Capability	1/3" or 4/5" (8.5 or 20 mm)	
Motor Nomenclature		
Type, Speed, Hz	Air Filled, 3600 Rpm, 60 Hz.	
Voltage, Phase	208/230/460/575 V., 3 Phase	
Insulation	Class E, B (10 HP and 15 HP)	
Bearings	Pre-lubricated, Double Shielded	
Accessories	Submersible Power Cable 50' (15 m)	Length as Required
Operational Mode	Manual	Low Level Strainer

REVISION HISTORY			
REV	DESCRIPTION	DATE	APPROVED







PUMP IN 18" SDR-11 RISER

	NAME	DATE
DRAWN		
CHECKED		
ENG APPR		
MGF APPR		

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MILLIMETERS
ANGLES ±X.X°
2 PL ±X.XX 3 PL ±X.XXX

SLIGO SYSTEMS
Ormond Beach, Florida

TITLE:
Series 3-3-2 Pump
In 18" SDR-11 Riser

SIZE A1 DWG NO. REV

SCALE WEIGHT

Attachment 2

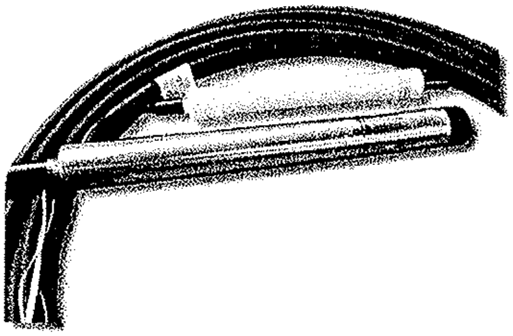
SLIGO SYSTEMS
Landfill Pumps & Controls
Ormond Beach, Florida
386 615 8780
www.sligosystems.com

Submersible Level Transducer

Series 700

FEATURES

- Custom Level Ranges up to 700 ft (210 m) H_2O
- Accuracy of up to ±0.05% FS Available
- Analog Outputs of 4-20 mA, 0-5 VDC or mV
- Welded 316 SS or Titanium Construction
- Optional Lifetime Lightning Protection
- Optional Temperature Measurement Output
- Custom Cable Lengths



APPLICATIONS

- Well Monitoring
- Level Control
- Oceanographic Research
- Lift Stations
- Ground Water Monitoring
- Surface Water Monitoring
- Slug Tests
- Pump Control
- Soil Remediation

The Series 700 family of submersible hydrostatic level transducers is specifically designed to meet the rigorous environments encountered in liquid level measurement and control. They can be configured to perform to specifications under most adverse, reactive conditions.

All Sligo Transducers utilize a highly accurate pressure sensor assembly specifically designed for hostile fluids and gases. The assembly is integrated with supporting electronics in a durable waterproof housing constructed of 316SS or Titanium. The attached electrical cable is custom manufactured to Sligo Systems' specifications and includes Kevlar® members to prevent errors due to cable elongation as well as a unique water block feature that self-seals in the event of accidental cuts to the cable. Each transducer is shipped with our latest SuperDry™ Vent Filter that prevents moisture from entering the vent tube for at least one year without maintenance even in the most humid environments.

These units are designed for installation in a Class I, Division 1, Groups A, B, C, and D, Class II, Division 1, Groups E, F and G, Class III, Division 1 hazardous location when connected to appropriate apparatus such as those manufactured by R. G. Stahl, Inc., and others. KPSI transducers are type approved by the American Bureau of Shipping (ABS) and are UL, CUL, and FM approved and have a IP 68 and NEMA 6P housing protection rating. The Series 700 is CE compliant to EN 61000-6-4:2001 and EN 61000-6-2:2001.

Series 700 Specifications

Specifications subject to change without notice.

Parameter	~~735~~[6]	~~730~~[6]	~~720~~	~~710~~	700	Units	Comments
LEVEL RANGES							
Full Scale Level Ranges[8]	5 thru 700 (1.5 thru 210)			2.5 thru 700 (.75 thru 210)		ft H_20 (m H_20)	for vented gage reference
	N/A	35 thru 700 (10 thru 210)	10 thru 700 (3 thru 210)			ft H_20 (m H_20)	for sealed gage reference
	N/A	35 thru 700 (10 thru 210)				ft H_20 (m H_20)	for absolute reference
Proof Pressure	1.5					x FS	
Burst Pressure	2.0					x FS	
STATIC PERFORMANCE							
Static Accuracy[1]	±0.05	±0.10	±0.25	±0.50	±1.00	%FSO	BFSL method
Resolution	Infinitesimal						
ENVIRONMENTAL							
Wetted Materials	316 SS or Titanium; Delrin®; polyurethane or Viton®						Delrin® and Viton® are registered trademarks of DuPont.
Compensated Temp Range	0 to 50					°C	
Thermal Error[2]	±0.05[4]					%FSO/°C	worst case over compensated temperature range
Operating Temp Range	-20 to 60					°C	
Protection Rating	IP 68, NEMA 6P						
ELECTRICAL							
Excitation	9 - 30 2.5 - 10					VDC	for mA, VDC and non-ratiomeric mV output for ratiometric mV output
Input Current	20 3.5					mA max	for mA output for VDC output
Output	4 - 20 0 - 5 0 - 100[3] 2.5 - 10					mA VDC mV mV / V	options available[7] non-ratiometric ratiometric (range dependent)
Zero Offset	±0.20[5] < 0.1 ±0.6					mA VDC mV	for mA output for VDC output for mV output
Output Impedance	See Loop Resistance diagram on page 7 <10 3000 - 5000					ohm	for mA output for VDC output for mV output
Insulation Resistance	100					mega ohm	at 50 VDC
Circuit Protection	Polarity, surge/shorted output						

Series 700 Specifications

Parameter	735[6]	730[6]	720	710	700	Units	Comments
PHYSICAL							
Approximate Weight	0.44 (198) 0.05 (79)					lbs (g) lbs/ft (g/m)	transducer cable
Cable							Tefzel®, Teflon® and Kevlar® are registered trademarks of DuPont.
Jacket Material	Polyurethane (std) Tefzel® (opt)						
Pull Strength	200 (90)					lbs (kg)	
Number of Conductors	4						
Conductor Size	22					AWG	
Cable Seal	Molded Polyurethane Viton® Gland						for polyurethane cable for Tefzel® cable
TEMPERATURE OUTPUT OPTION (NOT INTRINSIC SAFETY APPROVED)							
Temperature Range	0 to 50 -20 to 60					°C	available for 4-20mA output versions only
Output Signal	4-20					mA	
Temperature Measurement Accuracy	±4					°C	
LIGHTNING PROTECTION (OPTIONAL)							
Life Expectancy	> 1000 operations						
Peak Clamping Voltage	36 volts						
Response Time	< 10 nsecs						

Notes:

1 Static accuracy includes the combined errors due to nonlinearity, hysteresis and nonrepeatability on a Best Fit Straight Line (BFSL) basis, at 25°C per ISA S51.1.

2 Thermal error is the maximum allowable deviation from the Best Fit Straight Line due to a change in temperature, per ISA S51.1.

3 For ranges < 23 ft H_2O (7 m H_2O), output is 0-50 mV.

4 For ranges < 12 ft H_2O (4 m H_2O), maximum thermal error is ±0.1% FSO/°C.

5 For ranges <= 5 ft H_2O (1 m H_2O), zero offset is ±0.25 mA.

6 For ranges > 230 ft H_2O (70 m H_2O), output is 4-20 mA only.

7 Optional VDC outputs can be provided up to 2.5 VDC less than the excitation supply voltage.

8 Intermediate level ranges are available.

Series 700 Accessories

Uniquely-Designed Submersible Cable

Our level transducers utilize one of two types of custom cable made specifically for submersible applications. The cable of choice for most applications is a polyurethane-jacketed cable incorporating Kevlar® strength members to prevent errors due to cable elongation, and a water block liner to prevent water intrusion due to minor cuts to the cable jacket. Polyurethane cable is attached to the transducer using an injection molded polyurethane cable seal.

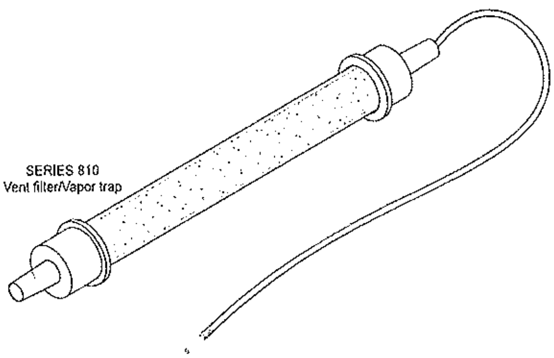
The other alternative is a Tefzel®-jacketed cable which provides superior chemical resistance and toughness yet preserving the other features found in the polyurethane-jacketed cable. Tefzel® is a Teflon® derivative from DuPont and is the better choice for caustic media or when a high degree of abrasion is anticipated. While more expensive and less flexible, it can save money in the long term due to reduced maintenance costs. Tefzel® cable is attached to the transducer using a compressed Viton® gland cable seal.

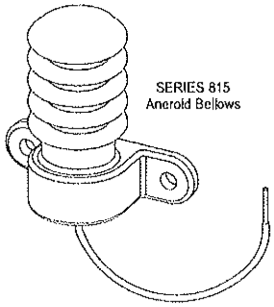
Both submersible cables have a pull strength of over 200 lbs. In all installations, care should be taken to ensure no damage occurs to the cable as cable damage represents one of the most frequent causes of transducer failure. In the case where the user is not sure which material is best, contact Pressure Systems for assistance.

Moisture Protection

Our submersible transducers are equipped with custom, vented cable. The vent provides an atmospheric reference for the sensor, which is necessary for ensuring the highest possible accuracy when making a level measurement. It must be noted that if left unprotected, it provides a pathway for water vapor to enter the level transducer. This vapor will condense into water and could create an offset in the transducer output, or cause permanent damage. For these reasons, a Series 810 desiccant-filled vent filter is provided free of charge with each Series 700 we ship. Our latest SuperDry™ Vent Filter prevents moisture from entering the vent tube for at least one year without maintenance. Replacement filters are available from the factory.

SuperDry™ Long Life Vent Filter





For those applications where periodic maintenance is not practical, our Series 815 Aneroid Bellows is a direct replacement for the vent filter. This sensitive bellows responds to and transmits changes in atmospheric pressure to the sensor while remaining a maintenance-free, closed system. It should be noted, however, that the bellows may not be a suitable replacement for the desiccant cartridge in applications where extremely high accuracy is required, usually 0.25% or better or where the bellows may be exposed to extreme temperature changes. The user is cautioned to evaluate a bellows in the specific application intended.

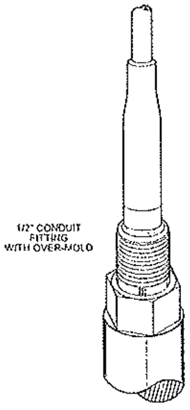
Series 700 Accessories

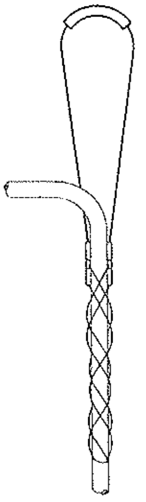
Installation Tips

The Series 700 family of submersible transducers may be suspended directly in the media or in a perforated 1" PVC instrumentation still well. Alternately, the transducer may be attached to a rigid conduit using a ½" NPT male conduit fitting.

When suspended by the cable, users often utilize our cable hanger (PN# 12-90-0931). This device slides onto the cable from the bare-wire end and is easily positioned anywhere on the cable by pushing the ends together. Once positioned, the cable hanger contracts to provide a snug grip.

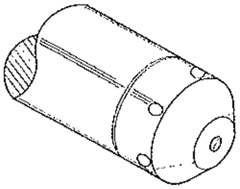
For applications requiring cable length in excess of 500 feet, consult the factory for proper installation and maintenance.

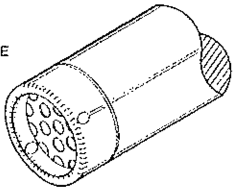


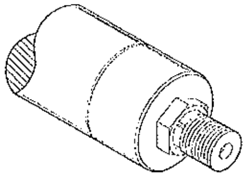

CABLE HANGER

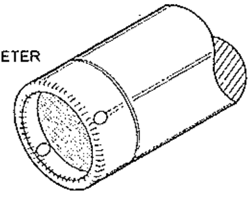
Nose Cap

Several different user-installable nose caps are available for the Series 700, 710, 720, 730, and 735 submersible level transducers. The closed-face port end cap with #8-32UNC-2B threaded hole is best used where weights are required and for those installations where users may encounter sharp, protruding objects. The standard submersible open-face port end cap which allows maximum contact with the liquid media is ideal for wastewater and "greasy" applications where clogging of the sensor is a concern. The ¼" male NPT pressure port end cap is not only useful for calibration purposes but also allows the device to be used as a submersible or above ground pressure transducer. The piezometer port end cap allows the unit to be buried in the ground without damage to the sensor diaphragm.


CLOSED-FACE


OPEN-FACE


NPT MALE


PIEZOMETER

Unamplified mV Output Signal Versions (Ratiometric vs. Non-ratiometric)

In addition to the amplified VDC and mA output signal versions, two unamplified millivolt output versions are offered depending on the available excitation supply voltage and the capabilities of the system to which the transducers are connected.

The ratiometric mV output version is used when the excitation is externally regulated or the system interfaced with the transducer is capable of compensating for fluctuations from the excitation supply. Such fluctuations to the supply will cause the output signal to fluctuate, and must therefore be measured and compensated. The benefit of a ratiometric design is that the output signal can also be compensated for temperature changes to the pressure sensor if the voltage sense lines are employed. **Transducers ordered with this option do not carry IS approvals.**

The non-ratiometric mV output version is used when the excitation voltage cannot be externally regulated or the system is incapable of compensating for changes to the excitation voltage.

Optional Lifetime Lightning/Surge Protection

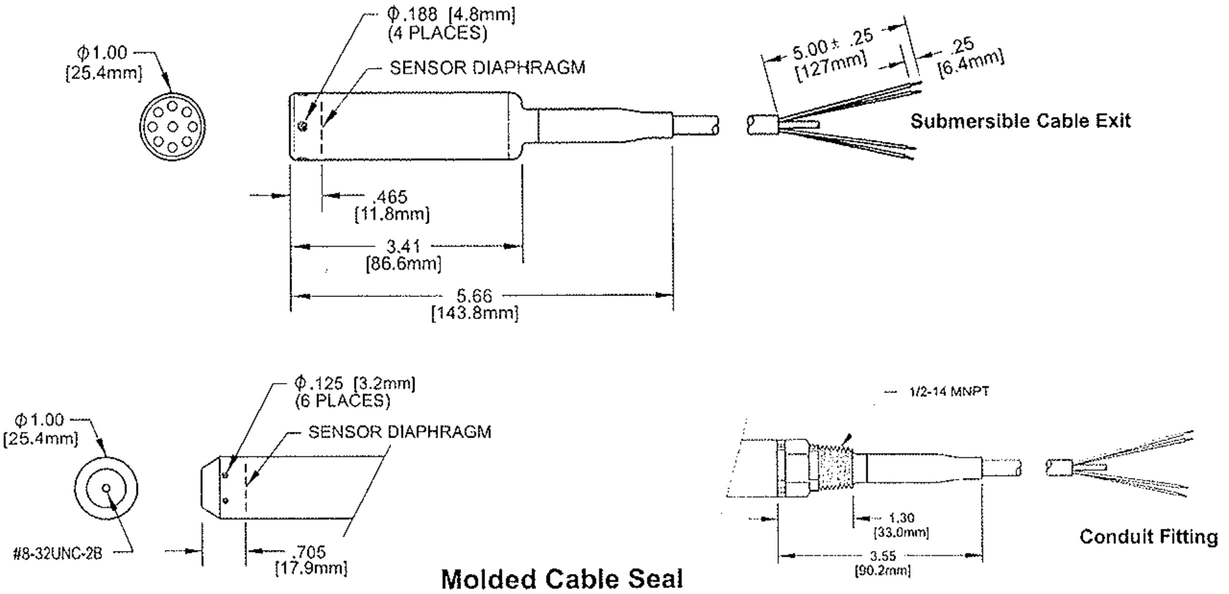
Lightning/Surge protection is offered for output signal versions of 0-5 VDC (PN# OPTION-012) and 4-20 mA (PN# OPTION-009). The option is ordered separately from the transducer.

Protection is achieved through the use of 2 components. One is located in a 6.5 inch long, 1 inch OD 316 SS housing extension to the non-sensing end of the transducer while the other is located at the surface and grounded via DIN-rail or ground wire. This option requires a minimum input voltage of 12 VDC. ***A unit ordered with this option is warranted for the life of the instrument against damage due to voltage surge.***

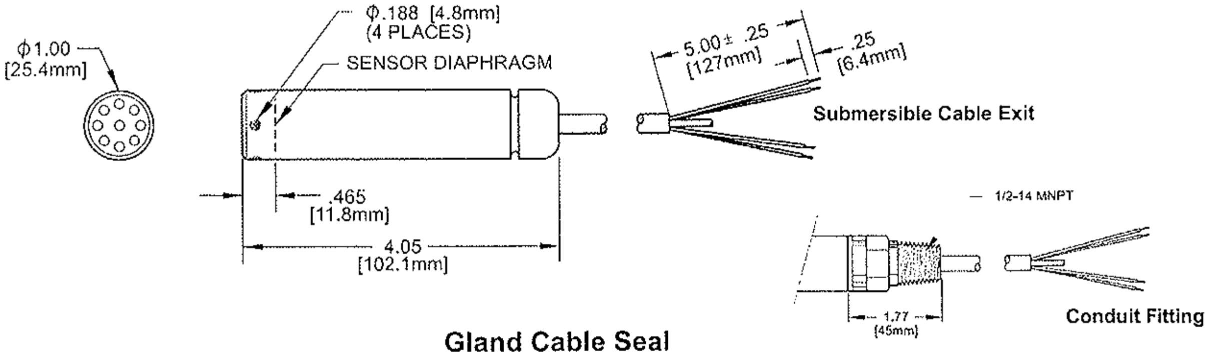
Temperature Measurement Output Option

As an option, a precision silicon temperature sensor can be installed within the transducer to provide a separate 4-20 mA temperature measurement output over the range of 0 to 50°C or -20 to 60°C. The accuracy of the temperature measurement is ±4°C. **Transducers ordered with this option do not carry IS approvals.**

Series 700 Technical Data



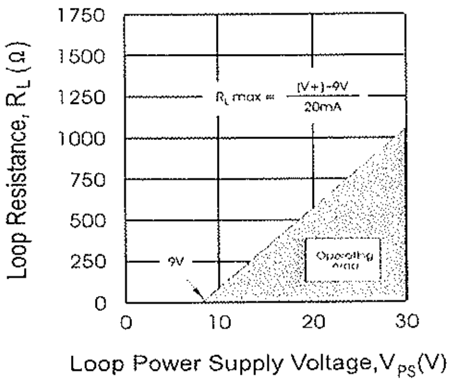
Molded Cable Seal



Gland Cable Seal

ELECTRICAL TERMINATION		
22AWG CONDUCTORS IN A SHIELDED CABLE WITH VENT TUBE		
4-20 mA	RED BLACK	+ EXCITATION - EXCITATION
0-5 VDC	RED BLACK WHITE	+ EXCITATION - EXCITATION + SIGNAL
mV	RED BLACK WHITE GREEN	+ OUTPUT + EXCITATION - EXCITATION - OUTPUT
ALL	DRAIN WIRE	SHIELD

LOOP RESISTANCE vs.
LOOP POWER SUPPLY



Geosyntec consultants

COMPUTATION COVER SHEET

Client: **Vista LF, LLC** Project: **Vista Landfill – Substantial Permit Mod** Project No.: **FL1229**

Phase No.:

Title of Computations **ANCHOR TRENCH DESIGN EVALUATION**

Computations by:
Signature
Printed Name Wade Tyner, E.I.T.
Title Staff Engineer
5 July 2007
Date

Assumptions and Procedures Checked by:
(peer reviewer)
Signature Juan D. Quiroz
Printed Name Juan D. Quiroz, Ph.D., P.E.
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9 July 2007
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9 July 2007
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Title Staff Engineer
25 July 2007
Date

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(pm or designate)
Signature Juan D. Quiroz
Printed Name Juan D. Quiroz, Ph.D., P.E.
Title Project Engineer
27 July 2007
Date

Approval notes:

Revisions (number and initial all revisions)

No.	Sheet	Date	By	Checked by	Approval

Written by: **W. Tyner** Date: **07/05/07** Reviewed by: **J. Quiroz** Date: **07/09/07**

Client: **Vista LF, LLC** Project: **Vista LF – Substantial** Project No.: **FL1229** Phase No.:

ANCHOR TRENCH DESIGN EVALUATION
VISTA CLASS III LANDFILL
APOPKA, FLORIDA

INTRODUCTION

The purpose of this calculation package is to present the adequacy of the anchor trench design associated with the Vista Class III Landfill facility located in Apopka, Florida. Calculations were performed to evaluate the anchorage provided by the perimeter anchor trench along the landfill footprint perimeter and adjacent to the landfill liner system side slope. The anchor trench will be constructed to hold in-pace the geosynthetics (i.e., drainage geocomposite and geomembrane) utilized for the landfill liner system.

The subsequent sections present several aspects of the anchor trench design evaluation and include the following items:

- Input parameters and assumptions used for the anchor trench analysis including the proposed anchor trench geometry, and geosynthetic and soil material properties;
- Static force equilibrium methodology utilized to evaluate the anchor trench design; and
- Results of the anchor trench calculations and adequacy of the proposed design.

INPUT PARAMETERS AND ASSUMPTIONS

Anchor Trench Configuration

Figure 1 presents the typical anchor trench configuration proposed for the Vista Class III Landfill facility. The liner protective layer is 2-ft thick, the side slopes are inclined at 3H:1V, and the geosynthetics are anchored in a 2 ft by 2 ft trench along the perimeter of the landfill footprint and adjacent to the landfill liner system side slope. The run-out length (L_{RO}) from the top of the side slope to the edge of the anchor trench is 2 ft. The geomembrane layer is also laid horizontally along the bottom of the anchor trench for added pullout resistance. The geosynthetic layers that are anchored in the trench consist of, from top to bottom, a double-sided drainage geocomposite underlain by a 60-mil high density polyethylene (HDPE) textured geomembrane layer.

General Fill Material Properties

The type of soil used to construct the anchor trenches will be general fill with an assumed unit weight of 110 pcf. In addition, a cohesion (c) of zero and angle of internal friction (ϕ) of 30° were selected to establish the shear strength of the soil. These material properties generally represent conservative values typical of compacted general fill.

HDPE Geomembrane Material Properties

The tensile strength of the geomembrane is required to evaluate the pullout resistance provided by the anchor trench. The minimum tensile strength of the proposed 60 mil HDPE textured geomembrane was based on the guidance provided by the Geosynthetic Research Institute, specifically *GRI Test Method GM-13 – Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes* (GRI, 2003). Minimum strength values as established by GRI GM-13 have been provided in Attachment 1 and indicate a minimum break or rupture strength (i.e., ultimate tensile strength, T_u), of 90 lb/in. For a factor of safety of 2 against rupture, the resulting allowable tensile strength (T_{allow}) is 45 lb/in.

Interface Friction Values

Interface friction (δ) values between geosynthetic-geosynthetic or soil-geosynthetic interfaces are required to evaluate the pullout resistance provided by the anchor trench, as will be discussed below. A summary of typical interface friction values for various geosyntethic and soil interfaces is provided in Attachment 2. A minimum δ value of 10° was conservatively utilized for the liner system interfaces and represents lower bound interface friction value

METHOD OF ANALYSIS

Anchor Trench Pullout Calculations

The methodology utilized to evaluate the proposed anchor trench design was based on the approach presented by Koerner (1999). [Note: The geosynthetic layers may be placed horizontally along the bottom of the anchor trench for added pullout resistance. The analysis presented herein will not consider this added resistance; and therefore represents a conservative analysis.] Ideally, the anchor trench is designed to pull out the geosynthetics slightly rather than tear or rupture the geosynthetics. So if pullout has occurred, it is easier to restore the anchor trench configuration than actually repair/replace a torn geosynthetic. Therefore, the holding capacity of the anchor trench should be less than the ultimate (tear) tensile strength of the geosynthetic to be anchored, irrespective of the applied loads.

The two basic elements associated with a typical anchor trench design are: (i) run-out length (L_{RO}), which is the length of geosynthetic from the crest of the side slope to the edge of the anchor trench; and (ii) depth of anchor trench (d_{AT}). As shown in Figure 1, the proposed design consists of L_{RO} = 2 ft and d_{AT} = 2 ft. If the calculated L_{AT} and d_{AT} are less than what is proposed, then the design is adequate.

Static force equilibrium, including passive and active earth pressure theory, was utilized to establish one equation with two unknowns, L_{RO} and d_{AT}. The assumed free-body diagram developed by Koerner (1999) is presented in Attachment 3, and the solution in terms of the two variables is defined as follows:

$$T_{allow} \cos \beta = F_{U\sigma} + F_{L\sigma} + F_{LT} - P_A + P_P$$

where

T_{allow} = allowable tensile force in the geomembrane

= $\sigma_{allow}\, t$;

$F_{U\sigma}$ = shear force above geomembrane due to cover soil

= $\sigma_n \tan\delta_U (L_{RO})$;

$F_{L\sigma}$ = shear force below geomembrane due to soil layer load

= $\sigma_n \tan\delta_L (L_{RO})$;

F_{LT} = shear force below geomembrane due to vertical component of T_{allow}

= $T_{allow} \sin\beta \tan\delta_L$;

P_A = active earth pressure against the backfill side of the anchor trench

= $(0.5\gamma_{AT}d_{AT} + \sigma_n) K_A d_{AT}$;

P_P = passive earth pressure against the in-situ side of the anchor trench

= $(0.5\gamma_{AT}d_{AT} + \sigma_n) K_P d_{AT}$;

γ_{AT} = unit weight of soil in anchor trench;

σ_n = applied normal stress from cover soil;

K_A = coefficient of active earth pressure = $\tan^2 (45 - \phi/2)$;

K_P = coefficient of passive earth pressure = $\tan^2 (45 + \phi/2)$;

ϕ = internal friction angle of soil;

L_{RO} = run-out length;

d_{AT} = depth of anchor trench.

or

$$T_{allow} \cos\beta = \sigma_n \tan\delta_U (L_{RO}) + \sigma_n \tan\delta_L (L_{RO}) + T_{allow} \sin\beta \tan\delta - (0.5\gamma_{AT} d_{AT}) K_A d_{AT} + (0.5\gamma_{AT} d_{AT}) K_P d_{AT}$$

As previously mentioned, a minimum δ value of 10° was utilized for all geosynthetic-geosynthetic and geosynthetic-soil interfaces.

ANCHOR TRENCH DESIGN EVALUATION RESULTS

Calculations were performed to evaluate the adequacy of the anchor trench design associated with the Vista Class III Landfill facility, and are included in Attachment 4. For the given configuration presented in Figure 1 and the geosynthetic material properties presented above, a minimum anchor trench depth (d_{AT}) of 1.6 ft was calculated. This value is less than the proposed d_{AT} of 2 ft, which indicates that the proposed design is adequate.

CONCLUSIONS

The results of the anchor trench design evaluation indicate that the proposed depth of anchor trench (d_{AT}) of 2 ft is adequate relative to geosynthetic pullout resistance. A required d_{AT} of 1.6 ft was calculated.

Prior to construction of the liner system, the interface friction angles between the actual soil and geosynthetic materials will be verified by performing site-specific interface shear strength testing.

Written by: **W. Tyner** Date: **07/05/07** Reviewed by: **J. Quiroz** Date: **07/09/07**

Client: **Vista LF, LLC** Project: **Vista LF – Substantial** Project No.: **FL1229** Phase No.:

REFERENCES

Koerner, R.M., Designing with Geosynthetics. 4th Ed. Prentice Hall, New Jersey, 1999.

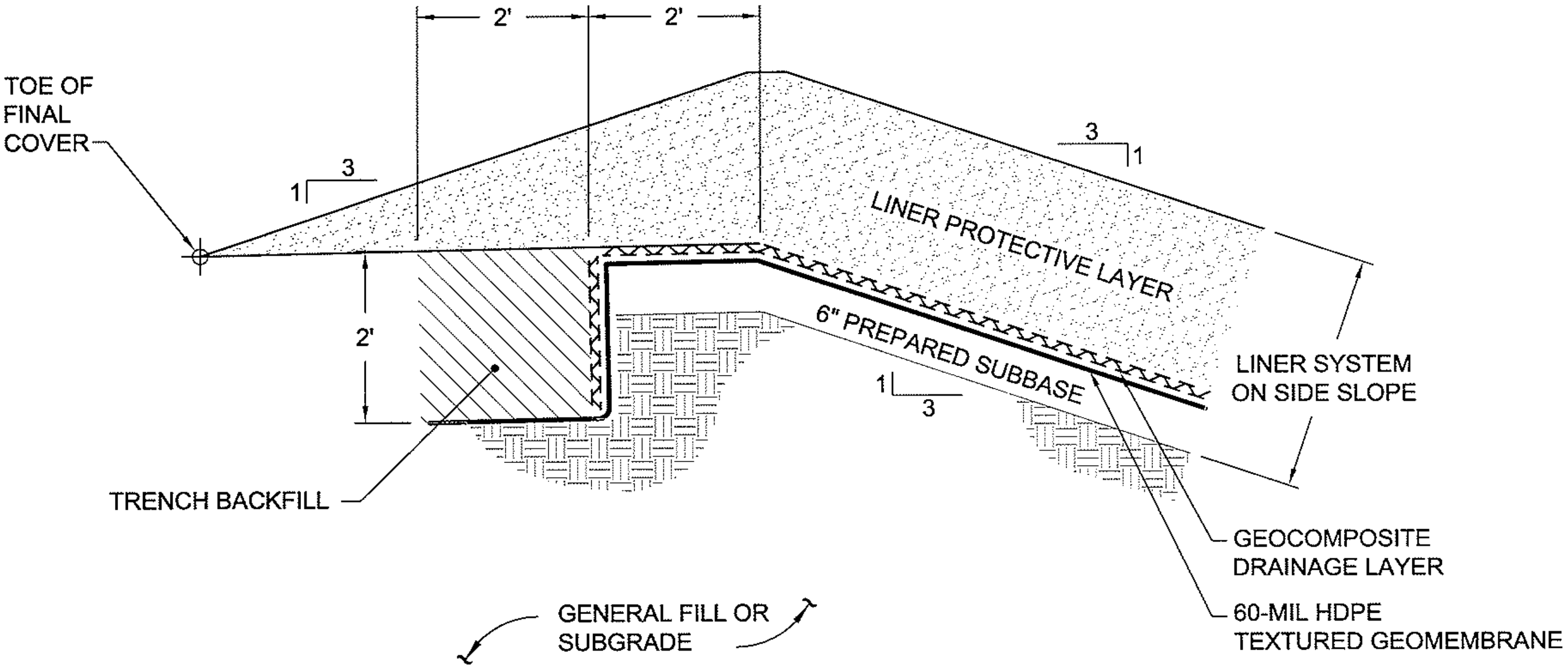
Koerner, R.M., Martin, J.P., and Koerner, G.R., "Shear Strength Parameters Between Geomembranes and Cohesive Soils," Journal of Geotextiles and Geomembranes, Vol. 4, No. 1, pp. 21-30, 1986.

Long, J. H., Daly, J. and Gilbert, R., "Structural Integrity of Geosynthetic Liner and Cover Systems for Solid Waste Landfills, Appendices A-K", Office of Solid Waste Research, Institute for Environmental Studies, University of Illinois at Urbana-Champaign, May, 1993.

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.

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.

FIGURES



ANCHOR TRENCH CONFIGURATION

Geosyntec consultants

TAMPA, FL

DATE:	JULY 2007	FILE NO.	FL1229.02F011
PROJECT NO.	FL1229.02	FIGURE NO.	1

I:\FL1229\FL1229.02\FIGURES\FL1229.02F011.DWG (5 December 2006) cvickers

ATTACHMENT 1

ENGLISH UNITS

Table 2(a) – High Density Polyethylene (HDPE) Geomembrane - Textured

Properties	Test Method	Test Value							Testing Frequency (minimum)
		30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils	
Thickness mils (min. ave.) • lowest individual for 8 out of 10 values • lowest individual for any of the 10 values	D 5994	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	per roll
Asperity Height mils (min. ave.) *(1)*	GM 12	10 mil	10 mil	10 mil	10 mil	10 mil	10 mil	10 mil	every 2nd roll *(2)*
Density (min. ave.)	D 1505/D 792	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	200,000 lb
Tensile Properties (min. ave.) *(3)* • yield strength • break strength • yield elongation • break elongation	D 6693 Type IV	63 lb/in. 45 lb/in. 12% 100%	84 lb/in. 60 lb/in. 12% 100%	105 lb/in. 75 lb/in. 12% 100%	126 lb/in. 90 lb/in. 12% 100%	168 lb/in. 120 lb/in. 12% 100%	210 lb/in. 150 lb/in. 12% 100%	252 lb/in. 180 lb/in. 12% 100%	20,000 lb
Tear Resistance (min. ave.)	D 1004	21 lb	28 lb	35 lb	42 lb	56 lb	70 lb	84 lb	45,000 lb
Puncture Resistance (min. ave.)	D 4833	45 lb	60 lb	75 lb	90 lb	120 lb	150 lb	180 lb	45,000 lb
Stress Crack Resistance *(4)*	D 5397 (App.)	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	per GRI GM10
Carbon Black Content (range)	D 1603 *(5)*	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	20,000 lb
Carbon Black Dispersion	D 5596	note *(6)*	note *(6)*	note *(6)*	note *(6)*	note *(6)*	note *(6)*	note *(6)*	45,000 lb
Oxidative Induction Time (OIT) (min. ave.) *(7)* (a) Standard OIT — or — (b) High Pressure OIT	D 3895 D 5885	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	200,000 lb
Oven Aging at 85°C *(7), (8)* (a) Standard OIT (min. ave.) - % retained after 90 days — or — (b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5721 D 3895 D 5885	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	per each formulation
UV Resistance *(9)* (a) Standard OIT (min. ave.) — or — (b) High Pressure OIT (min. ave.) - % retained after 1600 hrs *(11)*	GM11 D 3895 D 5885	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	per each formulation

(1) Of 10 readings; 8 out of 10 must be ≥ 7 mils, and lowest individual reading must be ≥ 5 mils

(2) Alternate the measurement side for double sided textured sheet

(3) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
Yield elongation is calculated using a gage length of 1.3 inches
Break elongation is calculated using a gage length of 2.0 inches

(4) P-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials.
The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.

(5) Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.

(6) Carbon black dispersion (only near spherical agglomerates) for 10 different views:
9 in Categories 1 or 2 and 1 in Category 3

(7) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

(8) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

(9) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.

(10) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.

(11) UV resistance is based on percent retained value regardless of the original HP-OIT value.

GEOSYNTHETIC RESEARCH INSTITUTE (2003), "GRI TEST METHOD GM-13 – TEST PROPERTIES, TESTING FREQUENCY AND RECOMMENDED WARRANTY FOR HIGH DENSITY POLYETHYLENE (HDPE) SMOOTH AND TEXTURED GEOMEMBRANES," REVISION 6, GEOSYNTHETIC RESEARCH INSTITUTE, FOLSOM, PA.

ATTACHMENT 2

Summary of Documented Interface Friction Values
Vista Class III Landfill
Apopka, Florida

Geosynthetic / Geosynthetic	δ (°)
Textured HDPE Geomembrane / Nonwoven Geotextile	15 to 35
Textured HDPE Geomembrane / Geocomposite Drainage Layer	17 to 29
Textured HDPE Geomembrane / Geonet	8 to 15
Geonet / Nonwoven Geotextile	14 to 22
Geosynthetic / Soil	**$\tan \delta / \tan \phi$**
Textured HDPE Geomembrane / Clay	0.8 to 0.9
Textured HDPE Geomembrane / Sand	0.7 to 0.8
Needle-punched Geotextile / Sand	0.8 to 1.0
Needle-punched Geotextile / Angular Gravel	0.7 to 0.9
Needle-punched Geotextile / Rounded Gravel	0.6 to 0.8
Needle-punched Geotextile / Silty Sands	0.96

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), Long et al. (1993), Koerner (1999), manufacturers literature, and unpublished results from Geosyntec Consultants.

ATTACHMENT 3

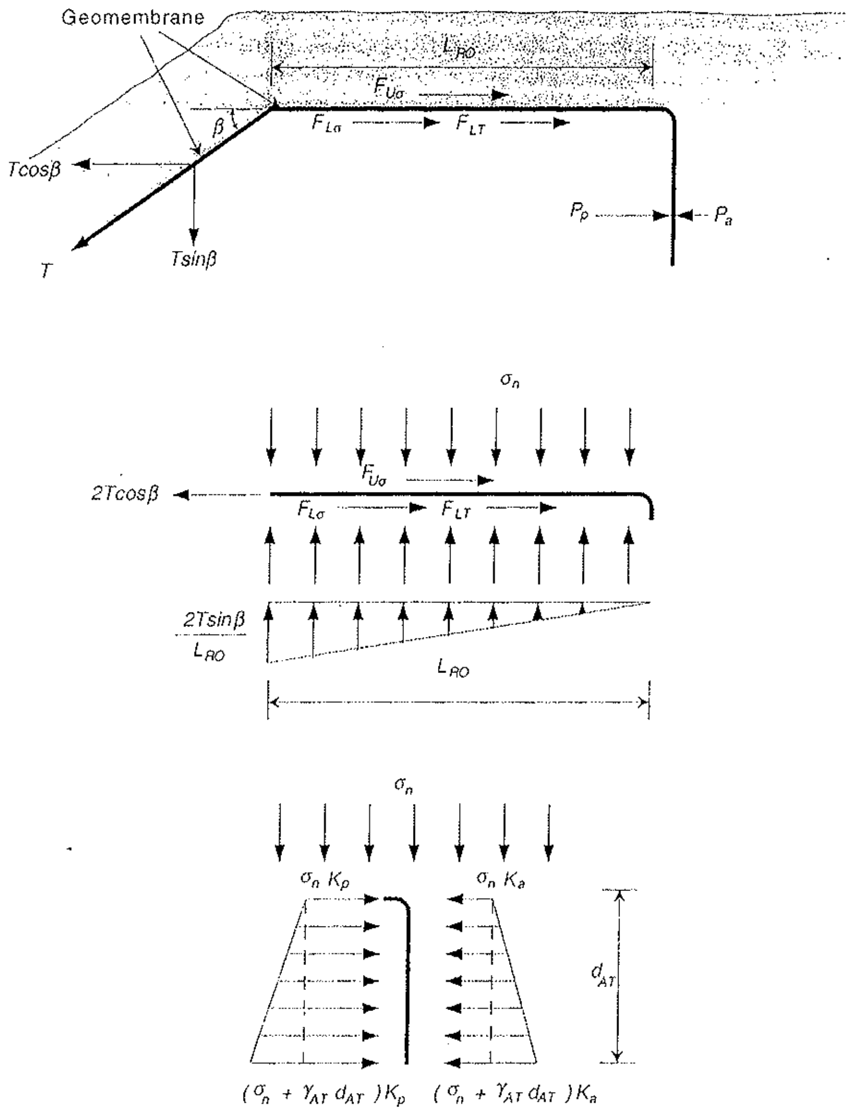


Figure 5.31 Cross section of geomembrane runout section with anchor trench and related stresses and forces involved.

be shown, this passive earth pressure is very effective in providing a resisting force (see Holtz and Kovacs [44]). Using the free-body diagram in Figure 5.31,

$$\Sigma F_x = 0$$

$$T_{\text{allow}} \cos \beta = F_{U\sigma} + F_{L\sigma} + F_{LT} - P_A + P_P \qquad (5.26)$$

KOERNER (1998). DESIGNING W/GEOSYNTHETICS. 4TH ED.

ATTACHMENT 4

Page ___ of ___

Geosyntec consultants

Written by: Juan Quiroz Date: 05/07/07 (DD MM YY) Reviewed by: ______ Date: __/__/__ (DD MM YY)

Client: Vista LF, LLC Project: Vista LF - Subst. Project/Proposal No. FL1229 Task No. ______

SIDE SLOPE CONFIGURATION

$3H:1V \Rightarrow \beta = 18.4°$

$\delta_{MIN} = 10°$ (CONSERVATIVE FOR ALL INTERFACES)

$\phi_{SOIL} = 30° \Rightarrow K_A = \tan^2(45 - \phi/2) = 0.333$

$K_P = \tan^2(45 + \phi/2) = 3$

$\gamma_{AT} = 110$ PCF

$\sigma_n = \gamma_{SOIL}\, h_{SOIL} = 110\,\text{PCF}\,(1\,\text{FT}) = 110$ PSF

$T_u = 90\ \frac{LB}{IN}$ PER GRI GM-13 $\Rightarrow$ FOR FS = 2

$$T_{ALLOW} = \frac{90\ ^{LB}/_{IN}}{2} = 45\ ^{LB}/_{IN}$$

$$= 540\ ^{LB}/_{FT}$$

PROPOSED $d_{AT} = 2$ FT & $L_{RO} = 2$ FT

SOLUTION

$$T_{ALLOW} \cos\beta = F_{U\sigma} + F_{L\sigma} + F_{LT} - P_A + P_P$$

$$T_{ALLOW} \cos\beta = \sigma_n \tan\delta_u L_{RO} + \sigma_n \tan\delta_U L_{RO} + T_{ALLOW} \sin\beta \tan\delta - (0.5\gamma_{AT}\, d_{AT}) K_A d_{AT}$$
$$+ (0.5\gamma_{AT}\, d_{AT}) K_P d_{AT}$$

$$540\ \frac{LB}{FT} \cos 18.43° = 2(110^{PSF}) \tan 10° (2^{FT}) + 540\ \frac{LB}{FT} \sin 18.43° \tan 10°$$
$$- 0.5(110\ \text{PCF})(d_{AT})\, 0.33\, d_{AT}$$
$$+ 0.5(110\ \text{PCF})(d_{AT})\, 3\, d_{AT}$$

Geosyntec consultants

Written by: JUAN QUIROZ Date: 05/07/07 (DD MM YY) Reviewed by: ____________ Date: ___/___/___ (DD MM YY)

Client: VISTA LF, LLC Project: VISTA LF - SUBST Project/Proposal No. FL1229 Task No. ______

SOLUTION (CONT.)

$$488.3\ \frac{LB}{FT} = 77.6\ \frac{LB}{FT} + 30.1\ \frac{LB}{FT} - 18.2\ d_{AT}^2 + 165\ d_{AT}^2$$

$$380.6\ \frac{LB}{FT} = 146.8\ \frac{LB}{FT^3}\ d_{AT}^2$$

$$d_{AT}^2 = 2.59\ FT^2$$

$$\underline{\underline{d_{AT} = 1.61\ FT}}$$

∴ PROPOSED $d_{AT} = 2$ FT IS ADEQUATE.

APPENDIX H-2

LINER SYSTEM VENEER SLOPE STABILITY

APP H

(H2)

Geosyntec
consultants

COMPUTATION COVER SHEET

Client: **Vista LF, LLC** Project: **Vista Landfill – Substantial Permit Mod** Project No.: **FL1229**

Phase No.: ________

Title of Computations **LINER SYSTEM VENEER SLOPE STABILITY**

Computations by:
Signature
Printed Name Wade Tyner, E.I.T.
Title Staff Engineer
Date 5 July 2007

Assumptions and Procedures Checked by:
(peer reviewer)
Signature Juan D. Quiroz
Printed Name Juan D. Quiroz, Ph.D., P.E.
Title Project Engineer
Date 9 July 2007

Computations Checked by:
Signature
Printed Name Sangho “Jay” Eun, E.I.T.
Title Senior Staff Engineer
Date 9 July 2007

Computations Backchecked by:
(originator)
Signature
Printed Name Wade Tyner, E.I.T.
Title Staff Engineer
Date 25 July 2007

Approved by:
(pm or designate)
Signature Juan D. Quiroz
Printed Name Juan D. Quiroz, Ph.D., P.E.
Title Project Engineer
Date 27 July 2007

Approval notes: ________________

Revisions (number and initial all revisions)

No.	Sheet	Date	By	Checked by	Approval

Written by: **W. Tyner** Date: **07/05/07** Reviewed by: **J. Quiroz** Date: **07/09/07**

Client: **Vista LF, LLC** Project: **Vista LF – Substantial** Project No.: **FL1229** Phase No.: ______

LINER SYSTEM VENEER SLOPE STABILITY
VISTA CLASS III LANDFILL
APOPKA, FLORIDA

INTRODUCTION

The purpose of this calculation package is to evaluate the veneer stability of the liner system associated with the Vista Class III Landfill facility located in Apopka, Florida. The veneer stability calculations address the construction (short-term) condition of the liner system during waste filling activities.

The subsequent sections present several aspects of the veneer stability analysis, and include the following items:

- Input parameters and assumptions used for the stability analyses including side slope geometry, and geosynthetic and soil material properties;
- Methodologies utilized to evaluate veneer stability; and
- Results of the stability analyses for each system analyzed.

INPUT PARAMETERS AND ASSUMPTIONS

Liner System Details

A detailed description of the liner system underlying the proposed landfill construction is provided below.

- 2-ft thick liner protective layer;
- Double-sided geocomposite drainage layer;
- 60-mil thick textured high density polyethylene (HDPE) geomembrane; and
- Subgrade.

Side Slope Configuration and Material Properties

The following side slope configuration, material properties and assumptions were established with respect to the veneer stability analyses.

- Liner system side slope is 3H:1V (33%).
- Total unit weight of liner system soil is 110 pcf.
- Assume an internal friction angle (ϕ) of 30° and a cohesion (c) of zero for the liner system soil.
- Liner system soil thickness is 2 ft.
- Maximum vertical height of slope between the perimeter anchor trench and the landfill cell floor is 50 ft along the 3H:1V side slope.
- Assume negligible water flow thickness (i.e., no seepage forces) along the length of the 3H:1V side slopes for the cover system.
- Assume zero interface adhesion (a) along a defined slip surface.
- Assume zero tension (T) in the geosynthetics above the slip surface, if any.
- Sliding within the liner system is governed by the interface friction angle (δ) of the weakest interface which can occur at soil-geosynthetic and/or geosynthetic-geosynthetic interfaces. The interface friction values for the liner system described above were varied to achieve the established minimum factor of safety requirement.

METHOD OF ANALYSIS

The veneer slope stability of the liner system inclined on a 3H:1V side slope was evaluated using the method proposed by Giroud et al. (1995) for geosynthetic-soil layered systems. The factor of safety (FOS) for a layered system of uniform thickness assuming no water flow along the slope length is given by the following equation:

$$FOS = \frac{\tan\delta}{\tan\beta} + \frac{a}{\gamma\, t \sin\beta} + \frac{t}{h}\,\frac{\tan\phi\ /\ (2\sin\beta\cos^2\beta)}{1 - \tan\beta\,\tan\phi} + \frac{c}{\gamma\, h}\,\frac{1/(\sin\beta\cos\beta)}{1 - \tan\beta\,\tan\phi} + \frac{T}{\gamma\, h\, t}$$

where:

a = interface adhesion along the slip surface;

c = cohesion of the soil component of the layered system;

h = vertical height of the slope;

T = tension in the geosynthetics above the slip surface;

t = soil layer thickness above the geomembrane;

β = slope angle;

δ = interface friction angle along the slip surface;

ϕ = internal friction angle of the soil component of the layered system; and

γ_t = total unit weight of soil.

As previously mentioned, a parametric analysis was performed to establish the minimum interface friction angle (δ) such that the calculated veneer stability factor of safety is equal to or greater than 1.3, the minimum requirement for short-term slope stability. The parametric analysis was performed by varying the interface friction angle until a factor of safety of 1.3 was achieved using the above equation.

VENEER STABILITY RESULTS

Attachment 1 presents the parametric analysis results obtained for the 3H:1V side slope liner system and a maximum vertical side slope height of 50 ft. Based on the input parameters presented above, a minimum interface friction angle of 22.5° is required to meet a factor of safety of 1.3, the minimum requirement for short-term slope stability. This value is within the range of typical soil-geosynthetic and geosynthetic-geosynthetic interface friction angles reported in the literature (e.g., Martin et al., 1984; Long et al., 1993; Williams and Houlihan, 1986). A summary table of typical interface friction angles is provided in Attachment 2.

CONCLUSIONS

The veneer stability analysis of the liner system 3H:1V side slope configuration with a maximum side slope height of 50 ft indicates that a minimum interface friction angle of 22.5° is required to achieve a factor of safety of 1.3. This value is within the range of typical soil-geosynthetic and geosynthetic-geosynthetic interface friction angles reported in the literature (see Attachment 2).

Prior to construction of the liner system, the interface friction angles between the actual soil and geosynthetic materials will be verified by performing site-specific interface shear strength testing.

Written by: **W. Tyner** Date: **07/05/07** Reviewed by: **J. Quiroz** Date: **07/09/07**

Client: **Vista LF, LLC** Project: **Vista LF – Substantial** Project No.: **FL1229** Phase No.: ______

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Giroud, J.P., Williams, N.D., Pelte, T., and Beech, J.F., "Stability of Geosynthetic-Soil Layered Systems on Slopes," Geosynthetics International, Vol. 2, No. 6, pp. 1115-1148, 1995.

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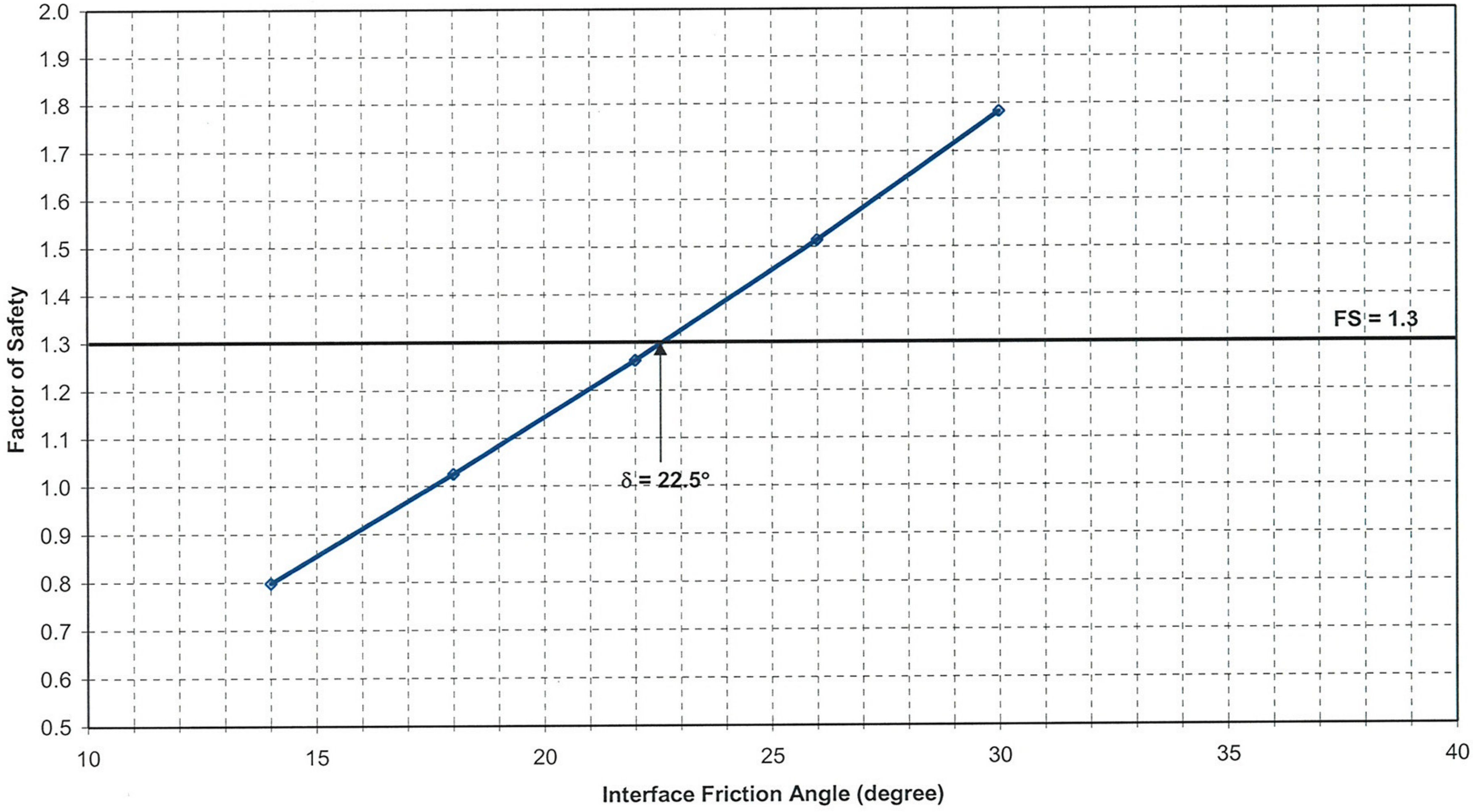
ATTACHMENT 1

3H:1V Side Slope Liner System Veneer Stability
Vista Class III Landfill
Apopka, Florida



3H:1V Side Slope Liner System Veneer Stability[1]
Vista Class III Landfill
Apopka, Florida

Drainage Layer Parameters	Case 1	Case 2	Case 3	Case 4	Case 5
Total unit weight of soil γ_t, pcf	110	110	110	110	110
Buoyant unit weight of soil γ_b, pcf	47.6	47.6	47.6	47.6	47.6
Thickness of soil layer t, ft	2	2	2	2	2
Thickness of water flow along slope t_w, ft	0.0000	0.0000	0.0000	0.0000	0.0000
Slope angle β, degrees	18.43	18.43	18.43	18.43	18.43
Interface friction angle δ, degrees	14	18	22	26	30
Interface adhesion a, psf	0	0	0	0	0
Soil internal friction angle ϕ, degrees	30	30	30	30	30
Height of slope h, ft	50.0	50.0	50.0	50.0	50.0
Tension in geosynthetics T, lbs/ft	0	0	0	0	0
Soil cohesion c, psf	0	0	0	0	0
Factor of Safety[1]	0.80	1.03	1.26	1.51	1.78

Notes: (1) Based on Giroud (1995) for geosynthetic-soil layered systems.

ATTACHMENT 2

Summary of Documented Interface Friction Values
Vista Class III Landfill
Apopka, Florida

Geosynthetic / Geosynthetic	δ (°)
Textured HDPE Geomembrane / Nonwoven Geotextile	15 to 35
Textured HDPE Geomembrane / Geocomposite Drainage Layer	17 to 29
Geonet / Nonwoven Geotextile	14 to 22
Geosynthetic / Soil	**tan δ / tan ϕ**
Textured HDPE Geomembrane / Clay	0.8 to 0.9
Textured HDPE Geomembrane / Sand	0.7 to 0.8
Needle-punched Geotextile / Sand	0.8 to 1.0
Needle-punched Geotextile / Angular Gravel	0.7 to 0.9
Needle-punched Geotextile / Rounded Gravel	0.6 to 0.8
Needle-punched Geotextile / Silty Sands	0.96

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), Long et al. (1993), Koerner (1999), manufacturers literature, and unpublished results from Geosyntec Consultants.

Vista Landfill, Class III Facility

Project Specifications

SECTION 02100

SURVEYING

PART 1 GENERAL

1.01 SCOPE

A. This section describes the requirements for surveying during construction, production of “as-built” documents, and calculating quantities for payment purposes. Survey work will be required to delineate areas for stripping; perform earthwork for general fill, liner subbase, and liner protective layer; install the liner system; construct the leachate management system including the leachate collection system, leachate sumps, and/or leachate transmission line; install drainage culverts; layout haul road and perimeter maintenance road; develop and manage borrow area; and to perform other work, as needed, to complete various construction activities.

1.02 RELATED SECTIONS AND PLANS

A. Section 02110 - Stripping

B. Section 02200 - Earthwork

C. Section 02215 - Trenching and Backfilling

D. Section 02240 - Liner Protective Layer

E. Section 02715 - HDPE Pipes and fittings

F. Construction Quality Assurance (CQA) Plan.

1.03 REFERENCES

A. National Geodetic Survey Standards.

1.04 SUBMITTALS

A. Interim surveys performed shall be submitted to the ENGINEER with each payment request to substantiate the quantities claimed.

B. CONTRACTOR will be required to submit survey notes during construction upon request by the ENGINEER.

1.05 PROJECT RECORD DOCUMENTS

A. CONTRACTOR shall maintain on-site, a complete and accurate survey log documenting the survey work performed.

B. CONTRACTOR shall maintain on-site, a plan clearly showing all site reference points, survey control points, and benchmarks.

C. CONTRACTOR shall maintain on-site an accurate and current set of marked-up drawings indicating the as-built conditions.

D. As-built surveys, stamped and signed, by a State of Florida Licensed/Registered Land Surveyor or Professional Engineer shall be submitted immediately following the completion of any applicable construction activity. Complete as-built surveys shall be submitted upon substantial completion of each phase of construction and are a prerequisite for contract closeout.

E. Upon completion of each work item, the CONTRACTOR shall prepare and/or update the as-built drawings.

PART 2 PRODUCTS

2.01 MATERIALS AND SURVEY EQUIPMENT

A. Provide materials and survey equipment as required to properly perform the surveys, including, but not limited to, instruments, tapes, rods, measures, mounts, and tripods, stakes and hubs, nails, ribbons, other reference markers, and all else as required.

B. The survey instruments used for this work shall be precise and accurate to meet the needs of the work described. All survey instruments should be capable of reading to a precision of 0.001 ft and with a setting accuracy of ± 0.8 seconds.

PART 3 EXECUTION

3.01 GENERAL

A. Maintain accurate and complete notes of surveys:
   1. Handwritten survey notes and information shall be written with lead pencil(s) and entered in "write in rain" notebooks. A copy of the numbered, dated, and signed field book pages shall be provided to the ENGINEER upon request for use in checking the work.
   2. Electronic field survey information shall be collected and backup equipment shall be available in the event of equipment malfunction.
      a. Electronic format for printed output of data collector field survey notes shall be compatible with the approved fieldbook notation format.
      b. Electronic format for printed output of data collector field work shall be compatible with the CONTRACTOR's and ENGINEER's computer equipment and software for verifying and checking the work. A copy of the data disk shall be submitted to the ENGINEER upon request.

B. During construction, survey notes shall be retained by the CONTRACTOR and shall be submitted to the ENGINEER for review upon request. Prior to the placement of successive soil layer, the CONTRACTOR shall submit a written statement certifying compliance of the preceding layer thickness and grades to the ENGINEER. Surveys will be required from the CONTRACTOR prior to approval by the ENGINEER for the placement of overlying materials.

C. Conformance check surveys for elevation and for horizontal coordinates shall be to the nearest 0.01 ft and for angles shall be to the nearest 20 seconds.

D. Measurement and payment surveys for elevation and for horizontal distances shall be to the nearest 0.1 ft ± 0.05 ft.

E. Perform construction layout surveys in advance of scheduled construction activities. At completion of a survey, provide a copy of the field notes, drawings, or sketches to the ENGINEER for review. The CONTRACTOR shall allow the CQA Consultant and/or ENGINEER three calendar days for review. The CONTRACTOR is responsible for rework and/or construction delays caused by survey or staking errors.

F. Set slope stakes in accordance with accepted surveying practices.

G. Set grade stakes required for construction activities as the work progresses. Set fine grade stakes on all items for which the Construction Drawings specify a definite grade line.

H. Upon completion of the work, the CONTRACTOR shall provide the ENGINEER with all original surveying field notes, layouts, computations, and electronic files in standard bound survey notebooks. Electronic file information shall be compatible with the ENGINEER's computer equipment and software as requested.

I. Protect survey control points and replace disturbed survey control points at no additional cost to the OWNER.

3.02 SPECIFIC FIELD REQUIREMENTS

A. Establish temporary control points, as necessary, to support construction activities.

B. Survey Documentation:
1. Record the following information in survey notebooks for each control point established and for all other surveying:
    a. control point designation;
    b. northing and easting in State Plane North American Datum (NAD83);
    c. elevation in National Geodetic Vertical Datum (NGVD29);
    d. date of establishment;
    e. description and sketch of the control point location; and
    f. a minimum of three reference features that can be seen from the control point.
2. Document survey work in the field notebooks using the format and procedures described below:
    a. title and consecutive number on the front cover;
    b. consecutively numbered pages;
    c. table of contents, indicated by survey task, on the first numbered page;
    d. legend indicating symbols used in survey notes;
    e. names of survey team for each task;
    f. notes on weather and equipment;
    g. date and time on each page to indicate when work was recorded;
    h. notes in a uniform character such that they can be interpreted and used by anyone with survey knowledge; and
    i. description and/or sketches of the survey control used.

C. Preliminary Surveys:

1. Earthwork Staking: Stakes for cut and fill limits shall establish the exterior limits of excavations and berms. The maximum staking interval shall be 50 feet. Stakes shall be prominently noted with description of point, vertical distance to design elevation, and offset distance as applicable.
2. Structures: Stake structure centerlines so that the orientation, position, limits, and foundation elevation(s) are positively identified. Mark stakes to reflect the design elevation and offset distance as applicable.
3. Ditches and Channels: Stake ditches and channels such that the layout remains undisturbed during construction.
4. Pipes and Culverts: Stake pipes and culverts on 50-ft maximum stationing. Place offset stakes beyond excavation limits and material stockpiles. Continuously check invert elevation during placement.

D. Final Surveys:
1. Final topography shall be staked at nominal 50-foot intervals. Additionally, the following points shall be staked and noted as applicable.
    a. Grade breaks.
    b. Mid-point of slopes less than 50 ft.
    c. Points of horizontal curvature and tangency.
    d. Points of stationing equation.
2. Pipes and culverts: Survey alignment and elevations of the top of all pipes at each change in grade and every 50 feet between changes in grades.

3.03 SURVEYS FOR MEASUREMENT AND PAYMENT

A. Perform surveys to evaluate quantities of work performed and percent of completed work.

B. Calculate and certify quantities and submit survey results, calculations, and certification to the ENGINEER for review and evaluation.

3.04 SURVEYS FOR CONFORMANCE CHECKS AND AS-BUILT DOCUMENTS

A. Survey the following surfaces to verify the lines and grades achieved during construction:
1. for berms, ditches, drainage swales, roads, and other earthwork;
    a. original grade surface;
    b. compacted surface of cut slopes;
    c. top of general fill; and
    d. finished grade surface; and
2. for the liner system;

a. top of compacted general fill;
b. top of liner subbase; and
c. top of liner protective layer.

B. Perform earthwork conformance checks and as-built surveying immediately upon completion of a given installation to verify compliance with the Construction Drawings, facilitate progress, and avoid delaying commencement of the next installation. Provide the following minimum spacing and locations for survey points:

1. surfaces with gradients less than 10 percent, survey on a square grid spaced not wider than 50 ft;
2. on slopes greater than 10 percent, a square grid spaced not wider than 50 ft shall be used, but in all cases, a line at the crest, midpoint, and toe of the slope shall be taken;
3. a line of survey points spaced not more than 50 ft apart shall be taken along any slope break (this will include the inside edge and outside edge of any bench on a slope); and
4. a line of survey points spaced not more than 50 ft apart and at each end shall be taken at the top of any pipes, culverts, discharge structures, or other appurtenances.

[END OF SECTION]

SECTION 02110

CLEARING, GRUBBING, AND/OR STRIPPING

PART 1 – GENERAL

1.01 SCOPE

A. This section describes the requirements for clearing, grubbing, and/or stripping activities. Clearing, grubbing, and/or stripping activities will be required to perform the earthwork, develop borrow area, and to perform other work, as needed, to complete various construction activities.

1.02 RELATED SECTIONS AND PLANS

A. Section 02100 – Surveying

B. Section 02200 – Earthwork

C. Section 02290 –Sediment and Erosion Control

D. Section 02930 – Vegetation

E. Construction Quality Assurance (CQA) Plan

1.03 COMPLIANCE WITH REGULATIONS

A. It is the sole responsibility of the CONTRACTOR to be completely familiar with and to follow all local, state, and federal regulations pertaining to the work required in this Section.

1.04 CONSTRUCTION QUALITY ASSURANCE

A. Clearing, grubbing, and/or stripping operations shall be monitored by the CQA Consultant as outlined in the CQA Plan.

B. The CONTRACTOR shall be aware of the activities set forth in the CQA Plan and shall account for these activities in the construction schedule.

C. The CONTRACTOR shall assist CQA personnel in every manner necessary for the proper performance of activities set forth in the CQA Plan.

D. CQA testing or inspections in no manner relieves the CONTRACTOR of the responsibility to perform all work in conformance with to the Construction Drawings and Specifications.

E. If quality control or quality assurance tests indicate work does not meet specified requirements, the CONTRACTOR shall perform the work as directed by the CQA Consultant at no additional cost to the OWNER.

1.05 EXISTING CONDITIONS

A. The CONTRACTOR shall comply with applicable regulations in locating and providing clearance for all underground and above ground utilities, if applicable, prior to beginning construction activities. The CONTRACTOR shall immediately notify the OWNER and the ENGINEER if utility lines or structures not shown on the Construction Drawings are encountered. Repair of damage and all restitution for liabilities resulting from damage to existing facilities due to activities by the CONTRACTOR shall be at the CONTRACTOR's expense.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Materials to be cleared, grubbed, and/or stripped include trees, shrubs, debris, muck, or other foreign matter, as needed, to develop the work area and enable construction activities.

B. Vegetative stabilization and erosion control of stripped soil stockpiles shall be as specified in Section 02930.

PART 3 – EXECUTION

3.01 FAMILIARIZATION

A. Prior to implementing any of the work described in this section, the CONTRACTOR shall become thoroughly familiar with the site, the site conditions, and all portions of the work described in this section.

B. CONTRACTOR shall note the elevation of groundwater for ground surface areas covered under this Contract. Some areas may also be inundated with water at the start of construction. CONTRACTOR is responsible for any dewatering required to execute the required work.

C. Inspection:

1. Prior to implementing any of the work in this section, the CONTRACTOR shall carefully inspect and verify that related work required by other sections is complete to the point where the work described in this section may properly commence without adverse impact.

2. If the CONTRACTOR has any concerns regarding the related work required by other Sections, he shall notify the ENGINEER in writing prior to the commencement of operations. Failure to notify the ENGINEER will be construed as CONTRACTOR acceptance of the related work of all other sections.

3.02 SEDIMENT AND EROSION CONTROL

A. Prior to implementing any work described in this section, the CONTRACTOR shall install all sediment and erosion controls in the relevant area(s) of construction.

B. CONTRACTOR is solely responsible for selecting, implementing, and maintaining proper and fully adequate sediment and erosion controls at all times during construction.

3.03 CLEARING AND GRUBBING

A. Clearing and/or grubbing shall be performed in areas identified in the contract documents or as directed by the ENGINEER. All sediment and erosion controls, as described in Section 02290 of the Specifications or as indicated on the Construction Drawings, shall be in place before the start of clearing.

B. If weather conditions are unsuitable for clearing and/or grubbing, as determined by the ENGINEER, the CONTRACTOR shall cease operations until permission to resume operations is obtained from the ENGINEER.

C. Clearing shall consist of removing trees, undergrowth, and deadwood. Trees shall be cut level with the adjacent ground surface. Grubbing shall consist of the removing stumps, roots, and surficial debris from the areas identified in this section or as directed by the ENGINEER.

D. Clearing and/or grubbing activities shall be performed in a manner so as to minimize disturbance to the surrounding areas.

E. All cleared and/or grubbed materials shall be reduced to mulch and stockpiled as directed by the ENGINEER.

3.04 STRIPPING

A. Stripping shall be performed in areas identified in this section or as directed by the ENGINEER. All sediment and erosion controls shall be in place before the start of stripping. Stripping shall include all vegetation, organics, and other deleterious materials as required by the ENGINEER. Stripping depth shall be a minimum of 6 inches. However, overstripping shall be avoided.

B. If soil or weather conditions are unsuitable for stripping, as determined by the ENGINEER, the CONTRACTOR shall cease stripping activities until permission to resume work is obtained from the ENGINEER.

C. Equipment and methods of operation shall be selected by the CONTRACTOR to minimize disturbance to the surrounding areas.

D. All stripped material shall be stockpiled in the areas designated by the ENGINEER. Stockpiled material shall be sloped and grassed as required in the Specifications or as directed by the ENGINEER.

3.05 SURVEYING AND CONSTRUCTION TOLERANCES

A. The CONTRACTOR shall retain a Surveyor who shall be responsible for providing survey control for the work. The areas to be cleared, grubbed, and/or stripped shall be surveyed prior to performing the work for the purpose of measurement and payment. All surveying shall be performed in accordance with Section 02100 of the Specifications.

3.06 PROTECTION OF WORK

A. The CONTRACTOR shall protect all prior work, including all materials and related work of other Sections.

B. In the event of damage, the CONTRACTOR shall immediately make all necessary repairs and replacements necessary, as directed and approved by the ENGINEER, at no additional cost to the OWNER.

[END OF SECTION]

SECTION 02200

EARTHWORK

PART 1 GENERAL

1.01 SCOPE

A. This section includes the requirements for site preparation, excavation, surface water control, excavation dewatering, stockpiling, subgrade preparation, general fill, subbase preparation, and earthwork materials. This section also includes the requirements to maintain the prepared subbase surface until the geosynthetics installer has completed construction of the liner system.

1.02 RELATED SECTIONS AND PLANS

A. Section 02100 – Surveying

B. Section 02110 – Stripping

C. Section 02215 – Trenching and Backfilling

D. Section 02240 – Protective Soil Layer

E. Section 02290 – Erosion and Sediment Control

F. Section 02930 – Vegetation

G. 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. Within 15 calendar days from Notice to Proceed, submit to the Engineer for review an Earthwork Work Plan. The Earthwork Work Plan shall include, at a minimum:

1. list of equipment proposed for the construction activities including earthwork and other scope of work specified described in the contract documents;
2. construction methods for each construction activity;
3. dewatering methods and techniques;
4. coordination of survey requirements for the earthwork;
5. proposed locations of temporary soil stockpile areas;
6. coordination of earthwork activities with surface water management and erosion and sediment control measures;
7. schedule for earthwork activities; and
8. dust control measures.

1.05 CONSTRUCTION QUALITY ASSURANCE

A. The earthwork will be monitored and tested by the CQA Consultant as required in the CQA Plan.

B. The CQA Consultant will perform soil conformance testing on general fill to establish compliance with this Section. Provide equipment and labor to assist the CQA Consultant in obtaining conformance samples from excavations and stockpiles.

C. The CQA Consultant will perform soil performance testing on the subgrade surface and general fill lifts to evaluate compliance with this Section. The CQA Consultant will indicate any portion of the earthwork that does not meet the requirements of this Section and will delineate the extent of the nonconforming area.

D. The Contractor shall correct all deficiencies and non-conformances identified by the CQA Consultant at no additional cost to the Owner.

E. 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 construction schedule.

1.06 EXISTING CONDITIONS

A. Existing site surface and subsurface conditions, based on available site data, are indicated on the Construction Drawings.

B. Contractor shall verify existing conditions as indicated in Section 02100.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Obtain material for general fill from the borrow sources designated by the Engineer.

B. General fill material shall be free of debris, foreign objects, large rock fragments, organics, and other deleterious materials. General fill material shall classify as SW, SP, SW-SM, SW-SC, SP-SM, SP-SC, SM, or SC according to the Unified Soil Classification System (per ASTM D 2487). General fill material having the indicated classification is expected to be available from designated borrow sources. Soils having other classifications may be acceptable as general fill, if approved by the Engineer.

C. General fill material used as liner subbase under the liner system of the landfill shall be free of sharp materials or any materials larger than 0.5 inches.

2.02 EQUIPMENT

A. Furnish compaction equipment to achieve the required minimum soil dry density within the range of acceptable moisture contents.

B. Furnish hand compaction equipment, such as a walk-behind compactor, hand tampers, or vibratory plate compactor, for compaction in areas inaccessible to large compaction equipment.

C. Furnish water trucks, pressure distributors, or other equipment designed to apply water uniformly and in controlled quantities to variable surface widths for required in-place moisture adjustment, to prevent drying of soil surfaces, and for dust control.

D. Furnish equipment such as excavators, scrapers, compactors, loaders, dozers, earth hauling equipment and all other equipment, as required for earthwork construction.

PART 3 EXECUTION

3.01 GENERAL

A. All general fill material to be compacted shall be at a moisture content that will readily facilitate effective compaction.

B. General fill material placed wet that exhibit pumping shall not be accepted regardless of the in-place density or percent compaction. Wet materials shall not be placed and compacted. Wet materials, if used, shall be allowed to dry in place, if feasible, or removed and replaced with suitable materials as directed by the ENGINEER.

3.02 SITE PREPARATION

A. Install construction fence and barricades around open trenches and excavated areas.

B. Install erosion and sediment controls in relevant areas of construction as indicated on the Construction Drawings and as required by Section 02290. Maintain the erosion and sediment controls for the duration of the Contract and until the contained areas are vegetated in accordance with Section 02930. Accumulated sediment behind silt fences and from drainage swales and structures shall be removed as required or as directed by the Engineer.

C. Prior to any earthwork activity, perform clearing, grubbing, and/or stripping as indicated on the Construction Drawings and in accordance with Section 02110.

D. Construct roads in accordance with the Construction Drawings and Section 02230.

3.03 SURAFCE WATER CONTROL

A. Installation of surface water and erosion controls shall be in accordance with approved Surface Water Management and Erosion Control Plan as specified in Section 02290.

B. Install surface water and erosion controls in and around work areas to control runoff and erosion and to prevent surface water run-on into excavations. Perimeter controls may include shallow ditches, berms, or localized regrading.

3.04 EXCAVATION

A. Excavate designated areas to the subgrade elevations or excavation limits indicated on the Construction Drawings. Stockpile excavated material in areas designated by the Construction Manager for use in subsequent construction.

B. Excavation of leachate sump areas shall be performed very carefully so as to not overexcavate and to provide smooth, intact soil surfaces for installation of liner system geosynthetics. Excavator bucket shall have straight (toothless) moldboards when excavating within 12 inches of final elevations. CONTRACTOR shall use a Gradall® or similar equipment when excavating the final 12 inches in the leachate sumps. Corners of the excavation shall be rounded.

3.05 EXCAVATION DEWATERING

A. Anticipate seepage of groundwater into, and accumulation of surface water runoff in excavations. Manage groundwater and surface water in excavations in accordance with this section.

B. Prevent surface water run-on from adjacent areas from entering the excavation.

C. All fill operations, except hydraulic filling, shall be performed in the dry. Contractor shall shall be prepared to lower the groundwater in local areas as required to construct sumps and drainage structures. Contractor shall expect that work areas may be inundated with water and be prepared to dewater as required to perform work.

3.06 STOCKPILING

A. Separate stockpiles by material type.

B. Stockpile excavated soils at the areas indicated on the Construction Drawings or as designated by the Engineer.

C. Construct stockpiles no steeper than 3H:1V (horizontal:vertical), grade to drain, seal by tracking perpendicular to the slope contours with a dozer, and dress daily during periods when fill is taken from the stockpile.

D. Silt fence or berms shall be constructed at the base of stockpiles that will not be immediately used.

E. Restore all areas used for stockpiling when stockpiles are removed as directed by the OWNER.

3.07 SUBGRADE PREPARATION

A. Subgrade material shall consist of soil relatively free of debris, foreign objects, organics and other deleterious materials.

B. Compact all subgrade within the limits of landfill cells to a minimum 95 percent of the Standard Proctor (ASTM D 698) maximum dry density at a moisture content approved by the Engineer.

C. In the presence of the CQA Consultant, perform subgrade proof rolling by driving a loaded dump truck (minimum weight of 10 tons per axle and minimum loaded weight of 20 tons) or other pneumatic-tired vehicle, back and forth across the area to confirm the firmness of subgrade surface. Overlap the passes such that one set of tires on each pass runs between the two sets of tire tracks from the previous pass. Soils shall not exhibit pumping or develop ruts more than two inches in depth. Minor rutting, defined as less than two inches in depth, shall be regarded or covered with general fill to match finish grade.

D. Subgrade for general fill shall be scarified to a depth of 2 inches using equipment identified in this section.

E. Unsuitable soils shall be removed and replaced with general fill to a minimum depth of 2 feet below the proposed subgrade elevation. Suitable soil exhibiting pumping or developing ruts more than two inches in depth will be removed to a minimum depth of 1 foot or dried in place, if feasible. Compact the general fill and liner subbase materials to a minimum 95 percent of standard Proctor (ASTM D 698) maximum dry density at a moisture content approved by the Engineer.

F. In excavations or other areas where water accumulates, implement measures to remove the water in accordance with this section. Maintain the subgrade surface free of standing water and in firm condition to meet proof rolling requirements of this section. Maintain dewatered areas until overlying construction is complete.

G. Manage surface water as described in Section 02290.

3.08 GENERAL FILL

A. Use fill that meets the requirements of this Section. Place fill to the limits and grades shown on the Construction Drawings. CONTRACTOR shall stage the placement of general fill in the cell such that the cell floor drains towards the toe of the perimeter berm temporarily. A drainage corridor shall be maintained until geosynthetic installer is prepared to place and weld the final panels of the geomembrane to completely “black-out” the cell floor.

B. Place general fill material on surfaces that are free of debris, vegetation, or other deleterious material.

C. Place general fill material in loose lifts with a thickness of 12 inches ± 1 inch. In areas where compaction is to be performed using hand operated equipment, place the fill material in loose lifts with a loose thickness of 6 inches ± 1 inch.

D. Prior to placing a succeeding lift of material over a previously compacted lift, thoroughly scarify the previous lift to a depth of 2 inches by discing, raking, or tracking with a dozer. Moisture condition the preceding lift if not within the acceptable moisture range.

E. The trafficking of scarified surfaces by trucks or other equipment, except compaction equipment, is not permitted.

F. Except as specified in this section, compact general fill in each lift to at least 95 percent of its standard Proctor maximum dry density (ASTM D 698). Compact general fill at moisture content as required to attain the specified density or as approved by the Engineer.

G. Do not place fill during periods of precipitation. Placement may occur during periods of misting or drizzle, but only as authorized by the Engineer.

H. Dust shall be controlled by the application of water to the general fill surfaces.

I. CONTRACTOR shall coordinate the final surface of the liner subbase in the cell with the geosynthetics installer. CONTRACTOR is responsible for maintenance of the subbase until its acceptance by the geosynthetics installer.

3.09 SURVEY CONTROL

A. Survey limits and elevations of excavations, subgrade, and top of general fill in accordance with Section 02100.

3.10 TOLERANCES

A. Perform the earthwork construction related to the berms, composite liner system, and roads to within ±0.1 ft. of the elevations and within 10 percent of the slopes shown or indicated on the Construction Drawings.

B. Positively draining slopes shall be maintained during all construction.

[END OF SECTION]

SECTION 02215

TRENCHING AND BACKFILLING

PART 1 GENERAL

1.01 SCOPE

A. This section describes the requirements for trenching, backfilling, placing, and compacting materials and to perform other work as directed by the ENGINEER.

1.02 RELATED SECTIONS AND PLANS

A. Section 02100 - Surveying

B. Section 02200 - Earthwork

C. 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.

B. Standard Specifications for Road and Bridge Construction, Florida Department of Transportation, 2000 Edition (FDOT Specifications).

C. Latest version of Occupational Safety and Health Administration (OSHA) Construction Standards.

1.04 SUBMITTALS

A. Submit a list of equipment for trenching and backfilling to the ENGINEER no less than 15 calendar days prior to construction/installation.

1.05 CONSTRUCTION QUALITY ASSURANCE

A. The trenching and backfilling will be monitored by the CQA Consultant as required in the CQA Plan.

B. The CONTRACTOR shall be aware of the activities required of the CQA Consultant in the CQA Plan and shall account for these activities in the construction schedule.

C. The CONTRACTOR shall correct all deficiencies and non-conformances identified by the CQA Consultant at no additional cost to the OWNER.

1.06 EXISTING CONDITIONS

A. In advance of trenching in an area, verify the accuracy of existing conditions indicated on the Construction Drawings. Immediately notify the ENGINEER in writing of deviations from the existing conditions indicated on the Construction Drawings.

B. The approximate locations of all known underground utilities, above ground utilities, and other structures, if any, are indicated on the Construction Drawings.

PART 2 PRODUCTS

2.01 MATERIALS

A. Embedment material and backfill material shall be obtained from the designated borrow area and shall meet the material requirements for general fill as specified in Section 02200.

2.02 EQUIPMENT

A. Provide, operate, and maintain all equipment necessary to perform the work described in this section.

PART 3 EXECUTION

3.01 GENERAL

A. In areas of trenching and backfilling, maintain and protect existing underground utilities, above ground utilities, and other structures, if any.

B. Do not damage or disturb, if possible, the existing work/systems that must remain after trenching and backfilling is completed. If damaged or disturbed, these systems shall be restored to the condition existing prior to the trenching and backfilling operations.

3.02 TRENCHING

A. Use sheeting and bracing where and whenever necessary to maintain the safety and stability of all slopes, trenches, and adjacent structures, if any. Satisfy all applicable local, state, and federal requirements for slope and trench sheeting and bracing, including requirements of the Occupational Safety and Health Administration (OSHA) construction standards. Provide required sheeting and bracing materials on site prior to start of trenching. Adjust spacing and arrangement of sheeting and bracing as required by conditions encountered. Remove sheeting and bracing as backfill progresses. Fill any voids left from sheeting or bracing withdrawal with general fill or other approved materials.

B. Trench soils for geosynthetics anchor trench, pipes, or to perform other work to depths and minimum dimensions indicated on the Construction Drawings. Fill material shall be placed and compacted with a hand tamper so as not to damage the geosynthetics or displace the pipes.

C. Protect and maintain the trench bottom. Remove rock fragments or raveled materials that collect on the trench bottom. Backfill excess excavation with general fill or other approved materials. Excavate any soft subgrade soils encountered at the trench bottom and backfill and compact general fill to subgrade elevation.

D. Dewater trenches and excavations as needed. Perform dewatering in accordance with Section 02200.

E. Stockpile excess material from trenching in accordance with Section 02200.

3.03 BACKFILLING

A. General:
  1. do not backfill with saturated material;
  2. do not backfill over wet or soft subgrade;
  3. do not disturb or damage the installed pipes during backfilling; and
  4. do not use heavy compaction equipment which exerts greater than 5 pounds per square inch ground pressure over pipes that are covered by less than 12 inches of backfill material.

B. Placement of backfill material:
  1. place the first lift of backfill material in a 12-inch loose lift. Place subsequent lifts of trench backfill material in 8-inch ±1-inch loose lifts; and

2. compact each lift to 95 percent of the maximum standard Proctor dry unit weight at a moisture content generally within ±3 percent of the optimum moisture content as determined by ASTM D 698, or as directed by the ENGINEER.

C. Placement of embedment fill:
   1. place embedment fill in 7-inch ±1-inch thick loose lifts to the elevation of the bottom of the pipe;
   2. compact embedment fill with a minimum of 4 passes of a vibratory plate compactor prior to placing pipe;
   3. place pipe on top of the compacted embedment fill;
   4. for pipes 12 inches in diameter or less, place additional pipe embedment fill on the sides and hand tamp the fill around the sides as needed to insure intimate contact between the pipe and the embedment fill below the spring line. Continue placing embedment fill until it is even with the top of the pipe. Compact the embedment fill with a minimum of 4 passes of a vibratory plate compactor. Do not compact on top of the pipe unless a minimum of 12 inches of trench backfill separates the compactor from the top of the pipe; and
   5. for pipes greater than 12 inches in diameter, place embedment fill in 7-inch ±1-inch thick loose lifts to the limits shown on the Construction Drawings. Compact each lift with a minimum of 4 passes of a vibratory plate compactor.

3.04 SURVEY CONTROL

A. Survey the limits of the anchor trench and limits and invert elevations of all pipes in accordance with Section 02100.

B. Survey the alignment and elevations of the top of all pipes at each change in grade and every 50 feet between changes in grades in accordance with Section 02100.

3.05 TOLERANCES

A. Install pipes to within ±0.1 ft of the elevations and within 10 percent of the slopes indicated on the Construction Drawings.

[END OF SECTION]

SECTION 02230

ROAD CONSTRUCTION

PART 1 GENERAL

1.01 SCOPE

A. This section describes the requirements for constructing the perimeter maintenance road and other roads as indicated on the Construction Drawings.

1.02 RELATED SECTIONS AND PLANS

A. Section 02100 - Surveying

B. Section 02200 – Earthwork

C. Section 02930 - Vegetation

D. 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.

B. Standard Specifications for Road and Bridge Construction, Florida Department of Transportation, 2000 Edition (FDOT Specifications).

1.04 SUBMITTALS

A. At least 14 days prior to the start of road construction, the CONTRACTOR shall provide for ENGINEER's review the equipment and construction method for placing and compacting the road materials.

B. For each source of the base material, submit the following to the ENGINEER for review at least 21 calendar days prior to road construction:
1. source of the material;
2. test results conducted on three samples of the material which demonstrates the material meets the requirements of the FDOT Specifications; and
3. a 50-pound representative sample of the proposed material.

1.05 CONSTRUCTION QUALITY ASSURANCE

A. The construction of the roads will be monitored by the ENGINEER as required by the CQA Plan.

B. The CQA Consultant will perform material conformance testing and installation quality control testing during road construction as required by the CQA Plan.

C. The CONTRACTOR shall be aware of the activities required by the CQA Consultant in the CQA Plan and account for these activities in the construction schedule.

D. The CONTRACTOR shall correct all deficiencies and non-conformances identified by the CQA Consultant at no additional cost to the OWNER.

PART 2 PRODUCTS

2.01 MATERIALS

A. Furnish base material for the perimeter maintenance road and other roads meeting the requirements of Base Course in Section 911 of the FDOT Specifications. CONTRACTOR shall submit reports of testing and supplier certifications showing that base material meets this section at least 21 days before material is delivered to the site.

B. Alternate base material may consist of a crushed concrete aggregate as approved by the ENGINEER. Base material shall meet requirements of Section 204-2 of the FDOT Specifications for Group 1 aggregates. CONTRACTOR shall submit reports of testing and supplier certificates showing that alternate base material meets this section at least 21 days before material is delivered to the site.

C. Furnish embankment material and prepared subbase materials for the perimeter maintenance road and other roads meeting the requirements of general fill material in Section 02200 from designated borrow area or other areas as directed by the ENGINEER.

2.02 EQUIPMENT

A. Furnish, operate, and maintain equipment necessary to construct roads in accordance with the requirements of this section.

B. Use Caterpillar CS 563 or equivalent self-propelled vibratory compactor, as approved by the ENGINEER, for compacting the subgrade, embankment, and base materials.

PART 3 EXECUTION

3.01 PERIMETER MAINTENANCE ROAD

A. The perimeter maintenance road and other roads shall be constructed to the thickness, grades, lines, and limits indicated on the Construction Drawings.

B. The base materials shall be placed in two equal lifts and compacted to the grades, lines, and limits indicated on the Construction Drawings and compacted in accordance with this Section.

C. The perimeter berm swale shall be constructed, graded, and sodded in accordance with the Construction Drawings.

3.02COMPACTION REQUIREMENTS AND TEST FREQUENCIES

A. Embankment materials for perimeter maintenance road and other roads shall be compacted to 95 percent of maximum dry density determined by ASTM D 698. Construction quality control tests will be performed by the CQA Consultant at a minimum frequency of one test for every 200 linear feet per lift or as directed by the ENGINEER.

B. Prepared subbase for perimeter maintenance road and other roads shall be compacted to 100 percent of maximum dry density determined by ASTM D 698. Construction quality control tests will be performed by the CQA Consultant at a minimum frequency of one test for every 200 linear feet per lift or as directed by the ENGINEER.

C. Base course materials for perimeter maintenance road and other roads shall be compacted to 95 percent of maximum dry density determined by ASTM D 698 or as directed by the ENGINEER. Construction quality control tests will be performed by the CQA Consultant at a minimum frequency of one test for every 200 linear feet per lift or as directed by the ENGINEER.

3.04 SURVEY CONTROL

A. Survey the grades, lines, and limits of the perimeter maintenance road construction in accordance with Section 02100 to verify compliance with the Construction Drawings.

3.05 TOLERANCES

A. Place and compact embankment materials and base materials to ± 0.1 ft of the elevations indicated on the Construction Drawings.

B. Construct the perimeter maintenance road to within ±0.1 ft of the final grades and slopes indicated on the Construction Drawings.

[END OF SECTION]

SECTION 02235

GRANULAR DRAINAGE MATERIAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section includes the requirements for granular drainage material in the leachate collection system, and in the leachate collection sumps.

1.02 RELATED SECTIONS AND PLANS

A. Section 02100 - Surveying

B. Section 02720 - Geotextiles

C. 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. For each source of granular drainage material, submit the following to the Engineer for review not less than 21 calendar days prior to use:
1. source of the material;
2. test results conducted on each material such that the material is fully represented in accordance with ASTM C 136, ASTM D 3042, and ASTM D 2434; and
3. a 50-pound representative sample of the material.

1.05 CONSTRUCTION QUALITY ASSURANCE

A. The installation of the granular drainage material will be monitored by the CQA Consultant as required in the CQA Plan.

B. The CQA Consultant will perform material conformance testing and installation quality control testing on the granular drainage materials as required in 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 construction schedule.

D. The Contractor shall correct all deficiencies and nonconformances identified by the CQA Consultant at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 MATERIALS

A. Furnish granular drainage materials consisting of homogeneous crushed or natural stones that is free of materials that, due to their nature or size, are deleterious to the intended use as determined by the Engineer.

B. Granular drainage material in the leachate collection system shall have a gradation (per ASTM C 136) that meets the requirements for a No. 57 stone in ASTM D 448 and shall have a minimum hydraulic conductivity of 1 cm/sec based on laboratory permeability testing conducted in accordance with the ASTM D 2434.

C. Granular drainage material in the leachate collection sumps shall have a gradation (per ASTM C 136) that meets the requirements for a No. 4 stone in ASTM D 448 and shall have a minimum hydraulic conductivity of 10 cm/sec based on laboratory permeability testing conducted in accordance with the ASTM D 2434.

D. Furnish granular drainage material having less than 5 percent loss by weight when tested in accordance with ASTM D 3042.

2.02 EQUIPMENT

A. Furnish, operate, and maintain equipment necessary to transport, place, and spread the granular drainage materials without damage to adjacent geosynthetics.

PART 3 EXECUTION

3.01 MATERIAL PLACEMENT

A. Do not commence placement of the granular drainage material until the CQA Consultant has completed conformance evaluation of the material and evaluation of previous work, including evaluation of the Contractor's survey results for previous work.

B. Place the granular drainage material to the minimum thicknesses and limits indicated on the Construction Drawings.

C. Surround granular drainage material with geosynthetic material as indicated on the Construction Drawings. Care shall be taken to avoid damage to geosynthetics during granular drainage material placement.

3.02 SURVEY CONTROL

A. Survey the limits and elevations of the top of the granular drainage material in accordance with Section 02100.

3.03 TOLERANCES

A. Construct the granular drainage material to the minimum thicknesses indicated on the Construction Drawings.

[END OF SECTION]

SECTION 02240

PROTECTIVE SOIL LAYERS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes the requirements for the liner protective layer and the cap protective layer (in the leachate collection sumps areas) that will be installed on top of the liner system.

1.02 RELATED SECTIONS AND PLANS

A. Section 02100 - Surveying

B. Section 02200 - Earthwork

C. Section 02740 - Geocomposites

D. Section 02770 - Geomembranes

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. The Contractor shall submit a plan to the Engineer for approval describing the placement of the protective layer in an upslope manner, 30 calendar days prior to the start of protective layer placement.

B. Identify source(s) of protective soil layer material at last 21 calendar days prior to use.

1.05 CONSTRUCTION QUALITY ASSURANCE

A. The protective soil layer construction will be monitored and tested by the CQA Consultant as required in the CQA Plan.

B. The CQA Consultant will perform soil conformance testing on the protective soil layer materials to establish compliance with this Section. Conformance testing on protective soil layer will be performed on materials obtained from the source and the completed protective soil layer. Provide equipment and labor to assist the CQA Consultant in obtaining conformance samples from excavation and stockpile areas.

C. The CQA Consultant will perform soil testing on the protective soil layer to evaluate compliance with this Section. The CQA Consultant will indicate any portion of the protective soil layer that does not meet the requirements of this Section and will delineate the extent of the nonconforming area.

D. The Contractor shall correct all deficiencies and non-conformances identified by the CQA Consultant at no additional cost to the Owner.

E. The Contractor shall be aware of the activities of the CQA Consultant required by the CQA Plan and shall account for these activities in the construction schedule.

PART 2 PRODUCTS

2.01 MATERIALS

A. Obtain material for protective soil layers from areas approved by the Engineer.

B. Protective soil layer material shall consist of relatively homogeneous natural soils that are free of materials, that due to their nature or size, are deleterious to the intended use as determined by the Engineer. No particles larger than 0.5 inches shall be allowed in protective soil layers.

C. The material for protective soil layer shall be classified according to the Unified Soil Classification System (per ASTM D 2487) as SW, SP, SW-SM, SW-SC, SP-SM, or SP-SC. Other soil classification may be accepted by the Engineer provided the soil meets the hydraulic conductivity requirement noted below.

D. Liner protective soil layer materials shall have:

1. hydraulic conductivity of no less than $1x10^{-4}$ cm/sec when tested according to ASTM D 2434;
2. less than 10 percent (typically) passing through a standard U.S. No. 200 sieve per ASTM D 422. A higher fines content may be accepted by the Engineer provided the soil meets the hydraulic conductivity requirement; and
3. less than 5 percent loss of weight when tested according to ASTM D 4373.

D. Cover protective soil layer materials shall have:
   1. hydraulic conductivity within the range of $1x10^{-3}$ cm/sec to $1x10^{-5}$ cm/sec when tested according to ASTM D 2434; and
   2. the same material requirements as for liner protective soil, except for hydraulic conductivity.

2.02 EQUIPMENT

A. Furnish, operate, and maintain equipment necessary to transport, place, and compact the protective soil layer material.

PART 3 EXECUTION

3.01 PLACEMENT

A. Construct the protective soil layers to the thickness, elevations, and limits indicated on the Construction Drawings and as specified in this Section.

B. All lifts of the protective soil layers shall be placed upslope where the slopes exceed 10 percent. The Contractor may deliver material downslope on specially constructed ramps as approved by the Engineer.

C. Prior to placing the protective soil layers, the Contractor shall verify by visual inspection that the underlying geosynthetic layer is free of holes, tears, wrinkles, or foreign objects. Material shall be spread over the underlying geosynthetics to cause the material to cascade over the geosynthetics rather than be shoved across the geosynthetics. The Contractor shall “work out” wrinkles in the geosynthetic layers to the satisfaction of the CQA Consultant prior to placement of the protective soil layer. In all cases, wrinkles shall not be of a size that they could fold back on themselves.

D. The protective soil layers shall be placed directly on top of the geosynthetics indicated on the Construction Drawings. The liner protective layer shall be placed in one lift. A low ground-pressure dozer shall be used for spreading in accordance with the requirements of

Sections 02740 and 02770. The tracked equipment shall operate only over previously placed protective soil material. The Contractor shall not operate equipment directly on the geomembrane or geocomposite.

E. The equipment used to spread and compact the protective soil layers shall comply with minimum cover requirements of Sections 02740 and 02770.

3.02 COMPACTION

A. Do not compact the liner protective soil layer. Liner protective soil layer shall be placed and tracked.

B. Cover protective soil layer lifts after the initial 12-inch lift shall be compacted to a dry unit weight of at least 95 percent of the standard Proctor maximum dry unit weight (ASTM D 698).

C. Moisture condition the soil if the moisture content of the material to be used as the cover protective soil layer is not appropriate to achieve the compaction requirements. The acceptable range of placement moisture contents will be determined by the CQA Consultant. Use a water truck and spray nozzle for wetting. Use discing, raking, or other appropriate methods to dry the material as required. During wetting or drying, regularly disc, rake, or otherwise mix the material to thoroughly blend the moisture throughout the lift.

3.03 SURVEY CONTROL

A. Survey the limits and elevation of the top of the protective soil layers in accordance with Section 02100.

3.04 TOLERANCE

A. Construct the protective soil layers to within +0.2 feet of the thickness shown on the Construction Drawings.

B. Construct the protective soil layers to within +0.5 feet of the elevations and within 10 percent of the slopes indicated on the Construction Drawings.

[END OF SECTION]

SECTION 02245

RIPRAP

PART 1 GENERAL

1.01 SCOPE

A. This section includes the requirements of riprap products.

1.02 RELATED SECTIONS AND PLANS

A. Section 02720 - Geotextiles

B. Construction Quality Assurance (CQA) Plan

1.03 REFERENCES

A. Standard Specifications for Road and Bridge Construction, Florida Department of Transportation, 2000 Edition (FDOT Specifications).

1.04 SUBMITTALS

A. Submit the following to the Engineer for review no less than 30 calendar days prior to riprap use.
   1. source of the riprap; and
   2. certification from the supplier that the riprap meets the material requirements of this Section.

1.05 CONSTRUCTION QUALITY ASSURANCE

A The placement of riprap will be monitored by the CQA Consultant as required by the CQA Plan.

B The CQA Consultant will perform material conformance testing 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 account for these activities in the construction schedule.

D. The Contractor shall correct all deficiencies and non-conformances identified by the CQA Consultant at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 MATERIALS

A. Riprap shall consist of hard, durable, angular field or quarry stone.

B. Riprap shall conform to Section 530-2.2.2 of the FDOT Specifications.

PART 3 EXECUTION

3.01 PLACEMENT

A. Place riprap to the thickness, elevations, and locations indicated on the Construction Drawings.

B. Place riprap upon geotextile separator or geocomposite meeting requirements of Section 02720 or Section 02740, respectively, and over prepared layers as indicated on the Construction Drawings.

C. Carefully place riprap to avoid segregation or disturbance or damage of the underlying material. Place the material in a manner to produce a well graded mass of riprap with the minimum practicable percentage of voids. Distribute the larger pieces throughout the entire mass such that the finished riprap is free from objectionable pockets of small or large pieces.

D. Do not place riprap by dumping into chutes or by similar methods likely to cause segregation of various sizes.

E. Do not place riprap in a manner that causes damage to an underlying geotextile separator or geocomposite. Repair damaged geotextile as directed by the Engineer and in accordance with Section 02720 or Section 02740.

3.02 SURVEY CONTROL

A. Survey the location of riprap placement in accordance with Section 02100.

3.03 TOLERANCES

A. Place the riprap to the minimum thicknesses as indicated on the Construction Drawings.

[END OF SECTION]

SECTION 02290

SEDIMENT AND EROSION CONTROL

PART 1 GENERAL

1.01 SCOPE

A. The CONTRACTOR shall furnish all labor, materials, tools, and incidentals required to install and maintain the temporary sediment and erosion control measures and structures including, but not limited to, silt fence, straw bales, check dams, and sediment traps, throughout the duration of the construction work. The CONTRACTOR shall also be responsible for removing the temporary sediment and erosion control measures and structures after the construction work is completed.

1.02 RELATED SECTIONS AND PLANS

A. Section 02100 – Surveying

B. Section 02110 – Stripping

C. Section 02200 – Earthwork

D. Section 02230 – Road Construction

E. Construction Quality Assurance (CQA) Plan

1.03 REFERENCES

A. The Florida Stormwater, Erosion, and Sedimentation Control Inspector's Manual, First Edition, January 1999.

1.04 COMPLIANCE WITH REGULATIONS

A. It is the sole responsibility of the CONTRACTOR to be completely familiar and comply with all local, state, and federal regulations pertaining to the work required in this section.

1.05 CONSTRUCTION QUALITY ASSURANCE

A. Sediment and erosion control activities shall be monitored as outlined in the CQA Plan.

B. The CONTRACTOR shall be aware of the activities set forth in the CQA Plan and shall account for these activities in the construction schedule.

C. The CONTRACTOR shall assist the CQA Consultant in every manner necessary for the proper performance of activities set forth in the CQA Plan.

D. CQA testing or inspections does not relieve the CONTRACTOR of the responsibility to construct all work in conformance with the Construction Drawings and Specifications.

E. If quality control or quality assurance tests indicate work does not meet specified requirements, the CONTRACTOR shall remove, replace, and retest the work at no additional cost to the OWNER.

1.06 SUBMITTALS

A. The CONTRACTOR shall submit samples and manufacturer's product data sheets and recommended methods of installation for the proposed silt fence to the ENGINEER at least 14 days prior to starting installation. The manufacturer's product data sheets shall provide documentation and certification that the silt fence products meet or exceed the requirements specified in Para. 2.01 of this Section.

PART 2 PRODUCTS

2.01 SILT FENCE

A. Furnish silt fence with either woven or nonwoven fabric. Silt fence shall:

1. be woven fabric consisting of slit films of polypropylene treated with ultraviolet light stabilizers or nonwoven fabric consisting of long chain polymeric filaments or polyester yarns;
2. be inert to hydrocarbons and chemicals commonly found in soils;
3. be resistant to mildew, rot, insects, and rodent attack;
4. have fence post of minimum 2” x 2” lumber and with minimum length of 36 inches spaced a maximum distance of 6 ft along fabric; and
5. have minimum fabric width of 36 inches.

2.02 VEGETATION

A. Vegetation shall be as specified in Section 02930 of these Specifications.

PART 3 EXECUTION

3.01 INSTALLATION

A. Silt fence shall be installed in accordance with the manufacturer's recommendations as needed or as directed by the ENGINEER, prior to any construction activities. Minimum fabric burial depth shall be 6 inches or as recommended by the manufacturer, whichever is greater.

B. The exterior slopes of landfill berms and road shoulders shall be grassed immediately after final grading and shaping.

C. The CONTRACTOR shall use straw bales to contain sediment and water from dewatering operations and promote infiltration. Accumulated sediment shall be removed and stockpiled for reuse in an area designated by the ENGINEER.

3.02 PROTECTION OF WORK

A. The CONTRACTOR shall protect all prior work, including materials and related work of other sections.

B. In the event of damage, the CONTRACTOR shall immediately make all repairs and replacements necessary, as directed and approved by the ENGINEER, at no additional cost to the OWNER.

[END OF SECTION]

SECTION 02715

HIGH DENSITY POLYETHYLENE (HDPE) PIPES AND FITTINGS

PART 1 GENERAL

1.01 SCOPE

A. This section includes requirements for high-density polyethylene (HDPE) pipes and fittings installation and products.

1.02 RELATED SECTIONS AND PLANS

A. Section 02100 - Surveying

B. Section 02215 - Trenching and Backfilling

C. Section 02235 - Granular Drainage Materials

D. 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.

B. Latest version of the American National Standards Institute (ANSI) standards:

1.	ANSI B16.1.	Standard Specifications for Cast-Iron Pipe Flanges and Flange Fittings.

C. Latest version of the American Society of Mechanical Engineers (ASME) standard:

1.	ASME B31.9	Building Services Piping §937.1 through 937.3.

1.04 SUBMITTALS

A. Submit the following to the Engineer for review not less than 30 calendar days prior to first installation of material under this section:

1. detailed shop drawings of all HDPE pipes, fittings, supports, and other appurtenances;

2. a list of materials to be furnished;
3. the names of the suppliers and the proposed dates of delivery of the materials to the site;
4. detailed procedures to be used for hydrostatic testing of the pipes and fittings;
5. documentation demonstrating that the manufacturer has adequate quality control procedures to ensure that fabrication of the HDPE pipes and fittings complies with the requirements of this section;
6. origin (resin supplier's name, resin production plant) and identification (brand name, number) of the polyethylene resin used; and
7. certification of minimum values and the corresponding test procedures for HDPE material properties listed in Tables 02715-1 and 02715-2.

B. Submit at least 30 calendar days prior to installation of any material covered by this section, manufacturer’s written certification of compliance with these Specifications for that material.

C. Submit at least 14 calendar days prior to installation, documentation of training and certification of personnel qualified for performing HDPE pipe joining operations.

1.05 CONSTRUCTION QUALITY ASSURANCE

A. The installation of HDPE pipe and fittings shall be monitored by the CQA Consultant as required by the CQA Plan.

B. The CQA Consultant may perform material conformance testing and installation quality assurance evaluations of the HDPE pipe and fittings.

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 PRODUCTS

2.01 GENERAL

A. Design and proportion all parts to have adequate strength and stiffness and to be adapted for the purposes shown on the Construction Drawings.

B. Furnish each HDPE manhole completely assembled with all pipes, valves, fittings, supports, gussets, and appurtenances such that field work involves only installation and connection of external products.

C. Furnish each HDPE manhole with watertight construction of welds and pipe penetrations.

2.02 HDPE COMPOUND

A. Furnish HDPE flat stock manufactured from new HDPE resin conforming to ASTM D 1248 (Type III, Class C Category 5, Grade P34), ASTM D 3350 (minimum cell classification as shown in Table 02715-1), and having a Plastic Pipe Institute (PPI) Rating of PE 3408. Furnish material having minimum certifiable property values listed in Table 02715-1.

B. Furnish HDPE pipe and fittings manufactured from new HDPE resin conforming to ASTM D 1248 (Type III, Class C Category 5, Grade P34), ASTM D 3350 (minimum cell classification as shown in Table 02715-2), and having a Plastic Pipe Institute (PPI) Rating of PE 3408. Furnish material having minimum certifiable property values listed in Table 02715-2.

2.03 HDPE PIPES AND FITTINGS

A. Unless otherwise shown on the Construction Drawings, furnish HDPE pipe and fittings that have a SDR of 11 and conform to ASTM F 714.

B. Furnish HDPE pipes in standard laying lengths not exceeding 50 feet.

C. Furnish HDPE pipes and fittings that are homogeneous throughout and free of visible cracks, holes (other than intentional manufactured perforations), foreign inclusions, or other deleterious effects, and are uniform in color, density, melt index, and other physical properties.

D. Furnish HDPE end caps at the end of pipes as shown on the Construction Drawings.

E. Furnish electrofusion couplings meeting the requirements of ASTM F 1055 and as recommended by the electrofusion coupling manufacturer.

F. Perforate pipe by factory drilling at locations shown on the Construction Drawings.

2.04 HDPE MANHOLES

A. Furnish manholes of the types, and to the dimensions, shown on the Construction Drawings.

B. Furnish manholes having exterior and interior surfaces that are smooth with no sharp projections, homogeneous throughout with respect to resin compound, and free of foreign inclusions and surface defects. Furnish HDPE manholes that are as uniform as commercially achievable in color, opacity, density, and other physical properties.

C. Shop fabricate manholes from HDPE pipe meeting the requirements of this Section. Shop fabricate 60-inch diameter manholes using an HDPE Standard Dimension Ratio (SDR) of 32.5 conforming to ASTM F 714.

D. Shop fabricate manhole pipe stub-outs with the same pipe SDR as the HDPE pipe entering the junction box. Fabricate with a minimum stub-out length of 12 inches, or more if necessary for thermal butt fusion of external pipes.

E. Shop fabricate cover and supports from minimum 1-inch thick HDPE flat stock.

F. Shop weld components of the HDPE manhole weld pipes and fittings to each other by thermal butt fusion. Weld other components, including supports, to the junction box by extrusion welding. Hot air welding is not acceptable. Do not join the pipe supports with the pipes unless specifically called for on the Construction Drawings.

2.05 IDENTIFICATION

A. Continuously indent print on the HDPE pipe, or space at intervals not exceeding 5 feet the following:

1. name and/or trademark of the HDPE pipe manufacturer;
2. nominal HDPE pipe size;

3. standard dimension ratio (e.g., SDR-11);
4. the letters PE followed by the polyethylene grade per ASTM D 1248, followed by the Hydrostatic Design Stress in 100's of psi (e.g., PE 3408);
5. Manufacturing Standard Reference (e.g., ASTM F 714); and
6. a production code from which the date and place of manufacture can be determined.

2.06 EMBEDMENT FILL AND BACKFILL MATERIALS

A. Furnish embedment fill materials in accordance with Section 02215.

B. Furnish trench backfill materials in accordance with Section 02215.

PART 3 EXECUTION

3.01

A. Perform HDPE manhole installation and pipe joining operations with trained and certified personnel.

3.02 HDPE PIPE, FITTINGS, AND APPURTENANCES

A. Deliver HDPE pipe, fittings, and appurtenances to the site at least 10 calendar days prior to the planned installation date.

B. Provide proper handling and storage of the HDPE pipe, fittings, and appurtenances at the site. Protect materials from excessive heat or cold, dirt, moisture, cutting, or other damaging or deleterious conditions. Provide any additional storage procedures required by the Manufacturer.

C. Exercise care when transporting, handling, and placing HDPE pipe and fittings. Use rope, fabric, or nylon slings and straps when handling HDPE pipe. Do not position slings, straps, at butt-fusion joints or at fittings.

D. The maximum allowable depth of cuts, gouges or scratches on the exterior surface of HDPE pipe, fittings, or appurtenances is 10 percent of the wall thickness. The interior of the pipe and fittings shall be free of cuts, gouges and scratches. Replace any HDPE pipe and fittings that become gouged, twisted, or crimped. Remove from the work area damaged pipes and fittings.

E. Whenever pipe laying is not actively in progress, close the open ends of all installed pipes using watertight plugs.

F. Perform trenching and backfilling of all installed pipe, fittings, and appurtenances in accordance with Section 02215.

G. Perform testing of all installed pipe, fittings, and appurtenances in accordance with this section.

3.03 HDPE PIPE AND FITTINGS INSTALLATION

A. Carefully examine HDPE pipe and fittings for cracks, damage or defects before installation. Do not use cracked, damaged, or defective material.

B. Inspect the interior of all pipe and fittings and remove any foreign material from the pipe interior before the pipe is moved into final position.

C. Perform field-cutting of pipes, where required, with a machine specifically designed for cutting pipe. Make cuts carefully without damage to pipe, so as to leave a smooth end at right angles to the axis of pipe. Taper cut ends and smooth sharp edges. Flame cutting is not allowed.

D. Do not lay pipe until the CQA Consultant has verified the bedding conditions.

E. Install HDPE pipe and fittings in accordance with the Manufacturer's recommendations and the requirements of this section.

F. Install pipe and fittings to the lines and grades shown on the Construction Drawings.

G. Place and compact embedment fill and trench backfill material as shown on the Construction Drawings and in accordance with Section 02215.

H. Provide all necessary adapters and/or fittings required when connecting different types and sizes of pipe or when connecting pipe made by different manufacturers.

3.04 HDPE PIPE, FITTINGS, AND APPURTENANCES CONNECTIONS

A. Personnel performing joining operations shall demonstrate proficiency to the satisfaction of the CQA Consultant.

B. Weather Conditions for Joining:

1. Do not join HDPE pipes and fittings at ambient temperatures below 40 degrees Fahrenheit (°F) or above 104°F, unless authorized in writing by the Construction Manager. For cold (<40°F) or hot (>104°F) weather joining, use the additional procedures authorized in writing by the Construction Manager.
2. Measure ambient temperatures at fusion machine.
3. Do not join HDPE pipe and fittings during any precipitation, in the presence of heavy fog or dew, or in areas of ponded water.

C. Prior to joining, clean the joint area to be free of moisture, dust, dirt, debris of any kind, and foreign material.

D. Joining equipment shall be approved for the applicable field joining processes. Fusion-welding apparatus shall be an automated device equipped with gauges giving the applicable temperatures and pressures.

E. Join HDPE pipe with thermal butt-fusion joints or electrofusion adapters. Fabricate joints in compliance with ASTM D 2657, ASTM F 1055, the manufacturer's recommendations, and the requirements of this section.

F. Install flanged connections of HDPE pipe and fittings as shown on the Construction Drawings and as follows:
   1. Thermally butt-fuse HDPE flange connection (flange adapter) to HDPE pipe.
   2. Use Type 316 stainless steel lap joint flange. Outside diameter and drillings shall comply with American National Standards Institute (ANSI) B16.1.
   3. Use Type 316 stainless steel flange bolts, nuts and washers that meet the requirements of ANSI B16.1. Lubricate bolt threads prior to attaching nuts. Tighten bolts to a torque of 100 ±5 foot-pounds.

G. Bolt HDPE flange adapter and stainless steel lap joint flanges at the ambient temperature of the surrounding soil to prevent relaxation of the flange bolts and loosening of the joint due to thermal contraction of the polyethylene. Draw bolts up evenly and in line. Retighten bolts 1 and 4 hours after initial tightening.

3.05 FIELD TESTING AND INSPECTION

A. Notify the CQA Consultant a minimum of 24 hours in advance of pipe testing or pipe inspection.

B. HDPE Pipe and Fittings Hydrostatic Testing:

1. Provide testing apparatus, including pumps, hoses, gauges, taps, plugs, drains, temporary connections, and fittings to perform testing in accordance with this Section.

2. HDPE Pipe and Fittings Hydrostatic Testing:
    a. Pressure test all installed HDPE solid wall pipe prior to placing fill over the pipes.
    b. Perform tests in the presence of the CQA Consultant and in accordance with the detailed test procedure submitted by the Contractor in accordance with this section.
    c. Test HDPE solid wall pipes at 130 psi internal pressure. Test pipes in accordance with ASME B31.9 §937.1 through §937.3.
    d. Test pipes at the required internal pressure for a minimum of one hour after the pressure in the pipe has stabilized. The test duration does not include the initial expansion phase after the pipe is first pressurized. The duration of the expansion phase shall be as recommended by the manufacturer.
    e. Identify any leaks, remove the water, and make repairs to the pipe.
    f. Retest the pipe until acceptance criteria are achieved in accordance with the approved procedures for testing prior to placing backfill over the pipe.
    g. Test gauges shall be calibrated within one year of date of test. Calibration shall be traceable to national or industry standards where possible.
    h. Acceptance criteria for hydrostatic testing is zero leakage for the stabilized pressure for the minimum duration of the test.

C. HDPE Pipe Inspection:
    1. Inspect fusion joints for evidence of excess or insufficient bead size, contamination, offset, or any other evidence of inadequate joining. The surface of the HDPE pipe shall be clean at the time of inspection. Wipe or wash the HDPE pipe surface if surface contamination inhibits inspection.
    2. Repair any pipe sections where greater than 4 percent pipe diameter deflection from vertical is observed.

D. Defects and Repairs:
    1. Repair Procedures:
        a. Repair any portion of the HDPE pipe exhibiting a flaw, or poor quality fusion joint by removing bad joint or pipe section and replacing with a new pipe section.
        b. When making repairs, satisfy the following:
            (1) clean and dry all pipe surfaces immediately prior to repair; and

(2) only use approved fusion equipment or electrofusion fitting.

2. Repair Verification:
   a. Inspect each repair using the methods described in the this Section. Repair areas that fail the inspection.

3.06 SURVEY CONTROL

A. Survey the top of HDPE pipe at each change in direction or grade and on no greater than 50-foot centers and at all manhole inlets and outlets in accordance with Section 02100.

3.07 TOLERANCES

A. Install all HDPE pipes to within ±0.1 feet of bottom of pipe elevations as indicated on the Construction Drawings.

B. Provide positive slope of gravity lines at all locations to within ±10 percent of the values indicated on the Construction Drawings.

TABLE 02715-1

REQUIRED HDPE FLAT STOCK PROPERTIES ASTM D 3350 CELL CLASSIFICATION PROPERTIES AND RANGES

Properties	Cell Range	Qualifiers	Units	Specified Values	Test Method
Specific Gravity	3	minimum	N/A	0.94	ASTM D 1505
Melt Flow Index	3 to 5	maximum	g/10 min	<0.4	ASTM D 1238 (Condition E)
Flexural Modulus	5	minimum	lb/in^2	110,000	ASTM D 790
Tensile Strength	4 or 5	minimum	lb/in^2	3,000	ASTM D 638
Environmental Stress Crack	3	minimum	hrs	$F_{20} > 192$	ASTM D 1693
Hydrostatic Design Basis at 73°F	4	minimum	lb/in^2	1,600	ASTM D 2837
UV Stabilizer	C	minimum	% Carbon Black	2	ASTM D 1603

TABLE 02715-2

REQUIRED HDPE PIPE AND FITTINGS PROPERTIES ASTM D 3350 CELL CLASSIFICATION PROPERTIES AND RANGES

Properties	Cell Range	Qualifiers	Units	Specified Values	Test Method
Specific Gravity	3	minimum	N/A	0.94	ASTM D 1505
Melt Flow Index	4 or 5	maximum	g/10 min	<0.15	ASTM D 1238 (Condition E)
Flexural Modulus	5	minimum	lb/in^2	110,000	ASTM D 790
Tensile Strength	4 or 5	minimum	lb/in^2	3,000	ASTM D 638
Environmental Stress Crack	3	minimum	hrs	$F_{20} > 192$	ASTM D 1693
Hydrostatic Design Basis at 73°F	4	minimum	lb/in^2	1,600	ASTM D 2837
UV Stabilizer	C	minimum	% Carbon Black	2	ASTM D 1603

[END OF SECTION]

SECTION 02720

GEOTEXTILES

PART 1 GENERAL

1.01 SCOPE

A. This section includes the requirements for geotextile products and installation.

1.02 RELATED SECTIONS AND PLANS

A. Section 02215 - Trenching and Backfilling

B. Section 02235 - Granular Drainage Materials

C. Section 02245 - Riprap

D. 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.

B. Federal Standard No. 751a - Stitches, Seams, and Stitching.

1.04 SUBMITTALS

A. Submit the following to the Engineer for review not less than 21 calendar days prior to use.
   1. geotextile Manufacturer and product name;
   2. certification of minimum average roll values and the corresponding test procedures for all geotextile properties listed in Tables 02720-1 and 02720-2; and
   3. projected geotextile delivery dates.

B. Submit to the Engineer for review at least 14 calendar days prior to geotextile placement, manufacturing quality control certificates for each roll of geotextile as specified in this section.

1.05 CONSTRUCTION QUALITY ASSURANCE

A. The installation of geotextiles will be monitored by the CQA Consultant as required in the CQA Plan.

B. The CQA Consultant will perform material conformance testing of the geotextiles as required in 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 construction schedule.

D. The Contractor shall correct all deficiencies and nonconformances identified by the CQA Consultant at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 GEOTEXTILE

A. Furnish geotextile products with minimum average roll values (95 percent lower confidence limit) meeting or exceeding the required property values in Tables 02720-1 (for geotextile filters) and 02720-2 (for geotextile separators).

B. Furnish geotextiles that are stock products.

C. Furnish geotextiles that are manufactured from first quality polymers, with no more than 20 percent reclaimed polymer used in production.

D. 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.

2.02 MANUFACTURING QUALITY CONTROL

A. Sample and test the geotextile to demonstrate that the material conforms to the requirements of this section.

B. Perform manufacturing quality control tests to demonstrate that the geotextiles properties conform to the values specified in Tables 02720-1 and 02720-2. Perform as a minimum, the following manufacturing quality control tests at a minimum frequency of once per 50,000 square feet with minimum of 1 test per resin lot:

Test	Procedure
Mass per unit area	ASTM D 5261
Grab strength	ASTM D 4632
Tear strength	ASTM D 4533
Puncture strength	ASTM D 4833
Static Puncture strength	ASTM D 6241

C. Perform additional manufacturing quality control tests on the geotextile filter at a minimum frequency of once per 100,000 square feet with minimum of 1 test per resin lot, to demonstrate that the apparent opening size (ASTM D 4751) and permittivity (ASTM D 4491) of the geotextile conform to the values specified in Table 02720-1.

D. Submit quality control certificates signed by the geotextile manufacturer quality control manager. The certificates shall state that the geotextiles are continuously inspected and are needle-free. The quality control certificates shall also include: lot, batch, and roll number and identification; and results of manufacturing quality control tests including description of test methods used.

E. Do not supply any geotextile roll that does not comply with the manufacturing quality control requirements.

F. If a geotextile 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 PACKAGING AND LABELING

A. Supply geotextiles in rolls wrapped in relatively impermeable and opaque protective wrapping. Wrapping which becomes torn or damaged shall be repaired with similar materials.

B. Mark or tag geotextile rolls in accordance with ASTM D 4873 with the following information:

1. manufacturer's name;
2. product identification;
3. lot or batch number;
4. roll number; and
5. roll dimensions.

C. Geotextile rolls not labeled in accordance with this section or on which labels are illegible upon delivery to the site shall be rejected and replaced at no expense to the Owner.

2.04 TRANSPORTATION

A. Deliver geotextiles to the site at least 14 calendar days prior to the planned deployment date to allow the CQA Consultant adequate time to perform conformance testing on the geotextile samples as described in the CQA Plan.

2.05 HANDLING AND STORAGE

A. Protect geotextiles from sunlight, moisture, excessive heat or cold, puncture, mud, dirt, and dust or other damaging or deleterious conditions. Follow all geotextile manufacturer recommendations for handling and storage. Geotextile rolls shall be covered with additional tarp cover (in addition to the roll cover) to prevent damage to the rolls.

B. Store geotextile rolls on palates or other elevated structures. Do not store geotextile rolls directly on the ground.

C. Outdoor storage of geotextile rolls shall not exceed the manufacturer's recommendation or longer than 6 months, whichever is less.

PART 3 EXECUTION

3.01 PLACEMENT

A. Do not commence geotextile installation until the CQA Consultant completes conformance evaluation of the geotextiles and performance evaluation of previous work, including evaluation of Contractor's survey results for previous work.

B. Handle geotextiles so as to ensure they are not damaged in any way.

C. Take necessary precautions to prevent damage to underlying layers including rutting during placement of the geotextiles.

D. After unwrapping the geotextiles from its opaque cover, do not leave them exposed for a period in excess of 30 calendar days.

E. If white colored geotextiles are used, take precautions against "snowblindness" of personnel.

F. Examine the geotextile surface after installation to ensure that no potentially harmful foreign objects are present. Remove any such objects and replace any damaged geotextiles.

3.02 SEAMS AND OVERLAPS

A. Continuously overlap a minimum of 6 inches and sew filter geotextiles (i.e., spot sewing is not allowed) using a "single prayer" seam. Sew seams using Stitch Type 401 as per Federal Standard No. 751a. In lieu of sewing, geotextile filters may be overlapped a minimum of two feet.

B. Do not install horizontal seams on slopes that are steeper than 10 horizontal to 1 vertical. Seams shall be along, not across, the slopes.

C. Overlap separator geotextiles a minimum of 12 inches and ensure that the overlap is maintained.

3.03 REPAIR

A. Repair any holes or tears in the geotextiles using a patch made from the same geotextile material. Extend geotextile patches a minimum of 1 foot beyond the damaged area. Sew geotextile patches into place no closer than 1 inch from any panel edge. Should any tear exceed 50 percent of the width of the roll, remove and replace that roll.

B. Remove any soil or other material that may have penetrated the torn geotextiles.

3.04 PLACEMENT OF SOIL MATERIALS

A. Place soil materials on top of geotextiles in such a manner as to ensure that:
   1. the geotextiles and the underlying materials are not damaged; and
   2. slippage does not occur between the geotextile and the underlying layers during placement.

B. Spread soil on top of the geotextile to cause the soil to cascade over the geotextile rather than be shoved across the geotextile.

C. Place aggregate over geotextile separators as indicated on the Construction Drawings prior to trafficking.

D. Place soil over geotextile filters as indicated on the Construction Drawings prior to trafficking.

TABLE 02720-1

REQUIRED PROPERTY VALUES FOR GEOTEXTILE FILTER

PROPERTIES (6)	QUALIFIER	UNITS (5)	SPECIFIED VALUES (1)	TEST METHOD
Product Requirements				
Type	--	--	Nonwoven needle-punched	--
Polymer composition	Minimum	%	95 polypropylene or polyester by wt	--
Mass per unit area	Minimum	oz/yd^2	8	ASTM D 5261
Filter Requirements				
Apparent opening size	Maximum	mm	$O_{95} \leq 0.21$	ASTM D 4751
Permittivity	Minimum	sec^{-1}	0.5	ASTM D 4491
Mechanical Requirements				
Grab strength	Minimum	lb	200	ASTM D 4632(2)
Tear strength	Minimum	lb	75	ASTM D 4533(3)
Puncture strength	Minimum	lb	90	ASTM D 4833(4)
Static puncture strength	Minimum	psi	500	ASTM D 6241
Durability Requirements				
Ultraviolet Resistance	Minimum	%	70	ASTM D 4355

Notes:

(1) All values represent minimum average roll values.
(2) Minimum of values measured in machine and cross machine directions with 1 inch clamp on Constant Rate of Extension (CRE) machine.
(3) Minimum value measured in machine and cross machine direction.
(4) Tension testing machine with a 1.75-inch diameter ring clamp, the steel ball being replaced with 0.31-inch diameter solid steel cylinder with flat tip centered within the ring clamp.
(5) mm = millimeter; % = percent
oz/yd^2 = ounce per square yard; sec = second
lb = pound; psi = pound per square inch
(6) See Paragraph 2.02 for required MQC test frequencies.

TABLE 02720-2

REQUIRED PROPERTY VALUES FOR GEOTEXTILE SEPARATOR

PROPERTIES (6)	QUALIFIER	UNITS (5)	SPECIFIED VALUES (1)	TEST METHOD
Product Requirements				
Type	--	--	Nonwoven needle-punched	--
Polymer composition	Minimum	%	95 polypropylene or polyester	--
Mass per unit area	Minimum	oz/yd^2	8	ASTM D 5261
Mechanical Requirements				
Grab strength	Minimum	lb	200	ASTM D 4632(2)
Tear strength	Minimum	lb	75	ASTM D 4533(3)
Puncture strength	Minimum	lb	90	ASTM D 4833(4)
Static puncture strength	Minimum	psi	500	ASTM D 6241
Durability Requirements				
Ultraviolet Resistance	Minimum	%	70	ASTM D 4355

Notes:

(1) All values represent minimum average roll values.
(2) Minimum of values measured in machine and cross machine directions with 1 inch clamp on Constant Rate of Extension (CRE) machine.
(3) Minimum value measured in machine and cross machine direction.
(4) Tension testing machine with a 1.75-inch diameter ring clamp, the steel ball being replaced with 0.31-inch diameter solid steel cylinder with flat tip centered within the ring clamp.
(5) % = percent
oz/yd^2 = ounce per square yard
lb = pound
psi = pound per square inch
(6) See Paragraph 2.02 for required MQC test frequencies.

[END OF SECTION]

SECTION 02740

GEOCOMPOSITES

PART 1 GENERAL

1.01 SCOPE

A. This section includes requirements for geocomposite drainage layer products and installation.

1.02 RELATED SECTIONS AND PLANS

A. Section 02240 – Protective Soil Layer

B. Section 02770 – Geomembranes

C. 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 Table 02740-1; 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 leachate collection drainage layer having properties meeting the required property values shown in Table 02740-1. 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 Table 02740-1, 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 Table 02740-1 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 testing of the liner system geocomposites shall be conducted using the actual boundary materials intended for the geocomposite at the normal design loads of 500 and 12,000 pounds per square foot (psf) for a minimum period of 24 hours and 100 hours, respectively. At the normal load of 12,000 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 Table 02740-1. 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
Puncture strength	ASTM D 4833
Static 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 Table 02740-1.

D. Perform manufacturing quality control tests to demonstrate that the geonet drainage core properties conform to the values specified in Table 02740-1. 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 Table 02740-1.

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
GEOCOMPOSITE PROPERTY VALUES

PROPERTIES (6)	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 strength	Minimum	lb	200	ASTM D 4632 (2)
Tear strength	Minimum	lb	75	ASTM D 4533 (2)
Puncture strength	Minimum	lb	90	ASTM D 4833 (3)
Static puncture strength	Minimum	psi	500	ASTM D 6241
Geocomposite:				
Transmissivity	Minimum	m^2/s	See notes 4 and 5	ASTM D 4716
Ply Adhesion	Minimum	lb/in	1.0	ASTM D 7005

Notes:

1. All values represent minimum average roll values.
2. Minimum value measured in machine and cross-machine direction.
3. Tension testing machine with a 1.75-inch diameter ring clamp, the steel ball being replaced with 0.31-inch diameter solid steel cylinder with flat tip centered within the ring clamp.

TABLE 02740-1 (Continued)

4. The design transmissivity of the geocomposite drainage layer in the bottom liner system shall be measured using water at a gradient of 0.02 under compressive stresses of 500 psf and of 12,000 psf for a period of 24 hours and 100 hours, respectively. For the test, the geocomposite shall be sandwiched between 60-mil textured HDPE geomembrane and soil actually used for the liner protective layer. The minimum required transmissivities are 9.0 x 10^{-4} m^2/s and 7.9 x 10^{-4} m^2/s under the compressive stresses of 500 psf and 12,000 psf, respectively.

5. The design transmissivity of the geocomposite drainage layer in the cover system shall be measured using water at a gradient of 0.33 under compressive stresses of 500 psf for a period of 24 hours. For the test, the geocomposite shall be sandwiched between 40-mil textured PE geomembrane and soil actually used for the cap protective layer. The minimum required transmissivity is 4.3 x 10^{-4} m^2/s under the compressive stresses of 500 psf.

6. See Paragraph 2.02 for required MQC test frequencies.

[END OF SECTION]

SECTION 02770

GEOMEMBRANES

PART 1 GENERAL

1.01 SCOPE

A. The section includes requirements for geomembrane products and installation.

1.02 RELATED SECTIONS AND PLANS

A. Section 02100 - Surveying

B. Section 02200 - Earthwork

C. Section 02215 - Trenching and Backfilling

D. Section 02740 - Geocomposites

E. Section 02780 - Geosynthetic Clay Liner (GCL)

F. 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 information to the Engineer for review not less than 45 calendar days prior to geomembrane use.

1. Geomembrane manufacturer capabilities, including:
    - a. daily production capacity available for this Contract; and
    - b. manufacturing quality control procedures.
2. A list of 10 completed facilities for which the manufacturer has supplied a minimum total of 10,000,000 square feet of polyethylene geomembrane. Provide the following information for each facility:
    - a. name, location, purpose of facility, and date of installation;

    - b. names of owner, project manager, design engineer, and installer; and
    - c. thickness and surface area of geomembrane provided.
  - 3. Origin (resin supplier's name, resin production plant) and identification (brand name, number) of the polyethylene resin used.
  - 4. Certification of minimum average roll values (95 percent lower confidence limit) for physical, mechanical, and environmental properties and the corresponding test procedures for the geomembrane properties listed in Table 02770-1. Submit values that are specific to the resin used in manufacture.
  - 5. Certification that welding rod or granules are compatible with the specifications and the resin of the geomembrane furnished for this project
  - 6. Manufacturer warranty as specified in this section.

B. Submit to the Engineer for review not less than 30 calendar days prior to geomembrane use the following documentation on the resin used to manufacture the geomembranes:
  1. Copies of quality control certificates issued by the resin supplier including the production dates and origin of the resin used to manufacture the geomembrane for this Contract.
  2. Results of tests conducted by the manufacturer to verify the quality of the resin used to manufacture the geomembrane rolls assigned to the project.
  3. Certification that no more than 10 percent reclaimed polymer is added to the resin during the manufacturing of the geomembrane to be used for this project and that all reclaimed polymer (if added) is same as the parent material.

C. Submit to the Engineer for review the following documentation on geomembrane roll production at least 14 calendar days prior to transporting any geomembrane to the site.
  1. Manufacturing certificates for each shift's production of geomembrane, signed by the manufacturer quality control manager.
  2. Certificate shall include:
     a. roll numbers and identification;
     b. sampling procedures; and
     c. results of manufacturer quality control tests, including descriptions of the test methods used (the manufacturer quality control tests to be performed are given in Part 2 of this section).

D. Submit to the Engineer for review the following information from the installer at least 14 calendar days prior to mobilization of the installer to the site.

1. Layout drawings showing the installation layout identifying geomembrane panel configurations, dimensions, details, locations of seams, as well as any variance or additional details which deviate from the Construction Drawings. The layout drawings shall be adequate for use as a construction plan and shall include dimensions, details, etc. The layout drawings, as modified and/or approved by the Engineer, shall become part of the contract.
2. Installation schedule.
3. Copy of installer's letter of approval or license by the manufacturer.
4. Installation capabilities, including:
    a. information on equipment proposed for this project;
    b. average daily production anticipated for this project; and
    c. quality control procedures to include quality control organization.
5. A list of 10 completed facilities for which the installer has installed a minimum of 5,000,000 square feet of polyethylene geomembrane. The following information shall be provided for each facility:
    a. the name and purpose of the facility, its location, and dates of installation;
    b. the names of the owner, project manager, and geomembrane manufacturer;
    c. name and qualifications of the supervisor of the installation crew;
    d. thickness and surface area of installed geomembrane;
    e. type of seaming and type of seaming apparatus used; and
    f. duration of installation.
6. Resumes of the installer superintendent and quality control chief to be assigned to this project, including dates and duration of employment.
7. Resumes of all personnel who will perform seaming operations on this project, including dates and duration of employment.
8. Evidence that the installation crew has the following experience.
    a. The superintendent shall have supervised the installation of a minimum of 2,000,000 square feet of polyethylene geomembrane.
    b. At least one seamer shall have experience seaming a minimum of 500,000 square feet of polyethylene geomembrane using the same type of seaming apparatus to be used at this site. Seamers with such experience will be designated "master seamers" and shall provide direct supervision over less experienced seamers.
    c. All other seaming personnel shall have seamed at least 100,000 square feet of polyethylene geomembrane using the same type of seaming apparatus to be used at this site. Personnel who have seamed less than 100,000 square feet of seams shall be allowed to seam only under the direct supervision of the master seamer or Superintendent.

E. Submit to the Engineer for review at least 14 days prior to geomembrane placement, a certificate of calibration less than 12 months old for the field tensiometer. Tensiometer shall be calibrated within one year of date of test. Calibration shall be traceable to national or industry recognized standards where possible.

F. Submit subgrade acceptance certificates, signed by the Installer, for each area to be covered by the geomembrane prior to that area being covered by geomembrane.

G. Within 14 calendar days of completion of the geomembrane installation, submit to the Engineer the executed installation warranty as specified in this section.

1.05 CONSTRUCTION QUALITY ASSURANCE

A. The construction of the geomembrane component of the liner system and final cover system will be monitored by the CQA Consultant as required in the CQA Plan.

B. The CQA Consultant will perform material conformance testing of geomembrane materials and installation quality assurance testing of the geomembrane liner and cover seams.

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 construction schedule.

D. The Contractor shall correct all deficiencies and nonconformances identified by the CQA Consultant at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 RESIN

A. Provide geomembrane manufactured from new, first-quality polyethylene resin. Do not add reclaimed polymer to the resin. The use of polymer recycled during the manufacturing process is permitted if performed with appropriate cleanliness and if the recycled polymer during the manufacturing process does not exceed 10 percent by weight of the total polymer weight.

B. Use high density polyethylene (HDPE) resin for liner system geomembranes having the following properties:

1. Specific Gravity (min.):	0.932 (ASTM D 792 Method B, or ASTM D 1505)
2. Melt Index (max.):	1.0 g/10 min (ASTM D 1238)

C. Use polyethylene (PE) resin for final cover geomembranes having the following properties:
   1. Specific Gravity (min.): 0.915 (ASTM D 792 Method B, or ASTM D 1505)
   2. Melt Index (max.): 1.0 g/10 min (ASTM D 1238)

2.02 GEOMEMBRANE PROPERTIES

A. Furnish 60-mil HDPE textured geomembranes having properties that comply with the required values shown in Table 02770-1.

B. Furnish 40-mil PE smooth and textured geomembranes having properties that comply with the required values shown in Table 02770-3.

C. Furnish geomembrane that meets the shear strength requirements of Section 02790 as tested by an approved testing laboratory.

D. In addition, furnish geomembrane that:
   1. contains a maximum of 1 percent by weight of additives, fillers, or extenders not including carbon black;
   2. does not have striations, pinholes, bubbles, blisters, nodules, undispersed raw materials, or any sign of contamination by foreign matter on the surface or in the interior;
   3. is free of holes, blisters, modules, undispersed raw materials, or any sign of contamination by foreign matter; and
   4. is manufactured in a single layer (thinner layers shall not be welded together to produce the final required thickness).

2.03 MANUFACTURING QUALITY CONTROL

A. Resin:
   1. Sample and test resin at a minimum frequency of one test per rail car to demonstrate that the resin complies with the requirements of this section. Perform tests on resin after the addition of additives to the virgin resin. Certify in writing that the resin meets the requirements of this section.
   2. Do not use any noncomplying resin.

B. Rolls:
   1. Continuously monitor for geomembrane defects during manufacture. Geomembranes shall be subjected to continuous spark testing by the Manufacturer at the factory.

2. Do not supply geomembrane that exhibits any defects.
3. Regularly monitor for geomembrane thickness during manufacture.
4. Do not supply geomembrane that fails to meet the specified thickness.
5. Sample and test the geomembrane, to demonstrate that its properties conform to the values specified in Tables 02770-1 and 02770-3. Perform the manufacture quality control tests at the following minimum frequencies with minimum of one test per lot:

Test	Frequency
Thickness	Every Roll
Asperity height	Every 2nd Roll
Specific gravity	200,000 lb
Yield strength	20,000 lb
Yield elongation	20,000 lb
Break strength	20,000 lb
Break elongation	20,000 lb
Carbon black (for HDPE)	20,000 lb
Carbon black (for LLDPE)	45,000 lb
Carbon black dispersion	45,000 lb
Tear resistance	45,000 lb
Puncture resistance	45,000 lb
Oxidative induction time (OIT)	200,000 lb
Stress crack resistance (for HDPE)	200,000 lb

Notes: Typical 60-mil roll (460-ft long and 23-ft wide) weighs approximately 3,100 lb assuming a specific gravity of 0.94. A resin lot is approximately 200,000 lb.

6. If a geomembrane sample fails to meet the quality control requirements of this Section, sample and test rolls manufactured, in the same resin batch, or at the same time, 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 any failing rolls.
7. Provided a written certification that the geomembrane meets the material requirements specified in GRI-GM13 or GRI-GM17 for the following properties using the indicated test procedures. Provide written certification that these tests have been performed on geomembrane rolls having the same formulation as the geomembrane rolls that will be delivered for the project.

Test	Procedure
Oven aging	ASTM D 5721
UV resistance	ASTM D 5885
Axi-Symmetric Break Resistance Strain (for LLDPE)	ASTM D 5617

C. Permit the CQA Consultant and/or Engineer to visit the manufacturing plant for project specific visits. If possible, such visits will be prior to, or during, the manufacturing of the geomembrane rolls for this project.

2.04 LABELING

A. Label the geomembrane rolls with the following information.
   1. thickness of the material;
   2. length and width of the roll;
   3. name of Manufacturer;
   4. product identification;
   5. lot number; and
   6. roll number.

B. Geomembrane rolls not labeled in accordance with this Section or on which labels are illegible upon arrival at the site will be rejected and replaced at no additional expense to the Owner.

2.05 TRANSPORTATION, HANDLING AND STORAGE

A. Deliver geomembranes to the site at least 14 calendar days prior to the planned deployment date to allow the CQA Consultant adequate time to perform conformance testing on the geomembrane samples as described in the CQA Plan.

B. Provide proper handling and storage of the geomembrane at the site. Protect the geomembrane from excessive heat or cold, dirt, puncture, cutting, or other damaging or deleterious conditions. Provide any additional storage procedures required by the Manufacturer.

C. Store geomembrane rolls on pallets or other elevated structures. Do not store geomembrane rolls directly on the ground surface. Do not store more than 3 rolls high.

PART 3 EXECUTION

3.01 FAMILIARIZATION

A. Prior to implementing any of the work described in this section, the Contractor shall become thoroughly familiar with all portions of the work falling within this section.

B. Inspection:
   1. Prior to implementing any of the work in this section, the Contractor shall carefully inspect the installed work of all other sections and verify that all work is complete to the point where the installation of this section may properly commence without adverse impact.
   2. If the Contractor has any concerns regarding the installed work of other sections, the Contractor shall immediately notify the Engineer in writing. Failure to inform the Engineer in writing or continuance of installation of the geomembrane will be construed as the Contractor's acceptance of the related work of all other sections.

3.02 SUBGRADE SURFACE PREPARATION

A. The Contractor shall provide certification in writing that the surface on which the geomembrane will be installed is acceptable. Where a GCL is installed on the subgrade prior to the geomembrane, the Contractor shall inspect the subgrade prior to GCL installation. This certification of acceptance shall be given to the CQA Consultant prior to commencement of geomembrane installation in the area under consideration.

B. Special care shall be taken to maintain the prepared surface.

C. No geomembrane shall be placed onto areas of standing water or hydrated GCL

D. Any damage to the GCL or prepared subgrade caused by installation activities shall be repaired at the Contractor's expense.

3.03 GEOMEMBRANE DEPLOYMENT

A. General:
   1. Textured geomembrane shall be used for all liner construction and on the side slopes of the final cover system as indicated on the Construction Drawings. Smooth geomembrane will be used on top of landfill as indicated on the Construction Drawings.

2. The Contractor shall produce layout drawings prior to geomembrane deployment. These drawings shall indicate the geomembrane configuration, dimensions, details, locations of seams, etc. The layout drawings must be approved by the Engineer prior to the installation of any geomembranes. The layout drawings, as modified and/or approved by the Engineer, shall become part of these specifications.
3. Do not deploy geomembrane until the layout drawings are approved by the Engineer.
4. Do not deploy a geomembrane panel in an area until the CQA Consultant has been provided with a certificate of subgrade acceptance for that area.
5. Do not deploy geomembranes until CQA Consultant completes conformance evaluation of the geomembrane and performance evaluation of previous work, including evaluation of Contractor's survey results for previous work.
6. Deploy each geomembrane panel in accordance with the approved layout drawings.

B. Field Panel Identification:
   1. A geomembrane field panel is a roll or a portion of roll cut in the field.
   2. Give each field panel an identification code (number or letter-number). This identification code shall be agreed upon by the CQA Consultant and the Installer.

C. Field Panel Placement:
   1. Place each geomembrane panel one at a time and seam each panel immediately after its placement.
   2. Use temporary rub sheets as required to prevent displacement or damage to underlying geosynthetics. High spots in geomembrane-backed geosynthetic clay liners shall be covered by a temporary rub sheets during placement of geomembrane.
   3. Do not place geomembrane panels when the ambient temperature is below 40° Fahrenheit (F), unless authorized in writing by the Engineer. For cold weather (<40°F) deployment, use the additional procedures authorized in writing by the Engineer.
   4. Do not place geomembranes during any precipitation, in the presence of heavy fog or dew, in an area of ponded water, or in the presence of high wind.
   5. Ensure that:
      a. No vehicular traffic drives directly on the geomembrane.
      b. Equipment used does not damage the geomembrane by handling, trafficking, or leakage of hydrocarbons (i.e., fuels).
      c. Personnel working on the geomembrane do not smoke, bring glass onto the geomembrane, or engage in other activities that could damage the geomembrane.
      d. The method used to unroll the panels does not scratch or crimp the geomembrane and does not damage lower geosynthetics or the supporting soil.
      e. The method used to place the panels minimizes wrinkles (especially differential wrinkles between adjacent panels). The method used to place the panels results

in intimate contact with geosynthetic clay liner. Adjust or repair any area of geomembrane wrinkles where the wrinkle height, measured perpendicular to the slope during the hottest portion of the day, is more than 4 inches.

f. The method used to place the panels does not cause the panels to lift up or trampoline during the coolest portion of the day.

g. The geomembrane is anchored or weighted with sandbags, or the equivalent, to prevent damage or uplift from wind. Install sufficient anchoring or weighting to prevent uplift and maintain such system until overlying material is placed.

6. Replace any field panel or portion thereof that becomes damaged (torn, twisted, or crimped). Remove from the work area damaged panels or portions of damaged panels.

D. Do not install geomembrane between one hour before sunset and one hour after sunrise unless approved by the Engineer.

3.04 FIELD SEAMING

A. Personnel shall be experienced as specified in this section. Do not perform seaming unless a "master seamer" and the CQA Consultant are on-site.

B. Orient seams parallel to the line of maximum slope (i.e., oriented down, not across, the slope). Minimize the number of seams in corners and at odd-shaped geometric locations. No horizontal seam shall be less than 10 feet from the toe of the slope, except where approved by the Engineer. Do not locate seams at an area of potential stress concentration.

C. Weather Conditions for Seaming:

1. Do not seam geomembrane at ambient temperatures below 40°F or above 104°F, unless authorized in writing by the Engineer. For cold (<40°F) or hot (>104°F) weather seaming, use the additional procedures authorized in writing by the Engineer.
2. Measure ambient temperatures between 0 to 6 inches above the geomembrane surface.
3. In all cases the geomembrane seam areas shall be dry and protected from wind.

D. Overlapping and Temporary Bonding:

1. Sufficiently overlap geomembrane panels for welding and to allow peel tests to be performed on the seam. Any seams that cannot be destructively tested because of insufficient overlap are failing seams.
2. Control the temperature of the air at the nozzle of heat bonding apparatus such that the geomembrane is not damaged.

E. Seam Preparation:
   1. Prior to seaming, clean the seam area and ensure that area to be bonded is free of moisture, dust, dirt, debris of any kind, and foreign material.
   2. If seam overlap grinding is required, complete the process according to the Manufacturer's instructions or within 60 minutes of the seaming operation. Do not grind to a depth that exceeds ten percent of the geomembrane thickness. Grinding marks shall not appear beyond 0.25 inch of the extrudate after it is placed.
   3. Align seams with the fewest possible number of wrinkles and "fishmouths".

F. General Seaming Requirements:
   1. Extend seams to the outside edge of panels to be placed in the anchor trench.
   2. If required, place a firm substrate such as a flat board or similar hard surface directly under the seam overlap to achieve proper support.
   3. Cut fishmouths or wrinkles at the seam overlaps along the ridge of the wrinkle to achieve a flat overlap. Seam the cut fishmouths or wrinkles and patch any portion where the overlap is less than 6 inches with an oval or round patch of geomembrane that extends a minimum of 6 inches beyond the cut in all directions.
   4. Place the electric generator used for power supply to the welding machines outside the area to be lined or mount it on soft tires such that no damage occurs to the geomembrane. Properly ground the electric generator. Place a smooth insulating plate or fabric beneath the hot welding apparatus after use.

G. Seaming Process:
   1. Approved processes for field seaming are extrusion welding and fusion welding. The primary method of welding shall be fusion. Seaming equipment shall not damage the geomembrane. Use only geomembrane Manufacturer-approved equipment.
   2. Extrusion Equipment and Procedures:
      a. Maintain at least one spare operable seaming apparatus on site.
      b. Equip extrusion welding apparatus with gauges giving the temperature in the apparatus and at the nozzle.
      c. Prior to beginning a seam, purge the extruder until all heat-degraded extrudate has been removed from the barrel. Whenever the extruder is stopped, purge the barrel of all heat-degraded extrudate.
   3. Fusion Equipment and Procedures:
      a. Maintain at least one spare operable seaming apparatus on site.
      b. Fusion-welding apparatus shall be automated self-propelled devices equipped with gauges giving the applicable temperatures and pressures.
      c. Fusion-welding apparatus shall produce a double-track seam.

d. Abrade the edges of cross seams to a smooth incline (top and bottom) prior to extrusion welding.

H. Trial Seams:

1. Make trial seams on excess pieces of geomembrane to verify that seaming conditions are adequate. Conduct trial seams on the same material to be installed and under similar field conditions as production seams. Conduct trial seaming at the beginning of each seaming period, and at least once each five hours, for each seaming apparatus used that day prior to seaming. Also, each seamer shall make at least one trial seam each day, for each day that seaming is performed by that seamer. Conduct trial seaming under the same conditions as the actual seaming. Prepare trial seams that are at least 15 feet long by 1 foot wide (after seaming) with the seam centered lengthwise for fusion equipment and at least 3 feet long by 1 foot wide for extrusion equipment. Prepare seam overlap as indicated in the "Overlapping and Temporary Bonding" Article of this Part.
2. Cut four specimens, each 1.0 inch wide, from the trial seam sample. Test two specimens in shear and two in peel, using a field tensiometer. The test specimens shall not fail in the seam. If a specimen fails, repeat the entire operation. If the additional specimen fails, do not accept the seaming apparatus or seamer until the deficiencies are corrected and two consecutive successful trial seams are achieved. A seamer may start production seaming prior to testing of the trial seams. In the event the trial seam fails, all production seams by the seamer are failed seams.

I. Nondestructive Seam Continuity Testing:

1. Nondestructively test field seams for continuity over their full length. Perform continuity testing as the seaming work progresses, not at the completion of field seaming. Complete any required repairs in accordance with the "Defects and Repairs" Article of this Part. Apply the following procedures:
    a. use vacuum testing for extrusion welds; and
    b. use air pressure testing for double-track fusion seams.
2. Vacuum Testing:
    a. Use the following equipment:
        i. A vacuum box assembly consisting of a stiff housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, port hole or valve assembly, and a vacuum gauge.
        ii. A system for applying 5 pound per square inch (psi) gauge suction to the box.
        iii. A bucket of soapy solution and applicator.

    b. Follow these procedures:

        - i. Energize the vacuum pump and reduce the tank pressure to 5 ±1 psi gauge.
        - ii. Wet an area of the geomembrane seam larger than the vacuum box with the soapy solution.
        - iii. Place the box over the wetted area.
        - iv. Close the bleed valve and open the vacuum valve.
        - v. Ensure that a leak tight seal is created.
        - vi. Examine the geomembrane through the viewing window for the presence of soap bubbles for not less than 20 seconds.
        - vii. If no bubbles appear after 20 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum 3 inch overlap, and repeat the process.
        - viii. Mark all areas where soap bubbles appear with a marker that will not damage the geomembrane and repair in accordance with the "Defects and Repairs" Article of this Part.

3. Air Pressure Testing:
    - a. Use the following equipment:
        - i. an air pump (manual or motor driven) or air reservoir, equipped with a pressure gauge, capable of generating and sustaining a pressure between 25 and 30 pounds per square inch;
        - ii. a rubber hose with fittings and connections; and
        - iii. a hollow needle, or other approved pressure feed device..
    - b. Follow these procedures:
        - i. Seal both ends of the seam to be tested.
        - ii. Insert needle, or other approved pressure feed device, into the tunnel created by the fusion weld.
        - iii. Insert a protective cushion between the air pump and the geomembrane.
        - iv. Energize the air pump to a pressure between 25 and 30 pounds per square inches, close valve, and sustain the pressure for not less than 5 minutes.
        - v. If loss of pressure exceeds 3 pounds per square inches, or does not stabilize, locate faulty area and repair in accordance with the "Defects and Repairs" Article of this Part.
        - vi. Cut opposite end of air channel from pressure gauge and observe release of pressure to ensure air channel is not blocked.
        - vii. Remove needle, or other approved pressure feed device, and seal both ends in accordance with the "Defects and Repairs" Article of this Part.

J. Destructive Testing:
   1. Perform destructive seam tests to evaluate seam strength and integrity. Perform destructive testing as the seaming work progresses, not at the completion of field seaming. Destructive seam test shall meet the seam properties presented in Tables 02770-2 and 02770-4.
   2. Sampling and Testing:
      a. Collect destructive test samples at a minimum average frequency of one test location per 500 feet of seam length and at additional locations of suspected nonperformance. The CQA Consultant will select test locations, including locations with evidence of excess geomembrane crystallinity, contamination, offset seams, or any other evidence of inadequate seaming.
      b. Cut samples at the locations designated by the CQA Consultant at the time the locations are designated. Number each sample and identify the sample number and location on the panel layout drawing. Immediately repair all holes in the geomembrane resulting from the destructive seam sampling in accordance with the repair procedures described in the "Defects and Repairs" Article of this Part. Test the continuity of the new seams in the repaired areas according to "Nondestructive Seam Continuity Testing" Article of this Part.
      c. Cut two strips 1 inch wide and 12 inch long with the seam centered parallel to the width from either side of the sample location. Test the two 1-inch wide strips in the field tensiometer in the peel mode. The CQA Consultant may request an additional test in the shear mode. If these samples pass the field test, prepare a laboratory sample at least 1 foot wide by 3.5 feet long with the seam centered lengthwise. Cut the laboratory sample into three parts and distribute as follows:
         i. one portion 1 foot long to the Installer;
         ii. one portion 1.5 feet long to the CQC Consultant for testing; and
         iii. one portion 1 foot long to the Engineer for archival storage.
   3. In the event of failing field or laboratory test results, the Contractor may reconstruct the entire seam between two passing destructive tests; otherwise, the CQA Consultant will identify the extent of the nonconforming area following the procedures given in the CQA Plan. Obtain additional samples for testing as requested by the CQA Consultant.

K. Defects and Repairs:
   1. Inspect the geomembrane before and after seaming for evidence of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection. Sweep or wash the geomembrane surface if surface contamination inhibits inspection.

2. Test each suspect location, both in seam and non-seam areas, using the methods described in the "Nondestructive Seam Continuity Testing" Article of this Part. Repair each location that fails nondestructive testing.
3. Cut and reseam wrinkles not conforming with Part 2 of this Section. Test the seams thus produced like any other seam.
4. Repair Procedures:
    a. Repair any portion of the geomembrane exhibiting a flaw, or failing a destructive or nondestructive test. Use the most appropriate of the available procedures:
        i. patching, used to repair large holes, tears, undispersed raw materials, and contamination by foreign matter;
        ii. abrading and reseaming, used to repair small sections of extruded seams;
        iii. spot seaming, used to repair minor, localized flaws;
        iv. capping, used to repair long lengths of failed seams;
        v. topping, used to repair areas of inadequate seams, which have an exposed edge less than 4 inches in length; and
        vi. removing bad seam and replacing with a strip of new material seamed into place (used with long lengths of fusion seams).
    b. When making repairs, satisfy the following:
        i. abrade surfaces of the geomembrane that are to be repaired no more than 60 minutes prior to the repair;
        ii. clean and dry all geomembrane surfaces immediately prior to repair;
        iii. only use approved seaming equipment;
        iv. extend patches or caps at least 6 inches beyond the edge of the defect, and round corners of patches to a radius of at least 3 inches; and
        v. cut the geomembrane below large caps to avoid potential for water or gas collection between the two sheets.
5. Repair Verification:
    a. Test each repair using the methods described in the "Nondestructive Seam Continuity Testing" Article of this Part. Repairs that pass the nondestructive test are adequate unless the CQA Consultant elects to also perform destructive tests. Re-repair and retest failed tests.

3.05 ANCHORAGE SYSTEM

A. The anchor trench shall be excavated prior to geomembrane placement to the lines, grades, and configuration indicated on the Construction Drawings.

B. Slightly rounded corners shall be provided in the trench where the geomembrane adjoins the trench to avoid sharp bends in the geomembrane.

C. Temporarily anchor each geomembrane panel in the anchor trench at the crest of the slope as soon as the panel is deployed or positioned.

D. Do not entrap loose soil, sand bags, or other materials between or beneath the geosynthetic layers.

E. Do not backfill the anchor trench until all geosynthetic layers are installed in the anchor trench. Backfill in accordance with the Construction Drawings and Section 02215.

F. Do not damage any geosynthetic layer when backfilling the anchor trench.

3.06 MATERIALS IN CONTACT WITH THE GEOMEMBRANE

A. Take all necessary precautions to prevent damage to the geomembrane during the installation of other components of the liner and final cover system.

B. Do not drive equipment directly on the geomembrane. Only use equipment above the geomembrane that meets the following ground pressure requirements.

Maximum Allowable Equipment Ground Pressure (pounds per square inches)	Minimum Thickness of Overlying Material (inches)
<5	12
<10	18
<20	24
>20	36

3.07 SURVEY CONTROL

A. Survey the installed geomembrane liner and final cover in accordance with Section 02100.

3.08 GEOMEMBRANE ACCEPTANCE

A. The Contractor shall retain all ownership and responsibility for the geomembrane until accepted by the Owner.

B. The geomembrane shall be accepted by the Owner when:
   1. the installation is finished;
   2. all documentation of installation is completed including the CQA Consultant’s final report; and
   3. verification of the adequacy of all field seams and repairs, including associated testing, is complete.

3.09 PROTECTION OF WORK

A. The Contractor shall use all means necessary to protect all prior work and all materials and completed work of other sections.

B. In the event of damage, the Contractor shall make all repairs and replacements necessary at no additional cost to Owner.

TABLE 02770-1
REQUIRED 60-mil HDPE GEOMEMBRANE PROPERTIES

Properties [3]	Qualifiers	Units [1]	Specified Values Textured	Test Method
Physical Properties				
Thickness	Nominal Minimum	mils	60 54	ASTM D 5199 (S) ASTM D 5994 (T)
Asperity Height	Minimum	mils	15	GRI-GM12
Specific Gravity	Minimum	N/A	0.94	ASTM D 792 (Method B) or ASTM D 1505
Carbon Black Content	Range	%	2-3	ASTM D 1603 or D 4218
Carbon Black Dispersion	N/A	none	9 of 10 in Category 1 or 2 and all in Category 1, 2, or 3	ASTM D 5596
Mechanical Properties				
Tensile Properties				
1. Tensile Strength at Yield	Minimum	lb/in	126	ASTM D 6693
2. Tensile Strength at Break	Minimum	lb/in	90	ASTM D 6693
3. Elongation at Yield	Minimum	%	12	ASTM D 6693
4. Elongation at Break	Minimum	%	100	ASTM D 6693
Tear Resistance	Minimum	lb	42	ASTM D 1004 Die C Puncture
Puncture Resistance	Minimum	lb	90	ASTM D 4833

Properties	**Qualifiers**	**Units (1)**	**Specified Values**	**Test Method**
			Textured	
Environmental Properties				
Stress Crack Resistance	Minimum	hrs	300 (2)	ASTM D 5397 (Appendix)
Oxidative Induction Time (OIT)	Minimum	min	100 / 400	ASTM D 3895 / D 5885

Notes:

1. % = percent
   hrs = hours
   min = minutes
   lb/in = pounds per inch
   lb = pound
   N/A = Not Applicable

2. For textured geomembrane, test is conducted on smooth geomembrane from the same resin lot (batch) as the textured geomembrane furnished.

3. See Paragraph 2.03 for required MQC test frequencies.

TABLE 02770-2

REQUIRED 60-mil HDPE GEOMEMBRANE SEAM PROPERTIES

Properties	**Qualifiers**	**Units** [3]	**Specified Values** [4] **Smooth or Textured**	**Test Method**
Shear Strength [1]				
Fusion	Minimum	lb/in (%)	120 (95)	ASTM D 6392
Extrusion	Minimum	lb/in (%)	120 (95)	ASTM D 6392
Peel Strength				
			FTB [2]	
Fusion	Minimum	lb/in (%)	91 (72)	ASTM D 6392
Extrusion	Minimum	lb/in (%)	78 (62)	ASTM D 6392

Notes:

1. Also called "Bonded Seam Strength". Value is at material yield point and failure shall occur in material outside of seam area.
2. FTB = Film Tear Bond. (Maximum 10 percent seam separation).
3. lb/in = pounds per inch. % = Percent of the specified minimum yield strength for the geomembrane.
4. Values listed for peel and shear strengths are for 4 out of 5 test specimen. The seam strength of the 5th specimen can be as low as 80% of the listed values.

TABLE 02770-3
REQUIRED 40-mil PE GEOMEMBRANE PROPERTIES

Properties (3)	**Qualifiers**	**Units (1)**	**Specified Values**	**Test Method**
			Smooth (S) / Textured (T)	
Physical Properties				
Thickness	Nominal Minimum	mils	40 36	ASTM D 5199 (S) ASTM D 5994 (T)
Asperity Height	Minimum	mils	15	GRI-GM12
Specific Gravity	Minimum	N/A	0.94	ASTM D 792 (Method B) or ASTM D 1505
Carbon Black Content	Range	%	2-3	ASTM D 1603 or D 4218
Carbon Black Dispersion	N/A	none	9 of 10 in Category 1 or 2 and all in Category 1, 2, or 3	ASTM D 5596
Mechanical Properties				
Tensile Properties				
1. Yield Strength (HDPE)	Minimum	lb/in	84	ASTM D 6693
2. Break Strength	Minimum	lb/in	152 (S) / 60 (T)	ASTM D 6693
3. Yield Elongation (HDPE)	Minimum	%	12	ASTM D 6693
4. Break Elongation	Minimum	%	HDPE: 700 (S) / 100 (T) LLDPE: 800 (S) / 250 (T)	ASTM D 6693
Tear Resistance	Minimum	lb	HDPE: 28 LLDPE: 22	ASTM D 1004 Die C Puncture
Puncture Resistance	Minimum	lb	HDPE: 72 (S) / 60 (T) LLDPE: 56 (S) / 44 (T)	ASTM D 4833

TABLE 02770-3 (continued)

Properties	**Qualifiers**	**Units** (1)	**Specified Values** **Smooth (S) / Textured (T)**	**Test Method**
Environmental Properties				
Stress Crack Resistance (HDPE)	Minimum	hrs	300 (2)	ASTM D 5397 (Appendix)
Oxidative Induction Time (OIT)	Minimum	min	100 / 400	ASTM D 3895 / D 5885

Notes:

1. % = percent
   hrs = hours
   min = minutes
   lb/in = pounds per inch
   lb = pound
   N/A = Not Applicable

2. For textured geomembrane, test is conducted on smooth geomembrane from the same resin lot (batch) as the textured geomembrane furnished.

3. See Paragraph 2.03 for required MQC test frequencies.

TABLE 02770-4

REQUIRED 40-mil PE GEOMEMBRANE SEAM PROPERTIES

Properties	**Qualifiers**	**Units** [3]	**Specified Values** [4] **Smooth or Textured**	**Test Method**
Shear Strength [1]				
Fusion	Minimum	lb/in	HDPE: 80	ASTM D 6392
			LLDPE: 60	
Extrusion	Minimum	lb/in	HDPE: 80	ASTM D 6392
			LLDPE: 60	
Peel Strength				
			FTB [2]	
Fusion	Minimum	lb/in	HDPE: 60	ASTM D 6392
			LLDPE: 50	
Extrusion	Minimum	lb/in	HDPE: 52	ASTM D 6392
			LLDPE: 44	

Notes:

1. Also called "Bonded Seam Strength". Value is at material yield point and failure shall occur in material outside of seam area.
2. FTB = Film Tear Bond. (Maximum 10 percent seam separation).
3. lb/in = pounds per inch.
4. Values listed for peel and shear strengths are for 4 out of 5 test specimen. The seam strength of the 5th specimen can be as low as 80% of the listed values.

[END OF SECTION]

SECTION 02780

GEOSYNTHETIC CLAY LINER

PART 1 GENERAL

1.01 SCOPE

A. This section includes the requirements for geosynthetic clay liner (GCL) products and placement.

1.02 RELATED SECTIONS AND PLANS

A. Section 02200 - Earthwork

B. Section 02770 - Geomembranes

C. 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 to the Engineer for review not less than 21 calendar days prior to use the following information regarding the GCL proposed for the project.
   1. manufacturer and product name;
   2. evidence that the manufacturer has more than two years of experience in the manufacturing of GCL;
   3. manufacturer's quality control procedures;
   4. manufacturer's requirements for the geotextile component of the GCL that include (as a minimum) mass per unit area, grab strength, and grab elongation;
   5. certification that manufacturer's requirements for geotextile component of GCL are met;
   6. certification of minimum average roll values (95 percent lower confidence limit) and the corresponding test procedures for all GCL properties listed in Table 02780-1; and
   7. manufacturer's recommended procedures for overlapping adjacent GCL panels.

B. Submit to the Engineer for review at least 14 days prior to GCL placement the manufacturing quality control certificates for each roll of GCL as specified in this section. Submit certificates signed by the manufacturer quality control manager. The quality control certificates shall include:
  1. lot, batch, or roll numbers and identification;
  2. sampling procedures; and
  3. results of Manufacturer quality control tests.

C. For each proposed GCL material, the Contractor shall submit for review by the Engineer at least 14 calendar days prior to transporting the GCL to the site the results of manufacturing quality control testing that are in compliance with requirements of this section.

1.05 CONSTRUCTION QUALITY ASSURANCE

A. The installation of the GCLs will be monitored by the CQA Consultant as required by the CQA Plan.

B. The CQA Consultant will perform material conformance testing of the GCLs.

C. The Contractor shall be aware of the activities required of the CQA Consultant per 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 and shall do so at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 GCL

A. Furnish GCL consisting of an internally reinforced bentonite core with woven and/or nonwoven geotextile backings. The GCL must be free of broken needles or fragments of needles.

B. Furnish GCL having properties that comply with the required values shown in Table 02780-1.

C. GCL consisting of an internally reinforced bentonite core with woven and/or nonwoven geotextile backings shall meet the following requirements:

1. Hydraulic conductivity is equal to or less than 5 x 10^{-9} centimeters per second, when measured in a flexible wall permeameter in accordance with ASTM D 5887 under an effective confining stress of 5 pounds per square inch.
2. Minimum roll width is 15 feet.
3. Minimum roll length is 100 feet.
4. Bentonite component is at least 90 percent sodium montmorillonite.
5. Bentonite component is applied at a minimum rate of 0.75 pounds per square foot, when measured at a water content not exceeding 25 percent.
6. Geotextile backings are woven and/or nonwoven materials, respectively, manufactured with polypropylene or polyester material, and conforming to the minimum property values shown in Table 02780-1.
7. Needlepunching is used to bind geotextile backings and bentonite core.
8. Bentonite is contained by the geotextiles in a manner that prevents more than nominal dislodgment of bentonite during GCL transportation, handling, and installation.

2.02 MANUFACTURING QUALITY CONTROL

A. Sample and test the GCL to demonstrate that the material complies with the requirements of this section.

B. Perform manufacturing quality control tests to demonstrate that GCL properties conform to the requirements in Table 02780-1. Perform the following tests at the minimum frequency indicated below with a minimum of one test per lot.

Test	Frequency
Bentonite content	45,000 sq. ft
Bentonite moisture content	45,000 sq. ft
Bentonite free swell	50 ton
Hydraulic conductivity	100,000 sq. ft
Tensile/Grab strength	45,000 sq. ft
Peel	45,000 sq. ft

C. Comply with the certification and submittal requirements of this section.

D. If a GCL sample fails to meet the quality control requirements of this section, sample and test rolls fabricated at the same time and 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 the failing rolls.

2.03 PACKING AND SHIPPING

A. Supply GCL in rolls wrapped in impermeable and opaque protective covers.

B. Mark or tag GCL rolls with the following information:
1. manufacturer's name;
2. product identification;
3. lot number;
4. roll number;
5. roll weight; and
6. roll dimensions.

C. GCL rolls not labeled in accordance with this section or on which labels are illegible upon delivery to the project site will be rejected and replaced at no additional expense to the Owner.

D. Deliver the GCL to the site at least 14 calendar days prior to the scheduled installation date to allow the CQA Consultant to obtain conformance samples and complete conformance testing as described in the CQA Plan.

2.04 HANDLING AND STORAGE

A. Handle, store, and care for the GCL in a manner that does not cause hydration or damage.

B. Protect the GCL from moisture, excessive heat or cold, puncture, or other damaging or deleterious conditions. Store the GCL rolls on pallets or other elevated structures. Do not store GCL rolls directly on the ground surface. Cover the GCL entirely with a tarp. Store GCL rolls out of direct sunlight. Follow any additional storage procedures required by the Manufacturer.

PART 3 EXECUTION

3.01 SURFACE PREPARATION

A. Provide certification in writing that the surface on which the GCL will be installed is acceptable as described below. Give this certification of acceptance to the CQA Consultant prior to commencement of GCL installation in the area under consideration.

B. Maintain the prepared soil surface until the GCL is placed. The subgrade should be rolled with a smooth-drum compactor to remove any wheel ruts, footprints, or other abrupt grade changes before placement of the GCL.

C. Do not place the GCL onto an area that has been softened by precipitation or that has cracked due to desiccation. Repair such areas in accordance with Section 02200 or Section 02225.

3.02 PLACEMENT

A. Do not commence GCL placement until the CQA Consultant completes conformance evaluation of this material and performance evaluation of previous work, including Contractor's survey results for previous work.

B. Weight GCL with sandbags or other means to prevent uplift or movement in wind. Immediately remove and replace any damaged or leaking sandbags.

C. Cut the GCL using a utility blade. Do not damage underlying material during cutting and fully repair any such damage.

D. Do not entrap stones or other foreign objects under the GCL. Do not drag equipment across the exposed GCL.

E. Replace any GCL that is damaged by any means including foreign objects, or installation activities.

F. Install GCLs in accordance with Manufacturer’s recommendation (i.e., typically geotextile on the outside of the roll facing down).

G. Do not install the GCL on a wet subgrade or in standing water. Prevent hydration of the bentonite core prior to completion of construction of the liner system.

H. Do not install the GCL during precipitation or other conditions that may cause hydration of the GCL.

I. Install the overlying geomembrane as soon as possible following GCL installation. Cover all GCL that is placed during a workday with overlying geomembrane. Cover and protect the edges of GCL from hydration due to storm water run-on.

J. Remove and replace GCL that becomes hydrated. Hydration is defined by a moisture content of 40 percent or greater when measured in accordance with ASTM D 2216 or

ASTM D 4643. However, the CQA Consultant shall be responsible for evaluating cases of GCL hydration and determining if the GCL needs to be removed and replaced.

K. Place earthen and other geosynthetics material components of the liner system over the GCL as soon after installation of the GCL as possible, but in no case longer than 7 days after the first GCL is placed.

3.03 OVERLAPS

A. On slopes steeper than 5 horizontal to 1 vertical, install GCLs continuously down the slope; that is, allow no horizontal seams on the slope.

B. Allow no horizontal seams on the base of the landfill within 5 feet of the toe of a slope.

C. Overlap GCL in strict accordance with the Manufacturer's recommended procedures. As a minimum, overlap adjacent panels at least 6 inches along the sides and 12 inches along the ends.

3.04 MATERIALS IN CONTACT WITH THE GCL

A. Perform installation of other components in a manner that prevents damage to the GCL.

B. Do not drive equipment directly on the GCL.

C. Install the GCL in appurtenant areas, and connect the GCL to appurtenances as indicated on the Construction Drawings. Do not damage the GCL while working around the appurtenances.

3.05 REPAIR

A. Repair any holes or tears in the GCL by placing a GCL patch over or under the hole. On slopes greater than 5 percent, the patch shall overlap the edges of the hole or tear by a minimum of 2 feet in all directions. On slopes 5 percent or flatter, the patch shall overlap the edges of the hole or tear by a minimum of 1 foot in all directions. Secure the patch with a water-based adhesive approved by the Manufacturer.

B. Remove any soil or other material that may have penetrated the torn GCL.

C. Do not nail or staple the patch.

TABLE 02780-1

REQUIRED GCL PROPERTY VALUES

PROPERTIES	QUALIFIERS	UNITS (4)	SPECIFIED VALUES (1)	TEST METHOD
GCL Properties (7)				
Bentonite Content (2)	Minimum	lb/ft^2	0.75	ASTM D 5993
Bentonite Moisture Content	Maximum	%	25	ASTM D 5993 or 2216
Bentonite Free Swell	Minimum	ml/2g	24	ASTM D 5890
Hydraulic Conductivity (5,6)	Minimum	cm/s	5×10^{-9}	ASTM D 5887
Tensile / Grab Strength (3)	Minimum	ppi / lb	23 / 90	ASTM D 6768 / 4632
Peel Strength (3)	Minimum	ppi / lb	2.1 / 15	ASTM D 6496 / 4632
Geotextile Properties				
Polymer Composition	Minimum	%	95 polyester or polypropylene	

Notes:
1. All values represent minimum average roll values.
2. Measured at a moisture content not exceeding 25 percent.
3. For geotextile backed GCLs.
4. lb/ft^2 = pounds per square foot
   cm/s = centimeter per second
   % = percent
   lb = pound
   ppi = pounds per inch
   ml/2g = milliliters per two grams
5. The GCL test specimen shall be hydrated for a minimum of 48 hours using sufficient backpressure to achieve a minimum B coefficient of 0.9 and using a confined effective consolidation stress not exceeding five pounds per square inch. Then, the hydraulic conductivity test on the GCL specimen shall be conducted, using water, at a confined effective consolidation stress not exceeding five pounds per square inch. The hydraulic conductivity test shall continue until steady state conditions are reached or a minimum of two pore volumes of water have passed through the test specimen.
6. See Paragraph 2.02 for required MQC test frequencies.

[END OF SECTION]

SECTION 02790

INTERFACE FRICTION CONFORMANCE TESTING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The work in this Section includes all labor, materials, tools and equipment necessary to perform conformance interface strength testing using a composite configuration (i.e., “sandwich” test) consisting of the following components, from top to bottom:

1. Protective soil;
2. Geocomposite drainage layer;
3. HDPE or PE textured geomembrane;
4. Compacted subbase layer (compacted to 95 percent of the maximum dry density, as determined by standard Proctor, ASTM D698, at optimum moisture content) or intermediate cover soils.

B. The Contractor shall be responsible to provide a bucket of representative soil to the Owner/Engineer 21 days prior to using the material and will provide assistance in obtaining geosynthetics samples from on-site stockpiles. The Engineer shall perform the test.

1.02 APPLICABLE SECTIONS

A. Section 02200 – Earthwork

B. Section 02900 – Geocomposite Drainage Layer

C. Section 02911 – Geomembrane

1.03 QUALITY CONTROL

A. The Materials Testing Laboratory performing the interface friction angle conformance testing shall be accredited by the Geosynthetics Accreditation Institute.

B. The Materials Testing Laboratory shall perform the required interface friction angle testing in accordance with the American Society for Testing and Materials (ASTM) method D5321.

C. The Materials Testing Laboratory shall provide test results to the CQA Consultant within five (5) days of receipt of the test samples. Test results shall be in the form of figures that present shear force versus displacement and shear stress versus normal stress. Both peak strength and large displacement (i.e., residual) strength shall be plotted. The laboratory shall report any influences or conditions that may have affected the test results. The laboratory shall indicated the correlation coefficient of the best-fit lines drawn through the strength data and the resulting peak strength and residual strength values for adhesion and friction angle.

PART 2 PRODUCTS

2.01 MATERIALS

A. Materials to be tested shall be obtained from materials that will be used during construction.

B. Sample size shall be determined by the Materials Testing Laboratory requirements.

C. Soil components used in the laboratory testing program shall be obtained from the borrow source or from soil stockpiles to be utilized in the construction of the soil components of the landfill.

D. Additional tests may be required at the discretion of the CQA Consultant.

2.02 TESTING CONDITIONS

A. The following testing conditions shall be utilized for the “sandwich” interface friction testing.

1. Use twelve (12) inch by twelve (12) inch square direst shear apparatus as defined by ASTM D5321;
2. Use site-specific soils and materials;

3. Test all geosynthetics in the direction parallel to the length of the roll (i.e., machine direction);
4. Orient surface texturing of the HDPE textured geomembrane so that machine direction is oriented parallel to the direction of movement of the testing apparatus;
5. Soil components shall be remolded and compacted into the testing apparatus at the minimum dry density and maximum moisture content permitted by the relevant Specification Sections;
6. The normal pressures, consolidation time and strain rate for the "sandwich" test shall be as indicated below:

Case	**System Analyzed**	**Composite Configuration (Sandwich Test)**	**Normal Stresses (psf)**	**Consolidation Time After Application of Normal Pressure (minutes)**	**Shear Force Displacement Rate (in./min.)**
1	Liner System	Liner Protective Layer Geocomposite Geomembrane Compacted Subbase	2,000 7,000 12,000	15	0.04
2	Liner System	Liner Protective Layer Geocomposite Geomembrane Compacted Subbase	100 300 500	15	0.04
3	Cover System	Cover Protective Layer Geocomposite Geomembrane Intermediate Cover	100 300 500	15	0.04

7. Test results will be used to develop a failure envelope;
8. The interface between the geocomposite drainage layer and the geomembrane will be wetted before initiating the shear deformation; and
9. All tests shall be run out to a minimum of three (3) inches of horizontal displacement. The large displacement (residual)

strengths shall be defined as the strength occurring at the point that shear stress levels off to a constant value or the shear stress at three (3) inches of horizontal displacement, whichever occurs first.

PART 3 - EXECUTION

3.01 INTERFACE STRENGTH REQUIREMENTS

A. Case 1: The interface strength for the "sandwich" shall equal or exceed a peak strength represented by a friction angle of 12.5° and a residual strength represented by a friction angle of 7.3° when measured in accordance with the ASTM D5321.

B. Case 2: The interface strength for the "sandwich" shall equal or exceed a peak shear strength equivalent to a friction angle of 22.5° when measured in accordance with the ASTM D5321.

C. Case 3: The interface strength for the "sandwich" shall equal or exceed a peak shear strength equivalent to a friction angle of 25.8° when measured in accordance with the ASTM D5321.

3.02 REVIEW OF TEST RESULTS

A. The CQA Consultant shall review all test reports to determine if the test results meet the minimum requirements stated above.

3.03 RETESTING

A. The Contractor, Geosynthetics Subcontractor or the Manufacturer may elect to retest failed tests. Testing may be done at the same laboratory or another independent laboratory. The CQA Consultant shall approve the testing laboratory and the testing conditions shall be in accordance with ASTM D5321 and this Section. Retesting shall be done at the Contractor's or Manufacturer's expense. Retest results shall be reviewed by the CQA Consultant

[END OF SECTION]

SECTION 02930

VEGETATION

PART 1 GENERAL

1.01 SCOPE

A. This section includes the requirements for sodding, seeding, liming, fertilizing, and maintaining vegetation until established and accepted. Areas to be vegetated include areas noted on the Construction Drawings and and any other areas as directed by the Engineer.

1.02 RELATED SECTIONS AND PLANS

A. Section 02100 - Surveying

B. Section 02200 - Earthwork

C. Construction Quality Assurance (CQA) Plan

1.03 REFERENCES

A. Standard Specifications for Road and Bridge Construction (SSRBC), Florida Department of Transportation, 2001 Edition (FDOT Specifications).

1.04 SUBMITTALS

A. Submit the following to the Engineer not less than 30 calendar days prior to use for review:
   1. proposed type and source of sod and seed; and
   2. manufacturer's product data for commercial fertilizer and lime and the recommended methods of application.

B. Submit a plan for handling and storage of materials to prevent damage by moisture, heat, or exposure. Include all recommendations of manufacturers and suppliers.

PART 2 PRODUCTS

2.01 MATERIALS

A. Sod shall be live, thriving, and meet the requirements of Florida Department of Agriculture and Consumer Services.

B. Seeds shall be live seed and meet the requirements of Florida Department of Agriculture and Consumer Services.

C. The seeds should have been harvested from the previous year's crop.

D. All seed bags shall have a label attached stating the date of harvest, LOT number, percent purity, percent germination, noxious weed certification, and date of test

E. Use fertilizer that is dry or liquid commercial grade fertilizer uniform in composition that meets the requirements of all State and Federal regulations and standards of the Association of Agricultural Chemists. Deliver fertilizer to the site in original, properly labeled, unopened, clean, containers each showing the manufacturer's guaranteed analysis conforming to applicable fertilizer regulations and standards. Use fertilizer that is 16-4-8 or as modified by the Engineer based on testing of the topsoil by the Contractor. Apply fertilizer to all sodded areas.

F. Use lime that is agricultural ground limestone with a minimum total neutralizing power of 90 percent. The lime shall have a gradation of at least 40 percent passing the U.S. Standard Number 100 sieve, and at 95 percent passing the U.S. Standard Number 8 sieve.

PART 3 EXECUTION

3.01 PLANTING AND APPLICATION OF FERTILIZER

A. Do not commence vegetation until the Engineer reviews the results of soil analyses.

B. Notify the Engineer 24 hours prior to laying sod, seeding, or fertilizing.

C. The seed and fertilizer shall be placed by hydro seeding, or other method approved by the Engineer.

D. The underlying soil layer should be graded to the lines and limits as indicated on the Construction Drawings. The soil layer surface shall be scarified and damp immediately prior to the seed or sod placement.

E. Repair all gullies, washes, or disturbed areas that develop subsequent to final dressing of the prepared surface.

F. Seeded areas shall be watered after germination as necessary until the vegetation is well established.

G. Apply fertilizer and lime to all vegetated areas unless otherwise indicated by the Engineer.

H. Apply fertilizer and lime at the specified rates. If not applied hydraulically, thoroughly rake the fertilizer and lime into the prepared surface to a minimum depth of 2 inches.

I. Application rates:
   1. Application rates for seeding shall be according to manufacture/supplier recommendations or as directed by the Engineer.
   2. Application rates for fertilizer and lime in this section may be adjusted after the results of the site soil test results performed by the Contractor are available.
   3. Base contract price on application rates for fertilizer and lime specified in this section. Contract price will be adjusted for any variations either decreasing or increasing the application rates

J. For areas to be covered with seed or sod:
   1. Apply fertilizer at a uniform rate of 1,200 pounds per acre or as otherwise directed by the Engineer.
   2. Apply agricultural lime at a rate of two tons per acre or as otherwise directed by the Engineer

3.03 MAINTENANCE

A. Maintain seeded and sodded areas immediately after placement until vegetation is well established and exhibits a vigorous growing condition.

B. The Contractor shall supply and apply supplemental irrigation for the maintenance period following the placement of the seed or sod. All seeded and sodded areas should receive a minimum of 1½ in. of water per week either by precipitation or supplemental irrigation.

C. Maintain the seeded and sodded areas in satisfactory condition. Maintenance of the seeded and sodded areas includes repairing eroded areas, revegetating, watering, and mowing (if applicable). A satisfactory condition of a seeded or sodded area is defined as a 10,000 square feet section of turf that has no bare spots larger than three square feet.

D. The inspection will be performed by the Engineer, who will determine whether repair of sodded areas or revegetation is required.

3.04 ACCEPTANCE

A. The vegetated areas shall be accepted at the end of the warranty period if a satisfactory condition as defined in this Section exists.

3.05 WARRANTY PERIOD

A. Vegetated areas shall be subject to a warranty period of not less than 60 days from the issuance of the Engineer’s final completion notice to the Contractor for the Contract over 100 percent of the areas seeded and sodded..

B. At the end of the warranty period, the Engineer will perform an inspection upon written request by the Contractor. Vegetated areas not demonstrating satisfactory condition of vegetation as outlined above, shall be repaired, resodded, and maintained to meet all requirements as specified herein at the Contractor's expense. All unaccepted areas requiring repair, replacement of sod and/or reseeding shall be subject to a 60 day warranty period commencing at the completion of the reworking.

C. After all necessary corrective work has been completed, the Engineer will certify in writing the final acceptance of the vegetated areas.

[END OF SECTION]

SECTION 15100

VALVES

PART 1 GENERAL

1.01 SCOPE

This specification identifies the minimum requirements for ball, gate, butterfly, check, and globe valves (valves) to be provided and installed.

1.02 REFERENCES

The publications listed below, latest revision, form a part of this specification to the extent referenced. The publications are referenced within the text by the designation only.

A. ANSI/ASME B31.3	Code for Chemical Plant Refinery Piping
B. ASME/ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys

PART 2 PRODUCTS

2.01 VALVES

A. Check and Ball valves shall be constructed of plastic or HDPE and shall contain Viton or Teflon seats and seals.

B. Butterfly valves shall have coated or painted cast iron, stainless steel, or plastic bodies with Viton seats and seals. The seats and seals shall wrap around the interior of the valve body to prevent leachate contact with the valve body.

C. Disks on butterfly valves shall be constructed of PVDF.

D. Flanges shall be HDPE or PVC. Stainless steel backing flanges shall be provided where necessary to prevent flange distortion or leakage at the flange joints.

E. Flange spacers shall be provided between flanges and butterfly valves to prevent the valve disc from contacting the flange face.

2.02 PRODUCT STORAGE

A. All flange faces shall be covered by plastic or other suitable covers.

B. All threaded connections shall be covered with plastic caps or plugs to protect against damage during shipment.

C. Each shipping crate or box shall be marked to clearly identify the contents. Like valves shall be crated or boxed together.

D. Bare metal surfaces prone to rusting prior to installation shall be coated with a suitable rust preventative.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

Installation of valves shall comply with the requirements of this specification and ANSI/ASME B31.3.

3.02 EXAMINATION

Prior to installation the Contractor shall verify that the valves have been handled properly, including verification that the valves are not damaged and the interior is free of dirt and debris.

3.03 INSTALLATION

A. Valves shall be installed in accordance with the requirements of the applicable design drawings.

B. If not otherwise specified on the applicable design drawings, valves shall be oriented to allow operator access to hand wheels or levers.

C. Valves shall be installed preceding all gauges.

D. All valves shall be accessible and located to provide easy replacement, repair or service.
E. No valve shall be installed with the stem pointing down below the horizontal.

(END OF SECTION 15100)

SECTION 16010

GENERAL ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE

A. This specification identifies the minimum requirements for the selection and installation of conduit, conduit fittings, conductor and other general electrical materials not specifically identified in other specifications.

B. Selection and installation of conduit, conductor, and other general electrical materials shall be in accordance with the requirements of this specification, manufacturer's instructions, the National Electric Code (NEC), local code, and as specified on applicable design drawings.

1.02 RELATED SPECIFICATIONS

A. Section 16170 - Grounding and Bonding

1.05 REFERENCES

A.	NEMA 250-1985	Enclosures for Electrical Equipment (1,000 Volts Maximum)
B.	ANSI/NFPA 70-1993	National Electrical Code
C.	ANSI/NFPA 70E-1988	Electrical Safety Requirements for Employee Workplaces
D.	ISA RP60.8-1990	Recommended Practice Electrical Guide for Control Centers.

1.04 ALTERNATES

A. Alternate selection and installation requirements will be considered, provided they meet the intent of this specification and result in construction and performance that is equivalent to and otherwise in accordance with this specification. All proposed alternates and deviations from this specification shall be described by the Contractor and may not be substituted until mutually agreed upon in writing by the Contractor and the Engineer.

1.05 SUBMITTALS

A. CONTRACTOR shall be responsible for preparing all submittals required for permitting. Drawings and specifications required by the permitting agency and not provided in this package shall be the CONTRACTORS responsibility. CONTRACTOR shall be responsible for identifying and supplying the appropriate size conductor and conduit to connect all equipment and control devices.

PART 2 PRODUCTS

2.01 GENERAL

A. All electrical equipment and material shall be new, unless otherwise noted or specified on the applicable design drawings; all new equipment and material shall be labeled or listed by Underwriters' Laboratories, Inc. (UL).

B. All material furnished under this specification shall be the standard products of manufacturers regularly engaged in the production of such equipment, and shall be that manufacturer's latest standard design. All similar items for similar uses shall be identical insofar as practical, and shall be the product of one manufacturer.

2.02 CONDUIT AND CONDUIT FITTINGS

A. Rigid steel conduit shall be UL listed, hot dipped galvanized.

B. All polyvinyl chloride (PVC) conduit shall be UL listed, schedule 40.

C. High density polyethylene (HDPE) pipe may be substituted for PVC for runs between the individual control panels and the control panels and the main power drop.

D. Primer and adhesive shall be a type approved for electrical-grade PVC conduit.

E. Electrical metallic tubing (EMT) shall be UL listed, hot dipped galvanized. The maximum EMT conduit size shall be 2 inches; its use shall be strictly limited to applications specified in this specification.

F. The minimum conduit size shall be 3/4 inch.

G. Couplings, connectors, and fittings shall be an approved type specifically designed and manufactured for the purpose. Conduit fittings shall be threaded-type steel for rigid steel conduit; EMT fittings shall be threadless-type steel. Conduit fittings shall be PVC for PVC conduit.

H. All conduit between the sump area and the control panel as well as any conduit that passes over the top of the landfill liner prior to entering the control panel shall be isolated with an approved conduit seal off to prevent the migration of landfill gasses into the cabinet.

I. Control wiring and power supply conductors shall not be installed in common conduit or breakout boxes.

J. Control and power conduit shall be separated by at least 12 inches for runs exceeding 5 feet. Smaller conduit spacing may be used at cabinet penetrations as necessary.

K. Liquid Tite® , or equivalent, flexible conduit may be used where appropriate. All Liquid Tite® conduit shall be connected at each end to an appropriate conduit coupler or conduit grip. Open ended conduits shall not be installed.

2.03 CONDUCTORS

A. All conductors shall be soft drawn copper with AWG sizes as specified by the electrician or electrical designer and shall be insulated for 600 volts. Conductors shall be insulated with THHW or THWN insulation or as indicated on the applicable design drawings. The electrical Contractor or the electrical engineer shall identify appropriate wire sizes.

B. Conductor size, insulation type, and the manufacturer's name shall be permanently marked on the conductor jacket at regular intervals.

C. All conductors shall be delivered to the job site in coils containing the manufacturer's name with an approval tag indicating conductor size and type of insulation.

D. Leachate pumps shall use only those power cables provided by the manufacturer. Power cables shall be continuous from the pump to the breakout box. No splices will be allowed in the cable between the pump and the breakout box.

2.04 SIGNAL AND COMMUNICATIONS CIRCUIT CONDUCTORS

A. Special cables shall be as specified on the applicable design drawings.

B. Instrument and control cables shall be individually shielded, twisted pairs in multi-pair cables. The number of pairs in each cable is specified on the applicable design drawings.

2.05 BREAKOUT JUNCTION BOXES

A. Breakout boxes shall be shall be of a type available from Sligo Systems, Inc. Ormond Beach, Florida or equivalent and shall be equipped with terminal strips, and internal desiccant.

2.06 WIRING DEVICES

A. All wiring devices shall be commercial-grade Hubbell, Bryant, or Arrow-Hart.

B. Weatherproof covers shall be cast aluminum and hinged.

2.07 SUPPORTS AND FASTENING

A. Conduit hangers, brackets, beam clamps, and other support and fastening devices shall be products manufactured by Unistrut, Superstrut, or a Engineer-approved equal that are designed for the proposed use. Wire and perforated strap iron shall not be used.

B. Fasteners and supports shall be a type approved by the Engineer.

2.08 MISCELLANEOUS EQUIPMENT

A. Copper clamps, connectors, and lugs in contact with dissimilar metals shall be tin-plated and a type approved by the Engineer.

B. All connections shall be made on terminal strips. Wire nuts shall not be used.

C. All wire shall be full length from termination to termination. Splices shall not be used.

PART 3 EXECUTION

3.01 GENERAL

A. Electrical systems shall be installed in accordance with the requirements of this specification, manufacturer's instructions, federal, state, and local regulations, and as specified on the applicable design drawings.

B. Materials, workmanship, and installation shall conform to all requirements of the legally constituted authorities having jurisdiction.

C. Where more stringent requirements than required by the NEC or local codes are specified herein, this specification shall take precedence.

D. The electrical systems specified on the design drawings are generally diagrammatic, and shall be followed as closely as actual construction and work of other trades will permit. The exact routing of conduit and location of secondary electrical devices, shall be determined in the field by the Contractor.

E. The Contractor shall coordinate all electrical work with the work of other trades or disciplines, verify all scales, and report any dimensional discrepancies or other conflicts to the Engineer before performing work.

F. The Contractor shall furnish and install all necessary hardware, hangers, blocking, brackets, bracing, runners, clamps, expendables, and other miscellaneous items required to complete the electrical systems specified in this specification and on the applicable design drawings.

3.02 ELECTRICAL CLASSIFICATION

A. The electrical classification for all areas of construction shall be nonhazardous. All sump areas shall be considered wet and damp.

B. All work performed by the Contractor and all materials selected or provided by the Contractor shall be in accordance with the requirements of the classifications in Paragraph 3.02A, at a minimum, and the specific requirements of this specification, and as specified on the applicable design drawings.

3.03 CONDUIT INSTALLATION

A. Rigid steel conduit shall be used in the following applications:

1. In all cases where circuits are exposed to physical damage

2. For stub-ups through concrete slabs, except PVC conduit shall be used to encase individual ground leads

3. In potentially wet locations, except as specified on the applicable design drawings

4. Where transitioning from below-grade PVC to above-grade rigid, rigid shall be used within 18 inches of grade or stub-up

B. Rigid PVC conduit shall be used in the following applications:

1. In all cases where circuits are below-grade and not subject to physical damage

2. To ensure compliance with the requirements of Paragraph 3.03A related to transition from below-grade to above-grade conduit runs.

C. Liquidtight shall be used in the following applications and in accordance with the requirements of Paragraph 3.07:

1. At motor connections

2. At expansion joints

3. At equipment that produces vibration

4. At connections to instruments

5. As required by the NEC or local code.

D. General Requirements

1. All conduit shall be installed in accordance with the requirements of this specification and as specified on the applicable design drawings.

2. Distribution of power, and control circuits shall be by a conduit and conductor system installed below grade where practicable. Below grade conduit shall be PVC or HDPE.

3. After cutting conduit, all ends shall be properly reamed to remove burrs that may damage to conductor insulation.

4. A minimum spacing of 12 inches shall be maintained between power and control conduits.

5. Rigid steel conduit, when run in earth or in sand or gravel fill, shall be protected by 3M Scotchrap™ No. 50, and applied to clean, degreased conduit pipe in a helical wrap, half-lap. Individual joint wrap shall overlap conduit wrap by a 3-inch minimum.

6. Conduit backfilling and encasement shall be as specified on the applicable design drawings.

7. Underground conduits from the main power drop, rising above-grade or entering concrete pull vaults shall be rigid steel conduit.

8. All necessary sleeves required where conduits pass through floors, footings, or walls shall be coordinated by and shall be the responsibility of the Contractor. All holes in concrete floors, vaults, or boxes shall be core drilled. Chipping of concrete is not permitted.

9. All conduit stub-ups for future use shall have couplings and plugs installed.

10. Running threads shall not be used for connecting conduits.

11. Bushings shall be installed where a rigid metal conduit enters a box, fitting, or other enclosure to provide protection to the wire from abrasion.

12. All underground coupling threads shall be painted with red lead or 3M Scotchrap™ pipe primer.

13. Above-grade conduit shall be supported in accordance with NEC support-spacing requirements. Groups of conduits clamped together in mid-span will not be acceptable as meeting the support requirements. Conduits shall be secured at 8-foot maximum intervals and within 3 feet of every outlet or termination, unless otherwise specified on the applicable design drawings.

14. Conduit shall not be supported from adjacent piping.

15. A No. 12 AWG, TW insulation copper pull conductor or a 3/16-inch diameter nylon pull rope shall be left in each empty conduit run installed under this specification.

16. No conduit in the final installation shall be crushed or otherwise deformed.

17. PVC conduit shall be installed using solvent joints.

18. Identification of need, selection, supply, and installation of conduit seals, vents, drains, and unions shall be the responsibility of the Contractor.

19. All conduit between the sump area and the control panel as well as any conduit that passes over the top of the landfill liner prior to entering the control panel shall be isolated with an approved conduit seal off to prevent the migration of landfill gasses into the cabinet.

20. The ends of all conduit shall be located above the seasonal high water line and shall be sealed against moisture and insect/rodent intrusion.

3.04 INSTALLATION OF CONDUCTORS

A. All conductors shall be installed in accordance with the requirements of this specification and as specified on the applicable design drawings.

B. All conductors shall be continuous from outlet to outlet and/or terminal to terminal, and shall be identified in accordance with the requirements of Paragraph 3.10.

C. Conductors shall not be pulled into any portion of the conduit until all construction work that might cause damage to the conductors has been completed. Mechanical means used to pull conductors shall be approved by the Contractor.

D. Conductors shall not be spliced in conduits under any circumstances.

E. Where required, splices in conductors and cables shall be in suitable enclosures and made using properly sized solderless connectors. All splices shall be provided with insulation equal to or greater than the insulation of the conductor. A minimum of 12 inches of free length shall be provided for each conductor to be spliced. The number of taps and splices shall be held to a minimum.

F. All ground, neutral, and line connections to receptacle and wiring device terminals shall be made as recommended by the manufacturer. Ground jumper from outlet box to ground terminal or devices shall be provided when the device is not approved for grounding through the mounting screws.

G. All conductors and cables shall be installed in accordance with the manufacturer's instructions. Methods of gripping cables and tension limitations shall be coordinated before pulling all cables. In no case shall the pulling force in pounds exceed values set forth by the manufacturer.

H. Only commercially prepared conductor pulling compounds that are noninjurious to the cable jacket or insulation and approved by the cable manufacturer shall be used. Using soaps, soap flakes, detergents, or similar preparations shall not be permitted.

I. An indication of phasing shall be maintained for all power circuits using color-traced conductors or by applying permanent labels to the conductors (Table 1).

J. Shield and/or shield drain conductors for electric instrument and transducer cables shall have continuity from the sensing element to the control panel. The shield shall be grounded only to the designated ground at a single point.

K. For connections to devices with screw terminals, no more than two conductors shall be installed to one screw. All such connections shall be made using lugs.

L. Wire nuts shall not be used.

M. Continuity and identification of all circuits shall be checked by the Contractor.

N. All conductors shall be terminated in terminal strips. Terminal strip connections shall be checked prior to approval.

O. All terminal strip connections shall be made inside either the control panel or an approved Breakout Junction Box.

P. All conductor splices shall be waterproof and located above the seasonal high water line.

Q. All conductors shall be installed in conduits. No direct burial cable shall be installed at the site. Control cable shall be installed in conduits between the breakout boxes and the sumps. Flow meter leads shall have the shortest exposed wiring length practicable.

3.05 INSTALLATION OF OUTLET, AND BREAKOUT JUNCTION BOXES

A. Breakout junction boxes shall be installed as specified on the applicable design drawings and at other locations where necessary or convenient for installation of conductors. Junction and pull boxes shall be the sizes recommended by the manufacturer and shall be appropriate for the sizes of conduit and conductors served. In no case shall junction boxes be less than 4-inches square by 1 1/2-inches deep.

B. Breakout junction boxes shall contain integral terminal strips for all connections and a replaceable desiccant.

C. All Breakout boxes shall be NEMA-4X rated.

D. Junction boxes shall be independently supported. Conduit fittings and junction boxes shall be accessible for maintenance.

E. All conduits in pull boxes shall be neatly supported using Unistrut.

F. Conduit bodies used as pull points for conductor, cable, and fiber optic cable installed in the collection and disposal system shall be installed in pull vaults. The conduit bodies shall be grouped and installed in the pull vaults and be accessible. Conduit ends shall be sealed to prevent the migration of water into the conduit.

G. All breakout boxes and other pull boxes shall be located such that all portions of the box and all entries into the box will be above the seasonal high water line.

3.06 MISCELLANEOUS INSTALLATION REQUIREMENTS

A. All control systems, conduits and conductors shall be terminated in junction boxes or at instruments as specified on the applicable design drawings.

B. Structures shall not be cut without authorization from the Engineer. Any required openings or spaces shall be arranged for in time to prevent any unnecessary cutting. All cutting shall be done by the appropriate trade involved.

C. Copper clamps, connectors, and lugs coming into contact with dissimilar metals shall be tin-plated and a Engineer-approved type. Where insulation is required, such fitting shall be protected by not less than two layers of 3M Scotchfill™ electrical insulation putty. Voids shall be filled and sharp edges shall be padded. The 3M Scotchfill™ electrical insulation putty shall be tightly wrapped with two half-lapped layers of 3M Scotch 33™ plastic-backed electrical tape.

3.07 CONNECTIONS AND TERMINATIONS TO EQUIPMENT

A. General

1. Interconnecting conduit and conductor shall be installed in accordance with the requirements of this specification, and as specified on the applicable design drawings.

2. Connections and terminations include those required for electric pump motors, instrumentation, control and circuit breaker panels, and breakout junction boxes.

3. Where possible, conduits shall enter the bottom of control and circuit breaker panels, junction and pull boxes, and miscellaneous enclosures. Entry shall be made using conduit fittings and bushings selected and provided by the Contractor or panel manufacturer. Top or side entry must be specifically approved by the Engineer.

4. Terminations to terminal strips shall be secured to the torque values specified by the manufacturer.

5. All conductors connecting to equipment shall be identified in accordance with the requirements of Paragraph 3.10.

3.08 ANCHORING

A. All panels shall be securely fastened to concrete posts or mounted on Unistrut connected to concrete posts. Posts shall be embedded a minimum of 3 feet into the surrounding ground and shall be outside the landfill liner system wherever possible. Mounting posts inside the liner system shall be placed so they do not penetrate the liner. Sizing of the concrete posts and associated bolts shall be determined by the Contractor.

3.09 IDENTIFICATION

A. General Requirements

1. All electrical enclosures, conduit, conductors, electric motors, and other electrical components shall be labeled by the Contractor in accordance with applicable federal, state, and local regulations.

2. In addition to the requirements above, all enclosures, conduit, conductors, and other electrical components shall be labeled by the Contractor with wire and conduit tag numbers as specified on the applicable design drawings.

3. All instrumentation conductors shall be labeled by the Contractor with wire tag numbers specified in the control system vendor design drawings.

4. All conduits shall be identified with the wiring and instrumentation numbers of conductors contained within the conduit.

7. Additional identification requirements shall be as described below.

B. Enclosures

1. Enclosures include control and circuit breaker panels and junction and pull boxes.

2. Labels printed "Danger High Voltage" shall be provided and affixed to all 480-volt panels.

3. All control and circuit breaker panels will be provided by the Contractor with appropriately engraved nameplates. The Contractor shall only provide and affix labeling in accordance with the requirements of Paragraph 3.10.

4. All junction or pull boxes shall be labeled with a description of the enclosed wiring.

C. Miscellaneous

1. Labels shall be provided on all switches and receptacles indicating the panel and circuit number to which the device is connected.

2. All grouped switches shall be labeled with an engraved device plate.

3.10 INSPECTION AND TESTING

A. General

1. Inspections and tests identified in this specification represent minimum or special requirements identified by the Engineer. The Contractor shall be responsible for identifying and implementing all inspections and tests to meet the requirements of this specification and to ensure that proper operation can be expected when the remediation system is put into service.

2. Any additional tests recommended by the equipment manufacturer shall be completed and documented prior to startup. A copy of all such testing must be provided to the Engineer for approval prior to startup.

3. All test data obtained shall be compiled by the Contractor and submitted to the Engineer.

4. All testing will be witnessed by the Engineer unless specifically waived by the Engineer. The Contractor shall notify the Engineer a minimum of 24 hours before conducting any testing.

5. The Engineer's witnessing of inspections or tests shall in no way relieve the Contractor of responsibility for carrying out the requirements of this specification.

B. Miscellaneous Inspections and Tests

1. A continuity test shall be performed on all conductors subsequent to installation, but prior to final termination. A report documenting the results of the continuity test shall be prepared by the Contractor and submitted to the Engineer.

2. Operational tests shall be performed on all motor control circuits.

3. Circuit breakers, motor starters, switches, relays, and other equipment shall be inspected for loose connections to ensure that contacts and working parts are correctly aligned and free from dust and foreign matter.

4. Motors shall be checked for proper rotation. A report documenting the results of the rotational check shall be prepared by the Contractor and submitted to the Engineer.

5. Circuit breakers with adjustable trips shall be checked for proper thermal and magnetic settings for proper protection. A report documenting all trip points and settings shall be prepared by the Contractor and submitted to the Engineer.

C. Insulation Resistance Testing

1. Insulation resistance testing shall be performed on all 480-volt loads to ensure insulation integrity.

2. All cables and conductors shall be visually inspected when received, or before installation. This inspection shall include investigating for concealed damage to cables on reels that are damaged or broken, and in boxes that have been punctured by sharp objects or severely crushed and dented from improper handling. Any cable showing signs of damage shall not be installed.

3. All cables and conductors shall be meggered phase-to-phase and phase-to-ground after installation, but before termination, to determine if insulation was damaged during installation. Insulation resistance during testing shall be 1 megohm.

4. Insulation resistance testing for final acceptance shall be made with all equipment connected and terminated, but with circuit protective devices open. Phase-to-ground tests shall be performed for each phase.

5. The Contractor shall submit the insulation resistance testing procedure for approval by the Engineer before insulation resistance testing.

6. A report documenting the results of the insulation resistance testing shall be prepared by the Contractor and submitted to the Engineer.

D. Grounding System Inspection and Testing

Grounding system inspection and testing shall be performed in accordance with the requirements of Section 16170.

ATTACHMENTS

TABLES

TABLE 1

CONDUCTOR COLOR-CODE CHART

CONDUCTOR	120/208	277/480
Phase A (1)	Black	Brown
Phase B (2)	Red	Orange
Phase C (3)	Blue	Yellow
Neutral	White	White or Light Grey
Equipment Ground	Green	Green

[END OF SECTION]

SECTION 16170

GROUNDING AND BONDING

PART 1 GENERAL

1.01 SCOPE

A. This specification identifies the minimum requirements for electrical grounding and bonding.

B. Grounding and bonding shall be in accordance with the requirements of this specification, the National Electric Code (NEC), local code, and as specified on the applicable design drawings.

1.02 ALTERNATES

Alternate selection and installation requirements will be considered, provided they meet the intent of this specification and result in construction and performance that is equivalent to and otherwise in accordance with this specification. All proposed alternates and deviations from this specification shall be described by the Contractor and may not be substituted until mutually agreed upon in writing by the Engineer.

1.03 RELATED SPECIFICATIONS

A.	Section 16010	General Electrical Requirements
B.	Section 16651	Control Panel Fabrication

1.04 REFERENCES

The publication listed below, latest revision applicable, form a part of this specification to the extent referenced. The publications are referred to within the text by the designation only.

A.	ANSI/NFPA 70	National Electrical Code (Latest Edition)
B.	ANSI/NFPA 70E	Electrical Safety Requirements for Employee Workplaces (Latest Edition)
C.	ANSI/UL-467	Standard for Safety Grounding and Bonding Equipment

PART 2 PRODUCTS

2.01 GENERAL

A. All electrical equipment and material shall be new, unless otherwise noted or specified on the applicable design drawings; all new equipment and material shall be labeled or listed by Underwriters' Laboratories, Inc. (UL).

B. All ground connectors shall be copper of the clamp type, or cadweld. All clamp accessories such as bolts, nuts, and washers shall also be bronze to assure a permanent corrosion resistant assembly. Ground lugs, ground rod clamps, and connectors shall be NEC-grade copper and tin-plated when in contact with dissimilar metals.

D. Ground rods shall be copper-clad steel conforming to ANSI/UL 467. Ground rods shall be ¾-inch diameter and driven a minimum of 5 feet into the groundwater.

E. Grounding resistance shall be checked and documented. The maximum allowable grounding resistance is 5 ohms. If a value greater than 5 ohms is measured then additional grounding will be required until a value of less than 5 ohms is achieved.

PART 3 EXECUTION

3.01 GENERAL

A. Electrical systems shall be installed in accordance with the requirements of this specification, manufacturer's instructions, federal, state, and local regulations, and as specified on the applicable design drawings.

B. The grounding system shall include but is not limited to ground cable fittings, connectors, and all other devices and material as required to render the system complete and meet the requirements of NEC Article 250. Except where specifically indicated otherwise, all exposed noncurrent carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in nonmetallic raceways and neutral conductor of the wiring system shall be grounded. The ground connection shall be made at the main service equipment and shall be extended to the grounding grid system.

C. The location of ground rods shall be the Contractor's responsibility. However, grounding rods shall be installed outside of the landfill liner system. The lengths of rods forming an individual ground array shall be equal and shall be of the quantity required to obtain a ground resistance of less than 5 ohms. The grounding system shall be in strict accordance with Article 250 of the N.E.C.

D. Grounding clamps shall be used to bond each separately derived system to the grounding electrode conductors.

E. All ground wire shall be bare.

F. Neutrals shall be solidly grounded at the transformer secondary only where it shall be bonded with the primary ground.

G. Each grounding type bushing shall have the maximum ground wire accommodation available in standard manufacture for the particular conduit size. Connection to the bushing shall be with wire of this maximum size. This type bushing shall be used at all panelboards disconnect switches, and at all distribution equipment.

H. All branch circuits and feeders shall include a ground conductor sized in accordance with the requirements of the applicable design drawings.

I. An additional copper ground conductor, sized in accordance with the requirements of the NEC, shall be provided in all raceways to ground all intermediate metal boxes, conduit, and equipment.

3.02 EQUIPMENT GROUND

A. Ground continuity throughout the sump area shall be maintained by means of a ground conductor run in all conduits. Grounding conductors run in conduit shall be insulated copper conductors, sized in accordance with the design drawings.

B. Metal supports for any electrical equipment, etc, shall be bonded to the nearest ground bus. If not indicated otherwise, provide #6 AWG conductor in 3/4-inch conduit.

C. Copper bonding jumpers shall be used to obtain a continuous metallic ground for all electrical equipment.

3.03 SHIELD GROUNDING

A. Shields on power cable shall be grounded at each termination in a manner recommended by the cable manufacturer.

B. Shielded instrumentation cable shall be grounded at one end only; this shall typically be at the "receiving" end of the signal carried by the cable. Instrumentation shall only be grounded at the location specified by the instrument manufacturer.

C. Termination of each shield drain wire shall be on its own terminal screw. All of these terminal screws in one rack shall be jumpered with No. 16 solid tinned bare copper wire; connection to ground shall be accomplished with a No. 12 green insulated conductor to the main ground bus.

3.04 LIGHTNING GROUNDS

A. Lightning protection devices shall be grounded to a separate grounding rod as specified by a licensed lighting protection specialist. Lightning protection devices shall also be bonded to the system ground unless otherwise directed by the lightning protection specialist.

[END OF SECTION]

SECTION 16651

CONTROL PANEL FABRICATION

PART 1 GENERAL

1.01 SCOPE

A. This specification identifies the minimum requirements for the design, fabrication and testing of the Pump Control Panel located at the leachate collection sump. The Contractor is responsible for the functional operation of panel wiring from the main power drop to the panel and from the panel to the leachate sump pumps and various instrumentation. Panel general arrangement and construction shall be as shown on the contract drawings and indicated in the specifications. Follow the panel manufacturers written requirements and recommendations for mounting and space allocation, wiring and grounding of all equipment contained in the pump control panel. It is the intent of this specification to provide a fully operational and ready-to-use system.

B. The control panel shall be designed in accordance with the requirements of this specification, and the design drawings. No change orders will be accepted unless a specific change of scope is requested in writing by the Engineer, fully approved and executed.

C. This specification describes the functional requirements of the control panel and all internal components necessary to provide a complete and operating system.

D. The Contractor shall provide overall system integration of existing pumping equipment with the Pump Control Panel. The Contractor shall be responsible for coordination of control wiring and communications between the Pump Control Panel, pumps, level transducers, flow meters, the leachate storage control panel, and any other instrumentation, equipment or control panels that require communication or input/output capabilities.

1.02 RELATED SPECIFICATIONS

A.	Section 16010	General Electrical Requirements.
B.	Section 16170	Grounding and Bonding
C.	Section 16652	Instrumentation

1.03 REFERENCES

The enclosures, wiring, and component parts of this system shall conform to the latest revision of the following codes and regulations:

A. National Electric Code (NEC), ANSI/NFPA 70

B. National Electric Safety Code (NESC), ANSI C2

C. American National Standards Institute (ANSI)

D. National Electrical Manufacturing Association (NEMA)

E. Electronics Industry Association / Telecommunications Industry Association (EIA/TIA)

F. All applicable federal, state, and local codes.

1.04 SUBMITTALS

A. The control panel manufacturer shall provide a copy of the panel design to the Engineer prior to beginning assembly of the panel. The Engineer shall review and provide written approval or required modifications prior to assembly.

B. The control panel manufacturer shall provide written documentation of functionality testing of the control panel and all instrumentation interfacing with the control panel.

PART 2 PRODUCTS

2.01 GENERAL

A. All wiring for control panel shall be provided by the contractor. Requirements shall comply with Section 16010.
B. The control panel shall be assembled by Sligo Systems, Inc. of Ormond Beach, Florida or an alternate contractor with equivalent qualifications. All control panel components shall be provided by the panel assembly contractor.
C. Alternate contractors for panel design and assembly shall be approved by the engineer, prior to beginning design.

2.02 PANEL COMPONENTS

The Leachate Sump Control Panel is intended to remotely operate one leachate sump pump located in each leachate sump. The pumps will consist of 7.5-HP submersible pumps. The

Leachate Sump Control Panel will also monitor leachate levels in the sumps and flow rates in the piping during sump pump operation.

A. All pump controls will be housed in stainless steel NEMA Type 4 cabinets. Cabinet Size will be determined by the panel manufacturer.

B. Controls will be protected from weather by placing them behind the outer door of the cabinet.

C. The Cabinet will be equipped with an appropriately sized service disconnect switch capable of de-energizing all equipment in the cabinet and all external equipment serviced by the cabinet. The service disconnect shall be accessible from the outside of the cabinet when the outer door is closed.

D. each sump pump will be controlled by a level transducer located inside the sump. The level transducer will monitor the depth of leachate in the sump and will start and stop the leachate pump at specific set points.

E. A high-high level alarm will be activated if the high-high level set point is activated. This alarm will activate a flashing strobe light on top of the control panel to notify the operator that leachate levels in the sump risers are too high.

F. The Leachate Sump Control Panel shall be capable of communicating with the Leachate Storage Area Control Panel such that all leachate sump pumps will be shut down in the event a signal is received indicating that one of the leachate storage tanks is full.

G. Operation of the sump pumps and the control panel shall conform to the operational notes set forth on the Process and Instrumentation Diagram.

H. Communication between the Sump Pump Control Panel and the Leachate Storage Area Control Panel shall use a radio telemetry system.

I. All pumps will operate on 460VAC 3 phase power.

J. A 110VAC, 20 amp convenience outlet shall be provided at each control cabinet location.

K. A convenience light fixture shall also be provided at the control cabinet. The light shall be sufficient to illuminate the sump area and the control cabinet area. An externally mounted light switch rated for exterior installation shall be installed at the control cabinet location.

L. The control cabinets shall be shielded from direct sunlight to the extent possible by installing a fiberglass or plastic backing and roof to the control panel mounting posts.

M. Three-position switches capable of overriding the level switch operation will be provided for each pump. The each switch will be equipped with a legend plate identifying the switch position. The switch positions shall be labeled as Hand, Off and Auto corresponding to the operation of the pump at that position. The Hand position will allow an operator to turn on the pump motor independent of the water level in the sump. The hand position shall be spring loaded to prevent the switch from being left in the hand position. The Off position will allow an operator to turn off the pump motor independent of the water level in the sump. The Auto position will return the pump to control by the level switches.

N. Each pump shall be protected by a Type E-1 current/voltage monitor. The monitor shall be set by the contractor to detect stuck impeller and no flow conditions.

O. A pilot light mounted on the front of the each panel. The pump control panel will be configured such that the pilot light will light when the pump is operating.

P. The pump control panel will be equipped with three beacon lights mounted on top of the panel box.

  a) A steady lit amber colored light shall be configured to indicate power is available to the panel. The amber light shall be lit when the main disconnect switch on the pump control panel is in the on position.

  b) A flashing red light shall be configured to indicate operational problems associated with:

    i) High or low voltage

    ii) High or low current

    iii) Water level has activated the High High Level switch.

  c) A flashing blue light shall be configured to indicate operational problems associated with the active level transducer or other internal PLC faults.

  d) Flashing lights shall be strobe activated types. Mechanical rotating lights shall not be used.

Q. Panel Wiring

  a) Wire PLC inputs and outputs to terminal blocks for field wiring connection.

R. Wireway

  a) Provide ventilated plastic wireways inside the panels for separating and organizing the wiring.

  b) Electric signals carried in one Wireway will be of similar types and voltage levels. Provide separate wireways for AC and DC wiring. Route internal wiring in separate wireway from space allowed for external field wiring. Provide each signal type with its own terminal strip.

S. Terminal Blocks

a) All fabricator wiring shall be limited to one side of the terminal strips. The other side of the terminal is reserved for field wiring connections.

T. Wire Marking

a) Permanently identify each wire at both ends with a permanent identification tag. Identify wiring according to wire identifiers on the control panel design plans provided. Wire from terminal block to terminal block without splicing.

2.03 LIGHTNING PROTECTION

A. The control cabinet location shall be protected from incoming voltage surges by an appropriately sized service entrance Transient Voltage Surge Supression (TVSS) unit. The TVSS shall be manufactured by Erico, Inc.

B. An additional TVSS unit shall be installed on the incoming communication conductors.

C. Two Lightning protection devices (lightning rods) shall be installed above the control panel to protect the system from lightning strikes.

D. Lightning protection and TVSS units shall be designed and installed by a qualified lighting protection specialist.

E. Grounding and bonding shall be accomplished in accordance with Section 16170, Grounding and Bonding.

PART 3 EXECUTION

3.01 GENERAL

A. The Control Panel shall provide system control for the proposed system as discussed in Part 2 of this specification and as depicted on the design drawings.

3.02 TESTING

A. The Control Panel will be given a complete visual inspection and fully powered point-to-point by the Contractor before notifying the Engineer that the system is ready for testing.

B. Testing will be conducted in accordance with the manufacturer's requirements. Written documentation of the field-testing shall be provided before the system is accepted by the Engineer.

C. The Contractor shall have the control cabinet installation inspected and verified by the control panel manufacturer. The inspector shall prepare an inspection report on the cabinet installation. The inspection report shall be provided to the Engineer prior to acceptance of the panel.

D. Electrical power shall be checked by the Contractor and written documentation shall be provided indicating that the incoming power is within the limits required by the control panel, pump, and instrumentation manufacturers.

3.03 FINAL INSPECTION AND COMMISSIONING

The Engineer shall inspect the panels after installation to ensure that each has been installed in accordance with this section and the contract drawings. The Contractor shall demonstrate the operation of the completed panel system to the Engineer to show that it operates as intended by the design. If system components fail or are inoperative during the testing and/or operational demonstration, they shall be repaired or replaced by the Contractor.

(END OF SECTION 16651)

SECTION 16652

INSTRUMENTATION

PART 1 GENERAL

1.01 SCOPE

A. This specification identifies the minimum requirements for the purchase and installation of instrumentation including:
   a) Level transducers;
   b) Flow meters; and
   c) Pressure Gauges.

B. The Contractor shall provide overall system integration of existing pumping equipment with the Pump Control Panel. The Contractor shall be responsible for coordination of control wiring and communications between the Pump Control Panel, pumps, level transducers, flow meters, the leachate storage control panel, and any other instrumentation, equipment or control panels that require communication or input/output capabilities.

1.02 RELATED SPECIFICATIONS

A.	Section 16010	General Electrical Requirements.
B.	Section 16651	Control Panel Fabrication

1.03 REFERENCES

The enclosures, wiring, and component parts pertaining to the installation of the electrical portions of the instrumentation shall conform to the latest revision of the following codes and regulations:

A. National Electric Code (NEC), ANSI/NFPA 70

B. National Electric Safety Code (NESC), ANSI C2

C. American National Standards Institute (ANSI)

D. National Electrical Manufacturing Association (NEMA)

E. Electronics Industry Association / Telecommunications Industry Association (EIA/TIA)

F. All applicable federal, state, and local codes.

1.04 SUBMITTALS

A. The contractor shall provide a cut sheet of all instrumentation proposed for the site. The Engineer shall review and provide written approval or required modifications prior to assembly.

B. Instrumentation shall be tested by the manufacturer and shall be accompanied by documentation of a passing test. All documentation shall be provided to the engineer prior to acceptance of the equipment.

PART 2 PRODUCTS

2.01 GENERAL

A. All wiring shall be provided by the Contractor or manufacturer. Requirements shall comply with Section 16010.

2.02 INSTRUMENTATION

A. Level transducers shall be as indicated on the Sheet 21 of 22 of the project drawings, or equivalent.
B. Flow meters shall be as indicated on the Sheet 21 of 22 of the project drawings, or equivalent. Flow meters shall be purchased with integral PVC or Stainless Steel spool sections, with flange connections.
C. Pressure gauges shall: have a 0 to 50 psi range; 4 inch face; and be glycerin filled.

2.03 FINAL INSPECTION AND COMMISSIONING

The Engineer shall inspect all instrumentation after installation to ensure that each has been installed in accordance with this section and the contract drawings. The Contractor shall demonstrate the operation of the instrumentation to the Engineer to show that it operates as intended by the design. If system components fail or are inoperative during the testing and/or operational demonstration, they shall be repaired or replaced by the Contractor.

[END OF SECTION]

Prepared for

WASTE MANAGEMENT

Vista Landfill, L.L.C.

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CONSTRUCTION QUALITY ASSURANCE (CQA) PLAN

VISTA LANDFILL, CLASS III
Apopka, Florida

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Project Number FL1229

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1. INTRODUCTION

1.1 Overview

This Construction Quality Assurance (CQA) Plan describes the quality assurance and construction quality control (CQC) activities that will be undertaken during construction of the Vista Landfill, Class III facility located in Apopka, Florida. The Vista Landfill, Class III facility is owned and operated by Vista Landfill, L.L.C. (Vista Landfill), which is a wholly owned subsidiary of Waste Management, Inc. of Florida (WMIF). The purpose of this document is to define the scope, formal organization, and procedures necessary to achieve a high level of quality and assure that the construction of the Vista Landfill, Class III is constructed in compliance with the approved design as shown or indicated in the Construction Drawings and the Technical Specifications. This plan addresses the CQA and CQC activities to be performed during construction.

1.2 Project Description

The construction required to develop the Vista Landfill, Class III facility is presented in the Construction Drawings and Technical Specifications. The development of Vista Landfill, Class III facility includes the following general activities.

- construction of a single geomembrane liner system;
- construction of the leachate collection, removal, transmission and storage systems;
- construction of the final cover system components above the landfill surfaces;
- construction of surface water management system; and/or
- general site work including landfill grading and general earthwork.

1.3 CQA Plan Scope

The CQA Plan establishes the quality assurance and quality control monitoring and testing activities to be implemented during construction at the Vista Landfill, Class III facility. The CQA Plan was developed in consideration of the current Florida Department of Environmental Protection (FDEP) guidelines and regulations. The scope of the CQA Plan includes:

- defining the responsibilities of parties involved with the construction of the Vista Landfill, Class III facility;
- providing guidance in the proper construction of Vista Landfill, Class III facility components;
- establishing testing protocols for the evaluation of Vista Landfill, Class III facility components;
- establishing procedures for construction documentation; and
- providing the means for assuring that the overall construction conforms to the Construction Drawings and Technical Specifications.

The CQA Plan is intended to establish procedures for the CQA Consultant and to inform the Contractor of CQA activities during the construction at the Vista Landfill, Class III facility. The CQA Plan is considered a supplement to the Technical Specifications and a part of the construction contract. In the case of any conflict between the CQA procedures described in this plan and the requirements of the Technical Specifications, the Technical Specifications will govern.

1.4 CQA Plan Organization

The remainder of this CQA Plan is organized as follows:

- definitions of key terms are presented in Section 2;
- project organization and descriptions, responsibilities, and qualifications of key parties involved with the construction at the Vista Landfill, Class III facility are presented in Section 3;
- requirements for CQA documentation are described in Section 4;
- CQA activities for the soil components of the Vista Landfill, Class III facility, to include fill placement, liner system, final cover system, and general earthwork, are presented in Section 5;
- CQA activities for geomembranes, geosynthetic clay liner, geotextiles, and geocomposites are presented in Sections 6 through 9, respectively;

- CQA activities for piping and fittings are covered in Section 10;
- CQA activities for mechanical and electrical components are described in Section 11;
- CQA activities for concrete associated work are outlined in Section 12; and
- CQA activities for road construction and general civil site work are presented in Sections 13 and 14, respectively.

2. CQA PLAN DEFINITIONS

2.1 Construction Quality Assurance and Construction Quality Control

In the context of this document, construction quality assurance and construction quality control are defined as follows:

- Construction Quality Assurance (CQA) - The planned and systematic means and actions designed to assure adequate confidence that materials and/or services meet contractual and regulatory requirements and will perform satisfactorily in service.

- Construction Quality Control (CQC) - Those actions which provide a means to measure and regulate the characteristics of an item or service in relation to contractual and regulatory requirements.

- In the context of this document:

- CQA refers to means and actions employed by the CQA Consultant, Engineer, or Vista Landfill to assure conformity of the various components of the Vista Landfill, Class III facility construction project with the requirements of the Construction Drawings and Technical Specifications.

- CQC refers to those actions taken by the CQA Consultant, Contractor, Manufacturers, or Installers to ensure that the materials and the workmanship of the various components of the Vista Landfill, Class III facility construction project meet the requirements of the Construction Drawings and Technical Specifications. In the case of the geosynthetic components of these systems, CQC is provided by the CQA Consultant and/or Manufacturers and Installers of the various geosynthetics.

2.2 Plans and Specifications

In this CQA Plan, reference to Construction Drawings and Technical Specifications is understood to mean those plans and specifications issued as a part of a specific contract for construction of a component or phase at the Vista Landfill, Class III facility. In all cases, it is expected that this CQA Plan will conform to the Construction Drawings and Technical Specifications. In case of conflict, the approved Construction Drawings and Technical Specifications will govern.

2.3 Geosynthetics

Geosynthetics is the generic term for all synthetic materials used in geotechnical engineering applications; the term includes geotextiles, geogrids, geonets, geomembranes, geosynthetic clay liners (GCL), and geocomposites. There are four types of geosynthetic products referenced in this CQA Plan that are included in the Vista Landfill, Class III facility construction. These geosynthetics include: (i) high density polyethylene (HDPE) and polyethylene (PE) geomembranes used in the liner and final cover systems, respectively; (ii) GCL used along the leachate collection corridor; (iii) geotextiles used as filters or separators; and (iv) geocomposite drainage layers used in the liner and the final cover systems.

2.4 Construction Activities

In the context of this CQA Plan, the Vista Landfill, Class III facility construction is understood to include:

- geosynthetic and soil components of the liner system;
- leachate collection, removal, transmission, and storage systems;
- geosynthetic and soil components of the final cover system above the landfill surfaces;
- gas management system;
- surface-water management system components;
- other site work including grading and general earthwork;
- road work; and
- other construction activities as assigned by Vista Landfill.

2.5 CQA Lines of Communications

Successful execution of this CQA Plan is dependent on open and continuous communication between all parties having a role in the project. The lines of communication between Vista Landfill, Engineer of Record, Design Engineer, Construction Manager, Contractor, and CQA Consultant are defined in the organization charts included in Section 3 of this CQA Plan.

3. PROJECT ORGANIZATION AND PERSONNEL

3.1 Overview

The Vista Landfill, Class III facility construction organization chart is shown in Figure 3-1. It is understood that the Project Manager will act on behalf of Vista Landfill in all matters relating to the construction of the Vista Landfill, Class III facility. Day-to-day construction activities at the Vista Landfill, Class III facility will be managed through the direct interaction of several parties below Project Manager level including but not limited to the Construction Manager, Design Engineer, Contractor, and CQA Consultant. The organization chart for the Vista Landfill, Class III facility CQA Consultant is presented in Figure 3-2. The description, qualifications, and responsibilities of the parties responsible for construction and CQA at the Vista Landfill, Class III facility project are described below.

3.2 Construction Manager

The Construction Manager shall be an individual employed by the Project Manager and who is responsible for overall management of the construction project at the site. In this CQA plan the term "Construction Manager" shall refer specifically to an authorized representative of the Project Manager at the Vista Landfill, Class III facility. The Construction Manager will hold a baccalaureate degree in construction management, engineering, or related field or have 10 years of construction management experience. The Construction Manager will also have 3 years of landfill construction experience. The Construction Manager shall be responsible for coordination and oversight of all construction activities including: (i) contract administration; (ii) construction management; (iii) review of any modifications or changes to the construction contract documents; and (iv) final approval authority for contract or shop drawings and submittals.

3.3 Design Engineer

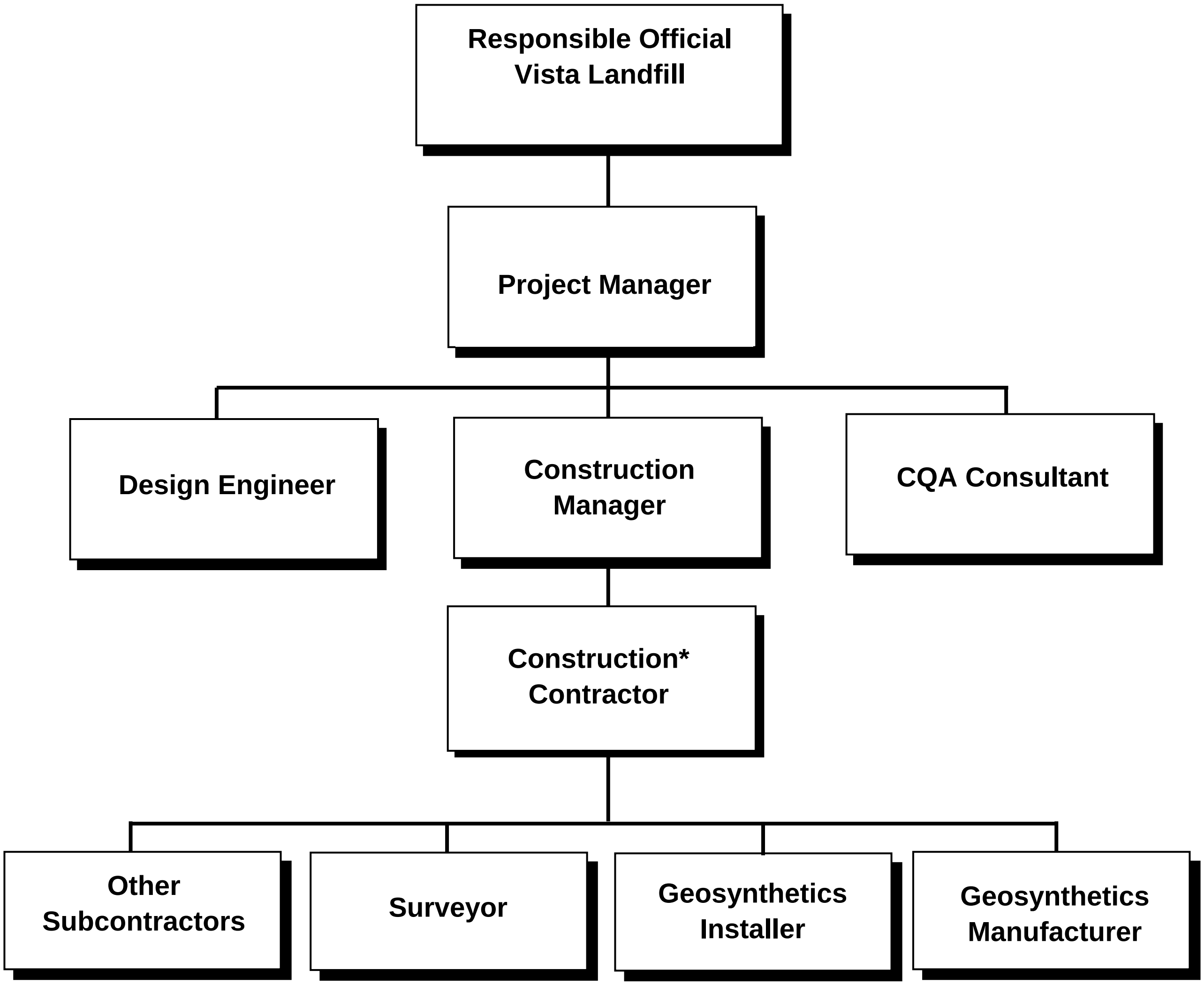
The Design Engineer is the individual representing the firm having responsibility for Vista Landfill, Class III facility design. The Design Engineer will hold a minimum of a baccalaureate degree in engineering, be a Professional Engineer registered in the state of Florida, and have 10 years experience in construction management, engineering, or related fields. The Design Engineer shall have expertise which demonstrates significant familiarity with geosynthetics and soils, as appropriate, including design and construction experience related to landfill liner system, and final cover system. The Design Engineer is responsible for approving all design and specification changes and making design clarifications that may be required during construction at the Vista Landfill, Class III facility. The Design Engineer shall assist the Construction Manager in reviewing and approving the Contractor's shop drawings and submittals as necessary. The Design Engineer will not be present on-site but will visit the project during construction and attend the project coordination meetings as required to assure conformance with plans and specifications. The Design Engineer will be capable of discussing and interpreting all elements of the Vista Landfill, Class III facility design. The Design Engineer shall have the authority to recommend changes or modifications to the Construction Drawings and Technical Specifications for approval by Vista Landfill and FDEP, as required.

3.4 Contractor

The Contractor is the firm or corporation having a legally binding agreement to construct components of the Vista Landfill, Class III facility construction, or shall be qualified construction personnel hired directly by Vista Landfill and working under the direct supervision of a construction foreman and superintendent. The Contractor is represented on-site by a qualified individual who is authorized to act on behalf of the Contractor in all matters pertaining to the construction at the Vista Landfill, Class III facility. The Contractor shall be qualified as required by the contract to perform all aspects of work required to successfully construct the project. The Contractor shall be registered in accordance with applicable local, state, and federal requirements and shall demonstrate significant prior related experience. The Contractor’s field representative shall be a qualified individual who is able to perform all tasks associated with Vista Landfill, Class III facility construction activities. The Contractor’s field representative shall demonstrate experience similar to the Construction Manager. The Contractor’s field representative shall have the authority to direct and instruct the Contractor’s crews and its subcontractors.

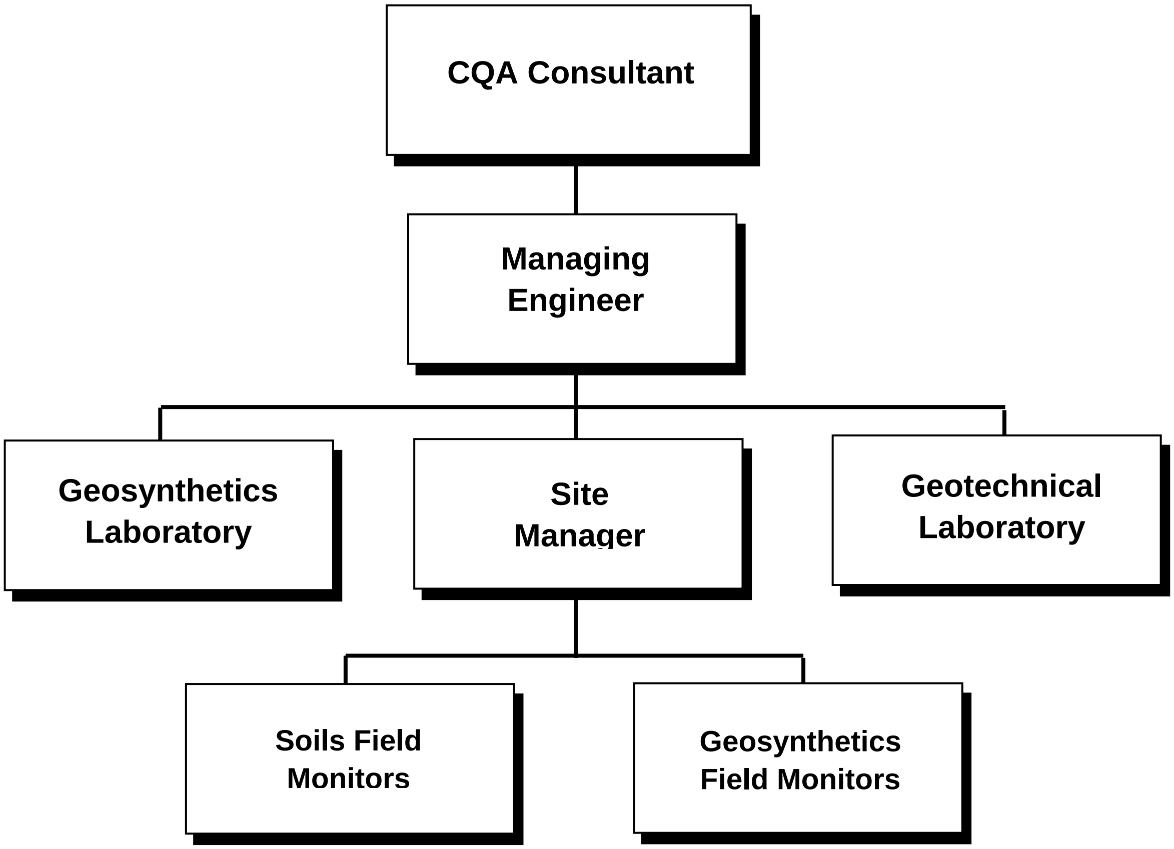
The Contractor is responsible for all construction materials and activities. The Contractor is also responsible for scheduling and coordination of the required work with its subcontractors to complete the project within the construction schedule approved by the Construction Manager. The Contractor shall provide an experienced supervisory representative at all times during any construction activity on-site. The Contractor is responsible for furnishing as-built record drawings and a copy of all documentation required during the construction at the Vista Landfill, Class III facility. The Contractor is also responsible for updating all construction drawings for any deviations from the original plans and specifications on a regular basis.

Figure 3-1
Vista Landfill, Class III Facility Construction Organization Chart



*The Construction Contractor is assumed to have earthwork capabilities as an integral part of the firm. Otherwise, the earthwork subcontractor is a major entity in this chart under the prime contractor.

Figure 3-2
Vista Landfill, Class III Facility CQA Organization Chart



The Contractor's field representative is responsible for coordinating and supervising the work of all subcontractors on site. At a minimum, the Contractor's field representative will be responsible for the following:

- informing the Construction Manager of any discrepancies between the plans and specifications and the field conditions;
- submitting all documentation required by the Construction Drawings and Technical Specifications in a timely manner;
- attending all project coordination meetings held on site;
- scheduling all phases of the construction;
- maintaining a daily log of all construction activities on site;
- implementing and verifying all QC procedures required of the Contractor and/or subcontractors; and
- submitting proposed alternative materials or construction methods to the Construction Manager for approval prior to acquisition and use.

3.5 CQA Consultant

3.5.1 Definition

The CQA Consultant is the party, independent from Vista Landfill and the Contractor, responsible for observing, testing, and documenting activities related to the CQA and CQC of the soil and geosynthetic components and other activities related to the construction at the Vista Landfill, Class III facility as described in this CQA Plan.

3.5.2 Qualifications

The CQA Consultant shall be a well-established firm specializing in geotechnical engineering, liner and final cover system design, construction management, and CQA. The CQA Consultant shall possess the equipment, personnel, and licenses necessary to conduct the monitoring and testing activities required by this CQA Plan and the Vista Landfill, Class III facility Construction Drawings and Technical Specifications. The CQA Consultant shall also be experienced in the installation and CQA of soil and geosynthetic materials similar to those materials to be used for the Vista Landfill, Class III facility construction. The CQA Consultant will be experienced in the preparation of CQA documentation including CQA plans, field documentation, field testing procedures, laboratory testing procedures, construction specifications for construction, construction plans, and CQA certification reports. The CQA Consultant shall provide qualified staff for the project.

In addition, the CQA Consultant shall provide the following, in writing, to Vista Landfill as required:

- corporate background and information;
- a detailed summary of the firm's CQA capabilities;
- a detailed summary of the firm's CQA experience; and
- a representative list of at least 10 completed facilities for which the CQA Consultant has provided CQA monitoring services for the installation of the corresponding geosynthetic material; for each facility, the following information will be provided:
    - name and purpose of facility, its location, and date of installation;
    - name of owner;
    - surface area of each geosynthetic material installed; and
    - telephone number of person familiar with the project.

The CQA Consultant shall provide resumes of personnel to be involved in the project including:

- the CQA Managing Engineer, who operates from the office of the CQA Consultant and who conducts periodic visits to the site as required;
- the CQA Site Manager, who is located at the site; and
- the CQA Field Monitors, who will be located at the site.

The CQA Consultant organization will be led by the CQA Managing Engineer, who will hold a baccalaureate degree in engineering and be a Professional Engineer registered to practice in the state of Florida. The CQA Site Manager will be the representative of the CQA Consultant on site and will have experience in similar construction and be specifically familiar with the construction of soil and geosynthetic components of the landfill.

3.5.3 Responsibilities

The CQA Consultant shall be responsible for monitoring and documenting the activities of the Contractor relative to the installation of the liner and final cover system components as well as various appurtenances related to the construction at the Vista Landfill, Class III facility. The CQA Consultant will be responsible for monitoring the compliance of construction materials delivered to the site with the submittals and/or shop drawings previously reviewed and approved by the Construction Manager. The CQA Consultant shall assure that the Contractor's construction methods and workmanship are performed in accordance with the Construction Drawings and Technical Specifications. The CQA Consultant shall be responsible for obtaining and testing samples of the various construction materials in accordance with the testing frequencies identified in this plan. The CQA Consultant shall also be responsible for obtaining, labeling, and shipping samples for off-site laboratory testing in accordance with the requirements of this plan and appropriate specifications.

The CQA Consultant shall be responsible for soils quality control testing to be performed by both the on-site and off-site testing laboratories. The CQA Consultant shall be responsible for staffing and operating the on-site soils laboratory, if required. Test results from the on-site and off-site laboratories shall be submitted to the Construction Manager within a time frame that will not impede or delay construction activities.

The on-site soils laboratory, if used, shall be equipped to perform routine index testing including, but not limited to:

- standard Proctor (ASTM D 698);
- particle-size analysis (ASTM D 422 and ASTM C 136);
- Atterberg limits (ASTM D 4318);
- moisture content (ASTM D 2216 and ASTM D 4643);
- soils classification (ASTM D 2487); and

- percent passing No. 200 sieve (ASTM D 1140).

The CQA Consultant shall also be responsible for conducting routine field tests during construction of the Vista Landfill, Class III facility, which shall include:

- moisture content by nuclear methods (ASTM D 3017);
- in-place density by nuclear methods (ASTM D 2922);
- lift thickness by direct measurement;
- sand cone (ASTM D 1556); and
- drive cylinder (ASTM D 2937).

The CQA Consultant will be responsible for the quality control of its on-site laboratory testing program and for documenting the calibration of the soils laboratory testing equipment. Equipment calibration certificates shall be maintained in the CQA Consultant's on-site project file. All tests will be conducted in accordance with ASTM or other applicable state or federal standards. Test results shall be submitted to the Construction Manager within a time frame that will not impede or delay construction of activities.

The duties of the CQA Personnel are discussed in the following subsections.

3.5.3.1 CQA Managing Engineer

The CQA Managing Engineer:

- reviews the landfill Construction Drawings and Technical Specifications;
- reviews soils and geosynthetics-related documents (such reviews are for familiarization and for evaluation of constructability only);
- attends project meetings related to construction quality activities;
- administers the CQA program (i.e., assigns and manages all on-site CQA personnel, reviews all field reports, and provides engineering review of all CQA-related activities);
- provides quality control of CQA documentation;

- reviews changes to the construction design, and assures any major changes are submitted to FDEP for approval prior to incorporation into the Construction Drawing and Technical Specifications; and

- with the CQA Site Manager, prepares the final certification report.

3.5.3.2 CQA Site Manager

The CQA Site Manager:

- acts as the on-site representative of the CQA Consultant;

- familiarizes all CQA Field Monitors with the site, project documents, and the CQA requirements;

- manages the daily activities of the CQA Field Monitors;

- attends regularly scheduled CQA-related meetings on-site;

- reviews the ongoing preparation of the construction record drawings;

- reviews test results provided by the Contractor;

- verifies the calibration and condition of on-site testing equipment;

- reviews the CQA Field Monitors' daily reports and logs;

- provides reports to the Construction Manager, and documents in a daily report any reported relevant observations by the CQA Field Monitors;

- prepares a daily report for the project;

- oversees the collection and shipping of all laboratory test samples;

- reviews results of laboratory testing and makes appropriate recommendations;

- reports any unresolved deviations from the CQA Plan and Construction Drawings and Technical Specifications to the Construction Manager;

- assists with the preparation of the final certification report;

- reviews appropriate certifications and documentation from the Contractor and the Geosynthetics Manufacturer and Installer, and makes appropriate recommendations;
- reviews the Geosynthetics Manufacturer's QC documentation;
- reviews the geosynthetics Installer's personnel qualifications for conformance with those required by the Technical Specifications; and
- performs duties of CQA Field Monitor as needed.

3.5.3.3 CQA Field Monitors

The duties of the CQA Field Monitors are monitoring and documenting construction of all soils and geosynthetics components of the landfill and other Vista Landfill, Class III facility activities, as assigned by the CQA Site Manager.

The duties of the CQA Field Monitors will include:

- monitoring material stockpiles for any deterioration of materials;
- monitoring surface-water drainage in the areas of soil and geosynthetic material stockpiles;
- preparing daily field reports;
- recording CQA and CQC activities on field logs;
- reporting problems to the CQA Site Manager;
- assisting with collection of samples from the constructed soil components in accordance with the CQA Plan;
- monitoring soil placement and compaction operations;
- monitoring the unloading and on-site handling and storage of the geosynthetics;
- monitoring geosynthetic repair operations;
- monitoring geosynthetic material deployment and installation operations; and

- collecting conformance samples for testing by CQA laboratories.

In addition to these specific duties, all CQA Field Monitors will document any on-site activities that could result in damage to the soils or geosynthetic components of the landfill. This is particularly true during the placement and compaction of the initial lift of soil on top of the underlying geosynthetic material. Any observations so noted by the CQA Field Monitors shall be reported immediately to the CQA Site Manager.

3.6 <u>Soils CQA Laboratory</u>

3.6.1 Definition

The Soils CQA Laboratory is the party, independent from Vista Landfill and Contractor, responsible for conducting geotechnical laboratory tests in accordance with standards referenced in the Construction Drawings and Technical Specifications and this CQA Plan. The testing results generated by the Soils CQA Laboratory shall be used by the CQA Consultant to verify compliance of the soils construction materials with the plans and specifications and submittals previously approved by the Construction Manager.

It is anticipated that the on-site Soils CQA Laboratory will be utilized to perform the conformance evaluation testing of the various soils components at the Vista Landfill, Class III facility. The off-site soils CQA Laboratory will be for more sensitive performance testing required during construction such as hydraulic conductivity testing which require tightly controlled laboratory conditions.

3.6.2 Qualifications

The Soils CQA Laboratory will be experienced in testing of soils similar to those proposed for use in the construction at the Vista Landfill, Class III facility in accordance with ASTM and other applicable soil test standards. The Soils CQA Laboratory will be capable of providing test results within a maximum of 7 working days of receipt of samples and will maintain that capability throughout the duration of the earthwork construction.

Prior to construction, the Soils CQA Laboratory, if different from the CQA Consultant, shall submit their qualifications and QA/QC procedures to the Construction Manager for review and approval. The qualifications presented by the Soils CQA Laboratory shall, as a minimum, include:

- corporate background and statement of qualifications;

- list of testing capabilities including reference to ASTM test methods;
- a laboratory QA/QC plan;
- information on staff size and experience; and
- information regarding test result turnaround time.

3.6.3 Responsibilities

The Soils CQA Laboratory will be responsible for testing various soils components at the Vista Landfill, Class III facility. These tests shall include, but not be limited to, material qualification (conformance) tests and material construction quality control (performance) tests as described in Construction Drawings and Technical Specifications. The CQA Consultant will be responsible for coordinating the Soils CQA Laboratory testing.

3.7 Geosynthetics CQA Laboratory

3.7.1 Definition

The Geosynthetics CQA Laboratory is the party, independent from Vista Landfill, Contractor, and geosynthetics Manufacturer and Installer, responsible for conducting tests on samples of geosynthetic materials used in construction of the landfill in accordance with standards referenced in the Construction Drawings and Technical Specifications and this CQA Plan. The testing results generated by the Geosynthetics CQA Laboratory shall be used by the CQA Consultant to verify compliance of the geosynthetic materials with plans and specifications and submittals previously approved by the Construction Manager.

3.7.2 Qualifications

The Geosynthetics CQA Laboratory shall hold current accreditation by Geosynthetic Research Institute (GRI) or be approved by the Design Engineer and have experience in testing geosynthetics similar to those proposed for use during construction at the Vista Landfill, Class III facility. The Geosynthetics CQA Laboratory shall be familiar with ASTM and other applicable geosynthetic test standards. The Geosynthetics CQA Laboratory will be capable of providing destructive test results for geomembrane field seams within 24 hours of receipt of samples and will maintain that capability throughout the duration of geosynthetic material installation.

Prior to construction, the Geosynthetics CQA Laboratory, if different from the CQA Consultant, shall submit their qualifications to the Construction Manager for review and approval. The qualifications presented by the Geosynthetics CQA Laboratory shall, as a minimum, include:

- corporate background and statement of qualifications;
- listing of testing capabilities including reference to ASTM or other applicable test methods;
- a laboratory QA/QC plan;
- information on staff size and experience; and
- information regarding test result turnaround time.

3.7.3 Responsibilities

The Geosynthetics CQA Laboratory will be responsible for testing various geosynthetic components of the landfill. These tests shall include, but not be limited to, geosynthetic conformance and performance tests and destructive testing of the geomembrane field seams as described in the Construction Drawings and Technical Specifications. The CQA Consultant will be responsible for coordinating the Geosynthetics CQA Laboratory testing.

3.8 Geosynthetics Manufacturers

The geosynthetics Manufacturers are the firms or corporations responsible for production of the geosynthetic materials to be used in construction at the Vista Landfill, Class III Facility. The geosynthetics Manufacturers shall be able to provide sufficient production capacity and qualified personnel to meet the demands of the project schedule. Prior to shipment of any material to the site, each geosynthetics Manufacturer shall be pre-qualified and approved by the Construction Manager. The geotextile, geomembrane, geocomposite and GCL Manufacturers shall meet the qualifications outlined in the Technical Specifications, respectively.

Each geosynthetics Manufacturer is responsible for the production and quality control of its respective geosynthetic product. In addition, each geosynthetics Manufacturer is responsible for the condition of the geosynthetic until the material is accepted by the

Contractor. Each geosynthetics Manufacturer shall produce a consistent high quality product that shall meet all the requirements of the Technical Specifications. Each geosynthetics Manufacturer shall submit quality control documentation to the Construction Manager for its respective products as required by the Technical Specifications.

3.9 Geosynthetics Installers

The geosynthetics Installers will be experienced and qualified to install the geosynthetic materials of the type specified for this project. The geosynthetics Installers will be approved and/or licensed by the geosynthetics Manufacturers. A copy of the approval letter or license will be submitted by the Contractor to the Construction Manager as required by the Technical Specifications. The geosynthetics Installers shall meet the qualifications outlined in the Technical Specifications. The geosynthetics Installers will designate one representative as its supervisor, who will be responsible for acting as the geosynthetics Installer's spokesman on site. The geosynthetics Installers will provide the Construction Manager with a list of proposed seaming personnel and their qualifications. This document will be reviewed by the CQA Consultant. Final approval of the geosynthetic Installer’s geomembrane seaming personnel will be the responsibility of the Construction Manager. Any proposed seaming personnel deemed insufficiently experienced will not be accepted. The most experienced seamer, the "master seamer", shall provide direct supervision, as required, over less experienced seamers. No field seaming shall take place without the master seamer being present.

The geosynthetics Installer's supervisor will be responsible for installation of the geosynthetics used in construction at the Vista Landfill, Class III facility and for providing supervision and guidance to the installation crew. The geosynthetics Installer's supervisor is also responsible for the following: (i) obtaining samples, as required by the CQA Plan and the specifications; (ii) field testing; (iii) documenting quality control testing activities; and (iv) coordinating the geosynthetics installation activities with the Construction Manager. The geosynthetics Installer's supervisor will be responsible for documenting the geosynthetics installation activities, including, but not limited to, on-site personnel, material inventories, production figures, test results, installation deficiencies, and resolution of construction problems.

3.10 Surveyor

The Surveyor is responsible for lines and grades required for control of the work on an ongoing basis during all phases of the Vista Landfill, Class III facility construction. Close interaction between the Surveyor, Contractor, and the CQA Consultant is essential to ensure that construction at the Vista Landfill, Class III facility is completed in accordance with the Construction Drawings and Technical Specifications. The project Surveyor shall be a state of Florida licensed Professional Land Surveyor or registered Professional Engineer who shall sign and seal all construction survey record drawings. All surveying personnel shall be experienced in the provision of surveying services, including detailed accurate documentation as required in the Technical Specifications. The Surveyor is responsible for all surveying activities and products in accordance with the Technical Specifications.

4. DOCUMENTATION

4.1 Overview

An effective CQA Plan depends largely on recognition of all construction activities that should be monitored and the assignment of responsibilities for the monitoring of each activity. This is most effectively accomplished and verified by the documentation of quality assurance and quality control activities. The CQA Consultant shall be responsible for assuring that the Contractor's quality control requirements have been addressed and satisfied.

The CQA Site Manager shall provide the Construction Manager descriptive daily field reports, data sheets, and logs, as requested, which document that monitoring activities have been accomplished. Examples of some of the forms that will be used to document CQA activities are included in Appendix A. The CQA Site Manager shall also maintain at the job site a complete file of Construction Drawings and Technical Specifications, this CQA Plan, the Contractor's Quality Control Plan(s), checklists, test procedures, daily logs, and other pertinent construction and CQA documents.

4.2 Daily Record Keeping

The CQA Consultant's daily reporting procedures shall include: (i) daily summary report; (ii) monitoring logs; (iii) testing data sheets; and (iv) when appropriate, problem identification and corrective measures reports.

4.2.1 Daily Summary Reports

The CQA Consultant's daily summary reports shall include the following information as applicable:

- an identifying sheet number for cross referencing and document control;
- date, project name, location, and other pertinent project identification;
- data on weather conditions;
- summary on meetings held and their results;
- process description(s) and location(s) of construction activities underway during

the time frame of report;

- descriptions and specific locations of areas, or units, of work being tested and/or observed and documented;
- description of locations where tests and samples were taken;
- a narrative summary of field test results;
- off-site materials received, including quality control documentation;
- decisions made regarding acceptance of units of work, and/or corrective actions to be taken in instances of substandard testing results;
- identifying sheet numbers of data sheets and/or problem reporting and corrective measures reports used to substantiate the decisions described above; and
- signature of the respective CQA Site Manager and/or the CQA Field Monitor.

4.2.2 CQA Monitoring Logs and Test Data Sheets

Monitoring observations, sampling information, and test results shall be recorded on the appropriate monitoring logs and test data sheets. The CQA Consultant shall use the monitoring logs and test data sheets to ensure completeness of the required CQA activities. Any corrections to the monitoring logs and test data sheets shall be single line crossed out, initialed by the CQA personnel responsible for the correction and dated. Examples of relevant monitoring logs are presented in Appendix A.

The CQA Consultant's monitoring logs and test data sheets shall include the following information as applicable:

- project specific information such as project name, location;
- the date the CQA activity was performed;
- a unique identifying sheet number for cross-referencing and document control;
- description or title of the CQA activity or test procedure;
- location of the CQA activity or location from which the sample was obtained;

- type of CQA activity or procedure used (reference to standard method when appropriate);

- recorded observation or test data, with all necessary calculations;

- results of the CQA activity and comparison with specification requirements (pass/fail); and

- the initials or signature of personnel involved in CQA inspection activity.

4.2.3 Nonconformance Identification and Reporting

A nonconformance is defined herein as material or workmanship that does not meet the specified requirement(s). Nonconformance identification and corrective measures reports should be cross-referenced to specific summary reports, logs, or test data sheets where the nonconformance was identified. The reports should include the following information as applicable:

- a unique identifying sheet number for cross-referencing and document control;

- detailed description of the problem;

- location of the problem;

- probable cause;

- how and when the problem was located;

- estimation of how long problem has existed;

- suggested corrective measures;

- documentation of corrections (reference to inspection data sheets);

- suggested methods to prevent similar problems; and

- signature of the appropriate CQA Field Monitor and concurrence by the CQA Site Manager.

In some cases, not all of the above information will be available or obtainable. However, when available, such efforts to document nonconformances could help to avoid similar nonconformances in the future. The CQA Site Manager shall distribute copies of the report to the Construction Manager for further actions.

4.3 Photographic Documentation

The CQA Site Manager will be responsible for obtaining photographic documentation of the Contractor's activities, materials installation methods, and testing procedures. Photographs will serve as a pictorial record of work progress, problems, and corrective measures. Photographic reporting data sheets should be utilized to organize and document photographs taken during construction at the Vista Landfill, Class III facility. Such data sheets could be cross-referenced or appended to summary reports, CQA monitoring logs, or test data sheets and/or problem identification and corrective measures reports. At a minimum, photographic reporting data sheets should include the following information:

- a unique identifying number on data sheets and photographs for cross-referencing and document control;
- person responsible for photograph;
- the date and location where the photograph was taken; and
- location and description of the work;

These photographs will serve as a pictorial record of work progress, problems, and corrective measures. Color prints shall be organized chronologically and kept in a permanent protective file. Negatives and/or digital files shall be stored in a separate protective file.

4.4 Design and/or Specifications Changes

Design and/or specifications changes may be required during construction. In cases of Contractor initiated changes, the Contractor must submit written requests for such changes to the Construction Manager. The Design Engineer shall review and respond to these requests in a timely manner. All design and/or specifications changes will be made only with the approval of the Engineer of Record and Design Engineer and approval by FDEP if required. Such changes will take the form of a change order to the contract if required.

4.5 Non-conformances

The Construction Manager will be informed in writing of any significant recurring nonconformance with the Construction Drawings, Technical Specifications, or CQA Plan by the CQA Consultant. The cause of the nonconformance will be determined by the CQA Consultant. The Contractor will be directed by the Construction Manager to make appropriate changes in materials or procedures in order to correct the nonconformance. When this type of evaluation is made, the results will be documented, and any revision to procedures or specifications must be approved by the Design Engineer.

4.6 CQA Certification Report

At the completion of construction phases, the CQA Consultant will provide Vista Landfill with a construction phase final certification report for submittal to FDEP. This report will acknowledge: (i) that the work has been performed in compliance with the approved Construction Drawings, Technical Specifications, and approved modifications; (ii) physical sampling and testing has been conducted at the appropriate frequencies; and (iii) that the summary documentation provides the necessary supporting information.

At a minimum, this report will include:

- summary of CQA activities;
- CQA monitoring logs and testing data sheets including sample location plans;
- laboratory test results;
- problem identification and reports of corrective measures reports;
- a descriptive summary of any changes to the Construction Drawings or Technical Specifications; and
- a summary statement indicating compliance with the Construction Drawings or Technical Specifications and any approved changes that are signed and sealed by the CQA Managing Engineer.

The record drawings, which include scale drawings depicting the location of the construction and details pertaining to the extent of construction (e.g., depths, plan dimensions, elevations, soil component thicknesses, etc.), and a geomembrane panel drawing prepared by the CQA Consultant will also be included as part of the final certification report.

4.7 Storage of Records

The CQA Site Manager will be responsible for all CQA document storage during the construction at the Vista Landfill, Class III facility. This includes the CQA Consultant's copy of the Construction Drawings and Technical Specifications, the CQA Plan, and the originals of all the data sheets and reports. When the Vista Landfill, Class III facility construction is complete and upon issuance of the final certification report, the CQA document originals will be organized and retained by the CQA Consultant until requested by Vista Landfill. Required records shall include, but not be limited to, field logbooks, other data collections forms, equipment calibration records, costs data, drawings, maintenance records, and all associated reports.

5. SOILS CONSTRUCTION

5.1 Introduction

CQA monitoring and testing shall be performed during installation of the liner system, the final cover system, and other earthwork components. Criteria to be used for determination of acceptability of the various soil components are identified in the Construction Drawings and Technical Specifications and this CQA Plan.

5.2 Soil Components

There are several principal soil components included in the Vista Landfill, Class III facility construction. The soil components or layers of the liner system include the following, from top to bottom:

- a 2-ft thick liner protective layer above the geomembrane;
- a gravel drainage layer in the leachate collection corridors and sumps; and
- a varying thickness of compacted general fill layers below the liner system.

The soil components or layers of the Vista Landfill, Class III facility final cover system above the waste include the following, from top to bottom:

- a 0.5-ft thick vegetative layer;
- a 1.5-ft thick cover protective soil layer above the geomembrane; and
- a 1.0-ft thick intermediate cover layer below the geomembrane.

General fill material is used in other areas of earthwork outside the liner or final cover systems. All general fill placement, grading, and compaction will be monitored and tested in accordance with the Construction Drawings, Technical Specifications, and this CQA Plan.

5.3 Record Drawings and As-Built Surveys

During construction of the soil components at the Vista Landfill, Class III facility, the CQA Consultant shall routinely review record drawings submitted by the Contractor. The drawings are used to verify location of work, percent of work completed, layer thickness, or final grades. Prior to the placement of successive soil or geosynthetic layers the CQA Consultant shall review as-built surveys that indicate compliance of the preceding layer thickness, lines, and grades. Once an as-built survey has been received, it will be the responsibility of the CQA Consultant to review the information in a timely manner and notify the Contractor of any noncompliance.

5.4 Related Construction Drawings and Technical Specifications

Several sections of the Technical Specifications should be referenced by the CQA Consultant for pertinent soil materials physical properties and construction requirements. Related specifications include the following:

- Section 02100 - Surveying;
- Section 02110 - Clearing, Grubbing, and/or Stripping;
- Section 02200 - Earthwork;
- Section 02215 - Trenching and Backfilling;
- Section 02225 – Low-Permeability Soil Layer;
- Section 02230 - Road Construction;
- Section 02235 - Drainage Gravel;
- Section 02240 - Protective Soil Layers;
- Section 02245 - Riprap;
- Section 02290 - Erosion & Sediment Control;
- Section 02920 – Vegetative Soil Layer; and/or
- Section 02930 - Vegetation.

Prior to the start of soils construction, the CQA Consultant shall review the information required by the Technical Specifications listed above. Compliance of the submittals with the Technical Specifications shall be determined by the Construction Manager.

5.5 Subgrade

During construction, monitoring of the subgrade preparation shall be performed by the CQA Consultant. The CQA Consultant shall monitor to assure a firm and smooth surface that is free of vegetation and other deleterious materials is achieved. Material placed to achieve grades indicated on the Construction Drawings shall be monitored by the CQA Consultant to verify that the subgrade material and fill placement, grading, and compaction complies with the Technical Specifications. Areas that do not meet the Technical Specifications will be delineated, and nonconforming areas will be reworked by the Contractor. This process will be repeated until acceptable results are achieved.

The CQA Consultant shall monitor the repair and rework of fill material that is damaged by excess moisture (causing softening). If such conditions are found to exist, the CQA Consultant shall evaluate the suitability of the subgrade by the following methods as applicable:

- moisture/density testing; and/or
- continuous visual inspection during proof-rolling.

5.6 Conformance Testing

It will be necessary for the CQA Consultant to observe and test the soil components to ensure they are uniform and conform to the requirements of the Technical Specifications. For soil materials obtained from on-site sources, visual inspections and conformance tests shall be performed by the CQA Consultant prior to the materials being used. If soil materials are obtained from off site borrow sources, visual inspection and conformance tests shall be performed at the source location or as the materials arrive at the Vista Landfill, Class III site. Borrow area inspections may also be utilized by the CQA Consultant to ensure that only suitable soil materials are transported to the Vista Landfill, Class III site. For off-site borrow areas containing non-uniform materials, it shall be necessary for the Contractor and the CQA personnel to coordinate excavation and monitoring of the segregation of substandard materials. All materials failing to comply with conformance standards shall be rejected for use at the Vista Landfill, Class III facility.

Initial evaluation of various soil types by CQA personnel during construction shall be largely visual; therefore, the CQA personnel must be experienced with visual-manual soil classification procedures. CQA personnel shall be aware that changes in color or texture can be indicative of a change in soil type. CQA personnel shall observe soils for deleterious materials (e.g., roots, stumps, and large objects). When necessary, the visual-manual procedure for the description and identification of soils shall be conducted by the CQA Consultant in accordance with test method ASTM D 2488.

5.6.1 Test Methods

Conformance tests used to evaluate the suitability of soil materials during construction shall be performed in accordance with the current ASTM or other applicable test procedures indicated in Table 5-1. Documentation and reporting of the test results shall be the responsibility of the CQA Consultant.

The standard Proctor test (ASTM D 698) shall be used for the evaluation of moisture/density relationships unless otherwise indicated. Any conflict regarding acceptance of test results shall be resolved by the Design Engineer.

5.6.2 Test Frequency

The frequency of conformance tests shall conform to the minimum frequencies presented in Table 5-1. The frequency of testing may be increased at the discretion of the CQA Consultant or if variability of the materials is observed. The testing frequencies described herein for general fill shall also apply to materials used by the Contractor in areas outside the limits of the liner and final cover systems at the Vista Landfill, Class III facility.

5.7 Construction Monitoring

During installation of the various soil components, the CQA Consultant shall visually observe and document the Contractor's earthwork activities for the following:

- changes in the soil consistency;
- the thickness of lifts as loosely placed and as compacted;
- soil conditioning prior to placement including general observations regarding moisture distribution, clod size, etc.;
- placement method which may damage or cause displacement or wrinkling of

geosynthetics;

- the action of the compaction and heavy hauling equipment on the construction surface (sheepsfoot penetration, pumping, cracking, etc.);
- the number of passes used to compact each lift;
- desiccation cracks or the presence of ponded water; and
- final lift or layer thickness.

5.8 Hydraulic Conductivity Testing Evaluations

As shown in Table 5-1, hydraulic conductivity (permeability) tests shall be conducted on soil materials proposed in the liner and final cover systems including the protective soil layers and drainage materials (i.e., gravel, processed tire chips). Permeability testing of these materials shall be performed in accordance with ASTM D 5084 or ASTM D 2434, as applicable. The CQA Consultant shall be responsible for documenting pertinent sampling information including the date the sample was obtained, sample identification number, and location.

5.9 Performance Testing

During construction, the CQA Consultant shall observe and test all soil components to ensure they are installed in accordance with the requirements of the Construction Drawings and Technical Specifications. The CQA Consultant shall also evaluate the procedures, methods, and equipment used by the Contractor to install the various soil components.

5.9.1 Test Methods

All performance testing shall be conducted in accordance with the Technical Specifications or as directed by the Design Engineer. The field testing methods, used to evaluate the suitability of soils during their installation, shall be performed by the CQA Consultant in accordance with current ASTM test procedures indicated in Table 5-2. Documentation and reporting of the test results shall be the responsibility of the CQA Consultant.

The standard Proctor test (ASTM D 698) shall be used for the evaluation of moisture/density relationships unless otherwise indicated. In-place surface moisture/density by nuclear test methods (ASTM D 3017 and D 2922) shall be used for in-situ field testing. The sand cone test method (ASTM D 1556) or drive cylinder test method (ASTM D 2937) shall be used to establish correlations of moisture and density in cases of uncertainty, and as a check of the nuclear surface moisture/density gauge calibration. Any conflict regarding acceptance of test results shall be resolved by the Design Engineer.

5.9.2 Test Frequency

Performance testing shall be conducted during the course of the work. The minimum construction performance testing frequencies are presented in Table 5-2. The frequency may be increased at the discretion of the CQA Consultant or if variability of the materials is observed by the CQA Consultant. Sampling locations shall be selected by the CQA Consultant. If necessary, the location of routine in-place density tests shall be selected using a non-biased sampling approach.

A special testing frequency shall be used at the discretion of the CQA Consultant when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas shall be considered when:

- rollers slip during rolling operations;
- lift thickness is greater than specified;
- material is at improper and/or variable moisture content;
- it is suspected that less than the specified number of roller passes are made;
- dirt-clogged rollers are used to compact the material;
- rollers may not have used optimum ballast;
- there is change to subgrade condition since subgrade approval;
- fill materials differ substantially from those specified;
- the degree of compaction is doubtful; and
- as directed by the Design Engineer or the Construction Manager.

During construction, the frequency of testing may also be increased in the following situations:

- adverse weather conditions;
- breakdown of equipment;
- at the start and finish of grading;
- material fails to meet specifications; and
- the work area is reduced.

5.10 Deficiencies

If a defect is discovered in the soils construction, the CQA Consultant shall immediately determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQA Consultant shall determine the extent of the deficient area by additional tests, observations, a review of records, or other means that the CQA Consultant deems appropriate. If the defect is related to adverse site conditions, such as overly wet soils or surface desiccation, the CQA Consultant shall define the limits and nature of the defect and the appropriate remedy.

As soon as possible, after determining the extent and nature of substandard materials, noncompliant construction practice, or other such deficiency in materials or workmanship which cannot be immediately resolved on-the-spot, the CQA Consultant shall notify the Construction Manager and Contractor and schedule appropriate retests when the work deficiency is to be corrected.

The CQA Consultant shall verify that the Contractor has corrected all noted deficiencies. If a specified criterion cannot be met, or unusual weather conditions hinder work, the Contractor shall submit suggested solutions or alternatives to the Construction Manager for review.

At locations where the field testing indicates in-situ conditions which do not comply with the requirements of the Technical Specifications, the failing area shall be reworked to the satisfaction of the CQA Consultant. Alternatively, at the CQA Consultant's option, undisturbed samples of in-place material shall be obtained for appropriate testing. All retests performed by the CQA Consultant must verify that the deficiency has been corrected before any additional work is performed by the Contractor in the area of the deficiency.

5.11 Documentation

The documentation of soils CQA testing activities is an important factor in assuring the successful construction, performance, and approval of the soil components of the Vista Landfill, Class III facility. The CQA monitoring observations, sample location descriptions, field test results, and on-site laboratory test results shall be documented by the CQA Consultant on forms specifically designed for their purpose. Reports and forms shall be submitted to the Construction Manager as requested.

TABLE 5-1

MINIMUM CONFORMANCE TESTING FREQUENCIES FOR SOIL COMPONENTS

TEST NAME/ TEST METHOD	GENERAL FILL	LINER PROTECTIVE SOIL	GRANULAR DRAINAGE MATERIAL	CAP PROTECTIVE SOIL	VEGETATIVE LAYER
SPECIFICATION SECTION	02200	02240	02235	02240	02920
Particle Size Analysis/ASTM D 422	1 test per 10,000 yd^3	N/A	N/A	1 test per 5,000 yd^3	1 test per 5,000 yd^3
Particle Size Analysis/ASTM C 136	N/A	1 test per 3,000 yd^3	1 test per 2,000 yd^3	N/A	N/A
Atterberg Limits/ASTM D 4318 (for plastic soils only)	N/A	N/A	N/A	N/A	N/A
Soil Classification/ASTM D 2487	1 test per 10,000 yd^3	1 test per 3,000 yd^3	1 test per 2,000 yd^3	1 test per 5,000 yd^3	1 test per 5,000 yd^3
Standard Proctor/ASTM D 698	1 test per 25,000 yd^3	N/A	N/A	1 test per 5,000 yd^3	N/A
Hydraulic Conductivity/ ASTM D 2434	N/A	1 test per 3,000 yd^3	1 test per 2,000 yd^3	1 test per 5,000 yd^3	N/A
Organic Content/ASTM D2974	N/A	N/A	N/A	N/A	1 test per 5,000 yd^3

TABLE 5-2
MINIMUM PERFORMANCE TESTING FREQUENCIES FOR SOIL COMPONENTS

TEST NAME/ TEST METHOD	GENERAL FILL/ MISC. SOILS	CAP PROTECTIVE SOIL
SPECIFICATION SECTION	02200	02240
In-Situ Moisture/ASTM D 3017	5 tests per acre per lift (1)	5 tests per acre per lift(1)
In-situ Density/ASTM D 2922	5 tests per acre per lift (1) or 1 test per 250 lf per lift	5 tests per acre per lift(1)
Sand Cone/ASTM D 1556 or Drive Cylinder/ASTM D 2937	1 test per 25 nuclear tests or 1 test per 250 lf per lift	1 test per 25 nuclear test

N/A = Not Applicable

NOTE: 1. A minimum of two nuclear moisture and density tests each day of active soils construction

6. GEOMEMBRANE

6.1 Introduction

The CQA Consultant shall perform conformance and destructive seam testing and shall monitor the installation of geomembranes as required by Section 02770 of the Technical Specifications and this CQA Plan. The testing used to evaluate the conformance of the geomembrane sheet and seams with the requirements of the Technical Specifications shall be carried out by the CQA Consultant. The testing will be performed in accordance with the current versions of the ASTM or other applicable test procedure indicated in Tables 6-1 and 6-2.

6.2 Manufacturing Plant Visit

At the request of Vista Landfill, the CQA Consultant, or authorized representative, shall visit the plant of the geomembrane Manufacturer for the purpose of collecting conformance samples and verifying that manufacturing quality control procedures are in conformance with Section 02770 of the Technical Specifications. If possible, such a visit shall be performed prior to or during the manufacturing of the geomembrane rolls for the Vista Landfill, Class III facility project. The CQA Consultant shall review the manufacturing process, quality control procedures, laboratory facilities, and testing procedures.

During the project specific plant visit, the CQA Consultant shall:

- verify that properties guaranteed by the geomembrane Manufacturer meet all specifications;
- verify that the measurements of properties by the geomembrane Manufacturer are properly documented and test methods used are acceptable;
- spot inspect the rolls and verify that they are free of holes, blisters, or any sign of contamination by foreign matter;
- review packaging and transportation procedures to verify that these procedures are not damaging the geomembrane;
- verify that all rolls are properly labeled; and
- verify that extrusion rods and/or beads manufactured for the field seaming of the

geomembrane are derived from the same base resin type as the geomembrane.

Upon completion of the manufacturing plant visit, a report describing the findings and observations shall be completed by the CQA Consultant and shall be included as an attachment to the final certification report.

6.3 Transportation, Handling and Storage

The CQA Consultant shall monitor the transportation, handling, and storage of the geomembrane on-site. The Construction Manager shall designate a geomembrane storage location. It will be the responsibility of the Contractor to protect the geomembrane stored on site from theft, vandalism, and damage.

Upon delivery at the site, the Contractor, Installer, and CQA Consultant shall conduct an inspection of the rolls for defects and damage. This inspection shall be conducted without unrolling the materials unless defects or damages are found or suspected. The CQA Consultant shall indicate to the Construction Manager:

- rolls, or portions thereof, which should be rejected and removed from the site because they have severe or non-repairable flaws which may compromise geomembrane quality; and
- rolls that include minor and repairable flaws that do not compromise geomembrane quality.

The CQA Consultant shall also monitor that equipment used to handle the geomembrane on-site is adequate and does not pose any risk of damage to the geomembrane when used properly.

6.4 Conformance Testing

6.4.1 Sampling Procedures

Upon delivery of the geomembrane rolls to the Vista Landfill, Class III facility, the CQA Consultant shall ensure that representative geomembrane conformance samples are obtained at the specified frequency and forwarded to the Geosynthetics CQA Laboratory for testing. Geomembrane conformance samples shall be taken across the entire width of the roll and shall not include the first 3 ft of material. Unless otherwise directed by the Design Engineer, samples shall be 3 ft long by the roll width. The required minimum geomembrane conformance sampling frequencies are provided in Table 6-1. The CQA

Consultant shall mark the machine direction on the samples with an arrow and affix a label, tag, or otherwise mark each sample with the following information:

- date sampled;
- project number;
- lot/batch number and roll number;
- conformance sample number; and
- CQA personnel identification.

6.4.2 Testing Procedures

Conformance testing of the geomembrane materials delivered to the site will be conducted to ensure compliance with both the Technical Specifications and the Manufacturer's list of minimum average roll values. As a minimum, the geomembrane conformance test procedures listed in Table 6-1 shall be performed by the Geosynthetics CQA Laboratory.

6.4.3 Test Results

All conformance test results shall be reviewed, accepted, and reported by the CQA Consultant before deployment of the geomembrane. Any non-conformance of the material's properties with the requirements of the Technical Specifications shall be reported to the Construction Manager. In all cases, the test results shall meet, or exceed, the property values listed in Appendix B.

6.4.4 Conformance Test Failure

In the case of failing test results, the Contractor may request that another sample from the failing roll be retested by the Geosynthetics CQA Laboratory with the Manufacturer's technical representative present during the test procedure. If the retest fails or if the option to retest is not exercised, then two isolation conformance samples shall be obtained by the CQA Consultant. These isolation samples shall be taken from rolls, which have been determined by correlation with the manufacturer's roll number, to have been manufactured prior to and after the failing roll. This method for choosing isolation rolls for testing should continue until passing tests are achieved. All rolls that fall numerically between the passing roll numbers shall be rejected. The CQA Consultant will verify that the Contractor has replaced all rejected rolls. The CQA Consultant shall document all actions taken in conjunction with geomembrane conformance failures.

6.5 Anchor Trench

The CQA Consultant shall verify and document that the anchor trench has been constructed as indicated in the Construction Drawings. The amount of anchor trench open at any time shall be limited to one day of geomembrane installation capacity. The anchor trench shall be constructed with proper drainage to prevent ponding.

Geosynthetic materials in the anchor trench shall be temporarily anchored with sand bags or other suitable methods approved by the CQA Consultant. The anchor trench shall be backfilled with suitable material as indicated in the Construction Drawings and Technical Specifications as soon as possible after all geosynthetics are installed. In-place moisture/density by nuclear methods testing of the compacted anchor trench backfill shall be performed at a frequency of one per 100 lineal feet of anchor trench.

The anchor trench shall be constructed with a slightly rounded corner where the geosynthetics enter the trench. No loose soil shall be allowed to underlie the geosynthetics in the anchor trench. The CQA Consultant shall verify that all temporary ballast (i.e., sandbags) and deleterious materials are removed from the anchor trench prior to backfilling. Backfilling of the anchor trench shall be performed when the geomembrane is in its most contracted state to prevent stress inducement and using extreme care to prevent any damage to the geosynthetic materials.

6.6 Geomembrane Placement

6.6.1 Field Panel Identification

A field panel is a piece of geomembrane larger than approximately 10 ft^2, which is to be seamed in the field, i.e., a field panel is a roll or a portion of roll cut in the field. The CQA Consultant shall assure that each field panel is given an "identification code" (number or letter-number) consistent with the as-built layout plan. This identification code shall be agreed upon by the Installer and CQA Consultant. This field panel identification code shall be as simple and logical as possible. The geosynthetic Manufacturer's roll numbers shall be traceable to the field panel identification code.

The CQA Consultant shall document the correspondence between roll numbers, factory panels, and field panel identification codes. The field panel identification code shall be used for all quality assurance/quality control records.

6.6.2 Field Panel Placement

The CQA Consultant shall monitor that field panels are installed substantially at the location indicated in the Installer's layout plan, as approved or modified. The CQA Consultant shall record the field panel identification code, Manufacturer’s roll number, location, date of installation, time of installation, and dimensions of each field panel.

Geomembrane placement shall not proceed at an ambient temperature below 40°F or above 104°F unless authorized by the Design Engineer. Geomembrane placement shall not proceed during any precipitation, in the presence of excessive moisture (e.g., fog, dew), in an area of ponded water, or in the presence of excessive winds. The CQA Consultant shall monitor that the above conditions are fulfilled and that the supporting soil has not been damaged by adverse weather conditions.

The CQA Consultant shall monitor geomembrane deployment for the following:

- any equipment used does not damage the geomembrane by handling, trafficking, excessive heat, leakage of hydrocarbons or other means;

- the prepared surface underlying the geomembrane has not deteriorated since previous acceptance, and is still acceptable immediately prior to geomembrane placement;

- any geosynthetic elements immediately underlying the geomembrane are clean and free of foreign objects or debris;

- all personnel working on the geomembrane do not smoke, wear damaging shoes, or engage in other activities which could damage the geomembrane;

- the method used to unroll the panels does not cause scratches or crimps in the geomembrane and does not damage the supporting soil;

- the method used to place the panels minimizes wrinkles (especially differential wrinkles between adjacent panels);

- adequate temporary loading and/or anchoring (e.g., sand bags, tires), not likely to damage the geomembrane, has been placed to prevent uplift by wind (in case of high winds, continuous loading, e.g., by adjacent sand bags, is recommended along edges of panels to minimize risk of wind flow under the panels); and

- direct contact with the geomembrane is minimized; i.e., the geomembrane is protected by geotextiles, extra geomembrane, or other suitable materials, in areas where excessive traffic may be expected.

The CQA Consultant shall observe the geomembrane panels, after placement and prior to seaming, for damage. The CQA Site Manager shall advise the Construction Manager which panels, or portions of panels, should be rejected, repaired, or accepted. Damaged panels or portions of damaged panels that have been rejected shall be marked and their removal from the work area recorded by the CQA Consultant. Repairs shall be made according to procedures described in this Section.

6.7 Field Panel Seaming

6.7.1 Panel Layout

The CQA Consultant shall review the panel layout drawing previously submitted to the Construction Manager by the Installer and verify that it is consistent with accepted state of practice. In general, seams should be oriented parallel to the line of maximum slope, i.e., oriented along, not across, the slope. In corners and odd-shaped geometric locations, the number of seams should be minimized. No horizontal seam should be less than 10 ft beyond the toe or shoulder of the slope, or areas of potential stress concentrations, unless otherwise authorized by the Design Engineer. A seam numbering system compatible with the field panel identification numbering system shall be agreed upon prior to any seaming.

6.7.2 Seaming Equipment and Products

Approved processes for field seaming are extrusion welding and fusion welding. Proposed alternate processes shall be documented and submitted to the Construction Manager for approval. Only equipment which has been specifically recommended by the geosynthetics Manufacturer by make and model shall be used. All seaming equipment shall be permanently marked with an identification number.

6.7.2.1 Fusion Process

The fusion-welding apparatus must be automated, self-propelled devices. The fusion-welding apparatus shall be equipped with gauges giving the applicable temperatures and welding speed. The CQA Consultant shall monitor ambient temperatures, geomembrane surface temperatures, apparatus speed, and apparatus temperatures at appropriate intervals.

The CQA Consultant shall also monitor that:

- the number of spare operable seaming apparatus agreed by the Construction Manager are maintained on site;

- equipment used for seaming will not damage the geomembrane;

- the seaming zone is dry and clean;

- there is sufficient overlap between panels;

- the electric generator is placed on a smooth base such that no damage occurs to the geomembrane;

- for cross seams, the edge of the cross seam is ground to a smooth incline (top and bottom) prior to welding;

- an insulating material is placed beneath the hot welding apparatus after usage; and

- a movable protective layer is used, as necessary, directly below each overlap of geomembrane that is to be seamed to prevent build-up of moisture between the sheets.

6.7.2.2 Extrusion Process

The extrusion-welding apparatus shall be equipped with gauges giving the temperature in the apparatus and at the nozzle. The CQA Consultant shall verify that the extrudate is comprised of the same resin as the geomembrane sheeting. The CQA Consultant shall monitor extrudate temperatures, ambient temperatures, and geomembrane surface temperatures at appropriate intervals.

The CQA Consultant shall also monitor that:

- the number of spare operable seaming apparatus agreed by the Construction Manager are maintained on site;

- equipment used for seaming is not likely to damage the geomembrane;

- the seaming zone is dry and clean;

- the extruder is purged prior to beginning a seam until all heat-degraded extrudate has been removed from the barrel;

- the electric generator is placed on a smooth base such that no damage occurs to the geomembrane; and

- an insulating material is placed beneath the hot welding apparatus after usage.

6.7.3 Seam Preparation

The CQA Consultant shall monitor that:

- prior to seaming, the seam area is clean and free of moisture, dust, dirt, debris of any kind, and foreign material;
- seams are overlapped a minimum of 4 inches;
- if seam overlap grinding is required, the process is completed according to the geosynthetics Manufacturer's instructions or Section 02770 of the Technical Specifications, whichever is the more stringent, prior to the seaming operation, and in a way that does not damage the geomembrane;
- the grind depth shall not exceed 10 percent of the geomembrane thickness;
- grinding marks shall not appear beyond the extrudate after it is placed; and
- seams are aligned with the fewest possible number of wrinkles and "fishmouths".

6.7.4 Weather Conditions for Seaming

The normally required weather conditions for seaming are as follows:

- Unless authorized by the Design Engineer, no seaming shall be attempted at an ambient temperature below 40°F or above 104°F.
- Between ambient temperatures of 40°F and 50°F, seaming is possible if the geomembrane is preheated by either sun or hot air device, and if there is no cooling of the geomembrane to below 50°F resulting from wind.
- In all cases, the geomembrane seam areas shall be dry and protected from rain and wind.

The CQA Consultant shall verify that methods used by the Installer for seaming at ambient temperatures below 40°F or above 104°F will produce seams that are entirely equivalent to seams produced at ambient temperatures between 40°F and 104°F and protect the overall quality of the geomembrane. The CQA Consultant shall monitor that seaming conducted during abnormal weather conditions is performed in accordance with the methods approved by the Design Engineer.

6.7.5 Overlapping and Temporary Bonding

The CQA Consultant shall monitor that:

- the panels of geomembrane have a finished overlap of a minimum of 4 in. for both extrusion and fusion welding, but in any event sufficient overlap shall be provided to allow peel tests to be performed on the seam;
- no solvent or adhesive is used; and
- the procedure used to temporarily bond adjacent panels together does not damage the geomembrane; in particular, the temperature of hot air at the nozzle of any spot welding apparatus is controlled such that the geomembrane is not damaged.

6.7.6 Trial Seams

The CQA Consultant shall verify that the Installer performs trial seam tests in accordance with Section 02770 of the Technical Specifications. The CQA Consultant shall observe and document the Installer's trial seam testing procedures. The trial seam samples shall be assigned an identification number and marked accordingly by the CQA Consultant. Each sample shall be marked with the date, time, machine temperature(s) and setting(s), number of seaming unit, and name of seaming technician. Trial seam samples shall be maintained until destructive seam testing of the applicable seams are tested and pass.

6.7.7 General Seaming Procedures

No geomembrane seaming shall be performed unless the CQA Consultant is on-site. The CQA Consultant shall monitor the general seaming procedure used by the installer as follows:

- If required for fusion welding, a movable protective layer of plastic will be placed directly below each overlap of geomembrane that is to be seamed. This is to prevent any moisture build-up between the sheets to be welded.
- If required, a firm substrate shall be provided by using a flat board, a conveyor belt, or similar hard surface directly under the seam overlap to achieve proper support.

- Fishmouths or wrinkles at the seam overlaps shall be cut along the ridge of the wrinkle in order to achieve a flat overlap. The cut fishmouths or wrinkles shall be seamed and any portion where the overlap is inadequate shall then be patched with an oval or round patch of the same geomembrane extending a minimum of 6 in. beyond the cut in all directions.

- If seaming operations are carried out at night, adequate illumination shall be provided by the Contractor/Installer to the satisfaction of the CQA Consultant.

- Seaming shall extend to the outside edge of panels to be placed in the anchor trench.

6.7.8 Nondestructive Seam Continuity Testing

The CQA Consultant shall monitor that the Installer shall nondestructively test all field seams over their full length using a vacuum test unit or air pressure test (for double fusion seams only). Spark testing will be performed if the seam cannot be tested using the vacuum or air pressure test methods. The purpose of nondestructive tests is to check the continuity of seams. Continuity testing shall be carried out as the seaming work progresses, not at the completion of all field seaming. The CQA Consultant shall:

- monitor nondestructive testing;

- document the results of the nondestructive testing; and

- inform the Contractor and Construction Manager of any noncompliance.

Any required seam repairs shall be made in accordance with the Technical Specifications. The CQA Consultant shall:

- observe the repair procedures;

- observe the retesting procedures; and

- document the results.

The seam number, date of observation, dimensions and/or descriptive location of the seam length tested, name of person performing the test, and outcome of the test shall be recorded by the CQA Consultant.

6.7.9 Destructive Testing

Destructive seam testing shall be performed during the geomembrane installation. The purpose of this testing is to evaluate seam strength. Destructive seam testing shall be done as the seaming work progresses, not at the completion of all field seaming.

6.7.9.1 Location and Frequency

The CQA Consultant shall select all destructive seam test sample locations. Sample locations shall be established as follows.

- A minimum frequency of one test location per 500 ft of seam length. This minimum frequency is to be determined as an average taken throughout the entire facility. This minimum frequency will be decreased for seams made outside the normal ambient temperature range of 40^{o}F to 104^{o}F.

- Test locations shall be determined during seaming at the CQA Consultant's discretion. Selection of such locations may be prompted by suspicion of excess crystallinity, contamination, offset welds, or any other potential cause of imperfect welding.

The Installer shall not be informed in advance of the locations where the seam samples will be taken.

6.7.9.2 Sampling Procedures

Destructive seam testing shall be performed as the seaming progresses in order to obtain the Geosynthetic CQA Laboratory test results before the geomembrane is covered by overlying materials. The CQA Consultant shall:

- observe sample cutting;

- assign a number to each sample, and mark it accordingly; and

- record sample location on geomembrane panel layout drawing.

All holes in the geomembrane resulting from destructive seam test sampling shall be immediately repaired in accordance with repair procedures described in Section 02770 of the Technical Specifications. The continuity of the new seams in the repaired area shall be nondestructively tested as described in this Section.

6.7.9.3 Size of Samples

At a given sampling location, two types of samples (field test samples and laboratory test samples) shall be taken. First, a minimum of two field samples or test strips should be taken for field testing. Each of these test strips shall be 1 in. wide by 12 in. long, with the seam centered parallel to the width. The distance between these two specimens shall be 42 in. If both specimens pass the field test described in this Section, a second full laboratory destructive sample shall be taken for testing by the Geosynthetics CQA Laboratory.

The full destructive sample shall be located between the two field test strips. The sample shall be 12 in. wide by 42 in. long with the seam centered lengthwise. The sample shall be cut into three parts and distributed as follows:

- one 12 in. by 12 in. portion to the Installer;
- one 12 in. by 12 in. portion to the Construction Manager for archive storage; and
- one 12 in. by 18 in. portion for Geosynthetics CQA Laboratory testing.

6.7.9.4 Field Testing

The test strips shall be tested in the field, for peel adhesion, using a gauged tensiometer. In addition to meeting the strength requirements outlined in Appendix B, all specimens shall exhibit a Film Tear Bond and shall not fail in the weld. If any field test sample fails to meet these requirements, the destructive sample has failed.

The CQA Consultant shall witness all field tests and mark all samples and portions with their number. The CQA Consultant shall also log the date, number of seaming unit, seaming technician identification, destructive sampling, and pass or fail description.

6.7.9.5 Geosynthetics CQA Laboratory Testing

Destructive test samples shall be tested by the Geosynthetics CQA Laboratory. Testing shall include "Bonded Seam Strength" and "Peel Adhesion" (ASTM D 6392). The minimum acceptable values to be obtained in these tests are presented in Appendix B. At least five specimens shall be tested for each test method. Specimens shall be selected alternately by test from the samples (i.e., peel, shear, peel, shear...). Both the inside and outside tracks of the double track fusion seams shall be tested for peel adhesion. A passing test shall meet the minimum required values in at least four out of five specimens.

The Geosynthetics CQA Laboratory shall provide test results no more than 24 hours after they receive the samples. The CQA Site Manager shall review laboratory test results as soon as they become available, and make appropriate recommendations to the Construction Manager.

6.7.9.6 Procedures for Destructive Test Failure

The following procedures shall apply whenever a sample fails a destructive test, whether that test was conducted in the field or by the Geosynthetics CQA Laboratory. The CQA Consultant will monitor that the Installer follows one of the two options below:

- The Installer can reconstruct the seam (e.g., remove the old seam and re-seam) between any two passed destructive test locations or between points judged by the CQA Consultant to represent conditions of the failed seam (e.g., a tie-in seam or a seam made by the apparatus and/or operator used in the failing seam);or

- The Installer can trace the welding path to an intermediate location a minimum of 10 ft from the point of the failed test in each direction and take a small sample for additional field testing in accordance with the destructive test procedure at each location. If these additional isolation samples pass the field test, then full laboratory samples are taken at both locations. If these laboratory samples meet the specified strength criteria, then the seam is reconstructed between these locations. If either sample fails, then the process is repeated to establish the zone in which the seam should be reconstructed or repaired.

All failed seams must be bounded by two locations from which samples passing laboratory destructive tests have been taken or the entire seam is reconstructed and retested. In cases exceeding 150 ft of reconstructed seam, a sample taken from the zone in which the seam has been reconstructed must pass destructive testing. Repairs shall be made in accordance with this section. The CQA Consultant shall document all actions taken in conjunction with destructive test failures.

6.8 <u>Defects and Repairs</u>

6.8.1 Identification

All seams and non-seam areas of the geomembrane shall be examined by the CQA Consultant for identification of defects, holes, blisters, undispersed raw materials and any sign of contamination by foreign matter. Because light reflected by the geomembrane helps to detect defects, the surface of the geomembrane shall be clean at the time of examination. The Construction Manager shall require the geomembrane surface to be broomed or washed by the Contractor if the amount of dust or mud inhibits examination.

6.9 Repair Procedures

Any portion of the geomembrane exhibiting a flaw, or failing a destructive or nondestructive test, shall be repaired by the geosynthetics Installer in accordance with Section 02770 of the Technical Specifications. Several procedures exist for the repair of these areas. The final decision as to the appropriate repair procedure shall be agreed upon between the Installer and CQA Consultant.

In addition, the following conditions shall be monitored by the CQA Consultant:

- surfaces of the geomembrane which are to be repaired shall be abraded no more than one hour prior to the repair;
- all surfaces must be clean and dry at the time of the repair;
- all seaming equipment used in repairing procedures must be approved;
- the repair procedures, materials, and techniques shall be approved by the CQA Consultant in advance of the specific repair;
- patches or caps shall extend at least 6 in. beyond the edge of the defect, and all corners of patches shall be rounded with a radius of at least 3 in.; and
- the geomembrane below large caps should be appropriately cut to avoid water or gas collection between the two sheets.

6.9.1 Verification of Repairs

Each repair shall be numbered and logged. Each repair shall be non-destructively tested using approved methods. Repairs which pass the non-destructive test shall be taken as an indication of an adequate repair. Large caps may be of sufficient extent to require destructive test sampling, at the discretion of the CQA Consultant or as specified in Table 6-2. The CQA Consultant shall observe all non-destructive testing of repairs and shall record the number of each repair, date, and test outcome.

6.10 Liner and Cap System Acceptance

The Contractor shall retain all responsibility for the geosynthetics until acceptance by the Construction Manager. The terms for the liner and cover system acceptance are described in Section 02770 of the Technical Specifications.

6.11 Materials in Contact with the Geomembrane

The procedures outlined in this section are intended to assure that the installation of materials in contact with the geomembrane do not cause damage. Additional quality assurance and quality control procedures are necessary to assure that systems built with these materials will be constructed in such a way to ensure proper performance.

6.11.1 Soils

The CQA Consultant shall monitor that the Contractor takes all necessary precautions to ensure that the geomembrane is not damaged during its installation, during the installation of other components of the liner and the final cover systems, or by other construction activities. The CQA Consultant shall monitor the following:

- placement of protective soil materials above the geomembrane which shall not proceed at an ambient temperature below 40°F or above 104°F unless otherwise approved by the Construction Manager;

- soil placement operations above the geomembrane shall be performed by the Contractor to minimize wrinkles in the geomembrane;

- equipment used for placing soil shall not be driven directly on the geomembrane;

- a minimum soil thickness of 1 ft is maintained between a light, track-mounted dozer (e.g., having a maximum ground pressure of 5 psi) and the geomembrane;

- a minimum soil thickness of 3 ft is maintained between rubber-tired vehicles and the geomembrane; and

- soil thickness shall be greater than 3 ft in heavily trafficked areas such as access ramps.

6.11.2 Appurtenances

The CQA Consultant shall monitor that:

- installation of the geomembrane in appurtenant areas, and connection of geomembrane to appurtenances have been made in accordance with the Construction Drawings and Technical Specifications;

- extreme care is taken by the Installer when seaming around appurtenances since neither non-destructive nor destructive testing may be feasible in these areas; and

- the geomembrane has not been visibly damaged when making connections to appurtenances.

TABLE 6-1

GEOMEMBRANE CONFORMANCE TESTING REQUIREMENTS

TEST NAME	TEST METHOD	MINIMUM TESTING FREQUENCY (1)
Specific Gravity	ASTM D 792 Method B or ASTM D 1505	1 test per 100,000 ft^2
Thickness	ASTM D 5199 or D 5994	1 test per 100,000 ft^2
Tensile Strength at Yield	ASTM D 6693	1 test per 100,000 ft^2
Tensile Strength at Break	ASTM D 6693	1 test per 100,000 ft^2
Elongation at Yield	ASTM D 6693	1 test per 100,000 ft^2
Elongation at Break	ASTM D 6693	1 test per 100,000 ft^2
Carbon Black Content	ASTM D 1603 or D 4218	1 test per 100,000 ft^2
Carbon Black Dispersion	ASTM D 5596	1 test per 100,000 ft^2
Interface Shear Strength	ASTM D 5321	1 sandwich test per cell

Note:

At least one test shall be performed for each resin lot. A resin lot shall be as defined by ASTM D 4354.

TABLE 6-2

GEOMEMBRANE SEAM TESTING REQUIREMENTS

TEST NAME	TEST METHOD	MINIMUM TESTING FREQUENCY
Peel Strength	ASTM D 6392 (1,3)	1 test every 500 ft
Shear Strength	ASTM D 6392 (2,3)	1 test every 500 ft
Vacuum Testing Welded Seams	—	100 percent of extrusion welds
Air Pressure Testing Welded Seams	—	100 percent of fusion welds

Notes:

1. For peel adhesion, seam separation shall not extend more than 10 percent into the seam interface. Testing shall be discontinued when the sample has visually yielded.
2. For shear tests, the sheet shall yield before failure of the seam.
3. For either test, sample failure shall be a Film Tear Bond (FTB).

7. GEOSYNTHETIC CLAY LINER

7.1 Introduction

The CQA Consultant shall perform conformance testing and shall monitor the installation of the geosynthetic clay liner (GCL) as required by Section 02780 of the Technical Specifications and this CQA Plan. The testing used to evaluate the conformance of the GCL with the requirements of the Technical Specifications shall be performed by the CQA Consultant. The testing shall be performed in accordance with the current versions of the ASTM or other applicable test procedure indicated in Table 7-1.

7.2 Transportation, Handling, and Storage

The CQA Consultant shall monitor the transportation, handling, and storage of the GCL on-site. The Construction Manager shall designate a GCL storage location. Handling of the rolls shall be performed in a competent manner such that damage does not occur to the GCL or its protective wrapping. Any protective wrapping that is damaged or stripped off the rolls shall be repaired immediately to the satisfaction of the CQA Consultant. During transportation, handling, and storage the GCL rolls will be protected from ultraviolet light exposure, precipitation or other inundation, mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions.

Upon delivery of the GCL at the site, the Contractor, Installer, and CQA Consultant shall conduct an inspection of the rolls for defects and damage. This inspection shall be conducted without unrolling the materials unless defects or damages are found or suspected. The CQA Consultant shall indicate to the Construction Manager:

- rolls, or portions thereof, which should be rejected and removed from the site because they have severe flaws; and
- rolls which include minor repairable flaws.

The CQA Consultant shall also monitor that equipment used to handle the GCL on-site is adequate and does not pose any risk of damage to the GCL when used properly.

7.3 Conformance Testing

7.3.1 Sampling Procedures

Upon delivery of the rolls of GCL, the CQA Consultant will assure that samples are removed and forwarded to the Geosynthetic CQA Laboratory for testing of conformance to both the Technical Specifications and the list of guaranteed properties provided by the Manufacturer. Conformance samples will be 3 ft long by the roll width. The CQA Consultant will mark the machine direction on the samples with a waterproof marker, and tape or otherwise secure the cut edges of the sample to eliminate the loss of the granular bentonite. The required minimum sampling frequencies are provided in Table 7-1. The rolls shall be immediately re-wrapped and replaced in their shipping trailers or in the temporary field storage area. The CQA Consultant shall mark the machine direction on the samples with an arrow and affix a label, tag, or otherwise mark each sample with the following information:

- date sampled;
- project number;
- lot/batch number and roll number;
- conformance sample number; and
- CQA personnel identification.

7.3.2 Testing Procedure

Conformance testing of the GCL materials delivered to the site will be conducted to ensure compliance with both the Technical Specifications and the Manufacturer's list of minimum average roll values. As a minimum, the GCL conformance test procedures listed in Table 7-1 shall be performed by the Geosynthetics CQA Laboratory.

7.3.3 Test Results

The CQA Consultant will examine all results from laboratory conformance testing and will report any non-conformance to the Construction Manager. The GCL conformance test results shall meet or exceed the minimum property values presented in Appendix C.

7.3.4 Conformance Test Failure

In the case of failing test results, the Contractor may request that another sample from the failing roll be retested by the Geosynthetics CQA laboratory with the Manufacturer's technical representative present during the test procedure. If the retest fails or if the option to retest is not exercised, then two isolation conformance samples shall be obtained by the CQA Consultant. These isolation samples shall be taken from rolls, which have been determined by correlation with the manufacturer's roll number, to have been manufactured prior to and after the failing roll. This method for choosing isolation rolls for testing should continue until passing tests are achieved. All rolls that fall numerically between the passing roll numbers shall be rejected. The CQA Consultant will verify that the Contractor has replaced all rejected rolls. The CQA Consultant shall document all actions taken in conjunction with GCL conformance failures.

7.4 Surface Preparation

The GCL shall not be placed on surfaces which are softened due to high water content or cracked due to desiccation. The CQA Consultant and the Installer will jointly verify that the surface on which the GCL will be installed is acceptable. The Contractor shall comply with the surface preparation and acceptance requirements identified in Section 02200 of the Technical Specifications. Additionally, the surface shall contain no loose stones and no ruts greater than 1-inch depth. The CQA Consultant shall notify the Contractor of any observed change in the supporting soil condition that may require repair work and verify that compacted soil repair work is completed in accordance with the requirements of the Technical Specifications of this CQA Plan.

7.5 Placement

The CQA Consultant shall verify that the Installer has taken all necessary precautions to protect the underlying subgrade during GCL deployment operations. The CQA Consultant shall verify that all GCL is handled in such a manner as to ensure they are not damaged in any way, and the following conditions are met:

- in the present of wind, all GCL are weighted with sandbags or the equivalent;
- GCL is kept continually under tension to minimize the presence of wrinkles;
- GCL is cut using a utility blade in a manner recommended by the Manufacturer;
- during placement, care is taken not to entrap fugitive stones or other debris under the GCL;

- the exposed GCL is protected from damage in heavily trafficked areas;
- a visual examination of the GCL is carried out over the entire surface, after installation, to assure that damaged areas, if any, are identified and repaired; and
- if a white colored GCL is used, precautions are taken against “snow blindness” of personnel.

7.6 Overlaps

The CQA Consultant shall monitor and verify the GCL overlapping procedures conform to the requirements of Section 02780 of the Technical Specifications. GCL panels shall be overlapped at a minimum of 6 inches along panel sides and a minimum of 12 inches along panel ends. Dry bentonite powder shall be applied, at a minimum rate of one pound per lineal foot, around pipe penetrations or other perforations of GCL which may be required.

7.7 Repair

The CQA Consultant shall monitor the repair of any holes or tears in the GCL or the geotextile backing. Repairs shall be made by placing a patch made from the same type GCL over the damaged area. On slopes greater than 5 percent, the patch shall overlap the edges of the hole or tear by a minimum of 2 ft in all directions. On slopes, 5 percent or flatter, the patch shall overlap the edges of the hole or tear by a minimum of 1 ft in all directions. The patch shall be secured to the satisfaction of the CQA Consultant to avoid shifting during soil placement or covering with another geosynthetic.

TABLE 7-1

GCL CONFORMANCE TESTING REQUIREMENTS

TEST NAME	TEST METHOD	MINIMUM TESTING FREQUENCY
Hydraulic Conductivity	ASTM D 5887	1 test per 200,000 ft^2

Note:

At least one test shall be performed for each lot. A lot shall be as defined by ASTM D 4354.

8. GEOTEXTILES

8.1 Introduction

The CQA Consultant shall perform conformance testing and shall monitor the installation of geotextile filters, and separators as required by Section 02720 of the Technical Specifications and this CQA Plan. The testing used to evaluate the conformance of the geotextiles with the requirements of the Technical Specifications shall be performed by the CQA Consultant. The testing shall be performed in accordance with the current versions of the ASTM or other applicable test procedure indicated in Table 8-1.

8.2 Transportation, Handling, and Storage

The CQA Consultant shall monitor the transportation, handling, and storage of the geotextile on-site. The Construction Manager shall designate a geotextile storage location. During transportation, handling, and storage, the geotextile shall be protected from ultraviolet light exposure, precipitation or other inundation, mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions.

Handling of the geotextile rolls shall be performed in a competent manner such that damage does not occur to the geotextile or to its protective wrapping. Rolls of geotextiles shall not be stacked upon one another to the extent that deformation of the core occurs or to the point where accessibility can cause damage in handling. Furthermore, geotextile rolls shall be stacked in such a way that access for conformance sampling is possible. Protective wrappings shall be removed less than one hour prior to unrolling the geotextile. After unrolling, a geotextile shall not be exposed to ultraviolet light for more than 30 calendar days.

Outdoor storage of geotextile rolls shall not exceed the Manufacturers recommendations or longer than 6 months whichever is less. For storage periods longer than 6 months a temporary enclosure shall be placed over the rolls, or they shall be moved to an enclosed facility. The location of temporary field storage shall not be in areas where water can accumulate. The rolls shall be elevated off the ground to prevent contact with ponded water.

Upon delivery at the site, the Contractor, Installer, and CQA Consultant shall conduct an inspection of the rolls for defects and damage. This inspection shall be conducted without unrolling the materials unless defects or damages are found or suspected. The CQA Consultant shall indicate to the Construction Manager:

- rolls, or portions thereof, which should be rejected and removed from the site because they have severe flaws; and
- rolls which include minor repairable flaws.

The CQA Consultant shall also monitor that equipment used to handle the geotextiles on-site is adequate and does not pose any risk of damage to the geotextiles when used properly.

8.3 Conformance Testing

8.3.1 Sampling Procedures

Samples shall be taken across the entire width of the roll and shall not include the first 3 feet. Unless otherwise specified, samples shall be 3 feet long by the roll width. The required minimum geotextile conformance sampling frequencies are provided in Table 8-1. The CQA Consultant shall mark the machine direction on the samples with an arrow and affix a label, tag, or otherwise mark each sample with the following information:

- date sampled;
- project number;
- lot/batch number and roll number;
- conformance sample number; and
- CQA personnel identification.

The geotextile rolls which are sampled shall be immediately rewrapped in their protective coverings to the satisfaction of the CQA Consultant.

8.3.2 Testing Procedure

Conformance testing of the geotextile materials delivered to the site will be conducted to ensure compliance with both the Technical Specifications and the Manufacturer's list of minimum average roll values. As a minimum, the geotextile conformance test procedures listed in Table 8-1 shall be performed by the Geosynthetics CQA Laboratory.

8.3.3 Test Results

The CQA Consultant shall review all laboratory conformance test results and verify compliance of the test results with the specification shown in Appendix D prior to deployment of the geotextiles. Any non-conformance shall be reported to the Construction Manager.

8.3.4 Conformance Test Failure

In the case of failing test results, the Contractor may request that another sample from the failing roll be retested by the Geosynthetics CQA Laboratory with the Manufacturer's technical representative present during the test procedure. If the retest fails or if the option to retest is not exercised, then two isolation conformance samples shall be obtained by the CQA Consultant. These isolation samples shall be taken from rolls, which have been determined by correlation with the Manufacturer's roll number, to have been manufactured prior to and after the failing roll. This method for choosing isolation rolls for testing should continue until passing tests are achieved. All rolls that fall numerically between the passing roll numbers shall be rejected. The CQA Consultant will verify that the Contractor has replaced all rejected rolls. The CQA Consultant shall document all actions taken in conjunction with geotextile conformance failures.

8.3.5 Placement

The CQA Consultant shall monitor the placement of all geotextiles to assure they are not damaged in any way, and the following conditions are met.

- On slopes, the geotextiles shall be securely anchored in the anchor trench and then deployed down the slope in such a manner as to continually keep the geotextile in tension.

- In the presence of wind, all geotextiles shall be weighted with sandbags or the equivalent. Such sandbags shall be installed during placement and shall remain until replaced with earth cover material.

- Trimming of the geotextiles shall be performed using only a upward cutting hook blade. Special care must be taken to protect other materials from damage which could be caused by the cutting of the geotextiles.

- The CQA Consultant shall monitor that the Installer is taking necessary precautions to prevent damage to underlying layers during placement of the geotextile.

- During placement of geotextiles, care shall be taken not to entrap stones, excessive dust, or moisture that could generate clogging of drains or filters.

- A visual examination of the geotextile shall be carried out over the entire surface, after installation, to ensure that no potentially harmful foreign objects, (e.g., stones, sharp objects, small tools, sandbags, etc.) are present.

8.4 Seams and Overlaps

All geotextile filters shall be continuously sewn (i.e., spot sewing is not allowed). Geotextiles shall be overlapped 6 in. prior to seaming. No horizontal seams shall be allowed on side slopes that are steeper than 10 horizontal to 1 vertical (i.e. seams shall be along, not across, the slope), except as part of a patch.

Sewing shall be done using polymeric thread with chemical and ultraviolet resistance properties equal to or exceeding those of the geotextile. The seams shall be sewn using a single row type "401" two-thread chain stitch. The CQA Consultant shall monitor the geotextile seaming procedures to verify that seams and overlaps are in accordance with Section 02720 of the Technical Specifications.

Geotextile separators may be overlapped a minimum of 2 feet in lieu of sewing.

8.5 Repair

The CQA Consultant shall monitor that any holes or tears in the geotextile are repaired as follows:

- On-slopes: A patch made from the same geotextile is double seamed into place (with each seam 1/4 in. to 3/4 in. apart and no closer than 1 in. from any edge) with a minimum 12-in. overlap. Should any tear exceed 50 percent of the width of the roll, that roll shall be removed from the slope and replaced.

- Non-slopes: A patch made from the same geotextile is sewn in place with a minimum of 12 in. overlap in all directions away from the repair area.

Care shall be taken to remove any soil or other material which may have penetrated the torn geotextile. The CQA Consultant shall observe all repairs and assure that any non-compliance with the above requirements is corrected.

8.6 Placement of Soil Materials

The CQA Consultant shall monitor the Contractor's placement of all materials located on top of a geotextile, to verify:

- that no damage occurs to the geotextile;
- that no shifting of the geotextile from its intended position occurs and underlying materials are not exposed or damaged;
- that excess tensile stress does not occur in the geotextile; and
- that equipment ground pressure on geotextiles overlying geomembranes does not exceed those specified in Section 02720 of the Technical Specifications.

Soil backfilling or covering of the geotextile with another geosynthetic shall be completed within 30 days. On side slopes, soil layers shall be placed over the geotextile from the bottom of the slope upward.

TABLE 8-1

GEOTEXTILE CONFORMANCE TESTING REQUIREMENTS

TEST NAME	TEST METHOD	MINIMUM TESTING FREQUENCY
Mass per Unit Area	ASTM D 5261	1 test per 100,000 ft^2
Grab Strength	ASTM D 4632 (1)	1 test per 100,000 ft^2
Trapezoidal Tear Strength	ASTM D 4533 (2)	1 test per 100,000 ft^2
Puncture Resistance	ASTM D 4833 (3)	1 test per 100,000 ft^2
Static Puncture Strength	ASTM D 6241	1 test per 100,000 ft^2
Apparent Opening Size (5)	ASTM D 4751	1 test per 200,000 ft^2
Permittivity (5)	ASTM D 4491	1 test per 200,000 ft^2

Notes:

1. Minimum value measured in machine and cross machine directions with 1 inch clamp on Constant Rate of Extension (CRE) machine.
2. Minimum value measured in machine and cross machine direction.
3. Tension testing machine with a 1.75-inch diameter ring clamp, the steel ball being replaced with 0.31-inch diameter solid steel cylinder with a flat tip centered within the ring clamp.
4. At least one test shall be performed for each lot. A lot shall be as defined by ASTM D 4354.
5. Apparent opening size and permittivity testing shall be performed for geotextile filter only.

9. GEOCOMPOSITES

9.1 Introduction

The CQA Consultant shall perform conformance testing and shall monitor the installation of the geocomposite drainage layers as required by Section 02740 of the Technical Specifications and this CQA Plan. The testing used to evaluate the conformance of the geocomposite drainage layers with the requirements of the Technical Specifications shall be performed by the CQA Consultant. The testing shall be performed in accordance with the current versions of the ASTM or other applicable test procedure indicated in Table 9-1.

9.2 Transportation, Handling and Storage

The CQA Consultant shall monitor the transportation, handling, and storage of the geocomposite on-site. The Construction Manager shall designate a geocomposite storage location. During transportation, handling, and storage, the geocomposite shall be protected from ultraviolet light exposure, precipitation or other inundation, mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions.

Handling of the geocomposite rolls shall be performed in a competent manner such that damage does not occur to the geocomposite or to its protective wrapping. Rolls of geocomposite shall not be stacked upon one another to the extent that deformation of the roll occurs or to the point where accessibility can cause damage in handling. Furthermore, geocomposite rolls shall be stacked in such a way that access for conformance sampling is possible. Protective wrappings shall be removed less than one hour prior to unrolling the geocomposite. After unrolling, a geocomposite shall not be exposed to ultraviolet light for more than 30 calendar days.

Outdoor storage of geocomposite rolls shall not exceed the Manufacturer's recommendations or longer than 6 months whichever is less. For storage periods longer than 6 months a temporary enclosure shall be placed over the rolls, or they shall be moved to an enclosed facility. The location of temporary field storage shall not be in areas where water can accumulate. The rolls shall be elevated off the ground to prevent contact with ponded water.

Upon delivery at the site, the Contractor, Installer, and CQA Consultant shall conduct an inspection of the rolls for defects and damage. This inspection shall be conducted without unrolling the materials unless defects or damages are found or suspected. The CQA Consultant shall indicate to the Construction Manager:

- rolls, or portions thereof, which should be rejected and removed from the site because they have severe flaws; and
- rolls which include minor repairable flaws.

The CQA Consultant shall also monitor that equipment used to handle the geocomposites on-site is adequate and does not pose any risk of damage to the geocomposites when used properly.

9.3 <u>Conformance Testing</u>

9.3.1 Sampling Procedures

Samples shall be taken across the entire width of the roll and shall not include the first 3 feet. Unless otherwise specified, samples shall consist of one section 3 feet long by the roll width for geonet and geocomposite testing and one section 10 feet long cut 1 foot from the edge of the geonet for testing of the unbonded geotextiles. The required minimum geocomposite conformance sampling frequencies are provided in Table 9-1. The CQA Consultant shall mark the machine direction on the samples with an arrow and affix a label, tag, or otherwise mark each sample with the following information:

- date sampled;
- project number;
- lot/batch number and roll number;
- conformance sample number; and
- CQA personnel identification.

The geocomposite rolls which are sampled shall be immediately rewrapped in their protective coverings to the satisfaction of the CQA Consultant.

9.3.2 Testing Procedure

Conformance testing of the geocomposite materials delivered to the site will be conducted to ensure compliance with both the Technical Specifications and the manufacturer's list of minimum average roll values. As a minimum, the geotextile, geonet, and geocomposite conformance test procedures listed in Table 9-1 shall be performed by the Geosynthetics CQA Laboratory.

9.3.3 Test Results

The CQA Consultant shall review all laboratory conformance test results and verify compliance of the test results with the specification shown in Appendix E prior to deployment of the geocomposites. Any non-conformance shall be reported to the Construction Manager.

9.3.4 Conformance Test Failure

In the case of failing test results, the Contractor may request that another sample from the failing roll be retested by the Geosynthetics CQA laboratory with the manufacturer's technical representative present during the test procedure. If the retest fails or if the option to retest is not exercised, then two isolation conformance samples shall be obtained by the CQA Consultant. These isolation samples shall be taken from rolls, which have been determined by correlation with the manufacturer's roll number, to have been manufactured prior to and after the failing roll. This method for choosing isolation rolls for testing should continue until passing tests are achieved. All rolls which fail numerically between the passing roll numbers shall be rejected. The CQA Consultant will verify that the Contractor has replaced all rejected rolls. The CQA Consultant shall document all actions taken in conjunction with geocomposite conformance failures.

9.4 Placement

The CQA Consultant shall monitor the placement of all geocomposites to assure they are not damaged in any way, and the following conditions are met.

- On slopes, the geocomposites shall be securely anchored in the anchor trench and then deployed down the slope in such a manner as to continually keep the geocomposites in tension.

- In the presence of wind, all geocomposites shall be weighted with sandbags or the equivalent. Such sandbags shall be installed during placement and shall remain until replaced with earth cover material.

- Trimming of the geocomposites shall be performed using only a upward cutting hook blade. Special care must be taken to protect other materials from damage which could be caused by the cutting of the geocomposites.

- The CQA Consultant shall monitor that the Installer is taking necessary precautions to prevent damage to underlying layers during placement of the geocomposite.

- During placement of geocomposites, care shall be taken not to entrap stones, soil, excessive dust, or moisture that could damage the geomembrane, generate clogging of drains or filters, or hamper subsequent drainage operations.

- A visual examination of the geocomposite shall be carried out over the entire surface, after installation, to ensure that no potentially harmful foreign objects, (e.g., stones, sharp objects, small tools, sandbags, etc.) are present.

9.5 Joining, Seams, and Overlaps

The components of the geocomposite (e.g., geotextile, geotextile) shall be seamed, joined, and overlapped to like components in adjacent geocomposites. Lower geotextile components of the geocomposites shall be overlapped such that the component has a minimum overlap of four inches. Adjacent edges of geonet component along the length of the geocomposite should be overlapped a minimum 2-3 inches and joined by tying the geonet together with white or yellow plastic fasteners or polymeric thread. Geonet for adjoining geocomposite panels (end to end) along the roll width should be shingled down in direction of slope and overlapped a minimum of 12 inches. Upper geotextile components of the geocomposites shall be continuously sewn (i.e., spot sewing is not allowed). Geotextiles shall be overlapped 6 in. prior to sewing. No horizontal seams shall be allowed on side slopes that are steeper than 10 horizontal to 1 vertical (i.e. seams shall be along, not across, the slope), except as part of a patch.

Sewing of geotextiles shall be done using polymeric thread with chemical and ultraviolet resistance properties equal to or exceeding those of the geotextile. The seams shall be sewn using a single row type "401" two-thread chain stitch. The CQA Consultant shall monitor the geotextile seaming and geonet tying procedures to verify that joining, seams, and overlaps are in accordance with Section 02740 of the Technical Specifications.

9.6 Repair

The CQA Consultant shall monitor that any holes or tears in the geocomposite are repaired as follows:

- A patch made from the same geocomposite will be secured into place by tying fasteners through the bottom geotextile and the geonet of the patch, and through the top geotextile and geonet.

- The patch will extend 2 feet beyond the edges of the hole or tear.

- The patch will be secured every 6 inches and heat sealed to the top geotextile of the geocomposite needing repair.

- If the hole or tear is more than 50 percent of the width of the roll, the damaged area should be cut out and the two portions of the geocomposite will be joined.

Care will be taken to remove any soil or other material which may have penetrated the torn geocomposite component. The CQA Consultant shall observe any repair and assure that any non-compliance with the above requirements is corrected.

9.7 Placement of Soil Materials

The CQA Consultant shall monitor the Contractor's placement of all soil materials located on top of a geocomposite, to verify:

- that no damage occurs to the geocomposite;
- that no shifting of the geocomposite from its intended position occurs and underlying materials are not exposed or damaged;
- that excess tensile stress does not occur in the geocomposite; and
- that equipment ground pressure on geocomposites overlying geomembranes does not exceed those specified in Section 02740 of the Technical Specifications.

Soil backfilling or covering of the geocomposite shall be completed within 30 days. On side slopes soil layers shall be placed over the geocomposite from the bottom of the slope upward.

TABLE 9-1

GEOCOMPOSITE CONFORMANCE TESTING REQUIREMENTS

TEST NAME	TEST METHOD	MINIMUM TESTING FREQUENCY (3)
Geotextile Components		
Mass per Unit Area	ASTM D 5261	1 test per 200,000 ft^2
Grab Strength	ASTM D 4632 (1)	1 test per 200,000 ft^2
Trapezoidal Tear Strength	ASTM D 4533 (2)	1 test per 200,000 ft^2
Apparent Opening Size	ASTM D 4751	1 test per 500,000 ft^2
Permittivity	ASTM D 4491	1 test per 500,000 ft^2
Geocomposite		
Transmissivity (4)	ASTM D 4716	1 test per 200,000 ft^2
Ply Adhesion	ASTM D 7005	1 test per 200,000 ft^2
Interface Shear Strength	ASTM D 5321	1 sandwich test per cell

Notes:

1. Minimum value measured in machine and cross machine directions with 1 inch clamp on Constant Rate of Extension (CRE) machine.
2. Minimum value measured in machine and cross machine direction.
3. At least one test shall be performed for each lot. A lot is defined by ASTM 4354.
4. The design transmissivity is the hydraulic transmissivity of the geocomposite measured using water (at 68°F ± 3°F) at a hydraulic gradient, compressive stress, and boundary conditions as described in the Technical Specifications. The duration of the tests shall be as noted in the Technical Specifications.

10. PIPES AND FITTINGS

10.1 Introduction

The CQA Consultant shall monitor the installation of ancillary materials such as pipes and fittings for the leachate collection and conveyance system and landfill gas management system as required by Sections 02715 of the Technical Specifications, the Construction Drawings and this CQA Plan.

10.2 Butt-Fusion Welding Process

The CQA Consultant shall monitor the assembling of lengths of HDPE pipe into suitable installation lengths by the butt-fusion process. Butt-fusion means the butt-joining of the pipe by softening the aligned faces of the pipe ends in a suitable apparatus and pressing them together under controlled pressure. Butt-fusion welding of the HDPE pipes and fittings shall be performed by the Contractor in accordance with the pipe manufacturer's recommendations as to equipment and technique.

10.3 Transportation, Handling, and Storage

The pipe is to be bundled together with plastic straps for bulk handling and shipment. The packing shall be such that either fork lifts or cranes equipped with slings can be used for safe handling. The pipe shall be segregated by wall thickness and diameter.

The CQA Consultant shall monitor the offloading of the pipe to assure that handling is done in a competent manner and that the pipes are not placed in areas where water can accumulate. The pipe shall not be stacked more then three high or in such a manner that could cause damage to the pipe. Furthermore, the pipe shall be stacked in such a manner that access for any conformance sampling is possible. Outdoor storage should be no longer than 12 months. For outdoor storage periods longer than 12 months a temporary covering shall be placed over the pipes, or they shall be moved to within an enclosed facility.

10.4 Installation

The CQA Consultant shall monitor that care is taken during installation of the pipes such that they will not be cut, kinked, or otherwise damaged. Ropes, fabric, or rubber-protected slings and straps shall be used by the Contractor when installing pipes. The use of chains, cables, or hooks inserted into the pipe ends shall not be allowed.

The Contractor shall install the pipe and fittings in such a manner that the materials are not damaged. Slings for handling the pipe shall not be positioned at butt-fused joints of HDPE pipes. Sections of the pipes with deep cuts and/or gouges shall be removed and the ends of the pipeline rejoined. Care shall be exercised when lowering pipe into the trench to prevent damage or twisting of the pipe.

10.5 Testing

The CQA Consultant shall monitor the testing of all pipes as required by the Technical Specifications and as necessary to assure workmanship conforming the state-of-practice.

11. MECHANICAL AND ELECTRICAL

11.1 Introduction

The CQA Consultant shall monitor the materials used in and installation of all mechanical and electrical systems to assure compliance with the Technical Specifications and approved submittals. The mechanical and electrical systems include, but are not limited to, the following:

- leachate sump pumps and associated connections and wiring;
- overhead/buried power distribution system, power wiring, including power circuit connections for pump motors, and equipment mounting boards; and
- temporary support facilities for electric, water, and sanitary sewer services.

11.2 Related Construction Drawings and Technical Specifications

The mechanical work performed by the Contractor shall comply with the Construction Drawings, Technical Specifications, and approved submittals. These specifications shall be referenced for specific details of the mechanical equipment requirements and installation. The electrical work performed by the Contractor shall comply with Construction Drawings, Technical Specifications, and approved submittals. These specifications shall be referenced for specific details of the electrical requirements and installation.

11.3 Codes, Rules, Inspections, and Workmanship

The CQA Consultant shall monitor the work of the Contractor in the installation of all mechanical and electrical appurtenances in accordance with national codes and other regulations or authorities having jurisdiction over the work. The CQA Consultant shall observe and document construction acceptance testing procedures performed by the Contractor.

11.4 Record Drawings

The CQA Consultant shall monitor the maintenance by the Contractor of a set of prints on which the actual installation of all mechanical and electrical work shall be accurately shown, indicating any variation from Construction Drawings or approved submittals. Changes in layout or circuitry shall be clearly and completely indicated as the work progresses. These progress prints shall be inspected by the Design Engineer and Construction Manager and used to determine the progress of mechanical and electrical work.

At the completion each phase of the work, the CQA consultant shall obtain from the Contractor a set of record drawings of the work to include marked-up prints showing the dimensioned location of all underground systems.

12. CONCRETE

12.1 Introduction

This CQA Consultant shall monitor the construction and perform conformance testing of all concrete materials and finished products to assure compliance with Construction Drawings and Technical Specifications.

12.2 Inspections

The CQA Consultant shall monitor concrete workmanship to assure that the Contractor does not place concrete until foundations, forms, reinforcing steel, pipes, conduits, sleeves, anchors, hangers, inserts, and other work required to be built into concrete has been inspected and approved by the Construction Manager. The Contractor is required to notify the Construction Manager and CQA Consultant at least 24 hours in advance of concrete placement activities for scheduling of the inspection activities described above.

12.3 Field Quality Control Testing

Conformance testing of placed concrete shall be the responsibility of the CQA Consultant. The concrete test program shall meet the following requirements:

- Concrete samples will be obtained by the CQA Consultant at a frequency of one set of standard cylindrical test specimens for the first 5 cubic yards and every 25 cubic yards of concrete or any portion of thereafter for each structure. For each work shift, when concrete is delivered, at least one set of specimens will be made. A set of test specimens will consist of at least three standard cylinders. Each set of test specimens will be tested for 2-day, 7-day, and 28-day compressive strength, and a fourth cylinder will be held in reserve.

- Compressive strengths shall be determined from the standard test specimens taken according to ASTM C 31 and ASTM C 172, and cured and tested in accordance with ASTM C 39. Core drilling, if required, and testing will be in accordance with ASTM C 94.

- If required by the Engineer, slump and air content shall be determined with no less frequency than that of casting strength specimen sets. Air content and slump shall be determined in accordance with ASTM C 231 and ASTM C 143, respectively.

The CQA Consultant shall be responsible for reporting all test results to the Contractor and the Construction Manager. Materials determined by the Construction Manager to fail the requirements of the Construction Drawings and Technical Specifications shall be rejected.

13. ROAD CONSTRUCTION

13.1 Introduction

The CQA Consultant shall monitor and test materials used in the construction of the various roads to assure compliance with Construction Drawings and Technical Specifications.

13.2 Subgrade Preparation

In-place moisture/density testing by nuclear methods (ASTM D 3017 and D 2922) shall be performed by the CQA Consultant for all compacted fill materials. Fill placement and compaction shall be conducted in accordance with Section 02200 of the Technical Specifications. For road subgrades, nuclear moisture/density tests shall be performed at a minimum frequency of 1 test per 200 lineal ft per lift. The CQA Consultant shall monitor the Contractor's proof rolling of cut sections.

13.3 Subbase Layer

The CQA Consultant shall monitor and test the subbase layer to ensure it is constructed to the thickness grades and density as required by the Construction Drawings and the Technical Specifications. Moisture/density tests shall be performed at a minimum frequency of 1 test per 200 lineal feet per lift.

13.4 Base Layer

The CQA Consultant shall monitor the base aggregate to ensure it is constructed to the thickness, grades, and limits shown on the Construction Drawings. The CQA Consultant shall monitor the test section required in Section 02230 of the Technical Specifications.

13.5 Quality Control Testing

Quality control testing of the materials used in construction of the roads shall be the responsibility of the CQA Consultant. The frequency of CQA testing for the subbase aggregate and base aggregate materials is as follows:

- particle size analysis (ASTM C136) at a frequency of one test per 5,000 yd^3; and
- density and moisture (ASTM D 2922 and ASTM D 3017) at a frequency of one test per 300 lineal feet per lift.

Requirements for in-situ density of base aggregates shall be defined during the compaction of a test strip. The base aggregate shall be compacted in accordance with the requirements of Section 02230 of the Technical Specifications.

13.6 Repairs

If a defective area is discovered, the CQA Consultant will evaluate the extent and nature of the defect. After this determination the Contractor shall correct the deficiency to the satisfaction of the Construction Manager. The Contractor shall not perform additional work in the area until the Construction Manager approves the correction of the defect. In the event of damage, the Contractor shall immediately make repairs and replacements as necessary to the satisfaction of the Construction Manager.

14. GENERAL SITE WORK

14.1 Introduction

The CQA Consultant shall monitor the activities that are to be performed for various general site work items including, but not limited to riprap, erosion and sediment control, culverts, fences and gates, and vegetation for compliance with Construction Drawings and Technical Specifications.

14.2 Conformance Testing

Conformance testing of materials to ensure compliance with the Construction Drawings and Technical Specifications shall be performed by the CQA Consultant at the discretion of the Construction Manager. If non-conformances or other deficiencies are found by the CQA Consultant in the Contractors materials or completed work, the Contractor will be required to repair or replace the deficiency at no cost. Any noncompliant items shall be reported to the Construction Manager.

APPENDIX A

CQA FORMS AND LOG

APPENDIX B

REQUIRED GEOMEMBRANE AND SEAM PROPERTIES

TABLES 02770-1 through 02770-4
(from Technical Specification Section 02770)

APPENDIX C

REQUIRED GEOSYNTHETIC CLAY LINER PROPERTIES

TABLE 02780-1
(from Technical Specification Section 02780)

APPENDIX D

REQUIRED GEOTEXTILE FILTER AND SEPARATOR PROPERTIES

TABLES 02720-1 AND 02720-2
(from Technical Specification Section 02720)

APPENDIX E

REQUIRED GEOCOMPOSITE PROPERTIES

TABLE 02740-1

(from Technical Specification Section 02740)

APPENDIX A

CQA FORMS AND LOG

Geosyntec consultants

DAILY FIELD REPORT

PROJECT: ______________________________

LOCATION: ______________________ PROJECT NO.: __________ TASK NO.: __________

DESCRIPTION: ______________________________ Date: ______________

COPY TO: ______________________ PER: ______________________

Geosyntec
consultants

WEEKLY FIELD REPORT

PROJECT: ______________________________

LOCATION: ______________ PROJECT NO.: ________ TASK NO.: ________

DESCRIPTION: ______________ WEEK ENDING: ________

COPY TO: ______________ PER: ______________

Geosyntec
consultants

TRANSMITTAL LETTER

PROJECT: ____________________

LOCATION: ____________________ PROJECT NO.: __________ TASK NO.: ______

DESCRIPTION: ____________________ DATE: ________ day ________ month ________ year

ATTENTION: ____________________

ADDRESS: ____________________

____

☐ FOR APPROVAL
☐ FOR COMMENTS
☐ AS REQUESTED

☐ DRAWINGS
☐ PHOTOS
☐ LOGS

☐ TEST RESULTS
☐ DOCUMENTS
☐ CONTRACTS

☐ ____________
☐ ____________
☐ ____________

NO. OF COPIES	DRAWING NUMBER	DESCRIPTION	DATE

REMARKS

COPY TO: ____________________ FROM: ____________________

Geosyntec
consultants

CHANGE ORDER (CO)

REFERENCE NO.: ____________

PROJECT: ____________

LOCATION: ____________ PROJECT NO.: ________ TASK NO.: ______

DESCRIPTION: ____________ DATE: ________ day ________ month ________ year

FINANCIAL IMPACT:

☐ NOT APPLICABLE ☐ COST $ ____________ ☐ SAVINGS $ ____________

SCHEDULE IMPACT:

☐ NOT APPLICABLE ☐ DELAY EST. DAYS ____________ ☐ SAVINGS EST. DAYS ____________

REFERENCES: --

SPECIFICATION SECTION: --

CQA PLAN SECTION: --

MATERIAL TYPE: --

ITEM BEING CHANGED OR ADDED: --

REASON FOR CHANGE: --

EFFECTIVE DATE OF CHANGE: ________ day ____________ month ____________ year

FINANCIAL AND SCHEDULE CONSIDERATIONS: --

DECISION: ☐ APPROVED ☐ DENIED

OWNERS REPRESENTATIVE DATE

CQA REPRESENTATIVE DATE

PROJECT MANAGER DATE

COPY TO: --

CERTIFICATE OF ACCEPTANCE
SUBGRADE SURFACE

INSTALLER

NAME: ______________________________

ADDRESS: ______________________________

____

____

INSTALLER
AUTHORIZED
REPRESENTATIVE: ______________________

PROJECT

NAME: ______________________________

____

LOCATION: ______________________________

____

____

____

OWNER: ______________________________

I, The undersigned, duly authorized representative of ______________________________ do hereby accept the surface on which the geosynthetics will be installed and shall be responsible for maintaining the suitability of this surface, in accordance with the project specifications. (i.e., The contractor shall not install the geosynthetics until the subgrade surface is acceptable. Installation of the geosynthetics will be considered acceptance of the subgrade.)

PRIMARY: ☐ SECONDARY: ☐ OTHER: ______________________________

DATE	PANEL NOS.	SIGNATURE

Geosyntec
consultants

DESTRUCTIVE TEST LOG

PROJECT: ____________________

LOCATION: ____________________ PROJECT NO.: __________ TASK NO.: __________

DESCRIPTION: ____________________ YEAR: __________

INSTALLER: ____________________ ☐ PRIMARY ☐ SECONDARY ☐ OTHER __________

SAMPLE DISTRIBUTION: ☐ INSTALLER ☐ LABORATORY ☐ ARCHIVE ☐ OTHER __________

MINIMUM TEST REQUIREMENTS: FUSION: PEEL: __________ SHEAR: __________ ☐ ppi

EXTRUSION: PEEL: __________ SHEAR: __________ ☐ psi

SAMPLE DATA							FIELD DATA							LABORATORY DATA							
D.S. NO.	TRACK[1]		LOCATION		MACHINE NO.	OPER. ID	AVG. PEEL		AVG. SHEAR	PASS	FAIL	SAMPLE DATE	QA ID	RESULT DATE	AVG. PEEL		AVG. SHEAR	PASS	FAIL	RE-TEST	QA ID
	SINGLE	DOUBLE	SEAM	DIST.			INSIDE	OUTSIDE							INSIDE	OUTSIDE					

NOTES: (1) TRACK TYPES: E = EXTRUSION F = FUSION

Blank - Destructive Test Log.xls

REVIEWED BY: _______

SHEET _____ OF _____

Geosyntec consultants

MATERIAL INVENTORY

PROJECT: ____________________

LOCATION: ____________________ PROJECT NO.: __________ TASK NO.: ______

DESCRIPTION: ____________________ YEAR: __________

MATERIAL TYPE: ____________________ MANUFACTURER: ____________________

INVENTORY			Q.A. CONFORMANCE					Q.C. DOCUMENTS				
DATE	BATCH / ROLL NUMBER	QA ID	DATE SAMPLED	SAMPLE NO.	PASS	FAIL	QA ID	DATE REC'VED	DATE CHECKED	PASS	FAIL	QA ID

AVERAGE ROLL WIDTH: __________ (ft) AVERAGE ROLL LENGTH __________ (ft)

NUMBER OF ROLLS ABOVE: __________ CUMULATIVE NUMBER OF ROLLS: __________

CUMULATIVE AREA: __________ (ft^2) NO. OF CONFORMANCE TESTS (page/total): _____/_____

COMMENTS: ____________________

____

Blank - Material Inventory.xls REVIEWED BY: ______ SHEET _____ OF _____

Geosyntec
consultants

PANEL LAYOUT DETAIL

PROJECT: ____________________

LOCATION: ____________________ PROJECT NO.: ________ TASK NO.: ______

DESCRIPTION: ____________________ YEAR: ________

INSTALLER: ____________________ PRODUCT TYPE: ____________________

☐ PRIMARY ☐ SECONDARY ☐ OTHER ____________________ QA ID: ________

NORTH

☐

Blank - Panel Layout Detail.xls REVIEWED BY: _______ SHEET _____ OF _____

Geosyntec
consultants

PANEL PLACEMENT LOG

PROJECT: ____________________

LOCATION: ____________________ PROJECT NO.: __________ TASK NO.: ______

DESCRIPTION: ____________________ YEAR: ________

PRIMARY ☐ SECONDARY ☐ OTHER: __________ PRODUCT TYPE: ______________

PANEL NO.	BATCH / ROLL NO.	DATE (day/mo)	TIME	PLACEMENT LOCATION COMMENTS	WIDTH	LENGTH	QA ID

APPROXIMATE AREA: THIS PAGE: ______________ FT^2 ACCUMULATED: ______________ FT^2

NOTES: ______________________________

____

____

Blank - Panel Placement Log.xls REVIEWED BY: _______ SHEET _____ OF _____

Geosyntec consultants

PRODUCTION SEAM SUMMARY LOG

PROJECT: ____________________

LOCATION: ____________________ PROJECT NO.: ________ TASK NO.: ________

DESCRIPTION: ____________________ YEAR: ________

PRIMARY: ☐ SECONDARY: ☐ OTHER: ____________________

NDT SPECIFICATIONS: AIR TEST: _____ psi ± _____ psi for _____ minutes VACUUM TEST: _____ psi for minimum _____ seconds

PRODUCTION SEAM				LOCATION					NONDESTRUCTIVE TEST						
DATE (day/mo)	TIME	MACHINE NO.	OPER. ID	SEAM NO.	BEGIN	END	ACTUAL SEAM LENGTH (ft)	QA ID	LOCATION (ft)	TEST DETAILS	OPER. ID	PASS	FAIL	ACTION	QA ID

TOTALS: FUSION: ____________________ (ft) CUMULATED FUSION: ____________________ (ft)

EXTRUSION: ____________________ (ft) CUMULATED EXTRUSION: ____________________ (ft)

COMMENTS: ____________________

Blank - Production Seam Summary Log.xls REVIEWED BY: ______ SHEET _____ OF _____

Geosyntec
consultants

REPAIR SUMMARY LOG

PROJECT: ____________________

LOCATION: ____________________ PROJECT NO.: ________ TASK NO.: ________

DESCRIPTION: ____________________ YEAR: ________

INSTALLER: ____________________ ☐ PRIMARY ☐ SECONDARY ☐ OTHER ________

REPAIR NO./ CODE[1]	REP. TYPE[3]	DATE	LOCATION[2]				SIZE[2]			WELDER ID		QA ID	NON-DESTRUCTIVE TESTING					
			SEAM	PANEL	DIST.	OFFSET	LENGTH	WIDTH	DIA.	MACH. NO.	OP. ID		DATE	OP. ID	PASS	FAIL	ACTION	QA ID

NOTES: (1) REPAIR NUMBERS SHALL BE NUMBERED SEQUENTIALLY, REPAIR CODES: P = PATCH C = CAP S = ANCHOR TRENCH EXTENSION (SKIRT) DS = DESTRUCTIVE SAMPLE G = GRIND & WELD T = TOPPING ALONG FUSION SEAM R = RECONSTRUCTION (2) LOCATION & SIZE SHALL BE INDICATED IN FEET (3) REAIR TYPES: E = EXTRUSION F = FUSION

Blank - Repair Summary Log.xls REVIEWED BY: ______ SHEET _____ OF _____

Geosyntec
consultants

TRIAL SEAM LOG - EXTRUSION

PROJECT: ______________________________

LOCATION: ______________________________ PROJECT NO.: __________ TASK NO.: ______

DESCRIPTION: ______________________________ YEAR: __________

SPECIFICATIONS: PEEL: ________ SHEAR: ________ ☐ ppi ☐ psi

TENSIOMETER DESCRIPTION: ______________________________ SERIAL NO.: __________

TRIAL SEAM NO.	DATE (day/mo)	TIME	MACHINE NO.	OPER. ID	MAT. DESCR. (1)	PREHEAT TEMP. (°C / °F)	BARREL TEMP. (°C / °F)	PEEL	SHEAR	PASS	FAIL	RETEST NO.	QA ID

NOTE: (1) MATERIAL DESCRIPTION REFERS TO EITHER SMOOTH/SMOOTH (S/S); SMOOTH/TEXTURED (S/T); OR TEXTURED/TEXTURED (T/T).

REVIEWED BY: ______

SHEET ____ OF ____

Geosyntec
consultants

TRIAL SEAM LOG - FUSION

PROJECT: ____________________

LOCATION: ____________________ PROJECT NO.: __________ TASK NO.: ______

DESCRIPTION: ____________________ YEAR: __________

SPECIFICATIONS: PEEL: ________ SHEAR: ________ ☐ ppi ☐ psi

TENSIOMETER DESCRIPTION: ____________________ SERIAL NO.: __________

TRIAL SEAM NO.	DATE (day/mo)	TIME	MACHINE NO.	OPER. ID	MAT. DESCR. (1)	WEDGE TEMP. (°C / °F)	MACHINE SPEED SETTING	PEEL	SHEAR	PASS	FAIL	RETEST NO.	QA ID

NOTE: (1) MATERIAL DESCRIPTION REFERS TO EITHER SMOOTH/SMOOTH (S/S); SMOOTH/TEXTURED (S/T); OR TEXTURED/TEXTURED (T/T).

Blank -Trial Seam Log-Fusion.xls REVIEWED BY:______ SHEET_____OF_____

Geosyntec consultants

WASTE MANAGEMENT

DETERMINATION OF DENSITY (DRIVE CYLINDER) **(ASTM D 2937)**

PROJECT: ____________________

LOCATION: ____________________ PROJECT NO.: __________ TASK NO.: __________

DESCRIPTION: ____________________ DATE: ____ day __________ month ______ year

SOURCE: ____________________

SPECIFICATION REQUIREMENTS:

MATERIAL TYPE: FILL ☐ SUBGRADE ☐ SUBBASE ☐ CLAY ☐ OTHER: __________

% COMPACTION: ____________________ MOISTURE CONTENT RANGE: __________

TEST LOCATION: ____________________ TEST NO. __________

FIELD TEST DATA -- ASTM D2937 QA ID: __________

CYL HT 1 (IN): ______ CYL HT 2 (IN): ______ CYL DIA 1 (IN): ______ CYL DIA 2 (IN): ______

A	CYLINDER NO.: ______ VOLUME $^{(1)}$	(cf)	#DIV/0!	E	WET UNIT WEIGHT = D/A	(lbs)	#DIV/0!
B	WEIGHT OF SAMPLE & CYLINDER	(lbs)		F	DRY UNIT WEIGHT = E/(1 + (T/100)	(pcf)	#DIV/0!
C	WEIGHT OF CYLINDER	(lbs)		G	PERCENT COMPACTION = F/L	(%)	#DIV/0!
D	WEIGHT OF WET SAMPLE = B - C	(lbs)	0.00	H	PASS/FAIL		

NOTE 1. CYLINDER VOLUME IS OBTAINED BY MEASURING THE HEIGHT AND DIAMETER, OF FOUR EQUALLY SPACED POINTS, TO AN ACCURACY OF 0.01-IN., AND CALCULATING THE VOLUME USING AVERAGE HEIGHT AND DIAMETER

FIELD MOISTURE CONTENT -- ASTM D2216 QA ID: __________

O	WT. OF TARE NO. ______	(gm)		R	WT. OF WATER = P - Q	(lbs)	0.0
P	WT. OF WET SOIL & TARE	(gm)		S	WT OF DRY SOIL = Q - O	(pcf)	0.0
Q	WT. OF DRY SOIL & TARE	(gm)		T	MOISTURE CONTENT = (R/S)X100		#DIV/0!

PROCTOR TEST DATA [L] MAXIMUM DRY UNIT WT. (pcf) ______ (M) OPT. MOIST. CONTENT (%) ______

COMPARISION WITH NUCLEAR GAUGE - ASTM D 6938 QA ID: __________

U	DELTA MOISTURE CONTENT = T - X		#DIV/0!	X	FDT MOISTURE CONTENT	(%)	
V	FDT WET UNIT WT.	(pcf)		Y	FDT DRY UNIT WT.	(pcf)	
W	DELTA DRY UNIT WT. = F - Y		#DIV/0!				

COMMENTS

Geosyntec consultants

FIELD NUCLEAR MOISTURE/DENSITY TEST LOG **(ASTM D 6938)**

PROJECT: ______

LOCATION: ______ PROJECT NO.: ______ TASK NO.: ______

DESCRIPTION: ______ DATE: ______ day ______ month ______ year

SPECIFICATION REQUIREMENTS: MATERIAL SOURCE: ______

MATERIAL TYPE: ☐ FILL ☐ SUBGRADE ☐ SUBBASE ☐ CLAY ☐ OTHER: ______ MAX. LIFT THICKNESS: ______ (in.)

MINIMUM COMPACTION: ______ (%) ☐ ASTM D 698 ☐ ASTM D 1557 MOISTURE CONTENT RANGE: - ______ to + ______ of OPT.

NUCLEAR GAUGE TYPE: ______ GAUGE SERIAL NO.: ______ CORRECTION FACTOR: Y= ______

TEST NO.	TEST LOCATION	PROBE DEPTH / LIFT NO.	LABORATORY RESULTS			FIELD TEST RESULTS						RE-TEST NO.	RE-TEST	
			SAMPLE NO.	OMC (%)	MAX. DRY UNIT WT. (pcf)	FIELD MOISTURE CONTENT[1] (%)	WET UNIT WT (pcf)	DRY UNIT WT (pcf)	PERCENT COMPACT. (%)	PASS	FAIL		PASS	FAIL
		/												
		/												
		/												
		/												
		/												
		/												
		/												
		/												
		/												
		/												
		/												
		/												
		/												
		/												

NOTES: (1) FIELD MOISTURE CONTENT = GAUGE READING/CORRECTED MOISTURE

COMMENTS: ______

CHECKED BY: ______

Geosyntec
consultants

NUCLEAR GAUGE STANDARD COUNT LOG **(ASTM D 6938)**

PROJECT: ______________________________

LOCATION: ______________________ PROJECT NO.: ________ TASK NO.: ______

DESCRIPTION: ______________________________ YEAR: ________

NUCLEAR GAUGE MODEL: ______________ SERIAL NO.: ______________

DATE ARRIVED ON-SITE: ______________ DATE DEPARTED SITE: ______________

DATE OF MOST RECENT LEAK TEST: ______________________________

DATE (day/mo)	MOISTURE COUNT (≤ 2%)	DENSITY COUNT (≤ 1%)	PASS	FAIL	QA ID

DATE (day/mo)	MOISTURE COUNT (≤ 2%)	DENSITY COUNT (≤ 1%)	PASS	FAIL	QA ID

Geosyntec consultants

CONSTRUCTION QUANTITIES

PROJECT: ____________________

LOCATION: ____________________ PROJECT NO.: __________ TASK NO.: ______

DESCRIPTION: ____________________ YEAR: __________

CELL QUANTITIES: CELL AREA: __________ ft^2 0.0 acres

STRUCTURAL FILL VOLUME: __________ yd^3 NO. OF SF SOURCES: __________

CLAY LINER THICKNESS: __________ ft CLAY LINER VOLUME: 0 yd^3 NO. OF LIFTS: __________

NO. OF CL SOURCES: __________

PROTECTIVE COVER THICKNESS: __________ ft PROTECTIVE COVER VOLUME: 0 yd^3

NO. OF PC SOURCES: __________

TESTING QUANTITIES:

CLAY LINER / COMPACTED SOIL LAYER

TEST DESCRIPTION	TEST METHOD ASTM	TEST FREQUENCY		TESTS REQ. PER LIFT	TOTAL TESTS REQUIRED
		1 per	UNIT		

PROTECTIVE COVER

TEST DESCRIPTION	TEST METHOD ASTM	TEST FREQUENCY		TOTAL TESTS REQUIRED
		1 per	UNIT	

DRAINAGE AGGREGATE

TEST DESCRIPTION	TEST METHOD ASTM	TEST FREQUENCY		TOTAL TESTS REQUIRED
		1 per	UNIT	

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FIELD SAND CONE DENSITY TEST **(ASTM D 1556)**

PROJECT: ______

LOCATION: ______ PROJECT NO.: ______ TASK NO.: ______

DESCRIPTION: ______ DATE: ______ day ______ month ______ year

SPECIFICATION REQUIREMENTS:

MATERIAL TYPE: ☐ FILL ☐ SUBGRADE ☐ SUBBASE ☐ CLAY ☐ OTHER: ______

% COMPACTION: ______ MOISTURE CONTENT RANGE: - ______ to + ______ of OPT.

TEST LOCATION: ______ TEST NO.: ______

FIELD TEST DATA - ASTM D 1556

QA ID: ______

A	BULK UNIT WT. OF SAND[1]	(pcf)		H	WT. OF WET SOIL & TARE FROM HOLE	(lbs)	
B	INITIAL WT. OF SAND & JAR	(lbs)		I	TARE NUMBER		
C	FINAL WT. OF SAND & JAR	(lbs)		J	WT. OF TARE	(lbs)	
D	WT. OF SAND IN FUNNEL & HOLE (=B-C)	(lbs)	0	K	WT OF WET SOIL FROM HOLE (=H-J)	(lbs)	0
E	WT. OF SAND IN FUNNEL[2]	(lbs)		L	WET UNIT WT. (=K/G)	(pcf)	#DIV/0!
F	WT. OF SAND IN HOLE (=D-E)	(lbs)	0	M	DRY UNIT WT. (=L/[1+(U/100)])	(pcf)	#DIV/0!
G	VOLUME OF HOLE (=F/A)	(ft3)	#DIV/0!	N	PERCENT COMPACTION (=M/V)	(%)	#DIV/0!

NOTES

(1) USE CALIBRATION FORM

(2) THE WEIGHT OF SAND IN FUNNEL (E) IS OBTAINED BY WEIGHING THE SAND, A MINIMUM OF THREE TIMES, IN THE APPARATUS BEFORE AND AFTER THE APPARATUS HAS BEEN TURNED OVER ON THE BASE PLATE ALONG A FLAT SURFACE WITH THE SAND BEING EXPENDED.

FIELD MOISTURE CONTENT - ASTM D 2216

QA ID: ______

O	TARE NUMBER			S	WT. OF WATER (=Q-R)	(g)	0
P	WT. OF TARE	(g)		T	WT. OF DRY SOIL (=R-P)	(g)	0
Q	WT. OF WET SOIL & TARE	(g)		U	MOISTURE CONTENT (=[S/T]x100)	(%)	#DIV/0!
R	WT. OF DRY SOIL & TARE	(g)					

PROCTOR TEST DATA

MAXIMUM DRY UNIT WT. [V]: ______ (pcf) OPTIMUM MOISTURE CONTENT: ______ (%)

COMPARISON WITH NUCLEAR MOISTURE/DENSITY GAUGE - ASTM D 6938

QA ID: ______

W	FIELD DENSITY TEST (FDT) NUMBER			Z	FDT DRY UNIT WT.	(pcf)	
X	FDT WET UNIT WT.	(pcf)		AA	DELTA DRY UNIT WT. (=M-Z)		#DIV/0!
Y	FDT MOISTURE CONTENT	(%)		BB	DELTA MOISTURE CONTENT (=U-Y)		#DIV/0!

COMMENTS

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consultants

SOIL SAMPLE LOG

PROJECT: ____________________

LOCATION: ____________________ PROJECT NO.: __________ TASK NO.: __________

DESCRIPTION: ____________________ YEAR: __________

SITE SAMPLE NO.	LAB SAMPLE NO.	VISUAL DESCRIPTION	SOURCE (LOCATION/DEPTH)	MATERIAL TYPE	DATE SAMPLED (day/mo)	TEST METHODS	QA ID

NOTES: ____________________

CHECKED BY: __________

Geosyntec consultants

DRIVE CYLINDER (DC) AND FIELD DENSITY TEST (FDT) COMPARISON

PROJECT: ______________________ PROJECT NO.: ____________ TASK NO.: ____________

LOCATION: ______________________ DATE: ________ day ____________ month ____________ year

SOURCE: ______________________ TROXLER SERNO: ____________ TROXLER ID: ____________

A Drive Cyl. Number	B Drive Cyl. Wet Density	C Drive Cyl. Moisture	D Drive Cyl. Dry Density	E FDT Wet Density	F FDT Moisture	G FDT Dry Density	H Wet Density Variation	I Moisture Variation	J Dry Density Variation
							0	0	0
							0	0	0
							0	0	0
							0	0	0
							0	0	0
							0	0	0
							0	0	0
							0	0	0
							0	0	0
							0	0	0
							0	0	0
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							0	0	0
							0	0	0
							0	0	0
							0	0	0
							0	0	0
							0	0	0
							0	0	0
							0	0	0
							0	0	0
							0	0	0
							0	0	0
							0	0	0

APPENDIX B

REQUIRED GEOMEMBRANE AND SEAM PROPERTIES

TABLES 02770-1 through 02770-4
(from Technical Specification Section 02770)

TABLE 02770-1
REQUIRED 60-mil HDPE GEOMEMBRANE PROPERTIES

Properties (3)	Qualifiers	Units (1)	Specified Values	Test Method
			Textured	
Physical Properties				
Thickness	Nominal Minimum	mils	60 54	ASTM D 5199 (S) ASTM D 5994 (T)
Asperity Height	Minimum	mils	15	GRI-GM12
Specific Gravity	Minimum	N/A	0.94	ASTM D 792 (Method B) or ASTM D 1505
Carbon Black Content	Range	%	2-3	ASTM D 1603 or D 4218
Carbon Black Dispersion	N/A	none	9 of 10 in Category 1 or 2 and all in Category 1, 2, or 3	ASTM D 5596
Mechanical Properties				
Tensile Properties				
1. Tensile Strength at Yield	Minimum	lb/in	126	ASTM D 6693
2. Tensile Strength at Break	Minimum	lb/in	90	ASTM D 6693
3. Elongation at Yield	Minimum	%	12	ASTM D 6693
4. Elongation at Break	Minimum	%	100	ASTM D 6693
Tear Resistance	Minimum	lb	42	ASTM D 1004 Die C Puncture
Puncture Resistance	Minimum	lb	90	ASTM D 4833

Properties	**Qualifiers**	**Units** [(1)]	**Specified Values** **Textured**	**Test Method**
Environmental Properties				
Stress Crack Resistance	Minimum	hrs	300 [(2)]	ASTM D 5397 (Appendix)
Oxidative Induction Time (OIT)	Minimum	min	100 / 400	ASTM D 3895 / D 5885

Notes:

1. % = percent
   hrs = hours
   min = minutes
   lb/in = pounds per inch
   lb = pound
   N/A = Not Applicable

2. For textured geomembrane, test is conducted on smooth geomembrane from the same resin lot (batch) as the textured geomembrane furnished.

3. See Paragraph 2.03 for required MQC test frequencies.

TABLE 02770-2

REQUIRED 60-mil HDPE GEOMEMBRANE SEAM PROPERTIES

Properties	Qualifiers	Units (3)	Specified Values (4) Smooth or Textured	Test Method
Shear Strength (1)				
Fusion	Minimum	lb/in (%)	120 (95)	ASTM D 6392
Extrusion	Minimum	lb/in (%)	120 (95)	ASTM D 6392
Peel Strength				
			FTB (2)	
Fusion	Minimum	lb/in (%)	91 (72)	ASTM D 6392
Extrusion	Minimum	lb/in (%)	78 (62)	ASTM D 6392

Notes:

1. Also called "Bonded Seam Strength". Value is at material yield point and failure shall occur in material outside of seam area.
2. FTB = Film Tear Bond. (Maximum 10 percent seam separation).
3. lb/in = pounds per inch. % = Percent of the specified minimum yield strength for the geomembrane.
4. Values listed for peel and shear strengths are for 4 out of 5 test specimen. The seam strength of the 5th specimen can be as low as 80% of the listed values.

TABLE 02770-3
REQUIRED 40-mil PE GEOMEMBRANE PROPERTIES

Properties [3]	Qualifiers	Units [1]	Specified Values Smooth (S) / Textured (T)	Test Method
Physical Properties				
Thickness	Nominal Minimum	mils	40 36	ASTM D 5199 (S) ASTM D 5994 (T)
Asperity Height	Minimum	mils	15	GRI-GM12
Specific Gravity	Minimum	N/A	0.94	ASTM D 792 (Method B) or ASTM D 1505
Carbon Black Content	Range	%	2-3	ASTM D 1603 or D 4218
Carbon Black Dispersion	N/A	none	9 of 10 in Category 1 or 2 and all in Category 1, 2, or 3	ASTM D 5596
Mechanical Properties				
Tensile Properties				
1. Yield Strength (HDPE)	Minimum	lb/in	84	ASTM D 6693
2. Break Strength	Minimum	lb/in	152 (S) / 60 (T)	ASTM D 6693
3. Yield Elongation (HDPE)	Minimum	%	12	ASTM D 6693
4. Break Elongation	Minimum	%	HDPE: 700 (S) / 100 (T) LLDPE: 800 (S) / 250 (T)	ASTM D 6693
Tear Resistance	Minimum	lb	HDPE: 28 LLDPE: 22	ASTM D 1004 Die C Puncture
Puncture Resistance	Minimum	lb	HDPE: 72 (S) / 60 (T) LLDPE: 56 (S) / 44 (T)	ASTM D 4833

TABLE 02770-3 (continued)

Properties	Qualifiers	Units [(1)]	Specified Values Smooth (S) / Textured (T)	Test Method
Environmental Properties				
Stress Crack Resistance (HDPE)	Minimum	hrs	300 [(2)]	ASTM D 5397 (Appendix)
Oxidative Induction Time (OIT)	Minimum	min	100 / 400	ASTM D 3895 / D 5885

Notes:

1. % = percent
   hrs = hours
   min = minutes
   lb/in = pounds per inch
   lb = pound
   N/A = Not Applicable

2. For textured geomembrane, test is conducted on smooth geomembrane from the same resin lot (batch) as the textured geomembrane furnished.

3. See Paragraph 2.03 for required MQC test frequencies.

TABLE 02770-4

REQUIRED 40-mil PE GEOMEMBRANE SEAM PROPERTIES

Properties	Qualifiers	Units (3)	Specified Values (4) Smooth or Textured	Test Method
Shear Strength (1)				
Fusion	Minimum	lb/in	HDPE: 80 LLDPE: 60	ASTM D 6392
Extrusion	Minimum	lb/in	HDPE: 80 LLDPE: 60	ASTM D 6392
Peel Strength				
			FTB (2)	
Fusion	Minimum	lb/in	HDPE: 60 LLDPE: 50	ASTM D 6392
Extrusion	Minimum	lb/in	HDPE: 52 LLDPE: 44	ASTM D 6392

Notes:

1. Also called "Bonded Seam Strength". Value is at material yield point and failure shall occur in material outside of seam area.
2. FTB = Film Tear Bond. (Maximum 10 percent seam separation).
3. lb/in = pounds per inch.
4. Values listed for peel and shear strengths are for 4 out of 5 test specimen. The seam strength of the 5th specimen can be as low as 80% of the listed values.

[END OF SECTION]

APPENDIX C

REQUIRED GEOSYNTHETIC CLAY LINER PROPERTIES

TABLE 02780-1
(from Technical Specification Section 02780)

TABLE 02780-1

REQUIRED GCL PROPERTY VALUES

PROPERTIES	QUALIFIERS	UNITS (4)	SPECIFIED VALUES (1)	TEST METHOD
GCL Properties (7)				
Bentonite Content (2)	Minimum	lb/ft^2	0.75	ASTM D 5993
Bentonite Moisture Content	Maximum	%	25	ASTM D 5993 or 2216
Bentonite Free Swell	Minimum	ml/2g	24	ASTM D 5890
Hydraulic Conductivity (5,6)	Minimum	cm/s	5 x 10^{-9}	ASTM D 5887
Tensile / Grab Strength (3)	Minimum	ppi / lb	23 / 90	ASTM D 6768 / 4632
Peel Strength (3)	Minimum	ppi / lb	2.1 / 15	ASTM D 6496 / 4632
Geotextile Properties				
Polymer Composition	Minimum	%	95 polyester or polypropylene	

Notes:
1. All values represent minimum average roll values.
2. Measured at a moisture content not exceeding 25 percent.
3. For geotextile backed GCLs.
4. lb/ft^2 = pounds per square foot
   cm/s = centimeter per second
   % = percent
   lb = pound
   ppi = pounds per inch
   ml/2g = milliliters per two grams
5. The GCL test specimen shall be hydrated for a minimum of 48 hours using sufficient backpressure to achieve a minimum B coefficient of 0.9 and using a confined effective consolidation stress not exceeding five pounds per square inch. Then, the hydraulic conductivity test on the GCL specimen shall be conducted, using water, at a confined effective consolidation stress not exceeding five pounds per square inch. The hydraulic conductivity test shall continue until steady state conditions are reached or a minimum of two pore volumes of water have passed through the test specimen.
6. See Paragraph 2.02 for required MQC test frequencies.

[END OF SECTION]

APPENDIX D

REQUIRED GEOTEXTILE FILTER AND SEPARATOR PROPERTIES

TABLES 02720-1 AND 02720-2

(from Technical Specification Section 02720)

TABLE 02720-1

REQUIRED PROPERTY VALUES FOR GEOTEXTILE FILTER

PROPERTIES (6)	QUALIFIER	UNITS (5)	SPECIFIED VALUES (1)	TEST METHOD
Product Requirements				
Type	--	--	Nonwoven needle-punched	--
Polymer composition	Minimum	%	95 polypropylene or polyester by wt	--
Mass per unit area	Minimum	oz/yd^2	8	ASTM D 5261
Filter Requirements				
Apparent opening size	Maximum	mm	$O_{95} \leq 0.21$	ASTM D 4751
Permittivity	Minimum	sec^{-1}	0.5	ASTM D 4491
Mechanical Requirements				
Grab strength	Minimum	lb	200	ASTM D 4632(2)
Tear strength	Minimum	lb	75	ASTM D 4533(3)
Puncture strength	Minimum	lb	90	ASTM D 4833(4)
Static puncture strength	Minimum	psi	500	ASTM D 6241
Durability Requirements				
Ultraviolet Resistance	Minimum	%	70	ASTM D 4355

Notes:

(1) All values represent minimum average roll values.
(2) Minimum of values measured in machine and cross machine directions with 1 inch clamp on Constant Rate of Extension (CRE) machine.
(3) Minimum value measured in machine and cross machine direction.
(4) Tension testing machine with a 1.75-inch diameter ring clamp, the steel ball being replaced with 0.31-inch diameter solid steel cylinder with flat tip centered within the ring clamp.
(5) mm = millimeter
oz/yd^2 = ounce per square yard
lb = pound
% = percent
sec = second
psi = pound per square inch
(6) See Paragraph 2.02 for required MQC test frequencies.

TABLE 02720-2

REQUIRED PROPERTY VALUES FOR GEOTEXTILE SEPARATOR

PROPERTIES (6)	QUALIFIER	UNITS (5)	SPECIFIED VALUES (1)	TEST METHOD
Product Requirements				
Type	--	--	Nonwoven needle-punched	--
Polymer composition	Minimum	%	95 polypropylene or polyester	--
Mass per unit area	Minimum	oz/yd^2	8	ASTM D 5261
Mechanical Requirements				
Grab strength	Minimum	lb	200	ASTM D 4632(2)
Tear strength	Minimum	lb	75	ASTM D 4533(3)
Puncture strength	Minimum	lb	90	ASTM D 4833(4)
Static puncture strength	Minimum	psi	500	ASTM D 6241
Durability Requirements				
Ultraviolet Resistance	Minimum	%	70	ASTM D 4355

Notes:

(1) All values represent minimum average roll values.
(2) Minimum of values measured in machine and cross machine directions with 1 inch clamp on Constant Rate of Extension (CRE) machine.
(3) Minimum value measured in machine and cross machine direction.
(4) Tension testing machine with a 1.75-inch diameter ring clamp, the steel ball being replaced with 0.31-inch diameter solid steel cylinder with flat tip centered within the ring clamp.
(5) % = percent
oz/yd^2 = ounce per square yard
lb = pound
psi = pound per square inch
(6) See Paragraph 2.02 for required MQC test frequencies.

[END OF SECTION]

APPENDIX E

REQUIRED GEOCOMPOSITE PROPERTIES

TABLE 02740-1
(from Technical Specification Section 02740)

TABLE 02740-1
GEOCOMPOSITE PROPERTY VALUES

PROPERTIES (6)	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 strength	Minimum	lb	200	ASTM D 4632 (2)
Tear strength	Minimum	lb	75	ASTM D 4533 (2)
Puncture strength	Minimum	lb	90	ASTM D 4833 (3)
Static puncture strength	Minimum	psi	500	ASTM D 6241
Geocomposite:				
Transmissivity	Minimum	m^2/s	See notes 4 and 5	ASTM D 4716
Ply Adhesion	Minimum	lb/in	1.0	ASTM D 7005

Notes:

1. All values represent minimum average roll values.
2. Minimum value measured in machine and cross-machine direction.
3. Tension testing machine with a 1.75-inch diameter ring clamp, the steel ball being replaced with 0.31-inch diameter solid steel cylinder with flat tip centered within the ring clamp.

TABLE 02740-1 (Continued)

4. The design transmissivity of the geocomposite drainage layer in the bottom liner system shall be measured using water at a gradient of 0.02 under compressive stresses of 500 psf and of 12,000 psf for a period of 24 hours and 100 hours, respectively. For the test, the geocomposite shall be sandwiched between 60-mil textured HDPE geomembrane and soil actually used for the liner protective layer. The minimum required transmissivities are 9.0×10^{-4} m^2/s and 7.9×10^{-4} m^2/s under the compressive stresses of 500 psf and 12,000 psf, respectively.

5. The design transmissivity of the geocomposite drainage layer in the cover system shall be measured using water at a gradient of 0.33 under compressive stresses of 500 psf for a period of 24 hours. For the test, the geocomposite shall be sandwiched between 40-mil textured PE geomembrane and soil actually used for the cap protective layer. The minimum required transmissivity is 4.3×10^{-4} m^2/s under the compressive stresses of 500 psf.

6. See Paragraph 2.02 for required MQC test frequencies.

[END OF SECTION]

Prepared for:

WASTE MANAGEMENT

Vista Landfill, L.L.C.
242 West Keene Road
Apopka, FL 32703

WATER QUALITY MONITORING PLAN

VISTA LANDFILL, CLASS III
Apopka, Florida

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Project No. FL1229

July 2007

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1. INTRODUCTION

1.1 Purpose and Scope

This Water Quality Monitoring Plan (Plan) is submitted as part of a substantial permit modification application to implement a liner system for the disposal facility footprint at the Vista Landfill, Class III (Vista Landfill) located in Apopka, Florida. The Vista Landfill is permitted to accept only Class III waste. The liner system barrier layer, which Vista Landfill is voluntarily and proactively installing, will consist of a 60-mil high density polyethylene (HDPE) geomembrane. The purpose of this Plan is to describe the: (i) ground water monitoring program; (ii) leachate monitoring program; (iii) sampling and analytical methodologies; and (iv) reporting procedures. It is noted that there is no off-site surface water discharge and therefore no surface water monitoring required for the site. The Plan addresses the requirements of Rule 62-701.510 of the Florida Administrative Code (FAC).

1.2 Facility Location

The Vista Landfill facility is on 242 West Keene Road in Apopka, Florida. The general site location is shown in Figure 1. The site is within Section 28, Township 21 South, Range 28 East in Orange County, Florida. The main entrance of the facility is located at latitude 28°38’24.5”N, longitude 81°30’41.7”W on West Keene Road.

1.3 Plan Organization

The remainder of this Water Quality Monitoring Plan is organized as follows:

- Section 2 presents the ground water program, to include a description of well locations, sampling protocols, sample collection, decontamination procedures, sample handling procedures, chain-of-custody procedures, and analytical procedures;

- Section 3 provides a description of the leachate monitoring program; and

- Section 4 describes the water quality monitoring reporting procedures.

2. GROUND WATER MONITORING

2.1 Monitoring Wells

2.1.1 Well Locations

In accordance with the previously-approved Monitoring Plan Implementation Schedule (MPIS) and solid waste permit for the site, the 18 monitoring wells for the Phase 1 development (i.e., Cells 1 through 4) have been installed (see Table 1), and initial sampling has been completed for these wells and that data has been submitted to the Department. Five (5) wells were replaced (or relocated) but are required only to be sampled for the parameters in Rule 62-701-510(8)(b), FAC, since the initial sampling has been performed on the original wells. The proposed monitoring wells for each subsequent phase of landfill development will be installed and sampled for the parameters in Rule 62-701-510(8)(b), FAC prior to disposal of any Class III waste in future cells. The locations of the existing and proposed monitoring wells associated with the lined disposal facility are shown in Figure 2 and the proposed phasing is presented in Table 1. With the exception of the 5 replacement wells, the monitoring well locations and phasing have not changed from the approved solid waste permit.

2.1.2 Monitoring Well Classification

The approved MPIS for the site classified each existing monitoring well as either a background or compliance well, and all future monitoring wells were denoted as compliance wells. This section of the Plan proposes to re-designate some wells as either detection wells or background well, based on groundwater flow directions and locations. The discussion below provides the rationale for well re-classification.

Per Rule 62-701.510(3)(a), FAC, detection wells must be installed downgradient of the solid waste disposal unit. A potentiometric surface map generated from site-specific surficial aquifer data is provided in Figure 2. As indicated in Figure 2, ground water flow in the surficial aquifer generally follows topography. As for ground water flow in the Upper Floridan Aquifer System (FAS), several United States Geological Survey (USGS) Upper FAS potentiometric maps indicate flow to be northeast in the vicinity of the Vista Landfill. This is consistent with northeast groundwater flow in the deeper Floridan wells at the adjacent Keene Road Landfill. A summary of the proposed monitoring well re-classifications is presented in Table 1, which includes the original monitoring well classifications as designated in the approved MPIS. Table 1 also indicates which monitoring wells will be installed during each subsequent phase of landfill development.

When assigning the classification of the wells, Geosyntec was consistent with the locations presented in the approved MPIS, which were based on the hydrogeologic investigation and on site-specific conditions in accordance with Rule 62-701.510(2) and (3), FAC. Twelve (12) wells located 50 feet from the landfill, within the zone of discharge, are re-designated as “Detection” wells. Additionally, an effort has been made to show the configuration of the shallow ground water flow regime in Figure 2. Six (6) wells located on topographic highs and hydrogeologically upgradient of the landfill are re-designated as “Background” wells. Another well was noted to be in a downgradient location and was re-designated as a “Compliance” well. All other wells are shown in their approved locations and with their current designations as compliance or background wells. Table 2 shows the initial and re-designated classifications.

2.1.3 Future Well Construction

As noted above, the monitoring well network for Phase 1 development (i.e., Cells 1 through 4) has already been installed at the Vista Landfill facility. Additional ground water monitoring wells required for subsequent landfill development phases or future assessment of ground water quality will be installed using FDEP approved methods allowed under Chapter 62-701, FAC such as hollow stem auger (HSA) drilling methods under the direction of a qualified geologist. Additional monitoring wells will be installed so that the well screens (10 feet in length) are located to readily detect representative ground water conditions within the saturated thickness of the uppermost aquifer. Additionally, every attempt will be made to set the monitoring well screen so that the water table can be sampled at all times. Screens in the shallow well may be set 3 to 5 feet below the seasonal high water table to minimize potential changes in water quality due to air-water interactions while still allowing for collection of a sample representative of the uppermost water table.

A soil boring log will be prepared by the geologist or engineer by visually inspecting drill cuttings directly from the auger flights or samples from a standard penetration test, if used. After advancing the boring to the appropriate depth, the monitoring well will be constructed in accordance with typical details indicated in Figure 3. A probable screen size and sand pack gradation has been shown on Figure 3. Prior to installation, the design for the screen and sand pack will be checked based on soil samples in the vicinity of the new well or from the actual well cuttings. The well construction shown in Figure 3, including slot and sand pack size have been used successfully for installing existing wells at Vista Landfill and at the nearby Keene Road Landfill. Accordingly, this same configuration will be used for future wells, unless site specific or well specific conditions warrant otherwise.

The location of each well, in degrees, minutes and seconds of latitude and longitude, and the elevation of the top of the well casing to the nearest 0.01 foot, National Geodetic

Vertical Datum 1929 (NGVD 1929) or other datum consistent with the site and with Chapter 62-701, FAC, will be determined by a registered land surveyor in the State of Florida. In all cases, the monitoring wells will be installed at locations specified in the approved MPIS.

2.1.4 Well Development

All new ground water monitoring wells will be developed to ensure that representative ground water samples are obtained. Wells will be developed by initially swabbing or surge-blocking to agitate the water column followed by pumping to remove particulate matter in suspension. Wells will then be pumped until a minimum of five well volumes of water have been removed, where a well volume is defined as the volume of water in the well casing and sand filter pack. This process will continue until the suspended matter and turbidity levels have been reduced to levels acceptable for ground water sampling (nominally below 20 NTUs).

2.1.5 Well Abandonment

When necessary for disposal facility expansion and/or upon approval by Florida Department of Environmental Protection (FDEP), existing monitoring wells will be abandoned. The abandonment will be performed under the direction of an experienced geologist or engineer. This abandonment procedure will include: (i) removing the existing protective casing and concrete pad; (ii) cutting off the existing well or piezometer casing below the ground surface; (iii) backfilling the full length of the well or piezometer casing with cement grout; and (iv) backfilling with soil in the vicinity for drainage away from the well or piezometer. In some cases, overdrilling methods may be implemented to abandon the wells (e.g., where the wells could act as a potential conduit to groundwater within the footprint of a future cell). FDEP will be notified in writing before any monitoring wells are abandoned or plugged. FDEP will also be provided with copies of the well abandonment documentation, including copies of the well abandonment permit. Monitoring well abandonment will be performed in accordance with procedures outlined in Rule 62-532.500(4), FAC.

2.2 <u>Sampling Frequency and Description</u>

Ground water monitoring wells will be sampled in accordance with this Water Quality Monitoring Plan and any specific conditions in the site specific MPIS. The ground water monitoring program will include sampling and analysis of ground water samples for field and laboratory parameters described in Rule 62-701.510(6), FAC. In accordance with Rule 62-701.510(6)(b), FAC, all background and detection wells shall initially be sampled and analyzed for those parameters listed in Rule 62-701.510(8)(a) and (d), FAC as indicated in Table 2. However, any replacement wells will initially be sampled and analyzed only for those parameters listed in Rule 62-701.510(8)(a), FAC.

In accordance with Rule 62-701.510(6)(d), FAC, routine ground water samples will be collected semi-annually from the detection (downgradient) and background (upgradient) wells, and analyzed for the ground water indicator parameters listed in Rule 62-701.510(8)(a), FAC and presented in Table 3.

2.3 Ground Water Sample Collection

Ground water sampling will be completed in accordance with standard procedures for the field measurement and sampling activities, as mandated by Chapter 62-160, FAC. The FDEP will be notified at least fourteen days before any sampling will occur so that they may collect split samples. All ground water sampling will be performed in accordance with applicable sections of FDEP – Standard Operating Procedure-001/01, FS 2200 (FS 2200 [Revised June 2007]) as mandated by Rule 62-160.210(1), FAC.

Each monitoring well will be purged prior to sampling in order to remove stagnant water, stratified fluids, or residual drilling contaminants in, or near, the filter zone. Procedures in FS 2200 for well purging prior to sampling will be followed.

Procedures outlined in FS 2200 for obtaining samples from the ground water monitoring wells will be followed during sampling of the monitoring wells at the Vista Landfill facility.

In general, groundwater samples are collected from the pump discharge and do not contact field instruments (only the tip of water level indicators will contact groundwater within the well). Field instruments will be decontaminated and cleaned according to the procedures outlined in FS 2200.

2.4 Measurement of Ground water Elevations

The elevation of the ground water surface at each monitoring well will be measured prior to each purging and sampling event. All monitoring wells will be measured for water level on the same day. Procedures specified in FS 2200 for monitoring of ground water elevations will be followed.

2.5 Sample Containers, Preservation, and Shipping

2.5.1 Sample Containers and Preservation Procedures

The containers and procedures used for the preservation of ground water samples will be selected to satisfy the following two important requirements:

- samples will be prepared in such a way that accurate and valid analyses may be performed; and

- all sample preservation methods will adequately meet the requirements of chain-of-custody and sample security.

The types of containers, cleaning procedures, sample sealing procedures, and preservation procedures used during ground water sampling will be in accordance with FS 2200.

2.5.2 Packaging and Shipping

Sample packaging involves preparation of the sample container for shipment to the laboratory for analysis. The procedures and material used must adequately protect the sample container from accidental breakage and should be sufficient to prevent any spillage from escaping into the environment. Sample storage, packaging, and shipping procedures will be followed as outlined in FS 2200.

2.6 Chain-of-Custody Control Procedures

Appropriate chain-of-custody procedures will be followed during the transfer of ground water samples, as specified in FS 2200.

2.7 Sample Analysis

All ground water samples from the Vista Landfill monitoring wells will be submitted to an FDEP-approved analytical laboratory. The laboratory will possess the certifications required in accordance with Chapter 62-160, FAC and hold a certificate from the Department of Health Environmental Laboratory Certification Program under Chapter 62E-1, as referenced in Rule 62-160.300(1), FAC. All analysis procedures specified in FS 2200 will be followed during the analysis of ground water samples.

2.8 Evaluation Monitoring

If indicator parameters are detected in detection wells at concentrations significantly above background concentrations, or at concentrations above the FDEP water quality standards or criteria specified in Chapter 62-520, FAC, the respective wells may be resampled within

30 days of receipt of data to confirm the laboratory results. Upon receipt of the confirmation resampling results, or if the wells are not resampled, FDEP will be notified within 14 days and evaluation monitoring will be initiated upon notification by the Department in accordance with Chapter 62-701.510(7), FAC.

The evaluation monitoring will include: (i) continuation of routine sampling and analyses for all monitoring wells and surface water monitoring locations; (ii) within 90 days of initiating evaluation monitoring and annually thereafter, sampling and analysis of representative background wells and all affected detection wells or chemical constituents listed in Appendix II of 40 Code of Federal Regulations (CFR) Part 258 (see Attachment A); (iii) inclusion of new parameters confirmed in affected downgradient wells into routine monitoring; (iv) within 90 days of initiating evaluation monitoring, installation of compliance monitoring wells located at the compliance line of the zone of discharge (indicated on Figure 2), downgradient of the affected detection wells and sampling and analysis on a quarterly basis for the parameters listed in Rules 62-701.510(8)(a) and (d), FAC; and (v) within 180 days of initiating evaluation monitoring, submittal of a contamination evaluation plan, in accordance with Rule 62-701.510(7)(a)4, FAC, to FDEP. The contamination evaluation plan will be implemented upon FDEP approval of the plan.

Actions to be taken subsequently will depend on the results obtained from evaluation monitoring activities. Authorization from FDEP will be obtained prior to returning to routine monitoring. In accordance with Rule 62-701.510(7)(b)1, FAC, if the contamination evaluation report indicated that water quality standards are likely to be violated outside the zone of discharge, a remedial action plan will be submitted to the FDEP for review within 90 days. The remedial action plan will be implemented upon approval of the plan by FDEP.

Updates to Chapter 62-701.510, FAC which include changes to the Evaluation and Corrective Action requirements are incorporated by reference.

3. LEACHATE MONITORING

3.1 Monitoring Locations

A representative sample of leachate from the Vista Landfill will be collected and analyzed on an annual basis in accordance with Rule 62-701.510(6)(c), FAC. A representative leachate sample will be a grab sample obtained from either the leachate collection sumps, the leachate forcemain, or the leachate storage tanks. One leachate sample will be collected from all phases of the disposal facility.

3.2 Sampling Protocol

A representative leachate sample will be collected on an annual basis and analyzed as required by Rule 62-701.510(6)(c), FAC. The testing parameters which are listed in Rule 62-701.510(8)(c) and (d) are presented in Table 4 and Attachment A of this plan..

Leachate concentrations found during annual sample analysis will be evaluated for constituents in excess of the toxicity characteristic regulatory levels for hazardous waste, as described in 40 CFR 261.24. A list of these contaminants and the associated regulatory levels are presented in Attachment B. If such excesses are apparent, then a monthly sampling and analysis program will be initiated in accordance with Rule 62-701.510(6)(c)2 and the FDEP will be notified in writing. If in any three consecutive months no listed contaminant is found to exceed the regulatory level, the monthly sampling and analysis program will be discontinued and annual monitoring will be resumed.

3.3 Sample Collection

Leachate sampling will be performed in accordance with the procedures in FDEP Standard Operating Procedure-001/01, FS 1000, General Sampling Procedures (FS 1000) for the purpose of sampling activities, as mandated by Rule 62-160.210(1), FAC. The FDEP will be notified at least fourteen days before any sampling event will occur so that they may collect split samples.

3.4 Sample Containers and Preservation

The types of containers, cleaning procedures, and preservation procedures to be used for leachate sampling will be in accordance with requirements of FS 1000.

3.5 Packaging and Shipping

Leachate sample storage, packaging, and shipping procedures will follow procedures presented in FS 1000 in order to protect the sample container from accidental breakage or spillage during shipment.

3.6 Chain-of-Custody Control Procedures

Chain-of-custody procedures for the transfer of leachate samples will follow procedures specified in FS 1000.

3.7 Leachate Sample Analysis

Leachate samples from the disposal facility will be submitted to an analytical laboratory that holds a certificate from the Department of Health Environmental Laboratory Certification Program under Chapter 62E-1, as referenced in Rule 62-160.300(1), FAC. As mentioned previously, leachate samples will be analyzed annually for the parameters listed in Table 4 and in Attachment A.

4. WATER QUALITY MONITORING REPORTING

4.1 Ground Water and Leachate

4.1.1 Overview

Water quality monitoring reporting will be performed in accordance with Rule 62-701.510(9), FAC. Water quality monitoring reports will be submitted to FDEP after each sampling event in accordance with the MPIS.

4.1.2 Monitoring Report Contents

The monitoring report to the FDEP will contain the following information:

- facility name;
- facility identification number;
- sample collection date;
- analysis date;
- all analytical results, including all peaks even if below maximum contamination levels;
- identification number and designation of all ground water monitoring points;
- applicable water quality standards;
- quality assurance/quality control notations;
- method detection limits;
- STORET code numbers for all parameters;
- water levels recorded prior to evaluating wells or sample collection;
- an updated ground water surface contour map (signed and sealed by a professional geologist or professional engineer with experience in hydrogeologic investigations)

with contours at a minimum of 1 ft (0.3 m) intervals that indicates ground water elevation, unless site specific conditions dictate otherwise and flow direction;

- a summary of water quality standards or criteria that are exceeded; and

- a summary of leachate monitoring parameters, analytical results and evaluation of any constituents exceeding the regulatory levels in 40 CFR Part 261.24.

Surface water monitoring is not required and will not be included in the reports.

4.1.3 Technical Report Contents

Every two years or other frequency (e.g., two and ½ years) allowed by Rule 62-701.510, FAC, a technical report, prepared, signed, and sealed by a professional geologist or professional engineer with experience in hydrogeologic investigations, will be submitted to the FDEP. The report will be updated at the time of permit renewal. The report will summarize and interpret the water quality data and leachate monitoring results and water level measurements collected during the past two years. The report will contain:

- tabular displays of any data which shows that a monitoring parameter has been detected, and graphical displays of any leachate key indicator parameters detected (such as pH, specific conductance, TDS, TOC, sulfate, chloride, sodium, and iron), including hydrographs for all monitor wells;

- trend analyses of any monitoring parameters consistently detected;

- comparisons among shallow, middle, and deep zone wells, as applicable;

- comparisons between background water quality and the water quality in detection and compliance wells;

- correlations between related parameters such as total dissolved solids and specific conductance;

- discussion of erratic and/or poorly correlated data;

- an interpretation of the ground water contour maps and an evaluation of ground water flow rates; and

- an evaluation of the adequacy of the water quality monitoring frequency and sampling locations.

All field and laboratory records will be made available to the FDEP and will be retained throughout the post-closure care period for the disposal facility.

TABLES

Table 1: Monitoring Well Designation and Classification for the Vista Landfill

Monitoring Well Designation	Existing Classification	Proposed Classification	Installation Schedule[(1)]
MW-1A	Background	Background	Phase 1
MW-1B	Background	Background	Phase 1
MW-2AR	Background	Background	Phase 1
MW-2B	Compliance	Detection	Phase 1
MW-3A	Compliance	Detection	Phase 1
MW-3B	Compliance	Detection	Phase 1
MW-4A	Compliance	Detection	Phase 1
MW-4B	Compliance	Detection	Phase 1
MW-5A	Compliance	Detection	Phase 1
MW-5B	Compliance	Detection	Phase 1
MW-6AR	Background	Background	Phase 1
MW-6BR	Background	Background	Phase 1
MW-7A	Compliance	Background	Phase 1
MW-7B	Compliance	Background	Phase 1
MW-8R	Background	Background	Phase 1
MW-9A	Compliance	Background	Phase 2
MW-9B	Compliance	Background	Phase 2
MW-10A	Compliance	Detection	Phase 3
MW-10B	Compliance	Detection	Phase 3
MW-11A	Compliance	Detection	Phase 2
MW-11B	Compliance	Detection	Phase 2
MW-12A	Compliance	Compliance	Phase 3
MW-12B	Compliance	Compliance	Phase 3
MW-13A	Compliance	Compliance	Phase 3
MW-13B	Compliance	Compliance	Phase 3
MW-14A	Compliance	Compliance	Phase 2
MW-14B	Compliance	Compliance	Phase 2
MW-15A	Compliance	Compliance	Phase 2
MW-15B	Compliance	Compliance	Phase 2
MW-16A	Compliance	Compliance	Phase 3
MW-16B	Compliance	Compliance	Phase 3
MW-17A	Compliance	Background	Phase 3
MW-17B	Compliance	Background	Phase 3
MW-18A	Compliance	Compliance	Phase 3
MW-18B	Compliance	Compliance	Phase 3
MW-19A	Compliance	Compliance	Phase 3
MW-19B	Compliance	Compliance	Phase 3
MW-20A	Compliance	Compliance	Phase 3
MW-20B	Compliance	Compliance	Phase 3
MW-21A	Compliance	Compliance	Phase 3
MW-21B	Compliance	Compliance	Phase 3

Monitoring Well Designation	**Existing Classification**	**Proposed Classification**	**Installation Schedule**(1)
W-FL1	Compliance	Compliance	Phase 1
MW-FL2R	Compliance	Compliance	Phase 1
MW-FL3	Compliance	Detection	Phase 1
MW-FL4	Background	Background	Phase 3
MW-FL5	Background	Background	Phase 2
MW-FL6	Background	Background	Phase 2
MW-FL7	Background	Background	Phase 3
MW-FL8	Background	Compliance	Phase 3
MW-FL9	Background	Background	Phase 3

Notes: (1) Phase 1 includes Cells 1 through 4; Phase 2 includes Cells 5 through 8; and Phase 3 includes Cells 9 through 12.

Table 2: Initial Ground Water Monitoring Parameters

Field Parameters	**Laboratory Parameters**
Static Water Levels before Purging	Total Ammonia – N
Specific Conductivity	Chlorides
pH	Iron
Dissolved Oxygen	Mercury
Turbidity	Nitrate
Temperature	Sodium
Colors and Sheens (by observation)	Total Dissolved Solids (TDS)
	Those parameters listed in 40 CFR Part 258, Appendices I and II.

Note: The parameters presented in 40 CFR Part 258, Appendices I and II are reproduced in Attachment A of this Water Quality Monitoring Plan.

Table 3: Routine Semi-Annual Ground Water Monitoring Parameters

Field Parameters	Laboratory Parameters
Static Water Levels before Purging	Total Ammonia – N
Specific Conductivity	Chlorides
pH	Iron
Dissolved Oxygen	Mercury
Turbidity	Nitrate
Temperature	Sodium
Colors and Sheens (by observation)	Total Dissolved Solids (TDS)
	Those parameters listed in 40 CFR Part 258, Appendix I.

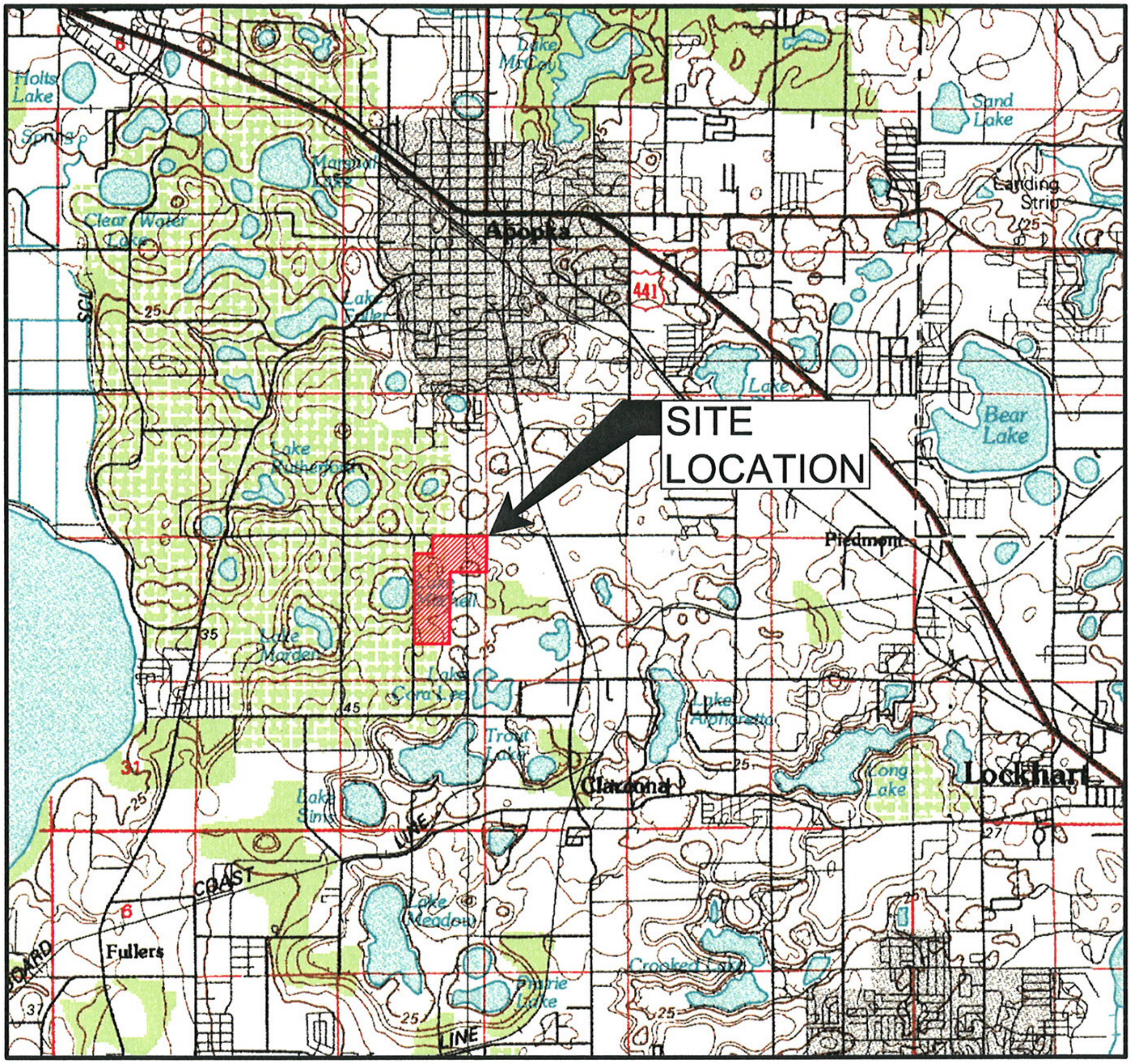
Note: The parameters presented in 40 CFR Part 258, Appendix I is reproduced in Attachment A of this Water Quality Monitoring Plan.

Table 4: Annual Leachate Monitoring Parameters

Field Parameters	Laboratory Parameters
Specific Conductivity	Total Ammonia – N
pH	Bicarbonate
Dissolved Oxygen	Chlorides
Colors, Sheens (by observation)	Iron
	Mercury
	Nitrate
	Sodium
	Total Dissolved Solids (TDS)
	Those parameters listed in 40 CFR Part 258, Appendix II.

Note: The parameters presented in 40 CFR Part 258, Appendix II is reproduced in Attachment A of this Water Quality Monitoring Plan.

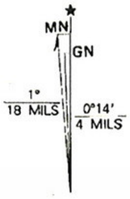
FIGURES



CONTOUR INTERVAL 5 METERS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

ORLANDO, FLORIDA
N2830–W8100/30 X 60

0 3000 6000
SCALE: 1" = 6000'



SITE LOCATION
VISTA LANDFILL
APOPKA, FL

Produced by the United States Geological Survey
Compiled from USGS 1:24 000-scale topographic maps dated
1953-1970. Planimetry revised from aerial photographs taken
1977 and other source data. Revised information not
field checked. Map edited 1979
Projection and 10 000-meter grid, zone 17: Universal
Transverse Mercator
25 000-foot grid ticks based on Florida coordinate
system, east and west zones
1927 North American Datum

Geosyntec consultants

TAMPA, FL

DATE:	JULY 2007	FILE NO.	FL1229.02F003
PROJECT NO.	FL1229.02	FIGURE NO.	1

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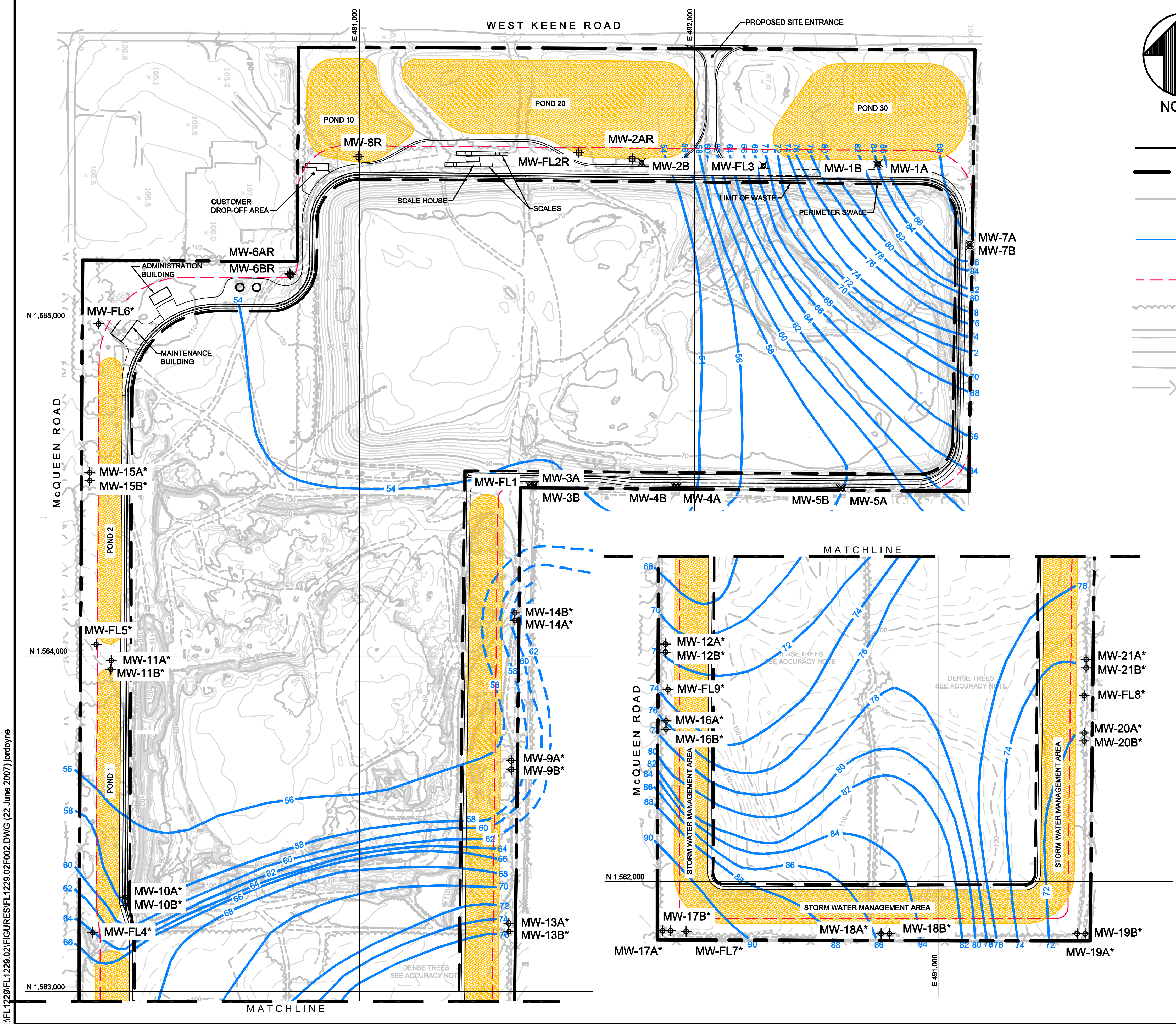

NORTH

300 150 0 300

SCALE IN FEET

LEGEND

— — —	APPROXIMATE PROPERTY BOUNDARY
80	EXISTING GROUND CONTOUR (SEE NOTE 1)
60	COMPOSITE SEASONAL HIGH GROUNDWATER SURFACE CONTOUR
- - -	ZONE OF DISCHARGE
~~	TREE LINE
═	UNIMPROVED / DIRT ROAD
═	IMPROVED / PAVED ROAD
—×—×—	FENCE
× 86.3	SPOT ELEVATION
⌘ MW-8	EXISTING MONITORING WELL
⌘ MW-FL2	EXISTING FLORIDAN AQUIFER MONITORING WELL
⊕ MW-8R	RELOCATED MONITORING WELL
⊕ MW-FL2R	RELOCATED FLORIDAN AQUIFER MONITORING WELL
✛ MW-9*	PROPOSED MONITORING WELL
✛ MW-FL5*	PROPOSED FLORIDAN AQUIFER MONITORING WELL

NOTES:

1. AERIAL TOPOGRAPHIC MAP PREPARED BY 3001, INC. AND COMPILED FROM PHOTOGRAPH DATED 18 MARCH 2007. CONTOURS PORTRAYED AS DASHED OR BROKEN LINES REPRESENT AREAS OF DENSE VEGETATION AND SHOULD BE CONSIDERED APPROXIMATE. THIS MAP HAS NOT BEEN FIELD VERIFIED. THIS MAP SHOULD BE FIELD VERIFIED PRIOR TO USE AS A BASIS FOR CONSTRUCTION.
2. HORIZONTAL AND VERTICAL CONTROL WAS ESTABLISHED BY 3001, INC. HORIZONTAL COORDINATE VALUES ARE BASED UPON THE NORTH AMERICAN DATUM OF 1983 (NAD83), FLORIDA EAST ZONE. CONTOURS AND SPOT ELEVATIONS ARE BASED ON THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29).

GROUND WATER MONITORING NETWORK

VISTA LANDFILL

Geosyntec consultants

TAMPA, FL

DATE:	JULY 2007	FILE NO.	FL1229.02F002
PROJECT NO.	FL1229	FIGURE NO.	2

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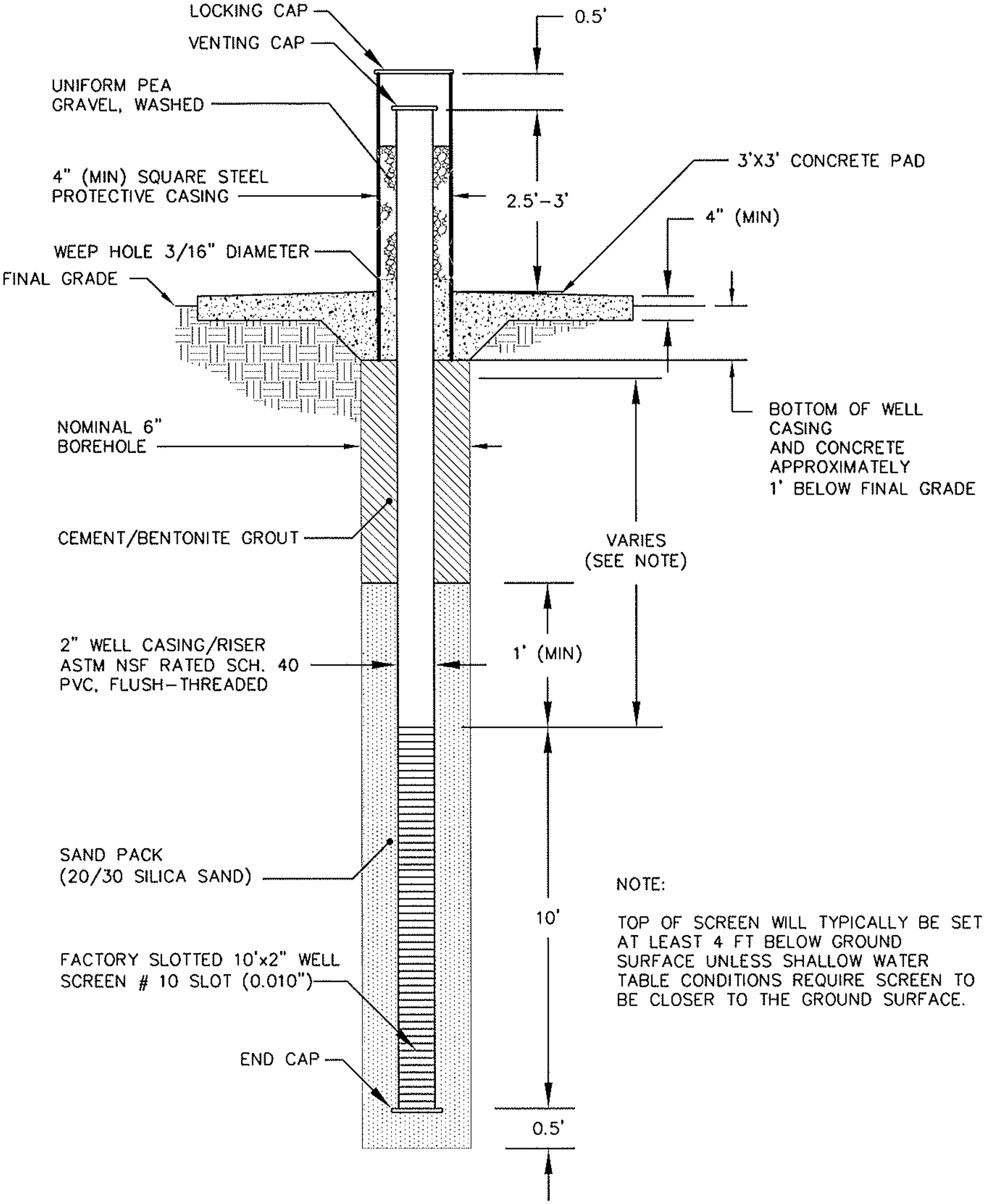

NOTE:

TOP OF SCREEN WILL TYPICALLY BE SET AT LEAST 4 FT BELOW GROUND SURFACE UNLESS SHALLOW WATER TABLE CONDITIONS REQUIRE SCREEN TO BE CLOSER TO THE GROUND SURFACE.

TYPICAL WELL CONSTRUCTION DETAIL

Geosyntec consultants

TAMPA, FL

DATE:	JULY 2007	FILE NO.	FL1229.02F001-W
PROJECT NO.	FL1229	FIGURE NO.	3

I:\FL1229\FL1229.02\WELLFIGURES\FL1229.02F001-W.DWG (22 June 2007) ecsordas

ATTACHMENT A

APPENDIX I AND II, 40 CFR PART 258, MONITORING PARAMETERS

ATTACHMENT A

APPENDIX I AND II, 40 CFR PART 258, MONITORING PARAMETERS

later, in the case of closure, post-closure care, or no later than 120 days after the corrective action remedy has been selected in accordance with the requirements of § 258.58.

(ii) The owner or operator is no longer required to maintain the items specified in paragraph (h)(2) of this section when:

(A) The owner or operator substitutes alternate financial assurance as specified in this section; or

(B) The owner or operator is released from the requirements of this section in accordance with § 258.71(b), 258.72(b), or 258.73(b).

(iii) If a local government guarantor no longer meets the requirements of paragraph (f) of this section, the owner or operator must, within 90 days, obtain alternative assurance, place evidence of the alternate assurance in the facility operating record, and notify the State Director. If the owner or operator fails to obtain alternate financial assurance within that 90-day period, the guarantor must provide that alternate assurance within the next 30 days.

(i) *State-Approved mechanism.* An owner or operator may satisfy the requirements of this section by obtaining any other mechanism that meets the criteria specified in § 258.74(l), and that is approved by the Director of an approved State.

(j) *State assumption of responsibility.* If the State Director either assumes legal responsibility for an owner or operator's compliance with the closure, post-closure care and/or corrective action requirements of this part, or assures that the funds will be available from State sources to cover the requirements, the owner or operator will be in compliance with the requirements of this section. Any State assumption of responsibility must meet the criteria specified in § 258.74(l).

(k) *Use of multiple mechanisms.* An owner or operator may demonstrate financial assurance for closure, post-closure, and corrective action, as required by §§ 258.71, 258.72, and 258.73 by establishing more than one mechanism per facility, except that mechanisms guaranteeing performance rather than payment, may not be combined with other instruments. The mechanisms must be as specified in paragraphs (a), (b), (c), (d), (e), (f), (g), (h), (i), and (j) of this section, except that financial assurance for an amount at least equal to the current cost estimate for closure, post-closure care, and/or corrective action may be provided by a combination of mechanisms rather than a single mechanism.

(l) The language of the mechanisms listed in paragraphs (a), (b), (c), (d), (e), (f), (g), (h), (i), and (j) of this section must ensure that the instruments satisfy the following criteria:

(1) The financial assurance mechanisms must ensure that the amount of funds assured is sufficient to cover the costs of closure, post-closure care, and corrective action for known releases when needed;

(2) The financial assurance mechanisms must ensure that funds will be available in a timely fashion when needed;

(3) The financial assurance mechanisms must be obtained by the owner or operator by the effective date of these requirements or prior to the initial receipt of solid waste, whichever is later, in the case of closure and post-closure care, and no later that 120 days after the corrective action remedy has been selected in accordance with the requirements of § 258.58, until the owner or operator is released from the financial assurance requirements under §§ 258.71, 258.72 and 258.73.

(4) The financial assurance mechanisms must be legally valid, binding, and enforceable under State and Federal law.

[56 FR 51029, Oct. 9, 1991, as amended at 58 FR 51547, Oct. 1, 1993; 60 FR 40105, Aug. 7, 1995; 60 FR 52342, Oct. 6, 1995; 61 FR 60337, Nov. 27, 1996; 63 FR 17729, Apr. 10, 1998]

§ 258.75 Discounting.

The Director of an approved State may allow discounting of closure cost estimates in § 258.71(a), post-closure cost estimates in § 258.72(a), and/or corrective action costs in § 258.73(a) up to the rate of return for essentially risk free investments, net of inflation, under the following conditions:

(a) The State Director determines that cost estimates are complete and accurate and the owner or operator has submitted a statement from a Registered Professional Engineer so stating;

(b) The State finds the facility in compliance with applicable and appropriate permit conditions;

(c) The State Director determines that the closure date is certain and the owner or operator certifies that there are no foreseeable factors that will change the estimate of site life; and

(d) Discounted cost estimates must be adjusted annually to reflect inflation and years of remaining life.

[61 FR 60339, Nov. 27, 1996]

APPENDIX I TO PART 258—CONSTITUENTS FOR DETECTION MONITORING[1]

Common name[2]	CAS RN[3]
Inorganic Constituents:	
(1) Antimony	(Total)
(2) Arsenic	(Total)
(3) Barium	(Total)
(4) Beryllium	(Total)
(5) Cadmium	(Total)
(6) Chromium	(Total)
(7) Cobalt	(Total)
(8) Copper	(Total)
(9) Lead	(Total)
(10) Nickel	(Total)
(11) Selenium	(Total)
(12) Silver	(Total)
(13) Thallium	(Total)
(14) Vanadium	(Total)
(15) Zinc	(Total)
Organic Constituents:	
(16) Acetone	67–64–1
(17) Acrylonitrile	107–13–1
(18) Benzene	71–43–2
(19) Bromochloromethane	74–97–5
(20) Bromodichloromethane	75–27–4
(21) Bromoform; Tribromomethane	75–25–2
(22) Carbon disulfide	75–15–0
(23) Carbon tetrachloride	56–23–5
(24) Chlorobenzene	108–90–7
(25) Chloroethane; Ethyl chloride	75–00–3
(26) Chloroform; Trichloromethane	67–66–3
(27) Dibromochloromethane; Chlorodibromomethane	124–48–1
(28) 1,2-Dibromo-3-chloropropane; DBCP	96–12–8
(29) 1,2-Dibromoethane; Ethylene dibromide; EDB	106–93–4
(30) o-Dichlorobenzene; 1,2-Dichlorobenzene	95–50–1
(31) p-Dichlorobenzene; 1,4-Dichlorobenzene	106–46–7
(32) trans–1,4-Dichloro-2-butene	110–57–6
(33) 1,1-Dichloroethane; Ethylidene chloride	75–34–3
(34) 1,2-Dichloroethane; Ethylene dichloride	107–06–2
(35) 1,1-Dichloroethylene; 1,1-Dichloroethene; Vinylidene chloride	75–35–4
(36) cis-1,2-Dichloroethylene, cis-1,2-Dichloroethene	156–59–2
(37) trans-1,2-Dichloroethylene; trans-1,2-Dichloroethene	156–60–5
(38) 1,2-Dichloropropane; Propylene dichloride	78–87–5
(39) cis-1,3-Dichloropropene	10061–01–5
(40) trans-1,3-Dichloropropene	10061–02–6
(41) Ethylbenzene	100–41–4
(42) 2-Hexanone; Methyl butyl ketone	591–78–6
(43) Methyl bromide; Bromomethane	74–83–9
(44) Methyl chloride; Chloromethane	74–87–3
(45) Methylene bromide; Dibromomethane	74–95–3
(46) Methylene chloride; Dichloromethane	75–09–2
(47) Methyl ethyl ketone; MEK; 2-Butanone	78–93–3
(48) Methyl iodide; Iodomethane	74–88–4
(49) 4-Methyl-2-pentanone; Methyl isobutyl ketone	108–10–1
(50) Styrene	100–42–5
(51) 1,1,1,2-Tetrachloroethane	630–20–6
(52) 1,1,2,2-Tetrachloroethane	79–34–5
(53) Tetrachloroethylene; Tetrachloroethene; Perchloroethylene	127–18–4
(54) Toluene	108–88–3
(55) 1,1,1-Trichloroethane; Methylchloroform	71–55–6
(56) 1,1,2-Trichloroethane	79–00–5
(57) Trichloroethylene; Trichloroethene	79–01–6
(58) Trichlorofluoromethane; CFC-11	75–69–4
(59) 1,2,3-Trichloropropane	96–18–4
(60) Vinyl acetate	108–05–4
(61) Vinyl chloride	75–01–4
(62) Xylenes	1330–20–7

[1] This list contains 47 volatile organics for which possible analytical procedures provided in EPA Report SW–846 "Test Methods for Evaluating Solid Waste," third edition, November 1986, as revised December 1987, includes Method 8260; and 15 metals for which SW–846 provides either Method 6010 or a method from the 7000 series of methods.

[2] Common names are those widely used in government regulations, scientific publications, and commerce; synonyms exist for many chemicals.

[3] Chemical Abstracts Service registry number. Where "Total" is entered, all species in the ground water that contain this element are included.

APPENDIX II TO PART 258—LIST OF HAZARDOUS INORGANIC AND ORGANIC CONSTITUENTS[1]

Common Name[2]	CAS RN[3]	Chemical abstracts service index name[4]	Suggested methods[5]	PQL (μ g/L)[6]
Acenaphthene	83–32–9	Acenaphthylene, 1,2-dihydro-	8100 8270	200 10
Acenaphthylene	208–96–8	Acenaphthylene	8100 8270	200 10
Acetone	67–64–1	2-Propanone	8260	100
Acetonitrile; Methyl cyanide	75–05–8	Acetonitrile	8015	100
Acetophenone	98–86–2	Ethanone, 1-phenyl-	8270	10
2-Acetylaminofluorene; 2-AAF	53–96–3	Acetamide, N-9H-fluoren-2-yl-	8270	20

Common Name[2]	CAS RN[3]	Chemical abstracts service index name[4]	Suggested methods[5]	PQL (µ g/L)[6]
Acrolein	107–02–8	2-Propenal	8030 8260	5 100
Acrylonitrile	107–13–1	2-Propenenitrile	8030 8260	5 200
Aldrin	309–00–2	1,4:5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-(1α,4α,4aβ,5α,8α,8aβ)-	8080 8270	0.05 10 ...
Allyl chloride	107–05–1	1-Propene, 3-chloro-	8010 8260	5 10
4-Aminobiphenyl	92–67–1	[1,1^{1}-Biphenyl]-4-amine	8270	20
Anthracene	120–12–7	Anthracene	8100 8270	200 10
Antimony	(Total)	Antimony	6010 7040 7041	300 2000 30
Arsenic	(Total)	Arsenic	6010 7060 7061	500 10 20
Barium	(Total)	Barium	6010 7080	20 1000
Benzene	71–43–2	Benzene	8020 8021 8260	2 0.1 5 .....
Benzo[a]anthracene; Benzanthracene	56–55–3	Benz[a]anthracene	8100 8270	200 10
Benzo[b]fluoranthene	205–99–2	Benz[e]acephenanthrylene	8100 8270	200 10
Benzo[k]fluoranthene	207–08–9	Benzo[k]fluoranthene	8100 8270	200 10
Benzo[ghi]perylene	191–24–2	Benzo[ghi]perylene	8100 8270	200 10
Benzo[a]pyrene	50–32–8	Benzo[a]pyrene	8100 8270	200 10
Benzyl alcohol	100–51–6	Benzenemethanol	8270	20
Beryllium	(Total)	Beryllium	6010 7090 7091	3 50 2
alpha-BHC	319–84–6	Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1α,2α,3β,4α,5β,6β)-.	8080 8270	0.05 10 ...
beta-BHC	319–85–7	Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1α,2β,3α,4β,5α,6β)-.	8080 8270	0.05 20 ...
delta-BHC	319–86–8	Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1α,2α,3α,4β,5α,6β)-.	8080 8270	0.1 20 ...
gamma-BHC; Lindane	58–89–9	Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1α,2α,3β,4α,5α,6β)-.	8080 8270	0.05 20 ...
Bis(2-chloroethoxy)methane	111–91–1	Ethane, 1,1^{1}-[methylenebis(oxy)]bis[2-chloro-.	8110 8270	5 10
Bis(2-chloroethyl) ether; Dichloroethyl ether.	111-44-4	Ethane, 1,1^{1}-oxybis[2-chloro-	8110 8270	3 10
Bis-(2-chloro-1-methylethyl) ether; 2,2^{1}-Dichlorodiisopropyl ether; DCIP, See note 7	108–60–1	Propane, 2,2^{1}-oxybis[1-chloro-	8110 8270	10 10
Bis(2-ethylhexyl) phthalate	117–81–7	1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester.	8060	20
Bromochloromethane; Chlorobromomethane.	74–97–5	Methane, bromochloro-	8021 8260	0.1 5 .....
Bromodichloromethane; Dibromochloromethane.	75–27–4	Methane, bromodichloro-	8010 8021 8260	1 0.2 5 .....
Bromoform; Tribromomethane	75–25–2	Methane, tribromo-	8010 8021 8260	2 15 5
4-Bromophenyl phenyl ether	101–55–3	Benzene, 1-bromo-4-phenoxy-	8110 8270	25 10
Butyl benzyl phthalate; Benzyl butyl phthalate.	85–68–7	1,2-Benzenedicarboxylic acid, butyl phenylmethyl ester.	8060 8270	5 10
Cadmium	(Total)	Cadmium	6010 7130 7131	40 50 1
Carbon disulfide	75–15–0	Carbon disulfide	8260	100

Common Name[2]	CAS RN[3]	Chemical abstracts service index name[4]	Suggested methods[5]	PQL (µ g/L)[6]
Carbon tetrachloride	56–23–5	Methane, tetrachloro-	8010 8021 8260	1 0.1 10 ...
Chlordane	See Note 8	4,7-Methano-1H-indene, 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-.	8080 8270	0.1 50 ...
p-Chloroaniline	106–47–8	Benzenamine, 4-chloro-	8270	20
Chlorobenzene	108–90–7	Benzene, chloro-	8010 8020 8021 8260	2 2 0.1 5 .....
Chlorobenzilate	510–15–6	Benzeneacetic acid, 4-chloro-α-(4-chlorophenyl)-α-hydroxy-, ethyl ester.	8270	10
p-Chloro-m-cresol; 4-Chloro-3-methylphenol.	59–50–7	Phenol, 4-chloro-3-methyl-	8040 8270	5 20
Chloroethane; Ethyl chloride	75–00–3	Ethane, chloro-	8010 8021 8260	5 1 10
Chloroform; Trichloromethane	67–66–3	Methane, trichloro-	8010 8021 8260	0.5 0.2 .. 5 .....
2-Chloronaphthalene	91–58–7	Naphthalene, 2-chloro-	8120 8270	10 10
2-Chlorophenol	95–57–8	Phenol, 2-chloro-	8040 8270	5 10
4-Chlorophenyl phenyl ether	7005–72–3	Benzene, 1-chloro-4-phenoxy-	8110 8270	40 10
Chloroprene	126–99–8	1,3-Butadiene, 2-chloro-	8010 8260	50 20
Chromium	(Total)	Chromium	6010 7190 7191	70 500 10
Chrysene	218–01–9	Chrysene	8100 8270	200 10
Cobalt	(Total)	Cobalt	6010 7200 7201	70 500 10
Copper	(Total)	Copper	6010 7210 7211	60 200 10
m-Cresol; 3-methylphenol	108–39–4	Phenol, 3-methyl-	8270	10
o-Cresol; 2-methylphenol	95–48–7	Phenol, 2-methyl-	8270	10
p-Cresol; 4-methylphenol	106–44–5	Phenol, 4-methyl-	8270	10
Cyanide	57–12–5	Cyanide	9010	200
2,4-D; 2,4-Dichlorophenoxyacetic acid	94–75–7	Acetic acid, (2,4-dichlorophenoxy)-	8150	10
4,4^{1}-DDD	72–54–8	Benzene 1,1^{1}-(2,2-dichloroethylidene)bis[4-chloro-.	8080 8270	0.1 10 ...
4,4^{1}-DDE	72–55–9	Benzene, 1,1^{1}-(dichloroethyenylidene)bis[4-chloro-.	8080 8270	0.05 10 ...
4,4^{1}-DDT	50–29–3	Benzene, 1,1^{1}-(2,2,2-trichloroethylidene)bis[4-chloro-.	8080 8270	0.1 10 ...
Diallate	2303–16–4	Carbamothioic acid, bis(1-methylethyl)-,S-(2,3-dichloro-2-propenyl) ester.	8270	10
Dibenz[a,h]anthracene	53–70–3	Dibenz[a,h]anthracene	8100 8270	200 10
Dibenzofuran	132–64–9	Dibenzofuran	8270	10
Dibromochloromethane; Chlorodibromomethane.	124–48–1	Methane, dibromochloro-	8010 8021 8260	1 0.3 5 .....
1,2-Dibromo-3-chloropropane; DBCP	96–12–8	Propane, 1,2-dibrome-3-chloro-	8011 8021 8260	0.1 30 ... 25 ...
1,2-Dibromoethane; Ethylene dribromide; EDB.	106–93–4	Ethane, 1,2-dibromo-	8011 8021 8260	0.1 10 ... 5 .....
Di-n-butyl phthalate	84–74–2	1,2-Benzenedicarboxylic acid, dibutyl ester.	8060 8270	5 10

Common Name[2]	CAS RN[3]	Chemical abstracts service index name[4]	Suggested methods[5]	PQL (µ g/L)[6]
o-Dichlorobenzene; 1,2-Dichlorobenzene.	95–50–1	Benzene, 1,2-dichloro-	8010	2
			8020	5
			8021	0.5
			8120	10 ...
			8260	5 .....
			8270	10 ...
m-Dichlorobenzene; 1,3-Dichlorobenzene.	541–73–1	Benzene, 1,3-Dichloro-	8010	5
			8020	5
			8021	0.2
			8120	10 ...
			8260	5 .....
			8270	10 ...
p-Dichlorobenzene; 1,4-Dichlorobenzene.	106–46–7	Benzene, 1,4-dichloro-	8010	2
			8020	5
			8021	0.1
			8120	15 ...
			8260	5 .....
			8270	10 ...
3,3^1-Dichlorobenzidine	91–94–1	[1,1^1-Biphenyl]-4,4^1-diamine, 3,3^1-dichloro-.	8270	20
trans-1,4-Dichloro-2-butene	110-57-6	2-Butene, 1,4-dichloro-, (E)-	8260	100
Dichlorodifluoromethane; CFC 12;	75–71–8	Methane, dichlorodifluoro-	8021	0.5
			8260	5 .....
1,1-Dichloroethane; Ethyldidene chloride.	75–34–3	Ethane, 1,1-dichloro-	8010	1
			8021	0.5
			8260	5 .....
1,2-Dichloroethane; Ethylene dichloride	107–06–2	Ethane, 1,1-dichloro-	8010	0.5
			8021	0.3 ..
			8260	5 .....
1,1-Dichloroethylene; 1,1-Dichloroethene; Vinylidene chloride.	75–35–4	Ethene, 1,1-dichloro-	8010	1
			8021	0.5
			8260	5 .....
cis-1,2-Dichloroethylene; cis-1,2-Dichloroethene.	156–59–2	Ethene, 1,2-dichloro-, (Z)-	8021	0.2
			8260	5 .....
trans-1,2-Dichloroethylene trans-1,2-Dichloroethene.	156–60–5	Ethene, 1,2-dichloro-, (E)-	8010	1
			8021	0.5
			8260	5 .....
2,4-Dichlorophenol	120–83–2	Phenol, 2,4-dichloro-	8040	5
			8270	10
2,6-Dichlorophenol	87–65–0	Phenol, 2,6-dichloro-	8270	10
1,2-Dichloropropane; Propylene dichloride.	78–87–5	Propane, 1,2-dichloro-	8010	0.5
			8021	0.05
			8260	5 .....
1,3-Dichloropropane; Trimethylene dichloride.	142–28–9	Propane, 1,3-dichloro-	8021	0.3
			8260	5 .....
2,2-Dichloropropane; Isopropylidene chloride.	594–20–7	Propane, 2,2-dichloro-	8021	0.5
			8260	15 ...
1,1-Dichloropropene	563–58–6	1-Propene, 1,1-dichloro-	8021	0.2
			8260	5 .....
cis-1,3-Dichloropropene	10061–01–5	1-Propene, 1,3-dichloro-, (Z)-	8010	20
			8260	10
trans-1,3-Dichloropropene	10061–02–6	1-Propene, 1,3-dichloro-, (E)-	8010	5
			8260	10
Dieldrin	60–57–1	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexa, chloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aα,2β,2aα,3β,6β,6aα,7β,7aα)-.	8080	0.05
			8270	10 ...
Diethyl phthalate	84–66–2	1,2-Benzenedicarboxylic acid, diethyl ester.	8060	5
			8270	10
0,0-Diethyl 0-2-pyrazinyl phosphorothioate; Thionazin.	297–97–2	Phosphorothioic acid, 0,0-diethyl 0-pyrazinyl ester.	8141	5
			8270	20
Dimethoate	60–51–5	Phosphorodithioic acid, 0,0-dimethyl S-[2-(methylamino)-2-oxoethyl] ester.	8141	3
			8270	20
p-(Dimethylamino)azobenzene	60–11–7	Benzenamine, N,N-dimethyl-4-(phenylazo)-.	8270	10
7,12-Dimethylbenz[a]anthracene	57–97–6	Benz[a]anthracene, 7,12-dimethyl-	8270	10
3,3^1-Dimethylbenzidine	119–93–7	[1,1^1-Biphenyl]-4,4^1-diamine, 3,3^1-dimethyl-.	8270	10
2,4-Dimethylphenol; m-Xylenol	105–67–9	Phenol, 2,4-dimethyl-	8040	5
			8270	10

Common Name[2]	CAS RN[3]	Chemical abstracts service index name[4]	Suggested methods[5]	PQL (µ g/L)[6]
Dimethyl phthalate	131–11–3	1,2-Benzenedicarboxylic acid, dimethyl ester.	8060 8270	5 10
m-Dinitrobenzene	99–65–0	Benzene, 1,3-dinitro-	8270	20
4,6-Dinitro-o-cresol 4,6-Dinitro-2-methylphenol.	534–52–1	Phenol, 2-methyl-4,6-dinitro	8040 8270	150 50
2,4-Dinitrophenol;	51–28–5	Phenol, 2,4-dinitro-	8040 8270	150 50
2,4-Dinitrotoluene	121–14–2	Benzene, 1-methyl-2,4-dinitro-	8090 8270	0.2 10 ...
2,6-Dinitrotoluene	606–20–2	Benzene, 2-methyl-1,3-dinitro-	8090 8270	0.1 10 ...
Dinoseb; DNBP; 2-sec-Butyl-4,6-dinitrophenol.	88–85–7	Phenol, 2-(1-methylpropyl)-4,6-dinitro-	8150 8270	1 20
Di-n-octyl phthalate	117–84–0	1,2-Benzenedicarboxylic acid, dioctyl ester.	8060 8270	30 10
Diphenylamine	122–39–4	Benzenamine, N-phenyl-	8270	10
Disulfoton	298–04–4	Phosphorodithioic acid, 0,0-diethyl S-[2-(ethylthio)ethyl] ester.	8140 8141 8270	2 0.5 10 ...
Endosulfan I	959–98–8	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexa- chloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide,	8080 8270	0.1 20 ...
Endosulfan II	33213–65–9	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexa- chloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide, (3α,5aα,6β,9β,9aα)-.	8080 8270	0.05 20 ...
Endosulfan sulfate	1031–07–8	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexa- chloro-1,5,5a,6,9,9a-hexahydro-,3-3-dioxide.	8080 8270	0.5 10 ...
Endrin	72–20–8	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aα, 2β,2aβ,3α,6α,6aβ,7β,7aα)-.	8080 8270	0.1 20 ...
Endrin aldehyde	7421–93–4	1,2,4-Methenocyclopenta[cd]pentalene-5-carboxaldehyde, 2,2a,3,3,4,7-hexachlorodecahydro-, (1α,2β,2aβ,4β,4aβ,5β,6aβ,6bβ,7R*)-.	8080 8270	0.2 10 ...
Ethylbenzene	100–41–4	Benzene, ethyl-	8020 8221 8260	2 0.05 5 .....
Ethyl methacrylate	97–63–2	2-Propenoic acid, 2-methyl-, ethyl ester	8015 8260 8270	5 10 10
Ethyl methanesulfonate	62–50–0	Methanesulfonic acid, ethyl ester	8270	20
Famphur	52–85–7	Phosphorothioic acid, 0-[4-[(dimethylamino)sulfonyl]phenyl] 0,0-dimethyl ester.	8270	20
Fluoranthene	206–44–0	Fluoranthene	8100 8270	200 10
Fluorene	86–73–7	9H-Fluorene	8100 8270	200 10
Heptachlor	76–44–8	4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-.	8080 8270	0.05 10 ...
Heptachlor epoxide	1024–57–3	2,5-Methano-2H-indeno[1,2-b]oxirene, 2,3,4,5,6,7,7-heptachloro-1a,1b,5,5a,6,6a-hexahydro-, (1aα, 1bβ, 2α, 5α, 5aβ, 6β, 6aα).	8080 8270	1 10
Hexachlorobenzene	118–74–1	Benzene, hexachloro-	8120 8270	0.5 10 ...
Hexachlorobutadiene	87–68–3	1,3-Butadiene, 1,1,2,3,4,4-hexachloro-	8021 8120 8260 8270	0.5 5 ..... 10 ... 10 ...
Hexachlorocyclopentadiene	77–47–4	1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-.	8120 8270	5 10
Hexachloroethane	67–72–1	Ethane, hexachloro-	8120 8260 8270	0.5 10 ... 10 ...
Hexachloropropene	1888–71–7	1-Propene, 1,1,2,3,3,3-hexachloro-	8270	10
2-Hexanone; Methyl butyl ketone	591–78–6	2-Hexanone	8260	50

Common Name[2]	CAS RN[3]	Chemical abstracts service index name[4]	Suggested methods[5]	PQL (μ g/L)[6]
Indeno(1,2,3-cd)pyrene	193–39–5	Indeno(1,2,3-cd)pyrene	8100 8270	200 10
Isobutyl alcohol	78–83–1	1-Propanol, 2-methyl-	8015 8240	50 100
Isodrin	465–73–6	1,4,5,8-Dimethanonaphthalene,1,2,3,4,10,10- hexachloro-1,4,4a,5,8,8a hexahydro-(1α,4α,4aβ,5β,8β,8aβ)-.	8270 8260	20 10
Isophorone	78–59–1	2-Cyclohexen-1-one, 3,5,5-trimethyl-	8090 8270	60 10
Isosafrole	120–58–1	1,3-Benzodioxole, 5-(1-propenyl)-	8270	10
Kepone	143–50–0	1,3,4-Metheno-2H-cyclobuta[cd]pentalen-2-one, 1,1a,3,3a,4,5,5,5a,5b,6-decachlorooctahydro-.	8270	20
Lead	(Total)	Lead	6010 7420 7421	400 1000 10
Mercury	(Total)	Mercury	7470	2
Methacrylonitrile	126–98–7	2-Propenenitrile, 2-methyl-	8015 8260	5 100
Methapyrilene	91–80–5	1,2-Ethanediamine, N,N-dimethyl-N^{1}-2-pyridinyl-N1/2-thienylmethyl)-.	8270	100
Methoxychlor	72–43–5	Benzene,1,1^{1}-(2,2,2,trichloroethylidene)bis[4-methoxy-.	8080 8270	2 10
Methyl bromide; Bromomethane	74–83–9	Methane, bromo-	8010 8021	20 10
Methyl chloride; Chloromethane	74–87–3	Methane, chloro-	8010 8021	1 0.3
3-Methylcholanthrene	56–49–5	Benz[j]aceanthrylene, 1,2-dihydro-3-methyl-.	8270	10
Methyl ethyl ketone; MEK; 2-Butanone	78–93–3	2-Butanone	8015 8260	10 100
Methyl iodide; Iodomethane	74–88–4	Methane, iodo-	8010 8260	40 10
Methyl methacrylate	80–62–6	2-Propenoic acid, 2-methyl-, methyl ester.	8015 8260	2 30
Methyl methanesulfonate	66–27–3	Methanesulfonic acid, methyl ester	8270	10
2-Methylnaphthalene	91–57–6	Naphthalene, 2-methyl-	8270	10
Methyl parathion; Parathion methyl	298–00–0	Phosphorothioic acid, 0,0-dimethyl	8140 8141 8270	0.5 1 ..... 10 ...
4-Methyl-2-pentanone; Methyl isobutyl ketone.	108–10–1	2-Pentanone, 4-methyl-	8015 8260	5 100
Methylene bromide; Dibromomethane	74–95–3	Methane, dibromo-	8010 8021 8260	15 20 10
Methylene chloride; Dichloromethane	75–09–2	Methane, dichloro-	8010 8021 8260	5 0.2 10 ...
Naphthalene	91–20–3	Naphthalene	8021 8100 8260 8270	0.5 200 5 ..... 10 ...
1,4-Naphthoquinone	130–15–4	1,4-Naphthalenedione	8270	10
1-Naphthylamine	134–32–7	1-Naphthalenamine	8270	10
2-Naphthylamine	91–59–8	2-Naphthalenamine	8270	10
Nickel	(Total)	Nickel	6010 7520	150 400
o-Nitroaniline; 2-Nitroaniline	88–74–4	Benzenamine, 2-nitro-	8270	50
m-Nitroaniline; 3-Nitroanile	99–09–2	Benzenamine, 3-nitro-	8270	50
p-Nitroaniline; 4-Nitroaniline	100–01–6	Benzenamine, 4-nitro	8270	20
Nitrobenzene	98–95–3	Benzene, nitro-	8090 8270	40 10
o-Nitrophenol; 2-Nitrophenol	88–75–5	Phenol, 2-nitro-	8040 8270	5 10
p-Nitrophenol; 4-Nitrophenol	100–02–7	Phenol, 4-nitro-	8040 8270	10 50
N-Nitrosodi-n-butylamine	924–16–3	1-Butanamine, N-butyl-N-nitroso-	8270	10
N-Nitrosodiethylamine	55–18–5	Ethanamine, N-ethyl-N-nitroso-	8270	20
N-Nitrosodimethylamine	62–75–9	Methanamine, N-methyl-N-nitroso-	8070	2

Common Name[2]	CAS RN[3]	Chemical abstracts service index name[4]	Suggested methods[5]	PQL (μ g/L)[6]
N-Nitrosodiphenylamine	86–30–6	Benzenamine, N-nitroso-N-phenyl-	8070	5
N-Nitrosodipropylamine; N-Nitroso-N-dipropylamine; Di-n-propylnitrosamine.	621–64–7	1-Propanamine, N-nitroso-N-propyl-	8070	10
N-Nitrosomethylethalamine	10595–95–6	Ethanamine, N-methyl-N-nitroso-	8270	10
N-Nitrosopiperidine	100–75–4	Piperidine, 1-nitroso-	8270	20
N-Nitrosopyrrolidine	930–55–2	Pyrrolidine, 1-nitroso-	8270	40
5-Nitro-o-toluidine	99–55–8	Benzenamine, 2-methyl-5-nitro-	8270	10
Parathion	56–38–2	Phosphorothioic acid, 0,0-diethyl 0-(4-nitrophenyl) ester.	8141	0.5
			8270	10 ...
Pentachlorobenzene	608–93–5	Benzene, pentachloro-	8270	10
Pentachloronitrobenzene	82–68–8	Benzene, pentachloronitro-	8270	20
Pentachlorophenol	87–86–5	Phenol, pentachloro-	8040	5
			8270	50
Phenacetin	62–44–2	Acetamide, N-(4-ethoxyphenl)	8270	20
Phenanthrene	85–01–8	Phenanthrene	8100	200
			8270	10
Phenol	108–95–2	Phenol	8040	1
p-Phenylenediamine	106–50–3	1,4-Benzenediamine	8270	10
Phorate	298–02–2	Phosphorodithioic acid, 0,0-diethyl S-[(ethylthio)methyl] ester.	8140	2
			8141	0.5
			8270	10 ...
Polychlorinated biphenyls; PCBs; Aroclors.	See Note 9	1,1'-Biphenyl, chloro derivatives	8080	50
			8270	200
Pronamide	23950–58–5	Benzamide, 3,5-dichloro-N-(1,1-dimethyl-2-propynyl)-.	8270	10
Propionitrile; Ethyl cyanide	107–12–0	Propanenitrile	8015	60
			8260	150
Pyrene	129–00–0	Pyrene	8100	200
			8270	10
Safrole	94–59–7	1,3-Benzodioxole, 5-(2-propenyl)-	8270	10
Selenium	(Total)	Selenium	6010	750
			7740	20
			7741	20
Silver	(Total)	Silver	6010	70
			7760	100
			7761	10
Silvex; 2,4,5-TP	93–72–1	Propanoic acid, 2-(2,4,5-trichlorophenoxy)-.	8150	2
Styrene	100–42–5	Benzene, ethenyl-	8020	1
			8021	0.1
			8260	10 ...
Sulfide	18496–25–8	Sulfide	9030	4000
2,4,5-T; 2,4,5-Trichlorophenoxyacetic acid.	93–76–5	Acetic acid, (2,4,5-trichlorophenoxy)-	8150	2
1,2,4,5-Tetrachlorobenzene	95–94–3	Benzene, 1,2,4,5-tetrachloro-	8270	10
1,1,1,2-Tetrachloroethane	630–20–6	Ethane, 1,1,1,2-tetrachloro-	8010	5
			8021	0.05
			8260	5 .....
1,1,2,2-Tetrachloroethane	79–34–5	Ethane, 1,1,2,2-tetrachloro-	8010	0.5
			8021	0.1 ..
			8260	5 .....
Tetrachloroethylene; Tetrachloroethene; Perchloroethylene.	127–18–4	Ethene, tetrachloro-	8010	0.5
			8021	0.5 ..
			8260	5 .....
2,3,4,6-Tetrachlorophenol	58–90–2	Phenol, 2,3,4,6-tetrachloro-	8270	10
Thallium	(Total)	Thallium	6010	400
			7840	1000
			7841	10
Tin	(Total)	Tin	6010	40
Toluene	108–88–3	Benzene, methyl-	8020	2
			8021	0.1
			8260	5 .....
o-Toluidine	95–53–4	Benzenamine, 2-methyl-	8270	10
Toxaphene	See Note 10	Toxaphene	8080	2
1,2,4-Trichlorobenzene	120–82–1	Benzene, 1,2,4-trichloro-	8021	0.3
			8120	0.5 ..
			8260	10 ...
			8270	10 ...
1,1,1-Trichloroethane; Methylchloroform	71–55–6	Ethane, 1,1,1-trichloro-	8010	0.3
			8021	0.3 ..
			8260	5 .....

Common Name[2]	CAS RN[3]	Chemical abstracts service index name[4]	Suggested methods[5]	PQL (μ g/L)[6]
1,1,2-Trichloroethane	79–00–5	Ethane, 1,1,2-trichloro-	8010	0.2
			8260	5 .....
Trichloroethylene; Trichloroethene	79–01–6	Ethene, trichloro-	8010	1
			8021	0.2
			8260	5 .....
Trichlorofluoromethane; CFC–11	75–69–4	Methane, trichlorofluoro-	8010	10
			8021	0.3
			8260	5 .....
2,4,5-Trichlorophenol	95–95–4	Phenol, 2,4,5-trichloro-	8270	10
2,4,6-Trichlorophenol	88–06–2	Phenol, 2,4,6-trichloro-	8040	5
			8270	10
1,2,3-Trichloropropane	96–18–4	Propane, 1,2,3-trichloro-	8010	10
			8021	5
			8260	15
0,0,0-Triethyl phosphorothioate	126–68–1	Phosphorothioic acid, 0,0,0-triethylester	8270	10
sym-Trinitrobenzene	99–35–4	Benzene, 1,3,5-trinitro-	8270	10
Vanadium	(Total)	Vanadium	6010	80
			7910	2000
			7911	40
Vinyl acetate	108–05–4	Acetic acid, ethenyl ester	8260	50
Vinyl chloride; Chloroethene	75–01–4	Ethene, chloro-	8010	2
			8021	0.4
			8260	10 ...
Xylene (total)	See Note 11	Benzene, dimethyl-	8020	5
			8021	0.2
			8260	5 .....
Zinc	(Total)	Zinc	6010	20
			7950	50
			7951	0.5

Notes

[1] The regulatory requirements pertain only to the list of substances; the right hand columns (Methods and PQL) are given for informational purposes only. See also footnotes 5 and 6.

[2] Common names are those widely used in government regulations, scientific publications, and commerce; synonyms exist for many chemicals.

[3] Chemical Abstracts Service registry number. Where "Total" is entered, all species in the ground water that contain this element are included.

[4] CAS index are those used in the 9th Collective Index.

[5] Suggested Methods refer to analytical procedure numbers used in EPA Report SW–846 "Test Methods for Evaluating Solid Waste", third edition, November 1986, as revised, December 1987. Analytical details can be found in SW–846 and in documentation on file at the agency. CAUTION: The methods listed are representative SW–846 procedures and may not always be the most suitable method(s) for monitoring an analyte under the regulations.

[6] Practical Quantitation Limits (PQLs) are the lowest concentrations of analytes in ground waters that can be realiably determined within specified limits of precision and accuracy by the indicated methods under routine laboratory operating conditions. The PQLs listed are generally stated to one significant figure. PQLs are based on 5 mL samples for volatile organics and 1 L samples for semivolatile organics. CAUTION: The PQL values in many cases are based only on a general estimate for the method and not on a determination for individual compounds; PQLs are not a part of the regulation.

[7] This substance is often called Bis(2-chloroisopropyl) ether, the name Chemical Abstracts Service applies to its noncommercial isomer, Propane, 2,2"-oxybis[2-chloro- (CAS RN 39638–32–9).

[8] Chlordane: This entry includes alpha-chlordane (CAS RN 5103–71–9), beta-chlordane (CAS RN 5103–74–2), gamma-chlordane (CAS RN 5566–34–7), and constituents of chlordane (CAS RN 57–74–9 and CAS RN 12789–03–6). PQL shown is for technical chlordane. PQLs of specific isomers are about 20 μg/L by method 8270.

[9] Polychlorinated biphenyls (CAS RN 1336–36–3); this category contains congener chemicals, including constituents of Aroclor 1016 (CAS RN 12674–11–2), Aroclor 1221 (CAS RN 11104–28–2), Aroclor 1232 (CAS RN 11141–16–5), Aroclor 1242 (CAS RN 53469–21–9), Aroclor 1248 (CAS RN 12672–29–6), Aroclor 1254 (CAS RN 11097–69–1), and Aroclor 1260 (CAS RN 11096–82–5). The PQL shown is an average value for PCB congeners.

[10] Toxaphene: This entry includes congener chemicals contained in technical toxaphene (CAS RN 8001–35–2), i.e., chlorinated camphene.

[11] Xylene (total): This entry includes o-xylene (CAS RN 96–47–6), m-xylene (CAS RN 108–38–3), p-xylene (CAS RN 106–42–3), and unspecified xylenes (dimethylbenzenes) (CAS RN 1330–20–7). PQLs for method 8021 are 0.2 for o-xylene and 0.1 for m- or p-xylene. The PQL for m-xylene is 2.0 μg/L by method 8020 or 8260.

PART 259 [Reserved]

ATTACHMENT B

40 CFR PART 261, TOXICITY CHARACTERISTICS

in ASTM Standard D-3278-78 (incorporated by reference, see § 260.11), or as determined by an equivalent test method approved by the Administrator under procedures set forth in §§ 260.20 and 260.21.

(2) It is not a liquid and is capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture or spontaneous chemical changes and, when ignited, burns so vigorously and persistently that it creates a hazard.

(3) It is an ignitable compressed gas as defined in 49 CFR 173.300 and as determined by the test methods described in that regulation or equivalent test methods approved by the Administrator under §§ 260.20 and 260.21.

(4) It is an oxidizer as defined in 49 CFR 173.151.

(b) A solid waste that exhibits the characteristic of ignitability has the EPA Hazardous Waste Number of D001.

[45 FR 33119, May 19, 1980, as amended at 46 FR 35247, July 7, 1981; 55 FR 22684, June 1, 1990]

§ 261.22 Characteristic of corrosivity.

(a) A solid waste exhibits the characteristic of corrosivity if a representative sample of the waste has either of the following properties:

(1) It is aqueous and has a pH less than or equal to 2 or greater than or equal to 12.5, as determined by a pH meter using Method 9040 in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," EPA Publication SW-846, as incorporated by reference in § 260.11 of this chapter.

(2) It is a liquid and corrodes steel (SAE 1020) at a rate greater than 6.35 mm (0.250 inch) per year at a test temperature of 55 °C (130 °F) as determined by the test method specified in NACE (National Association of Corrosion Engineers) Standard TM-01-69 as standardized in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," EPA Publication SW-846, as incorporated by reference in § 260.11 of this chapter.

(b) A solid waste that exhibits the characteristic of corrosivity has the EPA Hazardous Waste Number of D002.

[45 FR 33119, May 19, 1980, as amended at 46 FR 35247, July 7, 1981; 55 FR 22684, June 1, 1990; 58 FR 46049, Aug. 31, 1993]

§ 261.23 Characteristic of reactivity.

(a) A solid waste exhibits the characteristic of reactivity if a representative sample of the waste has *any* of the following properties:

(1) It is normally unstable and readily undergoes violent change without detonating.

(2) It reacts violently with water.

(3) It forms potentially explosive mixtures with water.

(4) When mixed with water, it generates toxic gases, vapors or fumes in a quantity sufficient to present a danger to human health or the environment.

(5) It is a cyanide or sulfide bearing waste which, when exposed to pH conditions between 2 and 12.5, can generate toxic gases, vapors or fumes in a quantity sufficient to present a danger to human health or the environment.

(6) It is capable of detonation or explosive reaction if it is subjected to a strong initiating source or if heated under confinement.

(7) It is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure.

(8) It is a forbidden explosive as defined in 49 CFR 173.51, or a Class A explosive as defined in 49 CFR 173.53 or a Class B explosive as defined in 49 CFR 173.88.

(b) A solid waste that exhibits the characteristic of reactivity has the EPA Hazardous Waste Number of D003.

[45 FR 33119, May 19, 1980, as amended at 55 FR 22684, June 1, 1990]

§ 261.24 Toxicity characteristic.

(a) A solid waste (except manufactured gas plant waste) exhibits the characteristic of toxicity if, using the Toxicity Characteristic Leaching Procedure, test Method 1311 in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," EPA Publication SW-846, as incorporated by reference in § 260.11 of this chapter, the extract from a representative sample of the waste contains any of the contaminants listed in table 1 at the concentration equal to or greater than the respective value given in that table. Where the waste contains less than 0.5 percent filterable solids, the waste itself, after filtering using the methodology outlined in Method 1311, is considered to be the extract for the purpose of this section.

(b) A solid waste that exhibits the characteristic of toxicity has the EPA Hazardous Waste Number specified in Table I which corresponds to the toxic contaminant causing it to be hazardous.

TABLE 1—MAXIMUM CONCENTRATION OF CONTAMINANTS FOR THE TOXICITY CHARACTERISTIC

EPA HW No.[1]	Contaminant	CAS No.[2]	Regulatory Level (mg/L)
D004	Arsenic	7440–38–2	5.0
D005	Barium	7440–39–3	100.0
D018	Benzene	71–43–2	0.5
D006	Cadmium	7440–43–9	1.0
D019	Carbon tetrachloride	56–23–5	0.5
D020	Chlordane	57–74–9	0.03
D021	Chlorobenzene	108–90–7	100.0
D022	Chloroform	67–66–3	6.0
D007	Chromium	7440–47–3	5.0
D023	o-Cresol	95–48–7	[4]200.0
D024	m-Cresol	108–39–4	[4]200.0
D025	p-Cresol	106–44–5	[4]200.0
D026	Cresol	....	[4]200.0
D016	2,4-D	94–75–7	10.0
D027	1,4-Dichlorobenzene	106–46–7	7.5
D028	1,2-Dichloroethane	107–06–2	0.5
D029	1,1-Dichloroethylene	75–35–4	0.7
D030	2,4-Dinitrotoluene	121–14–2	[3]0.13
D012	Endrin	72–20–8	0.02
D031	Heptachlor (and its epoxide).	76–44–8	0.008
D032	Hexachlorobenzene	118–74–1	[3]0.13
D033	Hexachlorobutadiene	87–68–3	0.5
D034	Hexachloroethane	67–72–1	3.0
D008	Lead	7439–92–1	5.0
D013	Lindane	58–89–9	0.4
D009	Mercury	7439–97–6	0.2
D014	Methoxychlor	72–43–5	10.0
D035	Methyl ethyl ketone	78–93–3	200.0
D036	Nitrobenzene	98–95–3	2.0
D037	Pentrachlorophenol	87–86–5	100.0
D038	Pyridine	110–86–1	[3]5.0
D010	Selenium	7782–49–2	1.0
D011	Silver	7440–22–4	5.0
D039	Tetrachloroethylene	127–18–4	0.7
D015	Toxaphene	8001–35–2	0.5
D040	Trichloroethylene	79–01–6	0.5
D041	2,4,5-Trichlorophenol	95–95–4	400.0
D042	2,4,6-Trichlorophenol	88–06–2	2.0
D017	2,4,5-TP (Silvex)	93–72–1	1.0
D043	Vinyl chloride	75–01–4	0.2

[1] Hazardous waste number.

[2] Chemical abstracts service number.

[3] Quantitation limit is greater than the calculated regulatory level. The quantitation limit therefore becomes the regulatory level.

[4] If o-, m-, and p-Cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used. The regulatory level of total cresol is 200 mg/l.

[55 FR 11862, Mar. 29, 1990, as amended at 55 FR 22684, June 1, 1990; 55 FR 26987, June 29, 1990; 58 FR 46049, Aug. 31, 1993; 67 FR 11254, Mar. 13, 2002]

Subpart D—Lists of Hazardous Wastes

§261.30 General.

(a) A solid waste is a hazardous waste if it is listed in this subpart, unless it has been excluded from this list under §§260.20 and 260.22.

(b) The Administrator will indicate his basis for listing the classes or types of wastes listed in this subpart by employing one or more of the following Hazard Codes:

Ignitable Waste	(I)
Corrosive Waste	(C)
Reactive Waste	(R)
Toxicity Characteristic Waste	(E)
Acute Hazardous Waste	(H)
Toxic Waste	(T)

Appendix VII identifies the constituent which caused the Administrator to list the waste as a Toxicity Characteristic Waste (E) or Toxic Waste (T) in §§261.31 and 261.32.

(c) Each hazardous waste listed in this subpart is assigned an EPA Hazardous Waste Number which precedes the name of the waste. This number must be used in complying with the notification requirements of Section 3010 of the Act and certain recordkeeping and reporting requirements under parts 262 through 265, 268, and part 270 of this chapter.

(d) The following hazardous wastes listed in §261.31 or §261.32 are subject to the exclusion limits for acutely hazardous wastes established in §261.5: EPA Hazardous Wastes Nos. FO20, FO21, FO22, FO23, FO26, and FO27.

[45 FR 33119, May 19, 1980, as amended at 48 FR 14294, Apr. 1, 1983; 50 FR 2000, Jan. 14, 1985; 51 FR 40636, Nov. 7, 1986; 55 FR 11863, Mar. 29, 1990]

§261.31 Hazardous wastes from non-specific sources.

(a) The following solid wastes are listed hazardous wastes from non-specific sources unless they are excluded under §§260.20 and 260.22 and listed in appendix IX.

Prepared for:

WM
WASTE MANAGEMENT

Vista Landfill, L.L.C.
242West Keene Road
Apopka, FL 32703

OPERATION PLAN

VISTA LANDFILL, CLASS III
Apopka, Florida

Prepared by:

Geosyntec
consultants

14055 Riveredge Drive, Suite 300
Tampa, FL 33637

Project No. FL1229

July 2007

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1. INTRODUCTION

1.1 Purpose and Scope of the Operation Plan

The Operation Plan provides a detailed description of the daily operations of the Vista Landfill, Class III facility, including contingency operations for emergencies. This Operation Plan complies with the requirements of Chapter 62-701, Florida Administrative Code (FAC) and Chapter 66, City of Apopka Code of Ordinances (a.k.a. Solid Waste Management Ordinance – SWMO).

1.2 Facility Location

Vista Landfill, Class III facility is located in the City of Apopka. The general site location is shown in Figure 1. The site is within Section 21, Township 21 South, Range 28 East in Orange County, Florida. The main entrance of the facility is located at latitude 28°38’24.5”N, longitude 81°80’41.7”W. The currently permitted footprint of the facility is shown in Figure 2.

2. FACILITIES AND PERSONNEL

2.1 Designation of Responsible Persons

In accordance with Rule 62-701.500(1), FAC, the facility has at least one trained operator at the facility during periods of waste acceptance (operation) during operation and at least one trained spotter at each working face. Note that if the trained operator is at the working face, he/she can also function as a trained spotter.

The District Manager for Vista Landfill, L.L.C. (Vista Landfill) and the Operations Supervisor/Site Manager for the Vista Landfill, Class III facility has responsibility of overall management and operation of the Vista Landfill, Class III facility. The District Manager has the authority to obtain the necessary personnel to operate the site and provide for their training and orientation. The District Manager ascertains the facility's need for equipment, has the authority to replace existing equipment or obtain new equipment, and is responsible for administering the provisions of the site operation plan.

The Compliance and Construction Engineer is responsible for facility compliance, as well as assisting with operational issues, groundwater, leachate and facility gas sampling, submittal of monitoring reports, surveying of disposal area limits, and facility planning.

The day-to-day operations of the site are directed by the Operations Supervisor/Site Manager who is responsible for site personnel attendance and performance. As such, he/she routinely directs the daily activities of the operations manager, scale-house attendant, facility operators and spotters, and other support personnel.

Vista Landfill, Class III facility is currently staffed approximately as follows:

- 1 – District Manager
- 1 – Compliance and Construction Engineer
- 1 – Site Manager/Operations Supervisor – Trained Operator and Trained Spotter
- 2 – Scale house Operators – Trained Spotters
- 3 – Trained Operators
- 3 – Trained Spotters
- 2 - Laborers

A list of personnel is attached as Attachment A.

2.1.1 Employee Training

A trained operator shall be on duty whenever the facility is operating and at least one trained spotter shall be on duty at all times that waste is received at the site to inspect the incoming waste. The operator(s) and spotter(s) of the Class III disposal area at Vista Landfill, Class III facility are trained in accordance with the requirements of Rule 62-701.320(15), FAC. Further, trained personnel are aware of, have access to, and will substantially comply with at all times, this operations plan. The operators shall be properly trained to operate the facility and the spotters shall be trained to identify and properly manage any hazardous or prohibited materials that are inadvertently received at the Class III disposal facility. Any trained operator at Vista Landfill, Class III facility shall complete 24 hours of initial training, and shall pass an examination as part of that training. Within three years after passing the examination, and every three years thereafter, operators shall complete an additional 16 hours of continued training. A trained spotter at Vista Landfill, Class III facility shall complete 8 hours of initial training. Within three years after attending the initial training, and every three years thereafter, spotters shall complete an additional 4 hours of continued training. The training of the operator and spotter is performed through those courses offered to the public through TREEO training at the University of Florida and other approved sources (see www.treeo.ufl.edu).

Vista Landfill, Class III facility will not employ a person to perform, nor may any person perform the duties of an operator or spotter at Vista Landfill, Class III facility unless that person is a trained operator or trained spotter, or an interim operator or interim spotter.

A trained operator shall be on duty whenever the facility is operating and at least one trained spotter shall be on duty at all times that waste is received at the site to inspect the incoming waste. An interim operator may perform the duties of an operator or spotter, but only under the supervision of a trained onsite operator. An interim spotter may perform the duties of a spotter, but only under the supervision of a trained onsite operator or trained onsite spotter.

An interim operator is a person who has not completed the required 24-hour initial training course, but has, in the opinion of Vista Landfill, Class III facility Operations Supervisor/Site Manager, shown competency as an operator through a combination of work experience, education and/or training and who has at least one year of experience at Vista Landfill, Class III facility or other similar facility. The determination to grant interim operator status may be made at the time of hiring, based on information provided in the resume or application. Alternatively, the Operations Supervisor/Site Manager may grant interim operator status following work observations.

An interim spotter is a person who has not completed the required 8-hour initial training course, but has, in the opinion of Vista Landfill, Class III facility Operations Supervisor/Site Manager, shown competency as a spotter through a combination of work experience, education and/or training. The determination to grant interim spotter status may be made at the time of hiring, based on information provided in the resume or application. Alternatively, the Operations Supervisor/Site Manager may grant interim spotter status following work observations.

Interim status for operators and spotters is not intended to exceed six months, provided that TREEO or other approved training is available during this period.

2.1.2 Training Records

The training records are kept at the facility at all times and are available for inspection by Florida Department of Environmental Protection (FDEP), upon request. A list of trained personnel is attached as Attachment A.

2.2 Onsite Structures

On-site structures include an administration building, scale house, and maintenance buildings/facilities used for equipment repair. The scale house is located near the entrance to the facility along the north property boundary.

2.2.1 Communications

Communication equipment at Vista Landfill, Class III facility consists of telephone service for outside communications and cellular phones or radios for communications between ground personnel and equipment personnel.

3. ENTRANCE PROCEDURES

3.1 Control of Incoming Waste

In accordance with Rule 62-701.200(14), FAC, only Class III waste, defined as *yard trash, construction and demolition debris, processed tires, asbestos, carpet, cardboard, paper, glass, plastic, furniture other than appliances, or other materials approved by the Department that are not expected to produce leachate which poses a threat to public health or the environment*, is knowingly accepted for disposal.

Vista Landfill, Class III facility does not knowingly dispose of hazardous waste, putrescible waste, liquid wastes, brown goods (small appliances, electronic goods, cathode ray tubes, etc…), or any other non-Class III waste material. Unacceptable loads are rejected as described in Section 4.2. Once Class III waste has been accepted and unloaded, if any unacceptable waste is found, spotter(s) will proceed to remove unacceptable wastes to a temporary staging area for placement at the end of the working day into containers destined for other facilities properly permitted to receive such wastes. If the generator or transporter of any unacceptable waste can be identified, they may be requested to remove the unacceptable material from the landfill.

Although State and City requirements do not currently prohibit the disposal of CCA treated wood at Class III Landfills, Vista Landfill is committed to being proactive. Spotters are encouraged to identify and remove CCA treated wood, for disposal at a lined facility, to reduce the quantity of CCA treated wood being disposed at Vista Landfill, Class III facility.

3.2 Hours and Days of Operation

Typical hours for acceptance of waste are:

Monday through Friday	7:00 am to 6:00 pm
Saturday	8:00 am to 12:00 pm

The actual hours of operation are posted at the main entrance to the facility. The facility is closed on Sundays and designated holidays. Access by all vehicles shall be via a single secured site entrance. The entrance allows for safe and orderly traffic flow into and out of the facility. Public access and receipt of waste occurs only when an attendant is on duty.

3.3 Weighing of Incoming Waste

All solid waste accepted at the facility is weighed. Tare weights of the trucks will be determined as the emptied vehicle leaves the site. Tare weights for waste haulers that regularly visit the site are recorded so that they do not need to be weighed each time they leave the site unless specifically required by contract or to meet facility needs. Invoices are based on the weight of waste disposed.

4. TRAFFIC CONTROL AND UNLOADING

4.1 Facility Access Control and Security

Traffic into and out of the site is controlled by the use of a single public entry, a complete perimeter 6-ft. chain link fence with a locking gate, and an attendant present during operating hours. There is a sign at the site entrance with an emergency contact name and phone number. Gates at all roadway points are kept locked outside of normal working hours. All refuse traffic is required to pass by the scale house to gain entry to active portions of the landfill. Public access and receipt of wastes occur only when an attendant is on duty. Additionally, signs indicating “no trespassing” are installed on the perimeter fencing and at each fence corner.

Once vehicles delivering wastes have been weighed, they follow signs posted along the access road(s) to the currently active areas of the facility. Trucks then proceed to and deposit trash at the appropriate working face. Signs and Scale house personnel direct small public vehicles to unload their loads in the appropriate disposal area.

The landfill access road and other on-site roads are maintained to allow access to monitoring devices and stormwater controls and for landfill inspections and fire fighting.

4.1.1 Access to and Unloading at the Active Face

Waste haulers are directed from the controlled entrance point to the working face by use of signage and facility personnel directing drivers when and where to enter, unload, and leave. A spotter or interim spotter directs traffic to the proper waste unloading location at the active face. Operator/spotters perform load spotting as the waste is deposited and additional spotting as the waste is spread and compacted.

A spotter is stationed at each working face at all times when the landfill receives waste in order to screen for any unauthorized materials. The equipment operator may serve as the spotter.

The operator then spreads the waste and performs additional spotting during each pass while compacting the waste.

4.2 Signs, Traffic Flow

Signs are utilized to inform the public of important information concerning Vista Landfill, Class III facility. Signs are placed near the entrance of the landfill to provide information concerning name of operating authority, traffic flow, operating hours, and restrictions or conditions of disposal.

Traffic control and safety requirement signs are located at and near the entrance and throughout the facility as required.

4.3 Random Load Checking Program

To monitor the waste received at Vista Landfill, Class III facility, a load-checking program to detect and discourage attempts to dispose of unauthorized wastes at the facility is implemented. The load-checking program consists of the following minimum requirements specified in Section 66-177(1)k, SWMO and Rule 62-701.500(6)(a), FAC., and is described below. The Facility Operations Manager implements the program.

1. Landfill personnel examine at least three random loads of solid waste delivered to the landfill each week. The waste collection vehicle drivers selected by the inspector are directed to discharge their loads at a designated location within the landfill. A detailed inspection of the discharged material is then made for any unauthorized wastes.

2. If unauthorized wastes are found, Vista Landfill will contact the generator, hauler, or other party responsible for shipping the waste to the landfill to determine the identity of the waste sources.

4.4 Recording Random Inspection Results

Information and observations from each random inspection are recorded in writing and retained at the site for at least three years. The recorded information includes, at a minimum, the following information:

1. Date and time of the inspection.
2. Names of the hauling firm and the driver of the vehicle.
3. Vehicle license plate number.
4. Source of waste, as stated by the driver.
5. Observations made by the inspector during the detailed inspection.

The written record is signed by the inspector.

4.5 Management of Hazardous Wastes

If any regulated hazardous wastes are identified by random load-checking, or are otherwise discovered to be improperly deposited at the landfill, the operator will promptly notify the following parties:

1. Florida Department of Environmental Protection: 407-894-7555.
2. Other agencies, as required.
3. The person responsible for shipping the wastes to the landfill.
4. The generator of the wastes, if known.

The area where the wastes are deposited will be immediately restricted from public access. If the generator or hauler cannot be identified, the District Manager (DM) or Operations Supervisor (OS) will assure the cleanup, transportation, and disposal of the waste at a permitted hazardous waste management facility. Subsequent shipments from sources found or suspected to be previously responsible for shipping regulated hazardous waste will be subject to precautionary measures prior to the facility accepting wastes.

4.6 Management of Special Wastes

Asbestos-containing materials, non-friable and friable, are accepted and disposed at Vista only under specific conditions. The asbestos waste generator/hauler must notify the DM or OS prior to transporting the asbestos waste. The asbestos is disposed of in designated and recorded areas. The asbestos is then carefully covered in a manner so that neither equipment nor personnel come in contact with the waste.

5. WASTE RECORDS

The Scale Attendant records, in tons per day, the amount of solid waste received at the site. Waste reports will be compiled monthly, and copies will be provided to the City of Apopka and FDEP quarterly.

Quarterly Waste Quantity Reports are submitted to:

Tom Luboznski, P.E. Solid Waste Section Florida DEP 3319 Maguire Blvd., Suite 232 Orlando, FL 32803	R. J. “Jay” Davoll, P.E. Community Development Dept. City of Apopka 120 E. Main St., 2nd Floor Apopka, FL 32704

or via electronic mail to

Tom.Luboznski@dep.state.fl.us	jdavoll@apopka.net

or via facsimile to

(407) 893-3167	(407) 703-1791

6. METHOD AND SEQUENCE OF FILLING WASTE

6.1 Basic Operations

Generally, waste placement and ongoing operations are screened from view as practical. Solid waste is placed into cells to construct horizontal lifts. The solid waste will continue to be placed in layers and compacted using landfill equipment. Lift depth may vary depending on specific conditions, daily volume of waste, width of working face, and good safety practices. The compacted waste will continue to be graded with slopes not to exceed 3H:1V. Access roads have maximum slopes of 10% in order to readily allow vehicular access to the working face even during inclement weather conditions. The working face is maintained to minimize the amount of exposed waste and initial cover necessary at the end of the week.

The landfill development sequence is illustrated on the Permit Drawings and is shown in Figure 3. Waste disposal activities will continue until the final grade elevations have been reached. The final grades are also illustrated on the permitted plans.

6.1.1 Filling Procedures

The refuse cell is the basic building block of a landfill. It is composed of several compacted layers of waste and enclosed by cover material. Basic instructions for constructing the refuse cell are outlined below.

6.1.2 Working Face

The working face is the portion of the uncompleted cell on which additional waste is spread and compacted. The working face is kept as small as practical to minimize equipment movement, cover material requirements, and the area of exposed waste, thus reducing blowing litter, vector problems, and operation costs. The optimal daily working face width varies depending on the number of vehicles bringing waste to the site. The working face is kept wide enough to prevent a large backlog of trucks.

In order to facilitate proper dumping and waste placement operations, multiple working faces may be required to accommodate commercial non-tipper trailers, commercial tipper trailers, other commercial vehicles, and non-commercial vehicles.

The Operations Supervisor/Site Manager has the discretion to utilize multiple working faces on an as-needed basis, depending on site conditions. If separate working faces are used, a spotter or operator/spotter will be present at each.

6.1.3 Dumping

When top dumping, the waste is dumped as near to the edge of the active working face as safe operations permit. For safety reasons, a minimum 8 to 10 ft separation is maintained between the waste trucks and the landfill equipment.

When bottom dumping, the waste is dumped near the toe of the working face and pushed up the slope. Truck separation, as discussed above, is maintained.

6.1.4 Pushing, Spreading and Compacting

Proper cell construction involves pushing, spreading, and compacting. These functions are accomplished with a bulldozer and/or a compactor. Solid waste at Vista Landfill, Class III facility is spread in layers approximately three feet thick and compacted using suitable heavy equipment. Bulky materials that are not easily compacted are worked into other materials as much as practical.

6.1.5 Cover

6.1.5.1 Initial Cover

The initial cover will be applied and maintained in accordance with Section 66-177(1)t, SWMO, and Rule 62-701.500(7)(e)(2) FAC. A 6-inch thick initial cover is placed on top of the waste at the end of each week's operation in order to mitigate blowing litter and aid in control of odors. An alternative weekly cover in the form of geosynthetic material, tarpaulin, or other approved materials such as 50:50 mix of soil: mulch may be applied to the active face at the conclusion of each working week.

6.1.5.2 Intermediate Cover

Intermediate cover, consisting of 12 inches of soil, shall be applied and maintained within 7 days of cell completion if additional waste will not be deposited within 180 days of cell completion. In accordance with Rule 62-701.500(7)(f), all or part of the intermediate cover may be removed before placing additional waste or installing the final cover.

6.1.5.3 Final Cover

Areas of the landfill which have been filled to design dimensions shall receive final cover within 180-days after attaining final elevation or in accordance with the closure plan for the landfill. The final cover will be constructed in accordance with Section 66-177(1)t, SWMO and Rule 62-701.600(5)(g) FAC. The barrier layer to be installed will either be a geosynthetic clay liner (GCL) or 40-mil linear low-density polyethylene (LLDPE). The barrier layer will be installed over a 6-inch, minimum, soil layer, and overlain by 18-inches of cover protective soil, and 6-inches of compost or topsoil capable of sustaining a good stand of grass. A geocomposite drainage layer will be placed above all or parts of the barrier layer, depending on the specific barrier layer selected at the time of closure.

6.2 Scavenging

Uncontrolled and unauthorized scavenging is not allowed at this facility. However, controlled removal by landfill personnel of recovered material recycling may be permitted.

7. EQUIPMENT

7.1 Heavy Equipment and Support Equipment - Number, Type, Use

Based on the available range of handling capacities and the initial projected waste receipts, the allocation of heavy equipment presented in Table 1 is sufficient to handle the wastes received at the facility. The primary functions of heavy facility equipment are spreading and compacting solid waste, and excavating, hauling, and spreading cover material. Equipment similarities allow different equipment to perform the same function as necessary. For example, when a compactor breaks down, a bulldozer can perform the compacting operation.

Support equipment is present at the site most of the time, but some may be off-site, temporarily out of service, or rented for a specific occasion. An on-site water truck is normally positioned close to the working face for fire protection. This water truck is also equipped with spray bars for dust control. A utility mower is fitted with attachments for mowing grassed areas. A backhoe/loader is available to assist in maintaining drainage courses and ditches, and for other site maintenance duties.

Equipment makes, models, and quantities listed on Table 1 are subject to change as facility needs or requirements change.

Table 1 – Equipment Inventory.

Equipment Description	Use
Cat 950G	Loader
Cat D8R	Dozer
Cat D6R	Dozer
Cat 826G	Compactor
Volvo 710A	Grader
Cat 420D	Backhoe
Ford F450	Service truck
Volvo A30D	Dump truck
Kubota M7030 SUDT	Tractor
Street Sweeper	Entrance road cleaning

Equipment Description	Use
Ford 1998	3000 Gallon water truck
Cat VC60D	Forklift
Kubota F2100	Mower

7.2 Back-Up Equipment

The equipment selection guide indicated in Table 1 is adequate even if one of the pieces of equipment is temporarily out of service. If a piece of equipment is out of service for an extended period or if additional equipment is required on a temporary basis, this equipment is available for rental nearby and can normally be available at the site within 24 hours.

7.3 Equipment Care

Routine preventive maintenance minimizes equipment downtime and increases equipment service life. Preventive maintenance varies with each piece of equipment. Therefore, the appropriate operation and maintenance (owner's) manual should be consulted. However, three applicable maintenance activities implemented at the site are:

- A routine inspection program;
- Routine Lubrication
- Maintenance records upkeep.

7.4 Notification in Case of Equipment Failure

If there is an equipment failure that will disrupt normal operations for more then 24 hours, the Central District office of FDEP must be notified:

Tom Luboznski, P.E.
email: Tom.Luboznski@dep.state.fl.us -
phone: (407) 893-3329
facsimile: (407) 893-3167
address: Florida Department of Environmental Protection
3319 Maguire Blvd., Suite 232
Orlando, FL 32803

8. ENVIRONMENTAL AND OPERATIONAL CONTROLS

8.1 Stormwater Control

Stormwater management within the active portion of the landfill is achieved by grading all working face areas so that stormwater will be diverted into a ditch at the landfill base channel or directly into the stormwater basin(s). This facility has no off site discharge of stormwater.

8.2 Dust Control

Dust is controlled in landfilling areas at Vista Landfill, Class III facility by water truck and by establishing vegetative cover on areas within final and intermediate cover. Entrance roads are paved to a point beyond the scale house to minimize dust and sediment from being tracked onto the highway.

8.3 Vector Control

Vector control consists of maintaining a clean site, waste screening, constructing sufficient initial and intermediate cover, and minimizing ponded water in areas of landfill cover. Proper compaction of wastes eliminates many of the breeding areas used by these pests during the work week. Proper implementation of the drainage design inhibits ponding on the site.

8.4 Noise Control

Operational measures, such as construction of temporary berms, may be used to reduce noise generated at the site. Noise will be minimized to the best practical extent; however, some noises will continue to be present such as back-up alarms and other measures which are required by the Occupational Health and Safety Administration (OSHA) for safety.

8.5 Litter Control

A litter control policy is employed to minimize litter from leaving the working face of the landfill. Portable fences may be used, where necessary, to control blowing litter in the active landfilling areas. The litter that escapes the portable fences, or the inbound vehicles, and
blows to other areas of the property is picked up on a daily basis.

Litter is policed in the immediate proximity of the landfill, as necessary, to control any problems which may arise from debris blowing from trucks traveling along West Keene Road to the landfill. Vista Landfill, Class III facility employees observe West Keene Road daily, and often several times each working day. The litter along West Keene Road is picked up at least weekly, from Clarcona Road to the facility entrance, or more often if necessary, as evaluated by employee observation. Vista Landfill understands that Vista Landfill, Class III facility is part of a community, and that litter policing is part of being a good neighbor within that community.

8.6 Fire Control

Fire protection procedures include maintaining soil stockpiles in the vicinity of the working face. The cover used in the landfill operation provides an effective firewall.

Should a fire occur at the landfill, the application of soil will be used to cut off the flow of oxygen into the burning areas. The local fire department will be contacted to assist site personnel and equipment, if necessary. Appropriate fire extinguishers are carried on the equipment at all times and can be used to control any small equipment fire that may occur. Greater detail for dealing with fires is given in Section 9.1 of this plan.

8.7 Gas Control

Vista accepts, and will continue to accept, only Class III materials which generate low levels of methane gas in comparison to generation rates at Class I landfills. The gas monitoring system will consist of 25 permanent gas monitoring probe locations in total build-out, as shown on the site plan presented in Figure 4. The gas probes are monitored on a quarterly basis for explosive gas content. Additionally, on-site structures are monitored quarterly.

Action must be taken whenever the measured methane concentration in soil monitoring probes exceeds the Lower Exposure Limit (LEL) for combustible gases at or beyond the landfill property boundary or exceeds 25% of the LEL in onsite structures. If the results of monitoring show that combustible gas levels exceed these concentrations, either the Site

Engineer or the Compliance Manager will:

1. immediately take all necessary steps to ensure protection of human health and notify the Department;
2. submit a gas remediation plan to the Department within 7 days of the exceedence;

3. complete remediation within 60 days of exceedence, unless otherwise approved by the Department.

Quarterly methane monitoring reports, using the form in Attachment B, are reviewed by the Site Engineer or Compliance Manager and submitted to the Department at the following address:

Tom Luboznski, P.E.
Solid Waste Section
Florida Department of Environmental Protection
3319 Maguire Blvd., Suite 232
Orlando, FL 32803

or via electronic mail: Tom.Luboznski@dep.state.fl.us or facsimile: (407) 893-3167.

In the event that a permanent gas probe is not available for sampling, a "bar hole" is created in the vicinity of the damaged or missing probe by hammering a 3-foot long by ½-inch diameter metal "bar" into the ground the full length of the bar (i.e., three feet), and removing it, thus creating a "hole." Methane concentration is measured in this bar hole by inserting the instrument probe into the void and aspirating sample gas through the meter for 20-30 pumps on the aspirator bulb. If methane is encountered, aspiration continues until a steady-state reading is obtained, typically within 20 pumps and always within 30 pumps. If no methane is encountered, aspiration is concluded after 30 pumps and "0%" is recorded.

Every attempt is made to replace a damaged or missing gas probe within a reasonable time frame, typically before the next quarterly sampling event. Site conditions such as construction may make this time frame impractical to achieve, however. Vista Landfill uses drilling vendors to replace permanent gas probes. One such vendor is listed below; however, other vendors may be used.

The Colinas Group
509 North Virginia Avenue
Winter Park, FL 32789
(407) 622-8176

8.8 Odor Control and Monitoring

Class III waste materials do represent a potential for the generation of odorous gasses. Most commonly, the odors are derived from the anaerobic decomposition of gypsum wallboard, which forms hydrogen sulfide (H_2S) gas. The following sections address Vista Landfill, Class III facility's routine control, monitoring, and response procedures for odors caused by H_2S.

8.8.1 Landfill Design and Operation

The primary lines of defense against odor generation are design and operation. The Class III landfill has been designed with base grades that remain above the seasonal high water table and with final grades that help shed stormwater runoff. This design helps to minimize the potential for saturating the waste, which could subsequently lead to odor generation. Operations at Vista Landfill, Class III facility ensure that waste is compacted and graded to remain consistent with the intent of the design. Attention to waste placement, compaction, grading, covering and surveying will help maintain this record. Any poorly drained or ponded areas on top of the waste should be regraded in a timely manner.

8.8.2 Weather

Another important factor that affects odor generation and transport is weather. Understanding seasonal and daily weather patterns can assist the understanding of what may be happening to transport odors once they are generated. Radiation inversions have been identified as an atmospheric condition that can trap odors near the ground, preventing dispersion. These inversions are caused when air near the ground surface is cooled more rapidly than the air above it. So, they are strongest just before daylight and during periods of clear skies and light winds.

The Operations Supervisor/Site Manager or Compliance Engineer record weather data from the on-site weather station on the Odor Survey Form (Attachment C). These daily weather logs are maintained on site and are available for review by FDEP and the City of Apopka upon request.

8.8.3 Odor Surveying

At least once daily, Vista Landfill, Class III facility personnel patrol the property to detect and document odors. Attachment C provides a log for the odor patrol. The log includes information such as odor descriptors and locations. Additionally, staff should perform the patrol as early as possible in the day to document what will likely be the worst-case weather conditions for odors. If a moderate or strong odor is detected near the property line, staff may proceed off site in an effort to document the lateral extent (or off site source) of the odor. Vista Landfill, Class III facility personnel will not enter onto private property for odor studies without the consent of the property owner.

Odor surveying may also be supplemented by use of a hydrogen sulfide meter to quantify hydrogen sulfide concentrations (see section 8.8.4 for discussion of H_2S meter use).

8.8.4 Odor Complaints

Attachments D and E provide a mechanism to log and track odor complaint calls received by Vista Landfill, Class III facility at its main telephone number: 407-886-2920. Complaints are logged and compared to Vista Landfill, Class III facility's own odor observations and daily odor log. The Vista Landfill, Class III facility Operations Supervisor/Site Manager or Compliance Engineer will acknowledge complaints within one business day and address them within three business days.

Vista Landfill, Class III facility continues to endeavor to be an environmentally conscientious neighbor and take appropriate responses to odor complaints. The initial response is to cover waste. Any eroded cover will be addressed first, followed by the minimization of working face (as much as practical) by the application of initial cover. Other responses include dispersal of granular deodorizer or monitoring and recording H_2S concentrations around the perimeter of the landfill or at offsite locations using a hydrogen sulfide meter. The Operations Supervisor/Site Manager or Compliance Engineer will determine an appropriate response to any given complaint.

Several levels of analysis are used to determine an appropriate response to a complaint. The first level of analysis is the comparison of complaints to weather data. An analysis of the wind strength and direction during the time of the odor problem may help verify or refute that Vista Landfill, Class III facility is causing odors. Other patterns may be identified to help explain the cause of the odors. For example, odors may be noticed following rain events, or during periods of low pressure. Data gathered during the daily odor monitoring is also evaluated. Data from monitoring and recording H_2S concentrations around the perimeter of the landfill or at offsite locations using a hydrogen sulfide meter may also be evaluated.

Vista Landfill may conduct monitoring and recording of H_2S concentrations around the perimeter of the landfill or at offsite locations using a borrowed or rented hydrogen sulfide meter. Hydrogen sulfide meters, such as the Jerome 631-X or other similar meter, are available from the Waste Management Southern Group office located in Atlanta, GA, (770) 805-4130, or a meter may be borrowed or rented from the following companies:

SCS Engineers
3012 U.S. Hwy 301 N., Suite 700
Tampa, FL 33619
Tel: 813-621-0080

Grove Scientific & Engineering
6140 Edgewater Drive, Suite F
Orlando, FL 32810
Tel: 407-298-2282

Alternatively, Vista Landfill may employ the services of a qualified professional to monitor and record H_2S concentrations around the perimeter of the landfill or at offsite locations.

8.9 Water Quality Monitoring

Groundwater and leachate are monitored in accordance with the requirements of FDEP and City of Apopka Operating Permits and Standard Operating Procedures (SOPs), as applicable. Extensive water quality monitoring is conducted at Vista Landfill, Class III facility on an annual (for leachate) and semi-annual (for groundwater) basis. The water quality monitoring locations are shown on the Permit Drawings. The Water Quality Monitoring Plan for the Vista Landfill, Class III facility provides detailed sampling and collection procedures in accordance with Rule 62-701.510, FAC.

Surface water monitoring is not required for the Vista Landfill, Class III facility in accordance with the current solid waste permit for the site.

8.10 Erosion Control

The landfill is inspected daily using the form in Attachment C. Corrective action to repair areas of erosion where waste is exposed or which cause malfunction of the storm water management system will be implemented within three days of occurrence. If the erosion cannot be corrected within seven days of occurrence the landfill operator will notify FDEP with a proposed correction schedule.

8.11 Leachate Containment and Control

Vista Landfill, Class III facility is equipped with a geomembrane liner system. Any liquid entering the landfill that may have contacted waste is collected in a Leachate Control System (LCS). The LCS drains collected liquid to the cell sump. Leachate in the sump is pumped to an auxiliary leachate storage facility with approximately 160,000 gallons of capacity and conveyed to a municipal sanitary sewer line located on West Keene Road for off-site treatment and disposal at the City of Apopka Waste Water Treatment Plant (WWTP) or an alternative WWTP. Quantities of leachate collected by the LCS are recorded in gallons per day at each cell and maintained as part of the landfill operating record.

9. CONTINGENCY OPERATIONS

Contingency operations include emergencies such as fire, natural disasters, and equipment failure. Waste will not normally be delivered to the site during emergency conditions; however, the following procedures will be initiated at the onset of a major event that may cause an emergency.

Emergency Coordinators

Primary:	Sheree Henninger and Irv Slike, District Managers	407-886-2920
Secondary:	Mike Donaldson, Operations Supervisor/Site Manager	321-229-6393

9.1 Fire Control Plan

On-site fire protection facilities consist of soil stockpiles in the vicinity of the working face. The initial cover used in the landfill operation provides an effective firewall. Instructions on fire fighting procedures are routinely provided for site personnel. Should fire occur at Vista Landfill, Class III facility, the application of additional cover will be used to cut off the flow of oxygen into the burning area. The local fire department will be contacted to assist Vista Landfill, Class III facility personnel and equipment, if necessary. Appropriate fire extinguishers are carried on the equipment at all times.

9.1.1 When Fire Occurs

The following procedures are followed in the event of a fire at the facility:

1. Extinguish small fires with fire extinguisher or smother with soil - do not remain near large fires or explosive materials;
2. Determine location, extent, type, and, if possible, cause of fire or explosion;
3. Notify on-site personnel and implement safety and fire control procedures;
4. If the fire cannot be immediately controlled, the following steps should be taken:
   a) Notify facility emergency coordinator
   b) Notify City of Apopka Fire Department (911, or 407-703-1756). Clearly state:
      - Location of facility
      - Location of fire or explosion in facility
      - Extent of fire or explosion

  - Type of fire or explosion
  - Actions now being taken
  - Injuries

c) Notify rescue squad, if necessary
d) Notify health care facility, if necessary

5. Notify Florida Department of Environmental Protection: 407-894-7555.

9.1.2 "Hot Load" Procedures

In the unlikely event that a "hot load" is not identified before entrance into the facility, the following procedures are implemented:

- The truck carrying the "hot load" is directed to dump the load in the landfill but away from the working face;
- The load is placed on top of intermediate cover which provides sufficient protection from the "hot load" and the underlying waste;
- Soil is then spread over the load to smother the "hot load"; and
- The "hot load" is monitored until there is no evidence of smoldering or high temperatures.

At the end of the day, or at a time when the waste has been well extinguished and cooled, the load is worked into the waste placement working face. The designated area for extinguishing the "hot loads" varies depending on the location of the working face, but is always away from the working face.

9.1.3 Fire Extinguishers

Fire extinguishers are installed in the following locations:

- Onsite buildings
- Heavy equipment.

9.2 Hurricane Preparedness

The following is a general guideline that is to be followed before, during and after any hurricane. Due to the nature of these storms, there may be some deviation from this guide.

The Emergency Coordinator will oversee all preparations for the incoming storm and remain aware of any pending situation by monitoring weather reports. Other Landfill personnel will report to the Emergency Coordinator as follows:

Landfill Alternate Emergency Coordinator
Shop Mechanic/Next Senior Operator
Office Senior Clerk

Adequate cover material soil will be stockpiled. All ditches will be checked and cleaned for adequate flow. All lightweight signs and equipment will be collected and stored in a secure area.

Vista Landfill also has prepared a Hurricane Preparation and Planning Emergency Supplier Response Resource Notebook to be used as a tool to aid Market Area Hurricane Response Managers in their efforts to obtain, manage, and maintain open supply lines for needed goods, materials, and services as part of their hurricane preparation and recovery plan(s). This notebook is available for review by FDEP and the City of Apopka upon request.

10. LANDFILL FINAL CLOSURE

A separate Closure Plan will be prepared for Vista Landfill, Class III facility at the time of closure. This closure plan will contain a closure report, closure design, closure operation plan, closure procedures, and discussions on long-term care and financial assurance.

10.1 Final Cover System

As shown in the Permit Drawings, the final cover system consists of a geomembrane barrier, a two-foot soil layer, and vegetative cover. The grades of the final cover system are 3H:1V on the side slopes.

10.2 Erosion Minimization on Closed Areas

Erosion of the final cover system is minimized by the establishment of vegetative cover as well as the installation of final cover swales, downchutes, and other surface water management systems. The swales intercept sheet flow from the final cover system and direct the water via downchutes to perimeter storm water ponds.

A vegetative cover is placed on the final cover slopes of the landfill to minimize erosion and reduce soil loss from the surface of the final cover system. Any substantial erosion damage or vegetative stress will be repaired before significant erosion has a chance to develop. Ruts or rills which are six (6) inches or greater in depth are considered substantial.

Corrective action to repair areas of erosion will be implemented within three (3) days of occurrence, weather permitting. If the erosion cannot be corrected within seven (7) days of occurrence the landfill operator will notify FDEP with a proposed correction schedule.

10.3 Inspections of Closed Area

The final cover system will be inspected quarterly using the form in Attachment C. The inspection will include observations for erosion, vegetative stress, obvious differential settlement, and ponding of water. The surface water control structures will be inspected and cleaned if they become obstructed.

11. FINANCIAL RESPONSIBILITY

Proof of financial responsibility is prepared in accordance with FDEP requirements. The final closure cost estimates will be updated annually between January 1 and March 1 by the Site Engineer and/or the Compliance Manager and sent for review and approval to:

Tom Luboznski, P.E.
Florida Department of Environmental Protection
3319 Maguire Blvd., Suite 232
Orlando, FL 32803

Upon receipt of approval of the updated estimate, a revised mechanism in the form of a bond, insurance certificate, or other acceptable financial assurance mechanism to demonstrate financial responsibility will be provided by Vista Landfill.

The revised mechanism is sent to:

Frank Hornbrook
Florida Department of Environmental Protection
2600 Blair Stone Road, MS 4565
Tallahassee, FL 32399

with a copy to:

City of Apopka:
R. Jay Duvall, P.E., City Engineer
City of Apopka
120 East Main Street - 2nd Floor
Apopka, Florida 32703

12. OPERATING RECORD

In accordance with Rule 62-701.500(3), FAC, an operating record shall be maintained at the site including all records, reports, analytical results and notification required by Chapter 62-701, FAC, as well as the training verifications required by Chapter 62-701, FAC. This record is kept at the facility and is available for inspection by the FDEP and the City of Apopka.

As part of the operating record, waste records are maintained in accordance with Rule 62-701.500(4), FAC. These waste records indicate the amount of each type of waste received each day. Waste reports, summarizing the waste records, are compiled monthly and copies are provided to FDEP quarterly. The waste records are kept at the facility and are available for inspection by the FDEP and the City of Apopka.

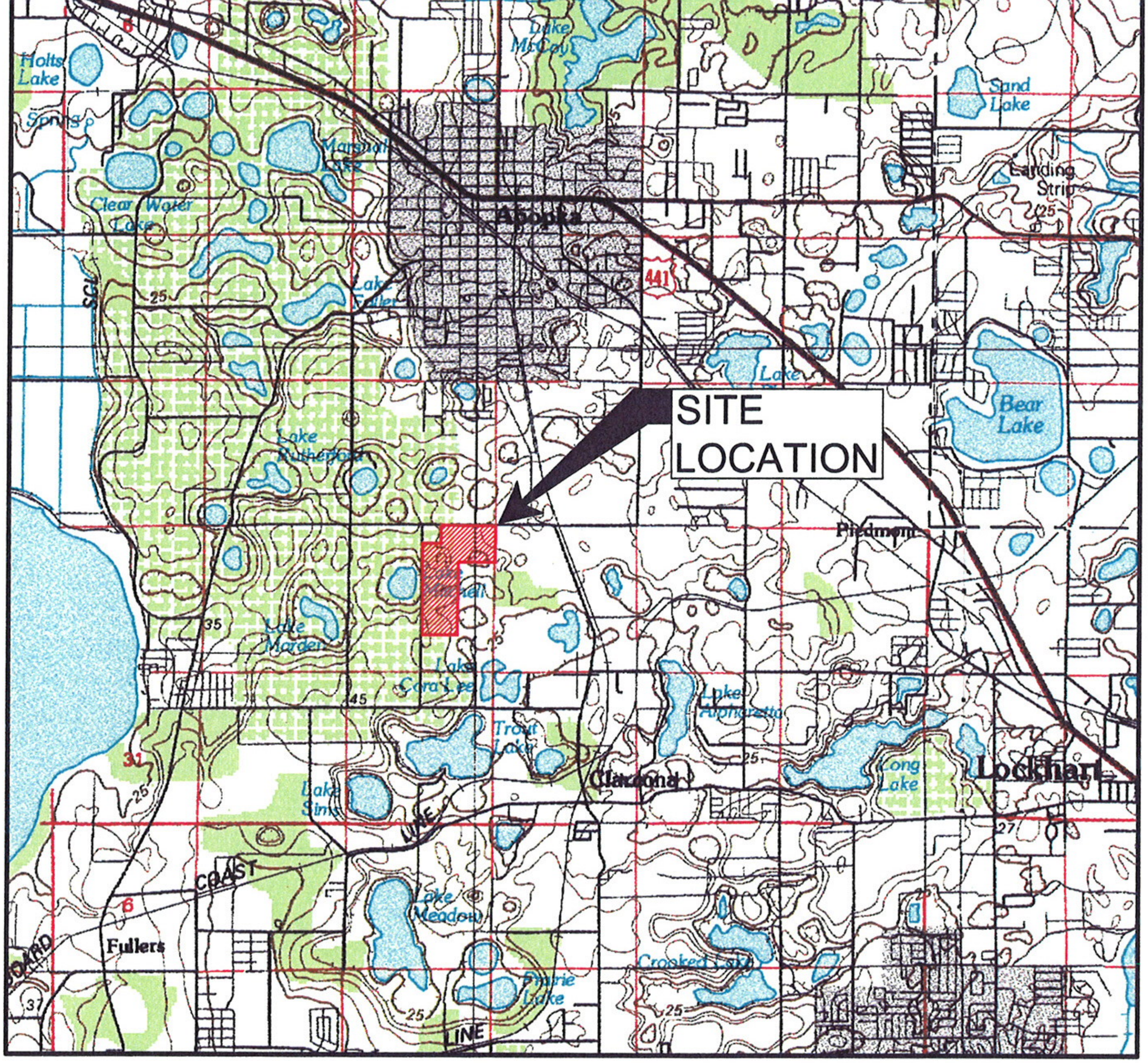
The operating record also includes the information and observations resulting from each random inspection of a waste load conducted as part of the load-checking program in accordance with Rule 62-701.500(6), FAC.

In addition, to satisfy the requirements of Rule 62-701.500(3), FAC, the operating record also includes the following:

- Records of all information used to develop or support the permit applications and any supplemental information required
- Records of all monthly information, including calibration and maintenance records, and water quality records
- An annual estimate of the remaining life and capacity in cubic yards of the existing, constructed facility and remaining life and capacity of other permitted areas not yet constructed (this estimate is reported annually to FDEP).

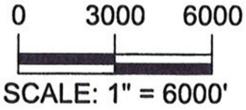
The operating records are maintained at the facility throughout the design life of the facility.

FIGURES



CONTOUR INTERVAL 5 METERS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

ORLANDO, FLORIDA
N2830–W8100/30 X 60



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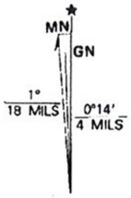

SITE LOCATION
VISTA LANDFILL
APOPKA, FL

Produced by the United States Geological Survey
Compiled from USGS 1:24 000-scale topographic maps dated 1953-1970. Planimetry revised from aerial photographs taken 1977 and other source data. Revised information not field checked. Map edited 1979
Projection and 10 000-meter grid, zone 17: Universal Transverse Mercator
25 000-foot grid ticks based on Florida coordinate system, east and west zones
1927 North American Datum

Geosyntec consultants

TAMPA, FL

DATE:	JULY 2007	FILE NO.	FL1229.02F003
PROJECT NO.	FL1229.02	FIGURE NO.	1

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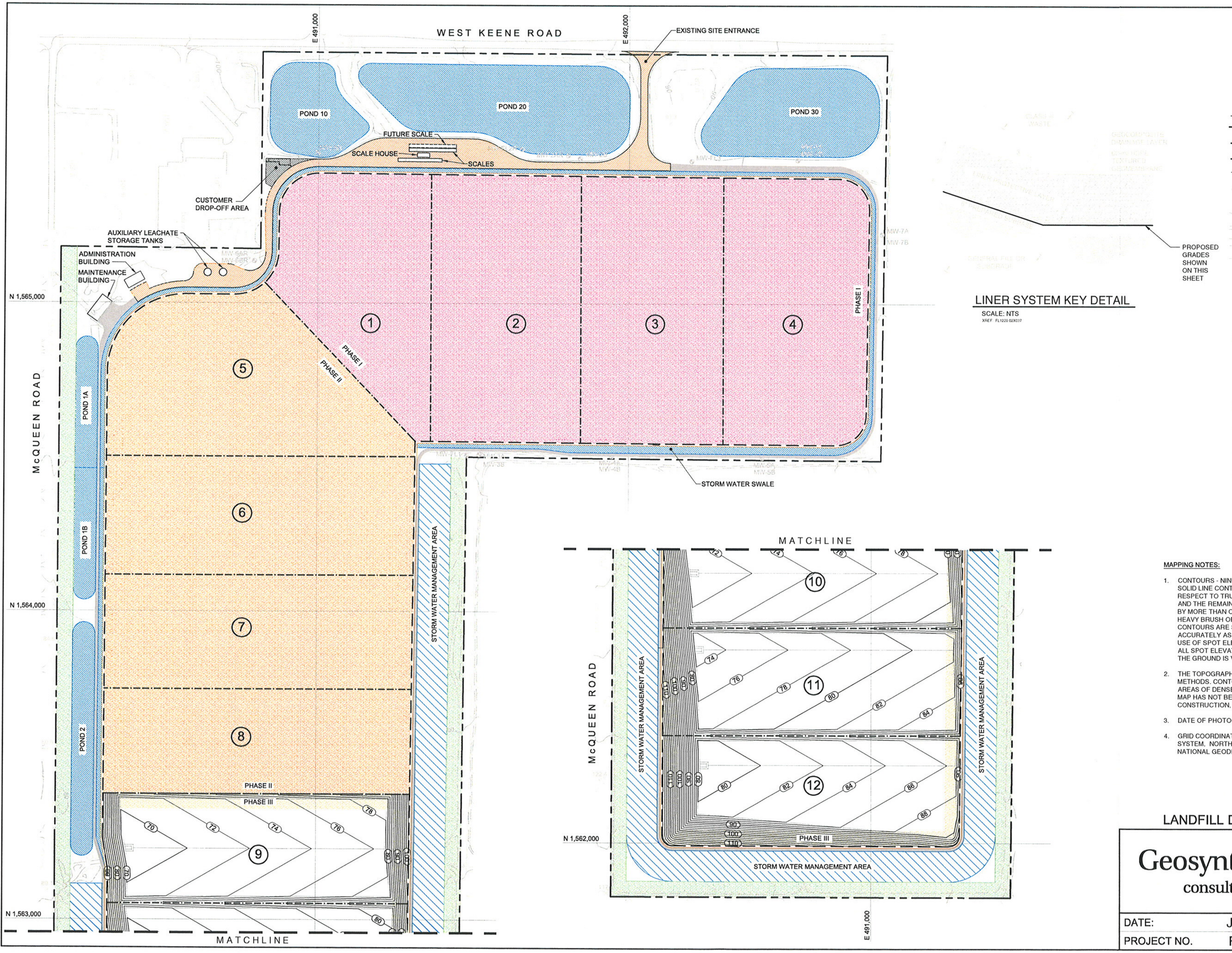

NORTH

150 75 0 150
SCALE IN FEET

LEGEND

— — —	APPROXIMATE PROPERTY BOUNDARY
— — —	LIMIT OF WASTE
— · —	INTERCELL BOUNDARY
—(60)—	TOP OF PREPARED SUBBASE
— 10 —	EXISTING GROUND CONTOUR (SEE NOTE 1)
	TREE LINE
	UNIMPROVED / DIRT ROAD
	IMPROVED / PAVED ROAD
—x—x—	FENCE
× 66.5	SPOT ELEVATION
● MW-1	EXISTING GROUNDWATER MONITORING WELL
③	CELL NUMBER
🟧	PAVED ACCESS ROAD
▨	GRAVEL ACCESS ROAD
🟩	UNDISTURBED LANDSCAPE BUFFER
🟦	STORM WATER POND OR SWALE
▨	STORM WATER MANAGEMENT AREA
🟥	PHASE I LINER FOOTPRINT
🟧	PHASE II LINER FOOTPRINT
🟨	PHASE III LINER FOOTPRINT

MAPPING NOTES:

1. CONTOURS - NINETY (90) PERCENT OF THE ELEVATIONS DETERMINED FROM THE SOLID LINE CONTOURS OF THIS TOPOGRAPHIC MAP HAVE AN ACCURACY WITH RESPECT TO TRUE ELEVATION OF ONE-HALF (1/2) CONTOUR INTERVAL OR BETTER AND THE REMAINING TEN (10) PERCENT OF SUCH ELEVATIONS ARE NOT IN ERROR BY MORE THAN ONE CONTOUR INTERVAL IN DENSELY WOODED AREAS WHERE HEAVY BRUSH OR TREE COVER FULLY OBSCURES THE GROUND AND THE CONTOURS ARE SHOWN AS DASHED LINES, THEY HAVE BEEN PLOTTED AS ACCURATELY AS POSSIBLE FROM THE STEREOSCOPIC MODEL, WHILE MAKING FULL USE OF SPOT ELEVATIONS OBTAINED DURING GROUND CONTROL SURVEYS AND ALL SPOT ELEVATIONS MEASURED PHOTOGRAMMETRICALLY IN PLACES WHERE THE GROUND IS VISIBLE.
2. THE TOPOGRAPHIC MAP WAS COMPILED BY 3001 INC. USING PHOTOGRAMMETRIC METHODS. CONTOURS PORTRAYED AS DASHED OR BROKEN LINES REPRESENT AREAS OF DENSE VEGETATION AND SHOULD BE CONSIDERED APPROXIMATE. THIS MAP HAS NOT BEEN FIELD VERIFIED. PRIOR TO USE AS A BASIS FOR DESIGN / CONSTRUCTION, IT SHOULD BE FIELD VERIFIED.
3. DATE OF PHOTOGRAPHY: 18 MARCH 2007
4. GRID COORDINATES ARE BASED ON FLORIDA EAST STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM 1983 (NAD 83). ELEVATIONS ARE BASED IN NATIONAL GEODETIC VERTICAL DATUM 1929 (NGVD 29).

LANDFILL DEVELOPMENT PHASING PLAN III

Geosyntec consultants

TAMPA, FL

DATE:	JULY 2007	FILE NO.	FL1229.02F018
PROJECT NO.	FL1229.02	FIGURE NO.	3C

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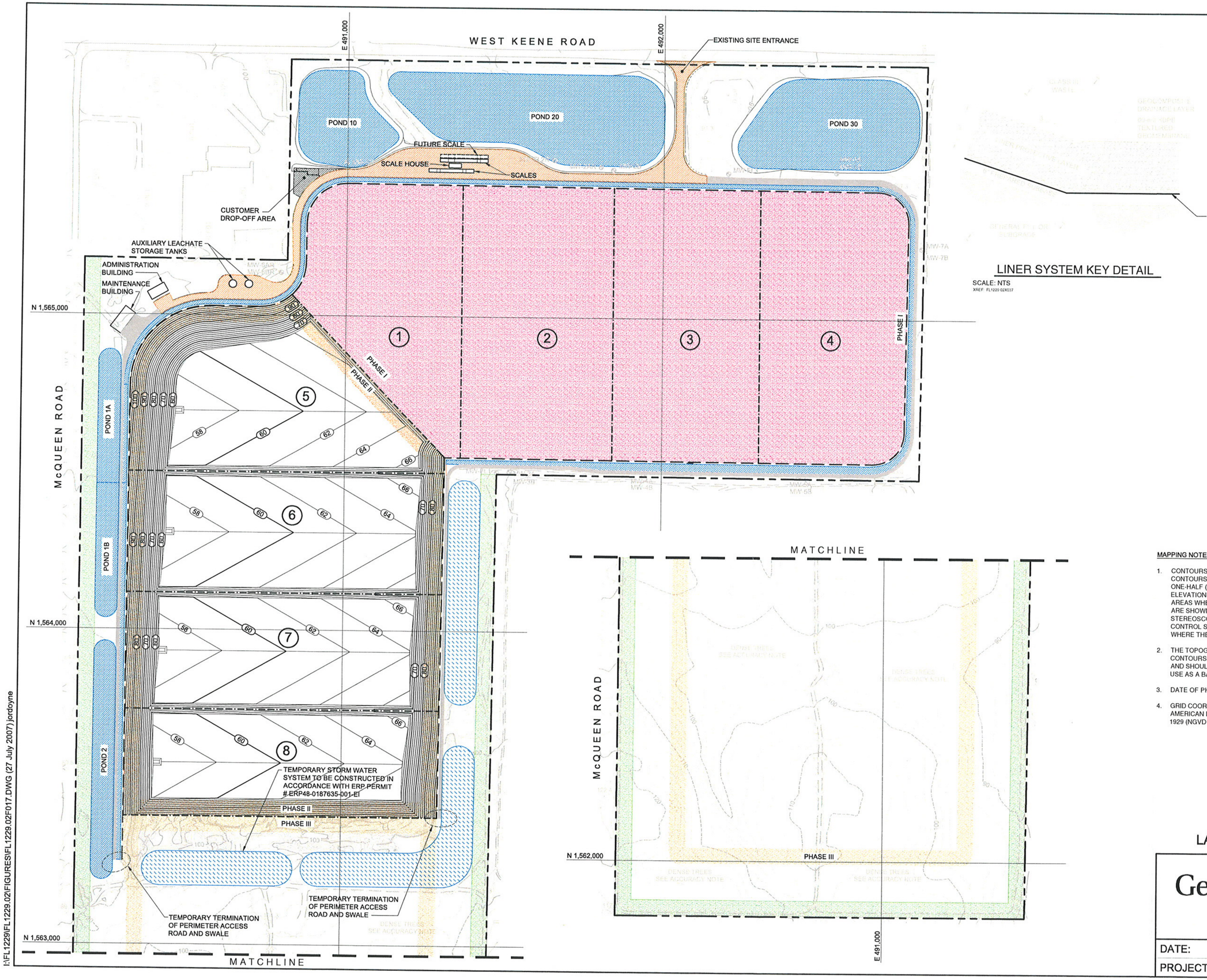

NORTH

150 75 0 150

SCALE IN FEET

LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- LIMIT OF WASTE
- INTERCELL BOUNDARY
- (60) TOP OF PREPARED SUBBASE
- EXISTING GROUND CONTOUR (SEE NOTE 1)
- TREE LINE
- UNIMPROVED / DIRT ROAD
- IMPROVED / PAVED ROAD
- FENCE
- SPOT ELEVATION
- EXISTING GROUNDWATER MONITORING WELL
- ③ CELL NUMBER
- PAVED ACCESS ROAD
- GRAVEL ACCESS ROAD
- UNDISTURBED LANDSCAPE BUFFER
- STORM WATER POND OR SWALE
- PHASE I LINER FOOTPRINT
- PHASE II LINER FOOTPRINT
- PHASE III LINER FOOTPRINT
- TEMPORARY STORM WATER SYSTEM

MAPPING NOTES:

1. CONTOURS - NINETY (90) PERCENT OF THE ELEVATIONS DETERMINED FROM THE SOLID LINE CONTOURS OF THIS TOPOGRAPHIC MAP HAVE AN ACCURACY WITH RESPECT TO TRUE ELEVATION OF ONE-HALF (1/2) CONTOUR INTERVAL OR BETTER AND THE REMAINING TEN (10) PERCENT OF SUCH ELEVATIONS ARE NOT IN ERROR BY MORE THAN ONE CONTOUR INTERVAL IN DENSELY WOODED AREAS WHERE HEAVY BRUSH OR TREE COVER FULLY OBSCURES THE GROUND AND THE CONTOURS ARE SHOWN AS DASHED LINES, THEY HAVE BEEN PLOTTED AS ACCURATELY AS POSSIBLE FROM THE STEREOSCOPIC MODEL, WHILE MAKING FULL USE OF SPOT ELEVATIONS OBTAINED DURING GROUND CONTROL SURVEYS AND ALL SPOT ELEVATIONS MEASURED PHOTOGRAMMETRICALLY IN PLACES WHERE THE GROUND IS VISIBLE.
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3. DATE OF PHOTOGRAPHY: 18 MARCH 2007
4. GRID COORDINATES ARE BASED ON FLORIDA EAST STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM 1983 (NAD 83). ELEVATIONS ARE BASED IN NATIONAL GEODETIC VERTICAL DATUM 1929 (NGVD 29).

LANDFILL DEVELOPMENT PHASING PLAN II

Geosyntec consultants

TAMPA, FL

DATE:	JULY 2007	FILE NO.	FL1229.02F017
PROJECT NO.	FL1229.02	FIGURE NO.	3B

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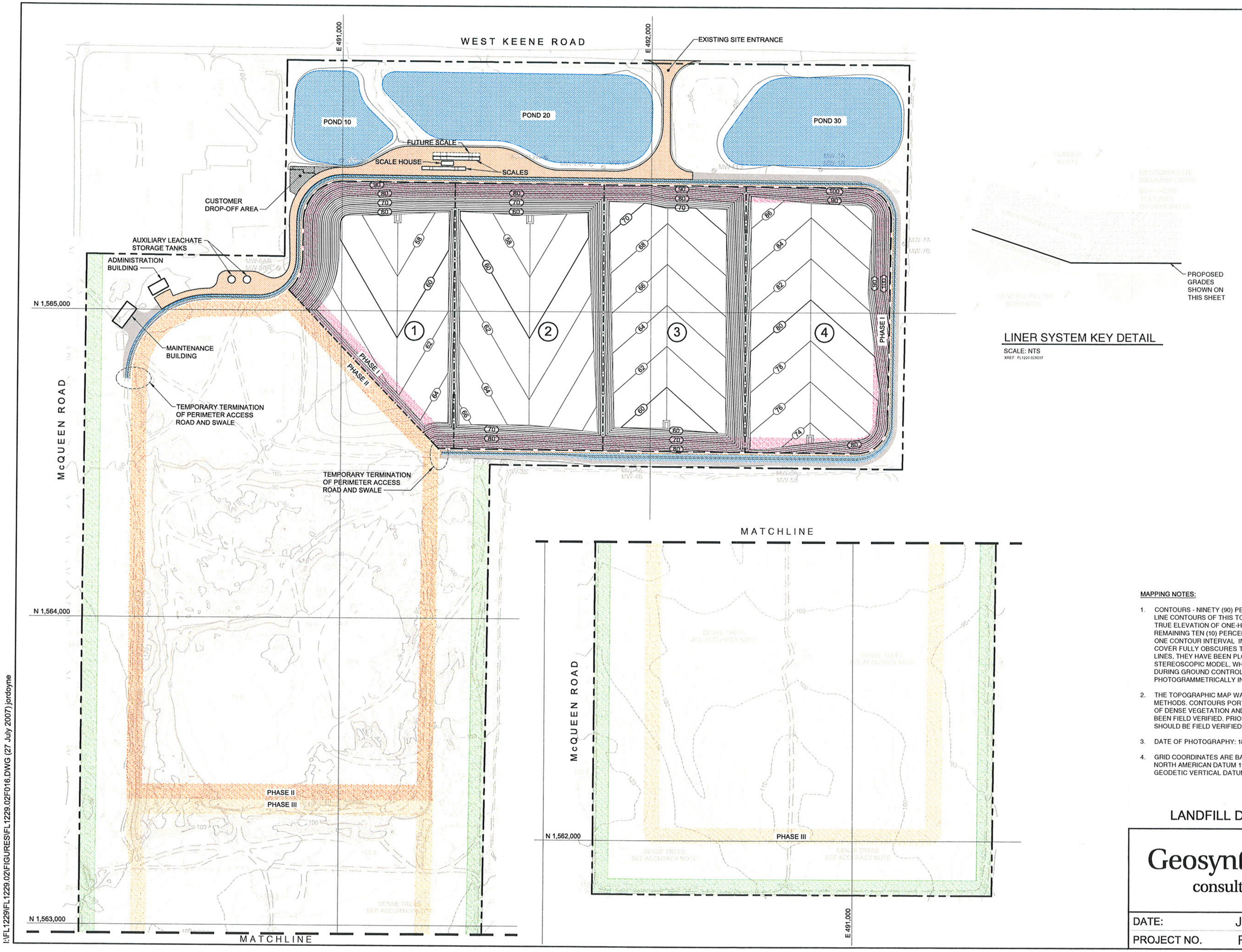

LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- LIMIT OF WASTE
- INTERCELL BOUNDARY
- (60) TOP OF PREPARED SUBBASE
- 80 EXISTING GROUND CONTOUR (SEE NOTE 1)
- TREE LINE
- UNIMPROVED / DIRT ROAD
- IMPROVED / PAVED ROAD
- FENCE
- SPOT ELEVATION
- EXISTING GROUNDWATER MONITORING WELL
- ③ CELL NUMBER
- PAVED ACCESS ROAD
- GRAVEL ACCESS ROAD
- UNDISTURBED LANDSCAPE BUFFER
- STORM WATER POND OR SWALE
- PHASE I LINER FOOTPRINT
- PHASE II LINER FOOTPRINT
- PHASE III LINER FOOTPRINT

MAPPING NOTES:

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LANDFILL DEVELOPMENT PHASING PLAN I

Geosyntec consultants

TAMPA, FL

DATE:	JULY 2007	FILE NO.	FL1229.02F016
PROJECT NO.	FL1229.02	FIGURE NO.	3A

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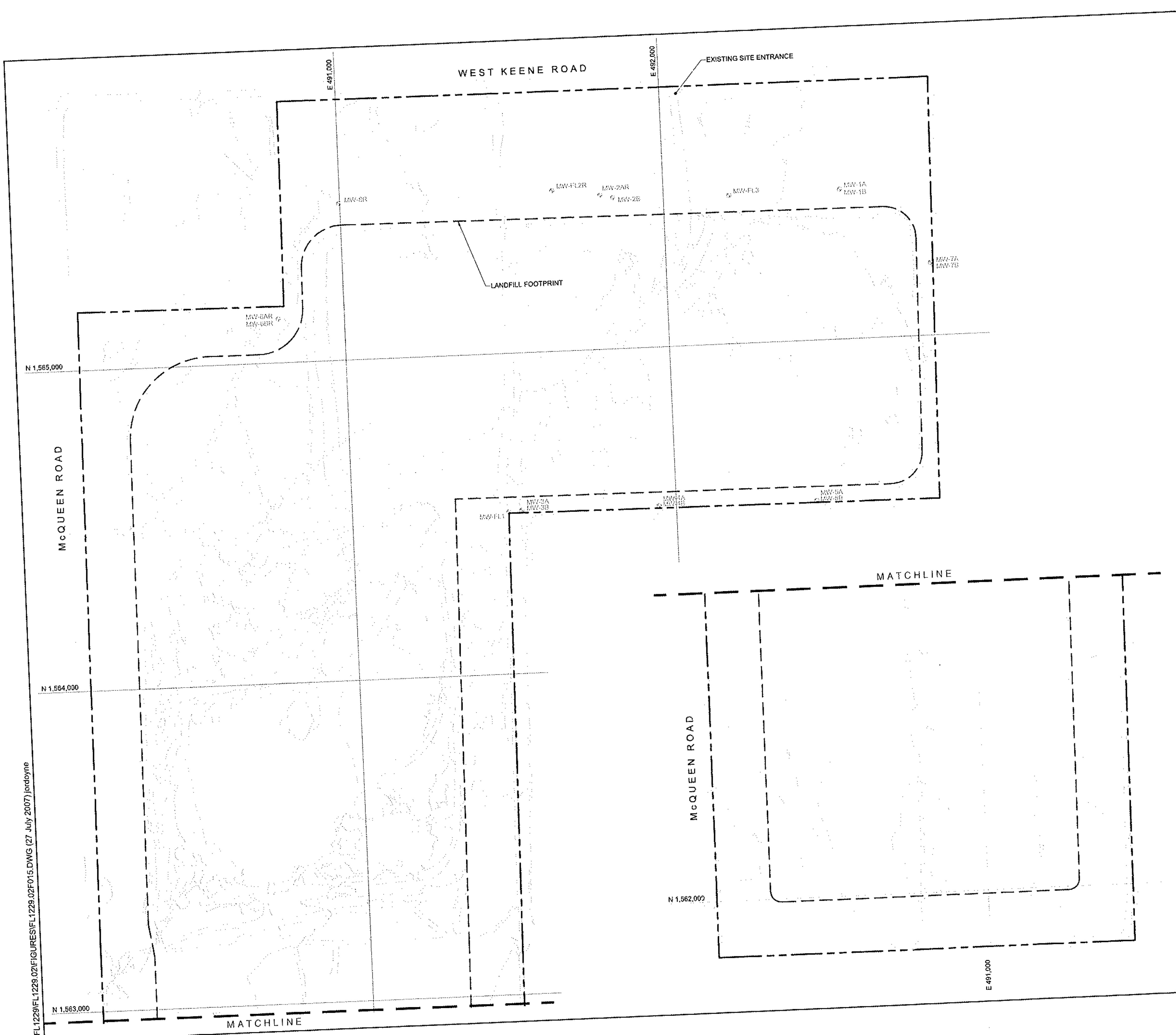

LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- LANDFILL FOOTPRINT
- EXISTING GROUND CONTOUR (SEE NOTE 1)
- TREE LINE
- UNIMPROVED / DIRT ROAD
- IMPROVED / PAVED ROAD
- FENCE
- SPOT ELEVATION
- EXISTING GROUNDWATER MONITORING WELL

MAPPING NOTES:

1. CONTOURS - NINETY (90) PERCENT OF THE ELEVATIONS DETERMINED FROM THE SOLID LINE CONTOURS OF THIS TOPOGRAPHIC MAP HAVE AN ACCURACY WITH RESPECT TO TRUE ELEVATION OF ONE-HALF (1/2) CONTOUR INTERVAL OR BETTER AND THE REMAINING TEN (10) PERCENT OF SUCH ELEVATIONS ARE NOT IN ERROR BY MORE THAN ONE CONTOUR INTERVAL IN DENSELY WOODED AREAS WHERE HEAVY BRUSH OR TREE COVER FULLY OBSCURES THE GROUND AND THE CONTOURS ARE SHOWN AS DASHED LINES, THEY HAVE BEEN PLOTTED AS ACCURATELY AS POSSIBLE FROM THE STEREOSCOPIC MODEL. WHILE MAKING FULL USE OF SPOT ELEVATIONS OBTAINED DURING GROUND CONTROL SURVEYS AND ALL SPOT ELEVATIONS MEASURED PHOTOGRAMMETRICALLY IN PLACES WHERE THE GROUND IS VISIBLE.

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3. DATE OF PHOTOGRAPHY: 18 MARCH 2007

4. GRID COORDINATES ARE BASED ON FLORIDA EAST STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM 1983 (NAD 83). ELEVATIONS ARE BASED IN NATIONAL GEODETIC VERTICAL DATUM 1929 (NGVD 29).

GENERAL NOTES:

5. GROUNDWATER MONITORING DATA SHOWN HEREON WAS OBTAINED FROM A SURVEY PREPARED BY PICKETT AND ASSOCIATES DATED 16 FEBRUARY 2007

6. GROUNDWATER TABLE CONTOURS ARE BASED ON SEASONAL HIGH WATER TABLE ELEVATIONS PRESENTED IN THE FOLLOWING REPORTS PREPARED BY DEVO ENGINEERING: "ESTIMATE OF SEASONAL HIGH GROUNDWATER ELEVATION" (DATED 21 OCTOBER 2002), "SUPPLEMENT # 1 TO REPORT DATED 21 OCTOBER 2002" (DATED 21 APRIL 2003), "WATER TABLE ESTIMATES AND PROPOSED BASE GRADE ELEVATIONS - BD4 SITE" (DATED 10 FEBRUARY 2004).

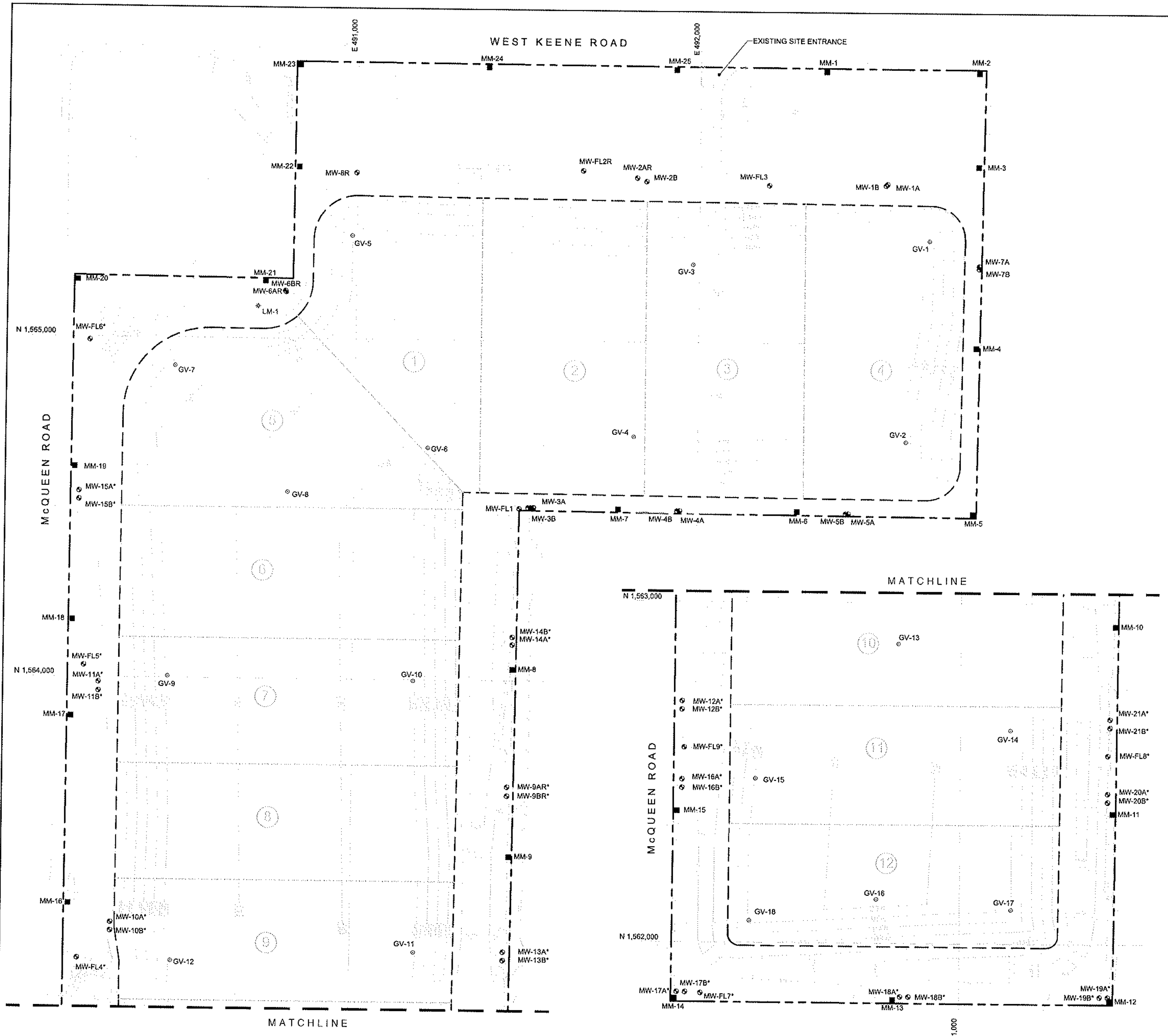
LANDFILL FOOTPRINT

Geosyntec consultants

TAMPA, FL

DATE:	JULY 2007	FILE NO.	FL1229.02F015
PROJECT NO.	FL1229.02	FIGURE NO.	2

FL1229\FL1229.02\FIGURES\FL1229.02F015.DWG (27 July 2007) jordoyne



NORTH

150 75 0 150

SCALE IN FEET

LEGEND

	APPROXIMATE PROPERTY BOUNDARY
	LIMIT OF WASTE
	INTERCELL BOUNDARY
	FINAL COVER SYSTEM CONTOUR
	EXISTING GROUND CONTOUR (SEE NOTE 1)
	TREE LINE
	UNIMPROVED / DIRT ROAD
	IMPROVED / PAVED ROAD
	FENCE
	SPOT ELEVATION
③	CELL NUMBERS
● MW-8	EXISTING GROUNDWATER MONITORING WELL
● MW-FL5*	PROPOSED GROUNDWATER MONITORING WELL
⊙ GV-9	PROPOSED GAS VENT PROBE
✲ LM-1	PROPOSED LEACHATE MONITORING POINT
■ MM-19	PROPOSED GAS MONITORING PROBE

MAPPING NOTES:

1. CONTOURS - NINETY (90) PERCENT OF THE ELEVATIONS DETERMINED FROM THE SOLID LINE CONTOURS OF THIS TOPOGRAPHIC MAP HAVE AN ACCURACY WITH RESPECT TO TRUE ELEVATION OF ONE-HALF (1/2) CONTOUR INTERVAL OR BETTER AND THE REMAINING TEN (10) PERCENT OF SUCH ELEVATIONS ARE NOT IN ERROR BY MORE THAN ONE CONTOUR INTERVAL. IN DENSELY WOODED AREAS WHERE HEAVY BRUSH OR TREE COVER FULLY OBSCURES THE GROUND AND THE CONTOURS ARE SHOWN AS DASHED LINES, THEY HAVE BEEN PLOTTED AS ACCURATELY AS POSSIBLE FROM THE STEREOSCOPIC MODEL, WHILE MAKING FULL USE OF SPOT ELEVATIONS OBTAINED DURING GROUND CONTROL SURVEYS AND ALL SPOT ELEVATIONS MEASURED PHOTOGRAMMETRICALLY IN PLACES WHERE THE GROUND IS VISIBLE.
2. THE TOPOGRAPHIC MAP WAS COMPILED BY 3001 INC. USING PHOTOGRAMMETRIC METHODS. CONTOURS PORTRAYED AS DASHED OR BROKEN LINES REPRESENT AREAS OF DENSE VEGETATION AND SHOULD BE CONSIDERED APPROXIMATE. THIS MAP HAS NOT BEEN FIELD VERIFIED. PRIOR TO USE AS A BASIS FOR DESIGN / CONSTRUCTION, IT SHOULD BE FIELD VERIFIED.
3. DATE OF PHOTOGRAPHY: 18 MARCH 2007
4. GRID COORDINATES ARE BASED ON FLORIDA EAST STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM 1983 (NAD 83). ELEVATIONS ARE BASED IN NATIONAL GEODETIC VERTICAL DATUM 1929 (NGVD 29).

GENERAL NOTES

5. GAS MONITORING DATA IS BASED UPON DRAWINGS TITLED "KEENE ROAD DISPOSAL CLASS III LANDFILL EXPANSION" PREPARED FOR BUTTREY DEVELOPMENT FOUR, LLC AND PREPARED BY BISHOP & BUTTREY, INC., DATED MAY 2004 AND REVISED JANUARY 2005.
6. PROPOSED GROUNDWATER MONITORING DATA IS BASED UPON DRAWINGS TITLED "CLASS III LANDFILL PERMIT RENEWAL, KEENE ROAD SOUTH" PREPARED FOR WASTE MANAGEMENT OF FLORIDA AND PREPARED BY S2LI, DATED JANUARY 2006.

ENVIRONMENTAL MANAGEMENT PLAN

Geosyntec consultants

TAMPA, FL

DATE:	JULY 2007	FILE NO.	FL1229.02F019
PROJECT NO.	FL1229.02	FIGURE NO.	4

I:\FL1229\FL1229.02\FIGU...\FL1229.02F019.DWG (27 July 2007) cvickers

ATTACHMENT A

VISTA LANDFILL, CLASS III FACILITY
PERSONNEL LIST

Name	Position	Certification(s)
Sheree Henniger	District Manager	
Irvin Slike	District Manager	
Ray Chewning	Compliance and Construction Engineer	P.E.
Michael Donaldson	Operations Supervisor/Site Manager	Operator/Spotter
Alvin Donaldson	Operator	Operator
Dana Allison	Operator	Operator
Jason Hall	Operator	Operator
Patricia Staley	Operator	Operator
Anibal Sanchez	Operator	Operator
Deborah Mangold	Spotter	Spotter
Leslie Holmes, Jr.	Operator	Operator
Charles Kelley	Operator	Operator
Diane Chenault	Spotter	Spotter

Florida DEP Solid Waste Management Facility Operator Courses

Donaldson, Michael A
Waste Management @ Pine Ridge Landfill
5400 Rex Road
Winter Garden, FL 34787

Phone: 4078770701
Fax: 4078776182

Track: "**Class I, II, III Landfill Operator 08/13/2003 - 08/12/2009**
Status: **Current**

Period: **Prior Courses**
No courses taken

Period: **08/13/2003 - 08/12/2006 - (Initial Period)**

Course #	Course Name	Provider	Completion Date	Hours
195	24-Hour Initial Training Course for Landfill Operators (Class I, II, III and C&D Sites)	Kohl Consulting, Inc.	08/13/2003	Initial
229	Landfill Compaction Training School-8 hours	Caterpilla & Ringhaver Equipment	11/08/2005	8
203	8-Hour Initial Training Course for Spotters at Class I, II, III Facilities, Waste Processing Facilities and C&D Facilities	University of Florida - TREEO	03/28/2006	8
			Total:	16

Period: **08/13/2006 - 08/12/2009**
No courses taken

Continuing Education (CE) Minimum 3 Year Requirement: I,II,III/C&D-16 hours TS/MRF-8 hours Spotter-4 hours.

Expired: If you have exceeded the 3 year training period without completing the minimum number of CE, you must start over by taking an approved initial course and pass exam.

Initial hours are not counted toward continuing education.

An Initial course can be taken as a CE course only if it was not taken as the operator's or spotter's initial training. No CE credit will be given for the same course taken within the same 3-year period.

If you have any questions, please contact djenkins@treeo.ufl.edu or jtouchton@treeo.ufl.edu or call 352.392.9570 extensions 227 or 212.

Florida DEP Solid Waste Management Facility Operator Courses

Donaldson, Alvin W
Waste Management @ Pine Ridge Landfill
5400 Rex Rd
Winter Garden, FL 34787

Phone: 4078770701
Fax: 4078776182

Track: "**Class I, II, III Landfill Operator 05/06/2004 - 05/05/2010**
Status: **Current**

Period: **Prior Courses**

Course #	Course Name	Provider	Completion Date	Hours
21	Solid Waste Landfill Operator's Short School	Solid Waste Association of North America (SWANA - Florida Chapter)	11/21/1997	20
138	Solid Waste Facility Operations for Landfill Operators	Kohl Consulting, Inc.	05/10/2000	20
			Total:	Prior

Period: **05/06/2004 - 05/05/2007 - (Initial Period)**

Course #	Course Name	Provider	Completion Date	Hours
195	24-Hour Initial Training Course for Landfill Operators (Class I, II, III and C&D Sites)	Kohl Consulting, Inc.	05/06/2004	Initial
196	16-Hour Initial Training Course for Transfer Station Operators	Kohl Consulting, Inc.	05/06/2004	10
196	16-Hour Initial Training Course for Transfer Station Operators	Kohl Consulting, Inc.	05/06/2004	10
229	Landfill Compaction Training School-8 hours	Caterpilla & Ringhaver Equipment	11/08/2005	8
			Total:	28

Period: **05/06/2007 - 05/05/2010**
No courses taken

Continuing Education (CE) Minimum 3 Year Requirement: I,II,III/C&D-16 hours TS/MRF-8 hours Spotter-4 hours.

Expired: If you have exceeded the 3 year training period without completing the minimum number of CE, you must start over by taking an approved initial course and pass exam.

Initial hours are not counted toward continuing education.

An Initial course can be taken as a CE course only if it was not taken as the operator's or spotter's initial training. No CE credit will be given for the same course taken within the same 3-year period.

If you have any questions, please contact djenkins@treeo.ufl.edu or jtouchton@treeo.ufl.edu or call 352.392.9570 extensions 227 or 212.

Florida DEP Solid Waste Management Facility Operator Courses

Allison, Dana
Equipment Operator
Waste Management @ Orlando
P O BOX 568245
ORLANDO, FL 328568245

Phone: 4074268252
Fax: 4074260345

Track: "**Class I, II, III Landfill Operator 05/06/2004 - 05/05/2010**
Status: **Current**

Period: **Prior Courses**

Course #	Course Name	Provider	Completion Date	Hours
21	Solid Waste Landfill Operator's Short School	Solid Waste Association of North America (SWANA - Florida Chapter)	11/15/1996	20
160	SWANA-Manager of Landfill Operations (MOLO) Course and Exam	Solid Waste Association of North America (SWANA - Florida Chapter)	02/09/2001	30
170	Health & Safety Issues for Solid Waste Management Facilities	University of Florida - TREEO	03/21/2003	8
			Total:	Prior

Period: **05/06/2004 - 05/05/2007 - (Initial Period)**

Course #	Course Name	Provider	Completion Date	Hours
195	24-Hour Initial Training Course for Landfill Operators (Class I, II, III and C&D Sites)	Kohl Consulting, Inc.	05/06/2004	Initial
196	16-Hour Initial Training Course for Transfer Station Operators	Kohl Consulting, Inc.	05/06/2004	10
196	16-Hour Initial Training Course for Transfer Station Operators	Kohl Consulting, Inc.	05/06/2004	10
229	Landfill Compaction Training School-8 hours	Caterpilla & Ringhaver Equipment	11/08/2005	8
			Total:	28

Period: **05/06/2007 - 05/05/2010**
No courses taken

Continuing Education (CE) Minimum 3 Year Requirement: I,II,III/C&D-16 hours TS/MRF-8 hours Spotter-4 hours.

Expired: If you have exceeded the 3 year training period without completing the minimum number of CE, you must start over by taking an approved initial course and pass exam.

Initial hours are not counted toward continuing education.

An Initial course can be taken as a CE course only if it was not taken as the operator's or spotter's initial training. No CE credit will be given for the same course taken within the same 3-year period.

Florida DEP Solid Waste Management Facility Operator Courses

Hall, Jason
Waste Management @ Orlando
4986 LB McLeod Rd
Orlando, FL 32811

Phone: 4078712530
Fax: 4078398400

Track: "**Class I, II, III Landfill Operator 03/30/2006 - 03/29/2009**
Status: **Current**

Period: **Prior Courses**

Course #	Course Name	Provider	Completion Date	Hours
203	8-Hour Initial Training Course for Spotters at Class I, II, III Facilities, Waste Processing Facilities and C&D Facilities	University of Florida - TREEO	05/04/2004	8
			Total:	Prior

Period: **03/30/2006 - 03/29/2009 - (Initial Period)**

Course #	Course Name	Provider	Completion Date	Hours
195	24-Hour Initial Training Course for Landfill Operators (Class I, II, III and C&D Sites)	Kohl Consulting, Inc.	03/30/2006	Initial
			Total:	0

Continuing Education (CE) Minimum 3 Year Requirement: I,II,III/C&D-16 hours TS/MRF-8 hours Spotter-4 hours.

Expired: If you have exceeded the 3 year training period without completing the minimum number of CE, you must start over by taking an approved initial course and pass exam.

Initial hours are not counted toward continuing education.

An Initial course can be taken as a CE course only if it was not taken as the operator's or spotter's initial training. No CE credit will be given for the same course taken within the same 3-year period.

If you have any questions, please contact djenkins@treeo.ufl.edu or jtouchton@treeo.ufl.edu or call 352.392.9570 extensions 227 or 212.

Florida DEP Solid Waste Management Facility Operator Courses

Staley, Patricia
Waste Management - Keene Road
255 W Keene Rd
Apopka, FL 32703

Phone: 4078862920
Fax: 4078898043

Track: "**Class I, II, III Landfill Operator 05/11/2006 - 05/10/2009**
Status: **Current**

Period: **Prior Courses**
No courses taken

Period: **05/11/2006 - 05/10/2009 - (Initial Period)**

Course #	Course Name	Provider	Completion Date	Hours
195	24-Hour Initial Training Course for Landfill Operators (Class I, II, III and C&D Sites)	Kohl Consulting, Inc.	05/11/2006	Initial
			Total:	0

Continuing Education (CE) Minimum 3 Year Requirement: I,II,III/C&D-16 hours TS/MRF-8 hours Spotter-4 hours.

Expired: If you have exceeded the 3 year training period without completing the minimum number of CE, you must start over by taking an approved initial course and pass exam.

Initial hours are not counted toward continuing education.

An Initial course can be taken as a CE course only if it was not taken as the operator's or spotter's initial training. No CE credit will be given for the same course taken within the same 3-year period.

If you have any questions, please contact djenkins@treeo.ufl.edu or jtouchton@treeo.ufl.edu or call 352.392.9570 extensions 227 or 212.

Florida DEP Solid Waste Management Facility Operator Courses

Sanchez, Anibal
Waste Management @ Keene Road
255 W Keene Rd
Apopka, FL 32703

Phone: 407 886-2920
Fax: 407 889-0843

Track: "**Class I, II, III Landfill Operator 03/30/2006 - 03/29/2009**
Status: **Current**

Period: **Prior Courses**
No courses taken

Period: **03/30/2006 - 03/29/2009 - (Initial Period)**

Course #	Course Name	Provider	Completion Date	Hours
195	24-Hour Initial Training Course for Landfill Operators (Class I, II, III and C&D Sites)	Kohl Consulting, Inc.	03/30/2006	Initial
			Total:	0

Continuing Education (CE) Minimum 3 Year Requirement: I,II,III/C&D-16 hours TS/MRF-8 hours Spotter-4 hours.

Expired: If you have exceeded the 3 year training period without completing the minimum number of CE, you must start over by taking an approved initial course and pass exam.

Initial hours are not counted toward continuing education.

An Initial course can be taken as a CE course only if it was not taken as the operator's or spotter's initial training. No CE credit will be given for the same course taken within the same 3-year period.

If you have any questions, please contact djenkins@treeo.ufl.edu or jtouchton@treeo.ufl.edu or call 352.392.9570 extensions 227 or 212.

Florida DEP Solid Waste Management Facility Operator Courses

Mangold, Debra
Waste Management @ Keene Road
255 W Keene Rd
Apopka, FL 32703

Phone: 4078862920
Fax: 4078898043

Track: "**Spotter / Waste Screener 05/09/2006 - 05/08/2009**
Status: **Current**

Period: **Prior Courses**
No courses taken

Period: **05/09/2006 - 05/08/2009 - (Initial Period)**

Course #	Course Name	Provider	Completion Date	Hours
203	8-Hour Initial Training Course for Spotters at Class I, II, III Facilities, Waste Processing Facilities and C&D Facilities	University of Florida - TREEO	05/09/2006	Initial
			Total:	0

Continuing Education (CE) Minimum 3 Year Requirement: I,II,III/C&D-16 hours TS/MRF-8 hours Spotter-4 hours.

Expired: If you have exceeded the 3 year training period without completing the minimum number of CE, you must start over by taking an approved initial course and pass exam.

Initial hours are not counted toward continuing education.

An Initial course can be taken as a CE course only if it was not taken as the operator's or spotter's initial training. No CE credit will be given for the same course taken within the same 3-year period.

If you have any questions, please contact djenkins@treeo.ufl.edu or jtouchton@treeo.ufl.edu or call 352.392.9570 extensions 227 or 212.

Florida DEP Solid Waste Management Facility Operator Courses

Holmes Jr., Leslie
Waste Management @ Pine Ridge Landfill
5400 Rex Drive
Winter Garden, FL 32787

Phone: 4078770701
Fax: 407877-6182

Track: "**Class I, II, III Landfill Operator 05/11/2006 - 05/10/2009**
Status: **Current**

Period: **Prior Courses**
No courses taken

Period: **05/11/2006 - 05/10/2009 - (Initial Period)**

Course #	Course Name	Provider	Completion Date	Hours
195	24-Hour Initial Training Course for Landfill Operators (Class I, II, III and C&D Sites)	Kohl Consulting, Inc.	05/11/2006	Initial
			Total:	0

Continuing Education (CE) Minimum 3 Year Requirement: I,II,III/C&D-16 hours TS/MRF-8 hours Spotter-4 hours.

Expired: If you have exceeded the 3 year training period without completing the minimum number of CE, you must start over by taking an approved initial course and pass exam.

Initial hours are not counted toward continuing education.

An Initial course can be taken as a CE course only if it was not taken as the operator's or spotter's initial training. No CE credit will be given for the same course taken within the same 3-year period.

If you have any questions, please contact djenkins@treeo.ufl.edu or jtouchton@treeo.ufl.edu or call 352.392.9570 extensions 227 or 212.

Florida DEP Solid Waste Management Facility Operator Courses

Kelley, Charles
Spotter
Waste Management - Pine Ridge LF
5400 Rex Road
Winter Garden, FL 34787

Phone: 407.886.2920
Fax: 407.889.8043

Track: "**Class I, II, III Landfill Operator 05/11/2006 - 05/10/2009**
Status: **Current**

Period: **Prior Courses**
No courses taken

Period: **05/11/2006 - 05/10/2009 - (Initial Period)**

Course #	Course Name	Provider	Completion Date	Hours
195	24-Hour Initial Training Course for Landfill Operators (Class I, II, III and C&D Sites)	Kohl Consulting, Inc.	05/11/2006	Initial
			Total:	0

Continuing Education (CE) Minimum 3 Year Requirement: I,II,III/C&D-16 hours TS/MRF-8 hours Spotter-4 hours.

Expired: If you have exceeded the 3 year training period without completing the minimum number of CE, you must start over by taking an approved initial course and pass exam.

Initial hours are not counted toward continuing education.

An Initial course can be taken as a CE course only if it was not taken as the operator's or spotter's initial training. No CE credit will be given for the same course taken within the same 3-year period.

If you have any questions, please contact djenkins@treeo.ufl.edu or jtouchton@treeo.ufl.edu or call 352.392.9570 extensions 227 or 212.

Florida DEP Solid Waste Management Facility Operator Courses

Chenault, Diane F
Waste Management @ Keene Road
255 W Keene Rd
Apopka, FL 32703

Phone: 4078862920
Fax: 4078898043

Track: "**Spotter / Waste Screener 05/09/2006 - 05/08/2009**
Status: **Current**

Period: **Prior Courses**
No courses taken

Period: **05/09/2006 - 05/08/2009 - (Initial Period)**

Course #	Course Name	Provider	Completion Date	Hours
203	8-Hour Initial Training Course for Spotters at Class I, II, III Facilities, Waste Processing Facilities and C&D Facilities	University of Florida - TREEO	05/09/2006	Initial
			Total:	0

Continuing Education (CE) Minimum 3 Year Requirement: I,II,III/C&D-16 hours TS/MRF-8 hours Spotter-4 hours.

Expired: If you have exceeded the 3 year training period without completing the minimum number of CE, you must start over by taking an approved initial course and pass exam.

Initial hours are not counted toward continuing education.

An Initial course can be taken as a CE course only if it was not taken as the operator's or spotter's initial training. No CE credit will be given for the same course taken within the same 3-year period.

If you have any questions, please contact djenkins@treeo.ufl.edu or jtouchton@treeo.ufl.edu or call 352.392.9570 extensions 227 or 212.

ATTACHMENT B

GAS MONITORING REPORT

Facility Name: ______________________

ANALYST: ______________________ DATE: __________

GAS INSTRUMENT TYPE: ______________________ SERIAL NO.: __________

PRESSURE INSTRUMENT TYPE: ______________________ SERIAL NO.: __________

WATER LEVEL INSTRUMENT TYPE: ______________________ SERIAL NO.: __________

WEATHER CONDITIONS: ______________________ BAROMETRIC PRESSURE: __________

CALIBRATION	Response	Adjustment	Acceptable	Int.
SPAN GAS 2.5% (by vol.)				
SPAN GAS 50% (by vol.)				

MONITOR POINT	TIME	PRESSURE (inches	METHANE (% by Vol. air)	METHANE (% LEL)	LIQUID LEVEL (FT. TOC)	COMMENTS

COMMENTS: BH = Bar Hole completed by hammering a bar (3 feet long x ½ inch dia.) into the ground then removing. The subsequent void is then measured for methane by inserting the instrument probe into the void and Aspirating sample gas through the meter. No liquid level possible for a Bar Hole.

Signature: ______________________

ATTACHMENT C

LANDFILL INSPECTION
AND
DAILY FIELD ODOR SURVEY FORM

Facility Name:
Facility Address:

Date: ______________
Time: ______________
Surveyor: ____________________

Are there any reasons for odor, such as a significantly large amount of trash being dumped, uncovering of trash that was covered the night before, odor producing leachate storage methods, new gas well installations or waste excavations? ____
____

If odors are possible, are they due to landfill gas or from landfill operations? ____________________

Are there odors detected from other nearby sources or activities going on that may generate nuisance odors? Describe them: ____
____

Weather Conditions

Wind Speed and Direction: __________
Barometric Pressure: ______________
Rainfall: ____________
Humidity: ___________
Temp: ______________

Odor Surveying Points

Survey Point ID/ Location	Odor Intensity S = Strong M = Medium SL = Slight N = None	Odor Description EG = rotten egg LFG = landfill gas NW = New Waste O = Other (describe)	Comments & Observations
1.			
2.			
3.			
4.			
5.			
6.			
7.			

DAILY – Condition of Landfill

Slopes and Berms: __________
Litter and Debris: __________
Haul Road Condition: ______________
Flagging: ______________________
Landfill Perimeter: __________
Erosion: ________________

WEEKLY - Cover

Weekly Cover applied at active area (s) (Y)___ (N)___
Week ending:____________________

QUARTERLY – Closed Areas

Quarter Ending _____________

Final Cover: erosion __________ vegetation __________ differential settlement _______ ponding _____
Surface Water Control Structures: ___________

Signature: ______________________

ATTACHMENT D

ODOR COMPLAINT FORM

FACILITY NAME: ______________________

FACILITY ADDRESS: ______________________

____

RECEIVED BY: ______________________

DATE: __________

TIME: __________

Contact Information of the Complainant

Name: ______________

Address: ______________

Address2: ______________

Phone: ______________

Odor Information

Date Detected: ______________

Time Detected: ______________

Location Detected: ______________

Grid Coordinates: ______________

Description of Complaint

Type of Odor: ______________________________

____

Intensity of Odor: ______________________________

____

Weather Conditions when odor was detected: ______________________________

____

Were odors noticed at this location in past: ______________________________

____

Weather Conditions (At the time odors were detected)

Wind Direction and Speed: __________

Barometric Pressure: __________

Rainfall: __________

Humidity: __________

Temperature: __________

Remarks

(Include information such as special waste being received, wash down of transfer station floor occurring, new gas well installation, location of current working face, etc.) ______________

____

____

____

____

Follow-up Contact with Complainant

Was follow-up contact made with the complainant? ______________

If so, answer the following questions:

When was contact made? Date: ______________ Time: __________

By whom and how was contact made? ______________________________

How was the contact made? (Letter, Phone Call, etc.) ______________

What issues were discussed with the complainant? ______________

____

____

ATTACHMENT E

ODOR COMPLAINT TRACKING CHART

FACILITY NAME: ______________________

REPORT COMPLETED BY: ______________________

MONTH: ______________________

YEAR: ______________________

	Date Received	Were Odors Detected During Daily Survey? Y or N	Survey Location(s) Odors were Detected	Call Logged By:	Complainant Name	Time and Date Odors were Detected	Grid Coordinates of Odor Detection	Wind Direction & Speed at Time of Odors	Remarks	Follow-up Conducted (Visit or Call?)
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										

Geosyntec consultants

COMPUTATION COVER SHEET

Client: **Vista LF, LLC** Project: **Vista Landfill – Substantial Permit Mod** Project No.: **FL1229**

Phase No.:

Title of Computations **FINAL COVER SYSTEM PERFORMANCE EVALUATION**

Computations by:	Signature		
	Printed Name	Jay Eun, E.I.T.	Date
	Title	Senior Staff Engineer	
Assumptions and Procedures Checked by: (peer reviewer)	Signature		
	Printed Name	Ayushman Gupta, P.E.	Date
	Title	Senior Engineer	
Computations Checked by:	Signature		
	Printed Name	Juan D. Quiroz, Ph.D., P.E.	Date
	Title	Project Engineer	
Computations Backchecked by: (originator)	Signature		
	Printed Name	Jay Eun, E.I.T.	Date
	Title	Senior Staff Engineer	
Approved by: (pm or designate)	Signature		
	Printed Name	Juan D. Quiroz, Ph.D., P.E.	Date
	Title	Project Engineer	

Approval notes:

Revisions (number and initial all revisions)

No.	Sheet	Date	By	Checked by	Approval

Written by: **Jay Eun** Date: **06/20/07** Reviewed by: **A. Gupta** Date:

Client: **Vista LF, LLC** Project: **Vista LF – Substantial** Project No.: **FL1229** Phase No.:

FINAL COVER SYSTEM PERFORMANCE EVALUATION
VISTA CLASS III LANDFILL
APOPKA, FLORIDA

INTRODUCTION

The purpose of this calculation package is to present the head-on-liner analyses associated with the requirements for the geocomopsite drainage layer to be specified for the final cover system at Vista Class III Landfill facility located in Apopka, Florida. The remainder of this calculation package presents the following:

- description of the final cover system;
- hydrologic evaluation of landfill performance (HELP) model analyses;
- head on the final cover geomembrane; and
- soil erosion resistance of final cover system

DESCRIPTION OF FINAL COVER SYSTEM

The general layout of the final cover system for the Vista Landfill is indicated on Sheet 18 of the Permit Drawing. The final cover system on the side slopes of the landfill consists of the following components, from top to bottom:

- 6-inch thick vegetative layer;
- 18-inch thick protective cover soil layer;
- geocomposite drainage layer consisting of a geonet with non-woven geotextile heat-bonded on both sides;
- 40-mil textured geomembrane liner; and
- intermediate soil cover.

The final cover system on the top slope area of the landfill will be configured as described above but not include a geocomposite drainage layer.

Written by: **Jay Eun** Date: **06/20/07** Reviewed by: **A. Gupta** Date:

Client: **Vista LF, LLC** Project: **Vista LF – Substantial** Project No.: **FL1229** Phase No.:

HELP MODEL ANALYSES

Purpose

The Hydrogeologic Evaluation of Landfill Performance (HELP) model, Version 3.07 [Schroeder, et. al., EPA/600/R-94/168a and EPA/600/R-94/168b, 1994] was used to estimate peak daily lateral drainage for the proposed final cover system for the Vista Landfill. The HELP model is a quasi-two dimensional water balance computer program used to evaluate the vertical movement of water through cover soils and closure systems in addition to the waste and components of the liner system.

Cases Analyzed

The typical range of soil permeability for borrow soils in Florida is between $1x10^{-3}$ and $1x10^{-5}$ cm/sec. To estimate peak daily lateral drainage, three cases were analyzed using $1x10^{-3}$, $1x10^{-4}$, and $1x10^{-5}$ cm/sec as the cover soil permeability.

Geocomposite Properties

The geocomposite properties used in the calculation of heads and lateral drainage rate for the Vista Class III Landfill are based on properties of commercially available geocomposites. It is not the objective of this section to identify specific geocomposites for use in the construction of the final cover system for the Vista Class III Landfill. However, the performance of commercially available materials is checked against the minimum requirements identified in this evaluation.

Reduction Factors

Reductions factors (RF) for the geocomposite drainage layer are explained in detail in the calculation package titled "Leachate Management System" (see Appendix ?? of this permit application). The reduction factors for infiltration, creep, chemical clogging and biological clogging used in the analyses for the final cover system are summarized in the table below.

RF_{in}	RF_{cr}	RF_{cc}	RF_{bc}	$(RF)_{total}$
1.1	1.3	1.1	1.3	2.04

Required Transmissivity Values

The required transmissivity values ($\square_{req'd}$) used in the HELP model analysis were obtained by applying the reduction factors (RF) and a factor of safety of 2.0 to the measured transmissivity values ($\square_{measured}$) as discussed in the calculation package titled "Leachate Management System Analysis" (see Appendix ?? of this permit application). Table 1 summarizes the calculated values for the geocomposite for the final cover system.

Input Data for HELP Model

The HELP model requires weather, soil, and basic design data as input and uses solution techniques that account for more than 10 above-surface and subsurface hydraulic processes including precipitation, runoff, and evapotranspiration. The description of each input data is explained in detail in the calculation package titled "Leachate Management System" (see Appendix ?? of this permit application). A summary of the input data used in the HELP model analysis is presented in Attachment 1 to this calculation package. Output files from the HELP model for each case are included in Attachment 2.

HEAD ON THE FINAL COVER GEOMEMBRANE

Table 1 presents a summary of the peak daily lateral drainage and heads for the final cover system. The head on the final cover system was computed using a method presented by Giroud, et. al. (2004). Giroud, et. al. (2004) developed a method for calculating the maximum liquid thickness and the maximum head in drainage systems composed of two layers, with the lower layer consisting of a geocomposite. The solution for maximum head takes into consideration the rate of liquid supply, the hydraulic conductivities of the two layers, the length of the drainage path, and the slope. The rate of liquid supply (q_h) was obtained from the HELP model analyses performed for each case. The peak daily lateral drainage in the geocomposite drainage layer (obtained from the HELP analysis for each case) was used as the rate of liquid supply.

Other parameters used in the head computation using Giroud's method are presented in the spreadsheets included in Attachment 3. As noted in Table 1, the head on the final cover geomembrane is less than the thickness of the geocomposite (0.25 inches) for all cases analyzed. It is noted that the minimum required $\square_{\text{measured}}$ to maintain a head-on-liner value within the thickness of the geocomposite can be achieved with commercially available products.

EROSION RESISTANCE OF FINAL COVER SYSTEM

The purpose of this calculation is to estimate the average annual soil loss from the proposed final cover system and evaluate the erosion resistance by comparing the calculated loss to the published acceptable range. Erosion of the final cover will be controlled by the cover swales, cover vegetation, and cover system maintenance program. The average annual soil loss on the cover can be estimated using the U.S. Department of Agriculture universal soil loss equation (USEPA, 1982):

$$A = RK(LS)CP$$

A = average annual soil loss (ton/acre/year);
R = rainfall and runoff erosivity index (Attachment 4);
K = soil erodibility factor, see Table 2 (ton/acre/year);
LS = factor accounting for slope length and slope steepness (Table 3);
C = cover management factor (Table 4); and
P = practice factor (Table 5)

The parameters used with the above Equation are:

- runoff erosivity index (R) equal to 400 (Attachment 4);

- soil erodibility factor (K) equal to 0.24 ton/acre/year for a fine sandy loam (soil similar to the silty sand used for the vegetated layer) with organic matter greater than 4 percent (from Table 2);

- LS factor for 200 ft of slope length and 33 percent of slope steepness equal to 13.1 (from Table 3);

- cover management factor (C) equal to 0.004 for vegetation a high productivity level (well maintained grass, Table 4); and

- practice factor (P) equal to 1 for no support practice (Table 5).

Using Equation 10 and the above parameter values:

$$A= (400)\ (0.24)\ (13.0)\ (0.004)\ (1)$$

$$A = 4.9 \text{ tons/acre/year}$$

The average annual soil loss due to erosion was calculated to be 4.9 tons/acre/year for the side slopes of 33 percent of the final cover. This value is approximately equal to the maximum soil loss considered acceptable (at 5 tons/acre/year) for landfill covers according to University of Wisconsin-Madison (1988). For a total soil unit weight of 110 pcf, this equates to approximately 0.023 inches per year.

Written by: **Jay Eun** Date: **06/20/07** Reviewed by: **A. Gupta** Date:

Client: **Vista LF, LLC** Project: **Vista LF – Substantial** Project No.: **FL1229** Phase No.:

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TABLES

TABLE 1
HEADS ON FINAL COVER GEOMEMBRANE
VISTA CLASS III LANDFILL
APOPKA, FLORIDA

					Geocomposite Drainage Layer					HELP Model		Giroud's Method	
Analysis Type	Soil Permeability	Vertical Stress (psf)	Drainage Length (ft)	Liner System Slope (%)	$\theta_{measured}$ [1] (m^2/sec)	RF*FS	$\theta_{req'd}$ [2] (m^2/sec)	Thickness geonet (in)	Permeability k (cm/s)	Peak Daily Lateral Drainage (ft^3/ac/day)	Peak Daily Average Head on Geomembrane (in)	Peak Daily Impingement Rate (ft^3/ac/day)	Peak Daily Head on Geomembrane (in)
Case 1	1.00E-03	500	150	33.3	4.3E-04	4.1	1.05E-04	0.250	1.65	8,906	0.18	8,906	0.25
Case 2	1.00E-04	500	150	33.3	4.3E-04	4.1	1.05E-04	0.250	1.65	3,311	0.05	3,311	0.09
Case 3	1.00E-05	500	150	33.3	4.3E-04	4.1	1.05E-04	0.250	1.65	1,027	0.02	1,027	0.22

Note:

[1] Measured transmissivity during laboratory testing.

[2] Transmissivity after applying reduction factors and factor of safety (i.e., transmissivity used in HELP model analysis).

TABLE 2
APPROXIMATE VALUES OF THE SOIL ERODIBILITY FACTOR (K) FOR USDA TEXTURAL CLASSES (USEPA, 1982)
VISTA CLASS III LANDFILL
APOPKA, FLORIDA

APPROXIMATE VALUES OF FACTOR K FOR USDA TEXTURAL CLASSES

(ton/acre/year)

Texture Class	*Organic matter content* 0.5%	 2%	 4%
	K	K	K
Sand	0.05	0.03	0.02
Fine sand	.16	.14	.10
Very fine sand	.42	.16	.28
Loamy sand	.12	.10	.08
Loamy fine sand	.24	.20	.16
Loamy very fine sand	.44	.38	.30
Sandy loam	.27	.24	.19
Fine sandy loam	.35	.30	.24
Very fine sandy loam	.47	.41	.33
Loam	.38	.34	.29
Silt loam	.48	.42	.33
Silt	.60	.52	.42
Sandy clay loam	.27	.25	.21
Clay loam	.28	.25	.21
Silty clay loam	.37	.32	.26
Sandy clay	.14	.13	.12
Silty clay	.25	.23	.19
Clay		0.13-0.29	

TABLE 3

VALUES OF THE FACTOR LS FOR SPECIFIC COMBINATIONS OF SLOPE LENGTH AND SLOPE STEEPNESS (USEPA, 1982)

VISTA CLASS III LANDFILL
APOPKA, FLORIDA

% Slope	Slope length (feet)											
	25	50	75	100	150	200	300	400	500	600	800	1000
0.5	0.07	0.08	0.09	0.10	0.11	0.12	0.14	0.15	0.16	0.17	0.19	0.20
1	0.09	0.10	0.12	0.13	0.15	0.16	0.18	0.20	0.21	0.22	0.24	0.26
2	0.13	0.16	0.19	0.20	0.23	0.25	0.28	0.31	0.33	0.34	0.38	0.40
3	0.19	0.23	0.26	0.29	0.33	0.35	0.40	0.44	0.47	0.49	0.54	0.57
4	0.23	0.30	0.36	0.40	0.47	0.53	0.62	0.70	0.76	0.82	0.92	1.0
5	0.27	0.38	0.46	0.54	0.66	0.76	0.93	1.1	1.2	1.3	1.5	1.7
6	0.34	0.48	0.58	0.67	0.82	0.95	1.2	1.4	1.5	1.7	1.9	2.1
8	0.50	0.70	0.86	0.99	1.2	1.4	1.7	2.0	2.2	2.4	2.8	3.1
10	0.69	0.97	1.2	1.4	1.7	1.9	2.4	2.7	3.1	3.4	3.9	4.3
12	0.90	1.3	1.6	1.8	2.2	2.6	3.1	3.6	4.0	4.4	5.1	5.7
14	1.2	1.6	2.0	2.3	2.8	3.3	4.0	4.6	5.1	5.6	6.5	7.3
16	1.4	2.0	2.5	2.8	3.5	4.0	4.9	5.7	6.4	7.0	8.0	9.0
18	1.7	2.4	3.0	3.4	4.2	4.9	6.0	6.9	7.7	8.4	9.7	11.0
20	2.0	2.9	3.5	4.1	5.0	5.8	7.1	8.2	9.1	10.0	12.0	13.0
25	3.0	4.2	5.1	5.9	7.2	8.3	10.0	12.0	13.0	14.0	17.0	19.0
30	4.0	5.6	6.9	8.0	9.7	11.0	14.0	16.0	18.0	20.0	23.0	25.0
40	6.3	9.0	11.0	13.0	16.0	18.0	22.0	25.0	28.0	31.0	--	--
50	8.9	13.0	15.0	18.0	22.0	25.0	31.0	--	--	--	--	--
60	12.0	16.0	20.0	23.0	28.0	--	--	--	--	--	--	--

Note:

Values given for slopes longer than 300 feet or steeper than 18% are extrapolations beyond the range of the research data and, therefore, less certain than the others.

TABLE 4

GENERALIZED VALUES OF COVER MANAGEMENT FACTOR (USEPA, 1982)

VISTA CLASS III LANDFILL

APOPKA, FLORIDA

Crop, rotation, and management	Productivity level	
	High	Mod
	C Value	
Base value continuous fallow, tilled up and down slope	1.00	1.00
CORN		
C.RdR.fall TP.conv	0.54	0.62
C.RdR.spring TP.conv	0.50	0.59
C.RdL.fall TP.conv	0.42	0.52
C.RdR.wc seeding, spring TP.conv	0.40	0.49
C.RdL.standing, spring TP.conv	0.38	0.48
C-W-M-M RdL. TP for C.disk for W	0.039	0.074
C-W-M-M-M RdL.TP for C. disk for W	0.032	0.061
C.no-till pl in c-k sod, 95-80% rc	0.017	0.053
COTTON		
Cot. conv (Western Plains)	0.42	0.49
Cot. conv (South)	0.34	0.40
MEADOW		
Grass & Legume mix	0.004	0.01
Alfalfa, lespodeza or Serea	0.020	
Sweet clover	0.025	
SORGHUM, GRAIN (Western Plains)		
RdL. spring TP. conv	0.43	0.53
No-till pl in shredded 70-50% rc	0.11	0.18
SOYBEANS		
B.RdL. spring TP. conv	0.48	0.54
C-B, TP annually, cov	0.43	0.51
B, no-till pl	0.22	0.28
C-B, no-till pl, fall shred C stalks	0.18	0.22
WHEAT		
W-F, fall TP after W	0.38	
W-F, stubble mulch, 500 lbs rc	0.32	
W-F, stubble mulch, 1000 lbs rc	0.21	

Abbreviations Defined:

B - soybeans
C - corn
c-k - chemically killed
conv. - conventional
cot - cotton
lbs rc - pounds of crop residue per acre remaining on surface after new crop seeding
% rc - percentage of soil surface covered by residue mulch after new crop seeding
70-50% rc - 70% cover for C values on last column: 50% for second column
RdR - residues (corn stoves straw, etc.) removed or burned
RdL - all residues left on field (on surface or incorporated)
TP - turn plowed upper 5 or more inches of soil inverted, covering residues)

F - fallow
M - grass & legume hay
pl - plant
W - wheat
wc - winter cover

TABLE 5
VALUES OF THE PARACTICE FACTOR (USEPA, 1982)
VISTA CLASS III LANDFILL
APOPKA, FLORIDA

Practice	Land slope (percent)				
	1.1-2	2.1-7	7.1-12	12.1-18	18.1-24
	(Factor P)				
Contouring (P_c)	0.60	0.50	0.60	0.80	0.90
Contour strip cropping (P_{sc})					
R-R-M-M (See Note 1)	0.30	0.25	0.30	0.40	0.45
R-R-M-M	0.30	0.25	0.30	0.40	0.45
R-R-W-M	0.45	0.38	0.45	0.60	0.68
R-W	0.52	0.44	0.52	0.70	0.90
R-O	0.60	0.50	0.60	0.80	0.90
Contour listing or ridge planting (P_{cl})	0.30	0.25	0.30	0.40	0.45
Contour terracing (P_1) (See Note 2)	$0.6/\sqrt{n}$ (See Note 3)	$0.5/\sqrt{n}$	$0.6/\sqrt{n}$	$0.8/\sqrt{n}$	$0.9/\sqrt{n}$
No support practice	1.0	1.0	1.0	1.0	1.0

Notes:

(1) R = rowcrop, W = fall-seeded grain, O = spring-seeded grain, M = meadow. The crops are grown in rotation and so arranged on the field that rowcrop strips are always separated by a meadow or winter grain strip.

(2) These P_1 values estimate the amount of soil eroded to the terrace channels and are used for conservation planning. For prediction of off-field sediment, the P_1 values are multiplied by 0.2.

(3) n = number of approximately equal-length intervals into which the field slope is divided by the terraces. Tillage operations must be parallel to the terraces.

ATTACHMENT 1

HELP MODEL INPUT DATA SUMMARY

INPUT DATA SUMMARY
CASE 1 - k = $1x10^{-3}$ cm/sec
VISTA LANDFILL
APOPKA, FLORIDA

WEATHER DATA AND SOIL LAYERS PROPERTIES

A. Evapotranspiration data

Data	Value	Units
Nearby city	Orlando	
State	Florida	
Latitude	27.98	
Evaporative zone depth	22	in
bare	10	
fair	22	
excellent	40	
Maximum leaf area index	5	
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	74	%
Second quarter relative humidity	72	%
Third quarter relative humidity	78	%
Fourth quarter relative humidity	76	%

B. Precipitation

Data	Value
Nearby city	Oralndo
State	Florida
Years for data generation	30

C. Temperature

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

Normal mean monthly temperature (°F)

January	59.8	July	82.2
February	60.8	August	82.2
March	66.2	September	80.9
April	71.6	October	74.5
May	77.1	November	68.7
June	80.9	December	61.3

D. Solar Radiation

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	24

E. Other Conditions

Area assumed in analysis		1	ac
Area of runoff at the Surface		100	%
Surface Slope Vegetation		3	
bare ground	1		
grass (poor)	2		
grass (fair)	3		
grass (good)	4		
grass (excellent)	5		

F. Geomembrane (Liner and Cover)

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	Slope %
FILE:										
1	1	Vertical percolation	6	5	0.457	0.131	0.058	0.001		
2	2	Lateral drainage	18	5	0.457	0.131	0.058	0.001		
3	2	Lateral drainage	0.250		0.85	0.01	0.005	1.65	150	33.3
4	4	Geomembrane liner	0.040	35				2E-13		
5	3	Barrier soil layer	18		0.479	0.371	0.251	0.0001		

INPUT DATA SUMMARY
CASE 2 - k = 1x10^{-4} cm/sec
VISTA LANDFILL
APOPKA, FLORIDA

WEATHER DATA AND SOIL LAYERS PROPERTIES

A. Evapotranspiration data

Data	Value	Units
Nearby city	Orlando	
State	Florida	
Latitude	27.98	
Evaporative zone depth	22	in
bare	10	
fair	22	
excellent	40	
Maximum leaf area index	5	
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	74	%
Second quarter relative humidity	72	%
Third quarter relative humidity	78	%
Fourth quarter relative humidity	76	%

B. Precipitation

Data	Value
Nearby city	Oralndo
State	Florida
Years for data generation	30

C. Temperature

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

Normal mean monthly temperature (°F)

January	59.8	July	82.2
February	60.8	August	82.2
March	66.2	September	80.9
April	71.6	October	74.5
May	77.1	November	68.7
June	80.9	December	61.3

D. Solar Radiation

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	24

E. Other Conditions

Area assumed in analysis	1	ac
Area of runoff at the Surface	100	%
Surface Slope Vegetation	3	
bare ground 1		
grass (poor) 2		
grass (fair) 3		
grass (good) 4		
grass (excellent) 5		

F. Geomembrane (Liner and Cover)

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	Slope %
FILE:										
1	1	Vertical percolation	6	10	0.398	0.244	0.136	1.2E-04		
2	2	Lateral drainage	18		0.398	0.244	0.136	1.0E-04		
3	2	Lateral drainage	0.250		0.85	0.01	0.005	1.65	150	33.3
4	4	Geomembrane liner	0.040	35				2E-13		
5	3	Barrier soil layer	18		0.479	0.371	0.251	0.0001		

INPUT DATA SUMMARY

CASE 3 - k = $1x10^{-5}$ cm/sec

VISTA LANDFILL

APOPKA, FLORIDA

WEATHER DATA AND SOIL LAYERS PROPERTIES

A. Evapotranspiration data

Data	Value	Units
Nearby city	Orlando	
State	Florida	
Latitude	27.98	
Evaporative zone depth	22	in
bare	10	
fair	22	
excellent	40	
Maximum leaf area index	5	
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	74	%
Second quarter relative humidity	72	%
Third quarter relative humidity	78	%
Fourth quarter relative humidity	76	%

B. Precipitation

Data	Value
Nearby city	Oralndo
State	Florida
Years for data generation	30

C. Temperature

Data	Value
Nearby city	Orlando
State	Florida
Years for data generation	30

Normal mean monthly temperature (°F)

January	59.8	July	82.2
February	60.8	August	82.2
March	66.2	September	80.9
April	71.6	October	74.5
May	77.1	November	68.7
June	80.9	December	61.3

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 Slope Vegetation		3	
bare ground	1		
grass (poor)	2		
grass (fair)	3		
grass (good)	4		
grass (excellent)	5		

F. Geomembrane (Liner and Cover)

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	Slope %
FILE:										
1	1	Vertical percolation	6	15	0.475	0.378	0.265	1.7E-05		
2	2	Lateral drainage	18		0.475	0.378	0.265	1.0E-05		
3	2	Lateral drainage	0.250		0.85	0.01	0.005	1.65	150	33.3
4	4	Geomembrane liner	0.040	35				2E-13		
5	3	Barrier soil layer	18		0.479	0.371	0.251	0.0001		

ATTACHMENT 2

HELP MODEL OUTPUT FILES

CASE 1

```
****************************************************************************
****************************************************************************
**                                                                        **
**                                                                        **
**          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:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\VISTA.D4
TEMPERATURE DATA FILE:      C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\COVER.D7
SOLAR RADIATION DATA FILE:  C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\COVER.D13
EVAPOTRANSPIRATION DATA:    C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\COVER.D11
SOIL AND DESIGN DATA FILE:  C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\COVER-3A.D10
OUTPUT DATA FILE:           C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\COVER-3A.OUT


TIME:  16: 6    DATE:  5/29/2007


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

  TITLE:  Oak Hammock Disposal 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   5
     THICKNESS                  =    6.00   INCHES
     POROSITY                   =    0.4570 VOL/VOL
     FIELD CAPACITY             =    0.1310 VOL/VOL
     WILTING POINT              =    0.0580 VOL/VOL
     INITIAL SOIL WATER CONTENT =    0.0949 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   5
  THICKNESS                =     18.00   INCHES
  POROSITY                 =     0.4570 VOL/VOL
  FIELD CAPACITY           =     0.1310 VOL/VOL
  WILTING POINT            =     0.0580 VOL/VOL
  INITIAL SOIL WATER CONTENT =     0.1518 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  = 0.100000005000E-02 CM/SEC




                    LAYER  3
                    --------

          TYPE 2 - LATERAL DRAINAGE LAYER
            MATERIAL TEXTURE NUMBER   0
  THICKNESS                =     0.25   INCHES
  POROSITY                 =     0.8500 VOL/VOL
  FIELD CAPACITY           =     0.0100 VOL/VOL
  WILTING POINT            =     0.0050 VOL/VOL
  INITIAL SOIL WATER CONTENT =     0.0187 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  =  1.64999998000     CM/SEC
  SLOPE                    =    33.30   PERCENT
  DRAINAGE LENGTH          =    150.0    FEET




                    LAYER  4
                    --------

          TYPE 4 - FLEXIBLE MEMBRANE LINER
            MATERIAL TEXTURE NUMBER  35
  THICKNESS                =     0.04   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 1 - VERTICAL PERCOLATION LAYER
            MATERIAL TEXTURE NUMBER   0
   THICKNESS                  =    12.00   INCHES
   POROSITY                   =     0.3980 VOL/VOL
   FIELD CAPACITY             =     0.2440 VOL/VOL
   WILTING POINT              =     0.1360 VOL/VOL
   INITIAL SOIL WATER CONTENT =     0.2102 VOL/VOL
   EFFECTIVE SAT. HYD. COND.  = 0.999999975000E-04 CM/SEC




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

  NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A
         FAIR STAND OF GRASS, A SURFACE SLOPE OF 33.%
         AND A SLOPE LENGTH OF  150. FEET.

  SCS RUNOFF CURVE NUMBER            =    68.80
  FRACTION OF AREA ALLOWING RUNOFF   =    100.0    PERCENT
  AREA PROJECTED ON HORIZONTAL PLANE =     1.000  ACRES
  EVAPORATIVE ZONE DEPTH             =    22.0    INCHES
  INITIAL WATER IN EVAPORATIVE ZONE  =     2.831  INCHES
  UPPER LIMIT OF EVAPORATIVE STORAGE =    10.054  INCHES
  LOWER LIMIT OF EVAPORATIVE STORAGE =     1.276  INCHES
  INITIAL SNOW WATER                 =     0.000  INCHES
  INITIAL WATER IN LAYER MATERIALS   =     5.830  INCHES
  TOTAL INITIAL WATER                =     5.830  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               = 22.0  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 WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR    TAMPA           FLORIDA

            NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

  JAN/JUL    FEB/AUG    MAR/SEP    APR/OCT    MAY/NOV    JUN/DEC
  -------    -------    -------    -------    -------    -------
   2.10       3.10       3.50       2.60       3.00       6.50
   8.10       7.20       6.80       3.90       1.70       2.10


     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    1 THROUGH   30
------------------------------------------------------------------------------

               JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
               -------  -------  -------  -------  -------  -------
 PRECIPITATION
 -------------
  TOTALS              2.04     2.84     2.82     2.30     2.52     6.14
               8.04     6.97     6.59     5.05     1.71     2.08

  STD. DEVIATIONS     1.28     1.69     1.83     1.80     1.68     3.45
               3.56     2.28     2.82     2.76     1.12     1.10

 RUNOFF
 ------
  TOTALS              0.000    0.001    0.005    0.008    0.004    0.076
               0.033    0.009    0.050    0.051    0.003    0.000

  STD. DEVIATIONS     0.001    0.006    0.020    0.044    0.014    0.176
```

```
                0.077   0.033   0.137   0.215   0.015   0.000

 EVAPOTRANSPIRATION
 ------------------
  TOTALS           1.455   2.115   2.715   2.179   1.867   4.028
                5.407   5.478   4.407   3.810   1.835   1.474

  STD. DEVIATIONS      0.723   0.846   1.136   1.318   1.210   1.729
                1.610   1.033   1.134   0.567   0.772   0.654

 LATERAL DRAINAGE COLLECTED FROM LAYER  3
 ----------------------------------------
  TOTALS           0.4880  0.5775  0.7134  0.7862  0.6119  1.2177
                1.7349  1.4464  1.9097  1.5357  0.6603  0.4152

  STD. DEVIATIONS      0.3939  0.4008  0.3924  0.5061  0.3677  0.9992
                1.2652  1.1675  1.8055  1.5324  0.4677  0.4227

 PERCOLATION/LEAKAGE THROUGH LAYER  4
 ------------------------------------
  TOTALS           0.0000  0.0000  0.0000  0.0000  0.0000  0.0001
                0.0001  0.0001  0.0001  0.0001  0.0000  0.0000

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

 PERCOLATION/LEAKAGE THROUGH LAYER  5
 ------------------------------------
  TOTALS           0.0017  0.0015  0.0016  0.0015  0.0015  0.0014
                0.0014  0.0013  0.0012  0.0013  0.0012  0.0013

  STD. DEVIATIONS      0.0026  0.0022  0.0023  0.0021  0.0020  0.0018
                0.0018  0.0017  0.0016  0.0015  0.0014  0.0014


-----------------------------------------------------------------------------
        AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-----------------------------------------------------------------------------


 DAILY AVERAGE HEAD ON TOP OF LAYER  4
 -------------------------------------
  AVERAGES         0.0008  0.0011  0.0012  0.0014  0.0011  0.0022
                0.0030  0.0025  0.0035  0.0027  0.0012  0.0007

  STD. DEVIATIONS      0.0007  0.0008  0.0007  0.0009  0.0006  0.0019
                0.0022  0.0020  0.0035  0.0026  0.0008  0.0007

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


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

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

```
                           INCHES          CU. FEET      PERCENT
                        -------------------  -------------  ----------
PRECIPITATION              49.08    (  7.630)    178170.1     100.00

RUNOFF                   0.242   ( 0.2729)       877.71      0.493

EVAPOTRANSPIRATION          36.769   ( 4.8955)    133472.42     74.913

LATERAL DRAINAGE COLLECTED     12.09687 (  3.53847)     43911.648   24.64592
 FROM LAYER  3

PERCOLATION/LEAKAGE THROUGH     0.00070 (  0.00014)        2.551      0.00143
 LAYER  4

AVERAGE HEAD ON TOP           0.002 (    0.001)
 OF LAYER  4

PERCOLATION/LEAKAGE THROUGH     0.01671  (  0.02230)       60.644      0.03404
 LAYER  5

CHANGE IN WATER STORAGE        -0.042   (  1.1535)       -152.33     -0.085

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

           PEAK DAILY VALUES FOR YEARS    1 THROUGH   30
  ------------------------------------------------------------------------
                              (INCHES)     (CU. FT.)
                             ----------    -------------
   PRECIPITATION                      4.85        17605.500

   RUNOFF                         0.984        3573.4153

   DRAINAGE COLLECTED FROM LAYER  3          2.45336       8905.71289

   PERCOLATION/LEAKAGE THROUGH LAYER  4      0.000064        0.23272

   AVERAGE HEAD ON TOP OF LAYER  4           0.181

   MAXIMUM HEAD ON TOP OF LAYER  4           0.255

   LOCATION OF MAXIMUM HEAD IN LAYER  3
       (DISTANCE FROM DRAIN)              0.0 FEET

   PERCOLATION/LEAKAGE THROUGH LAYER  5      0.000453        1.64309

   SNOW WATER                         0.00          0.0000


   MAXIMUM VEG. SOIL WATER (VOL/VOL)               0.3359

   MINIMUM VEG. SOIL WATER (VOL/VOL)              0.0580


    ***  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   30
       -------------------------------------------------------------
             LAYER       (INCHES)      (VOL/VOL)
             -----       --------      ---------
               1          0.6700        0.1117

               2          1.8554        0.1031

               3          0.0029        0.0115

               4          0.0000        0.0000

               5          2.0428        0.1702

            SNOW WATER       0.000

************************************************************************
************************************************************************
```

CASE 2

```
***************************************************************************
***************************************************************************
**                                                                       **
**                                                                       **
**          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:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\VISTA.D4
TEMPERATURE DATA FILE:      C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\COVER.D7
SOLAR RADIATION DATA FILE:  C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\COVER.D13
EVAPOTRANSPIRATION DATA:    C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\COVER.D11
SOIL AND DESIGN DATA FILE:  C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\COVER-4.D10
OUTPUT DATA FILE:           C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\COVER-4.OUT


TIME:  16: 8     DATE:   5/29/2007


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

  TITLE:  Oak Hammock Disposal 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  10
        THICKNESS                =     6.00   INCHES
        POROSITY                 =    0.3980 VOL/VOL
        FIELD CAPACITY           =    0.2440 VOL/VOL
        WILTING POINT            =    0.1360 VOL/VOL
        INITIAL SOIL WATER CONTENT =    0.2010 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  = 0.119999997000E-03 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                =    18.00   INCHES
  POROSITY                 =    0.3980 VOL/VOL
  FIELD CAPACITY           =    0.2440 VOL/VOL
  WILTING POINT            =    0.1360 VOL/VOL
  INITIAL SOIL WATER CONTENT  =    0.2735 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   = 0.999999975000E-04 CM/SEC


                     LAYER  3
                     --------

             TYPE 2 - LATERAL DRAINAGE LAYER
               MATERIAL TEXTURE NUMBER   0
  THICKNESS                =     0.25   INCHES
  POROSITY                 =    0.8500 VOL/VOL
  FIELD CAPACITY           =    0.0100 VOL/VOL
  WILTING POINT            =    0.0050 VOL/VOL
  INITIAL SOIL WATER CONTENT  =    0.0100 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =  1.64999998000      CM/SEC
  SLOPE                    =   33.30   PERCENT
  DRAINAGE LENGTH          =   150.0    FEET


                     LAYER  4
                     --------

             TYPE 4 - FLEXIBLE MEMBRANE LINER
               MATERIAL TEXTURE NUMBER  35
  THICKNESS                =     0.04   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 1 - VERTICAL PERCOLATION LAYER
             MATERIAL TEXTURE NUMBER   0
   THICKNESS                =    12.00   INCHES
   POROSITY                 =     0.3980 VOL/VOL
   FIELD CAPACITY           =     0.2440 VOL/VOL
   WILTING POINT            =     0.1360 VOL/VOL
   INITIAL SOIL WATER CONTENT =   0.2254 VOL/VOL
   EFFECTIVE SAT. HYD. COND.  = 0.999999975000E-04 CM/SEC




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

  NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE #10 WITH A
         FAIR STAND OF GRASS, A SURFACE SLOPE OF 33.%
         AND A SLOPE LENGTH OF  150. FEET.

  SCS RUNOFF CURVE NUMBER            =    87.20
  FRACTION OF AREA ALLOWING RUNOFF   =   100.0    PERCENT
  AREA PROJECTED ON HORIZONTAL PLANE =     1.000  ACRES
  EVAPORATIVE ZONE DEPTH             =    22.0    INCHES
  INITIAL WATER IN EVAPORATIVE ZONE  =     5.592  INCHES
  UPPER LIMIT OF EVAPORATIVE STORAGE =     8.756  INCHES
  LOWER LIMIT OF EVAPORATIVE STORAGE =     2.992  INCHES
  INITIAL SNOW WATER                 =     0.000  INCHES
  INITIAL WATER IN LAYER MATERIALS   =     8.835  INCHES
  TOTAL INITIAL WATER                =     8.835  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             = 22.0  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 WAS SYNTHETICALLY GENERATED USING
             COEFFICIENTS FOR    TAMPA            FLORIDA

             NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

   JAN/JUL   FEB/AUG   MAR/SEP   APR/OCT   MAY/NOV   JUN/DEC
   -------   -------   -------   -------   -------   -------
    2.10      3.10      3.50      2.60      3.00      6.50
    8.10      7.20      6.80      3.90      1.70      2.10


      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    1 THROUGH   30
-------------------------------------------------------------------------------

                  JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                  -------  -------  -------  -------  -------  -------
 PRECIPITATION
 -------------
  TOTALS             2.04     2.84     2.82     2.30     2.52     6.14
                     8.04     6.97     6.59     5.05     1.71     2.08

  STD. DEVIATIONS    1.28     1.69     1.83     1.80     1.68     3.45
                     3.56     2.28     2.82     2.76     1.12     1.10

 RUNOFF
 ------
  TOTALS            0.120    0.159    0.220    0.192    0.167    0.829
                    0.947    0.518    0.862    0.632    0.074    0.051

  STD. DEVIATIONS   0.175    0.226    0.321    0.421    0.304    0.995
```

```
                0.886   0.588   0.982   0.985   0.204   0.077

 EVAPOTRANSPIRATION
 ------------------
  TOTALS              1.819   2.710   2.882   2.392   2.332   4.519
                5.728   5.787   4.713   4.134   2.264   1.676

  STD. DEVIATIONS       0.635   0.762   1.167   1.337   1.432   1.635
                1.528   0.907   1.100   0.600   0.978   0.610

 LATERAL DRAINAGE COLLECTED FROM LAYER  3
 ----------------------------------------
  TOTALS              0.0892  0.0983  0.1058  0.0666  0.0004  0.1982
                0.5664  0.5402  0.7967  0.6646  0.1966  0.1080

  STD. DEVIATIONS       0.2269  0.2623  0.2903  0.2040  0.0010  0.5094
                0.8514  0.8292  1.1804  0.9206  0.3478  0.3257

 PERCOLATION/LEAKAGE THROUGH LAYER  4
 ------------------------------------
  TOTALS              0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
                0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

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

 PERCOLATION/LEAKAGE THROUGH LAYER  5
 ------------------------------------
  TOTALS              0.0021  0.0012  0.0009  0.0007  0.0006  0.0012
                0.0024  0.0024  0.0019  0.0023  0.0014  0.0007

  STD. DEVIATIONS       0.0064  0.0026  0.0017  0.0008  0.0009  0.0022
                0.0041  0.0032  0.0021  0.0035  0.0017  0.0011


-------------------------------------------------------------------------------
          AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


 DAILY AVERAGE HEAD ON TOP OF LAYER  4
 -------------------------------------
  AVERAGES              0.0002  0.0002  0.0002  0.0001  0.0000  0.0004
                0.0010  0.0009  0.0014  0.0011  0.0004  0.0002

  STD. DEVIATIONS       0.0004  0.0005  0.0005  0.0004  0.0000  0.0009
                0.0015  0.0014  0.0021  0.0016  0.0006  0.0006

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


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

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

```
                          INCHES          CU. FEET     PERCENT
                      ------------------  -------------  ---------
PRECIPITATION             49.08    (  7.630)    178170.1     100.00

RUNOFF                   4.771   ( 1.7458)     17318.60     9.720

EVAPOTRANSPIRATION          40.955   ( 4.6801)    148665.14    83.440

LATERAL DRAINAGE COLLECTED     3.43092 ( 2.45424)    12454.254    6.99009
 FROM LAYER  3

PERCOLATION/LEAKAGE THROUGH     0.00019 (  0.00012)        0.692     0.00039
 LAYER  4

AVERAGE HEAD ON TOP           0.001 (    0.000)
 OF LAYER  4

PERCOLATION/LEAKAGE THROUGH     0.01785 (  0.02477)       64.790     0.03636
 LAYER  5

CHANGE IN WATER STORAGE       -0.092   (  1.0520)      -332.72     -0.187

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

          PEAK DAILY VALUES FOR YEARS    1 THROUGH   30
  ------------------------------------------------------------------------
                                  (INCHES)     (CU. FT.)
                                 ----------   -------------
   PRECIPITATION                        4.85        17605.500

   RUNOFF                           2.689        9760.6553

   DRAINAGE COLLECTED FROM LAYER  3          0.91209      3310.87671

   PERCOLATION/LEAKAGE THROUGH LAYER  4       0.000027         0.09787

   AVERAGE HEAD ON TOP OF LAYER  4           0.049

   MAXIMUM HEAD ON TOP OF LAYER  4           0.115

   LOCATION OF MAXIMUM HEAD IN LAYER  3
       (DISTANCE FROM DRAIN)              0.0 FEET

   PERCOLATION/LEAKAGE THROUGH LAYER  5       0.001385         5.02621

   SNOW WATER                          0.00           0.0000


   MAXIMUM VEG. SOIL WATER (VOL/VOL)                0.3526

   MINIMUM VEG. SOIL WATER (VOL/VOL)               0.1360


    ***  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   30
     ----------------------------------------------------------------------
              LAYER       (INCHES)      (VOL/VOL)
              -----       --------      ---------
                1          1.1890        0.1982

                2          2.7193        0.1511

                3          0.0025        0.0100

                4          0.0000        0.0000

                5          2.1745        0.1812

             SNOW WATER        0.000

*******************************************************************************
*******************************************************************************
```

CASE 3

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              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:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\VISTA.D4
TEMPERATURE DATA FILE:      C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\COVER.D7
SOLAR RADIATION DATA FILE:  C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\COVER.D13
EVAPOTRANSPIRATION DATA:    C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\COVER.D11
SOIL AND DESIGN DATA FILE:  C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\COVER-5.D10
OUTPUT DATA FILE:           C:\DOCUME~1\SEUN\DESKTOP\HELPMO~1\COVER-5.OUT


TIME:  16:11    DATE:  5/29/2007


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

  TITLE:  Oak Hammock Disposal 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  15
      THICKNESS                 =    6.00   INCHES
      POROSITY                  =    0.4750 VOL/VOL
      FIELD CAPACITY            =    0.3780 VOL/VOL
      WILTING POINT             =    0.2650 VOL/VOL
      INITIAL SOIL WATER CONTENT =   0.3301 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  = 0.170000003000E-04 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                  =     18.00   INCHES
  POROSITY                   =     0.4750 VOL/VOL
  FIELD CAPACITY             =     0.3780 VOL/VOL
  WILTING POINT              =     0.2650 VOL/VOL
  INITIAL SOIL WATER CONTENT =     0.3898 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  = 0.999999975000E-05 CM/SEC



                    LAYER  3
                    --------

          TYPE 2 - LATERAL DRAINAGE LAYER
             MATERIAL TEXTURE NUMBER   0
  THICKNESS                  =     0.25   INCHES
  POROSITY                   =     0.8500 VOL/VOL
  FIELD CAPACITY             =     0.0100 VOL/VOL
  WILTING POINT              =     0.0050 VOL/VOL
  INITIAL SOIL WATER CONTENT =     0.0100 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  =  1.64999998000      CM/SEC
  SLOPE                      =    33.30   PERCENT
  DRAINAGE LENGTH            =    150.0    FEET



                    LAYER  4
                    --------

          TYPE 4 - FLEXIBLE MEMBRANE LINER
             MATERIAL TEXTURE NUMBER  35
  THICKNESS                  =     0.04   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 1 - VERTICAL PERCOLATION LAYER
             MATERIAL TEXTURE NUMBER   0
   THICKNESS                =    12.00   INCHES
   POROSITY                 =    0.3980 VOL/VOL
   FIELD CAPACITY           =      0.2440 VOL/VOL
   WILTING POINT            =     0.1360 VOL/VOL
   INITIAL SOIL WATER CONTENT  =     0.2282 VOL/VOL
   EFFECTIVE SAT. HYD. COND.   = 0.999999975000E-04 CM/SEC




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

  NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE #15 WITH A
         FAIR STAND OF GRASS, A SURFACE SLOPE OF 33.%
         AND A SLOPE LENGTH OF  150. FEET.

  SCS RUNOFF CURVE NUMBER            =    90.90
  FRACTION OF AREA ALLOWING RUNOFF   =    100.0    PERCENT
  AREA PROJECTED ON HORIZONTAL PLANE =      1.000  ACRES
  EVAPORATIVE ZONE DEPTH             =   22.0    INCHES
  INITIAL WATER IN EVAPORATIVE ZONE  =     8.242  INCHES
  UPPER LIMIT OF EVAPORATIVE STORAGE =     10.450  INCHES
  LOWER LIMIT OF EVAPORATIVE STORAGE =      5.830  INCHES
  INITIAL SNOW WATER                 =      0.000  INCHES
  INITIAL WATER IN LAYER MATERIALS   =     11.738  INCHES
  TOTAL INITIAL WATER                =     11.738  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              = 22.0  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 WAS SYNTHETICALLY GENERATED USING
             COEFFICIENTS FOR   TAMPA          FLORIDA

             NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

   JAN/JUL    FEB/AUG    MAR/SEP    APR/OCT    MAY/NOV    JUN/DEC
   -------    -------    -------    -------    -------    -------
     2.10       3.10       3.50       2.60       3.00       6.50
     8.10       7.20       6.80       3.90       1.70       2.10


      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    1 THROUGH   30
------------------------------------------------------------------------------

                  JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                  -------  -------  -------  -------  -------  -------
 PRECIPITATION
 -------------
  TOTALS              2.04     2.84     2.82     2.30     2.52     6.14
                      8.04     6.97     6.59     5.05     1.71     2.08

  STD. DEVIATIONS     1.28     1.69     1.83     1.80     1.68     3.45
                      3.56     2.28     2.82     2.76     1.12     1.10

 RUNOFF
 ------
  TOTALS             0.266    0.352    0.430    0.361    0.323    1.412
                     1.768    1.085    1.561    1.176    0.174    0.159

  STD. DEVIATIONS    0.332    0.440    0.558    0.665    0.501    1.539
```

```
               1.490   1.022   1.548   1.497   0.365   0.197

 EVAPOTRANSPIRATION
 ------------------
  TOTALS             1.664   2.845   2.762   2.235   2.194   4.305
               5.402   5.583   4.589   4.005   2.040   1.484

  STD. DEVIATIONS      0.585   0.714   1.162   1.234   1.330   1.565
               1.495   0.956   1.143   0.601   0.870   0.552

 LATERAL DRAINAGE COLLECTED FROM LAYER  3
 ----------------------------------------
  TOTALS             0.0762  0.0696  0.0428  0.0085  0.0003  0.0066
               0.0805  0.1471  0.2212  0.1893  0.0656  0.0641

  STD. DEVIATIONS      0.1595  0.2342  0.1129  0.0417  0.0006  0.0328
               0.2048  0.3937  0.4929  0.3228  0.1648  0.2018

 PERCOLATION/LEAKAGE THROUGH LAYER  4
 ------------------------------------
  TOTALS             0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
               0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

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

 PERCOLATION/LEAKAGE THROUGH LAYER  5
 ------------------------------------
  TOTALS             0.0021  0.0014  0.0013  0.0006  0.0006  0.0010
               0.0019  0.0025  0.0018  0.0018  0.0014  0.0007

  STD. DEVIATIONS      0.0056  0.0037  0.0023  0.0008  0.0011  0.0018
               0.0045  0.0049  0.0025  0.0025  0.0024  0.0009


-------------------------------------------------------------------------------
         AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


 DAILY AVERAGE HEAD ON TOP OF LAYER  4
 -------------------------------------
  AVERAGES             0.0002  0.0002  0.0001  0.0000  0.0000  0.0000
               0.0002  0.0004  0.0005  0.0005  0.0002  0.0002

  STD. DEVIATIONS      0.0004  0.0006  0.0003  0.0001  0.0000  0.0001
               0.0005  0.0010  0.0012  0.0008  0.0004  0.0005

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


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

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

```
                        INCHES         CU. FEET     PERCENT
                    ------------------  -------------  ---------
PRECIPITATION              49.08    (  7.630)    178170.1    100.00

RUNOFF                  9.069  ( 2.9693)    32919.61    18.477

EVAPOTRANSPIRATION         39.108  ( 4.8107)    141962.75    79.678

LATERAL DRAINAGE COLLECTED     0.97176 (  0.98221)     3527.506    1.97985
 FROM LAYER  3

PERCOLATION/LEAKAGE THROUGH    0.00005 (  0.00005)       0.193     0.00011
 LAYER  4

AVERAGE HEAD ON TOP          0.000 (    0.000)
 OF LAYER  4

PERCOLATION/LEAKAGE THROUGH    0.01714 (  0.02528)      62.208     0.03491
 LAYER  5

CHANGE IN WATER STORAGE       -0.083   (  1.1782)      -302.00     -0.169

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

          PEAK DAILY VALUES FOR YEARS    1 THROUGH   30
 -------------------------------------------------------------------------
                                  (INCHES)     (CU. FT.)
                                 ----------    -------------
   PRECIPITATION                     4.85       17605.500

   RUNOFF                        3.559       12918.6553

   DRAINAGE COLLECTED FROM LAYER  3         0.28296       1027.15051

   PERCOLATION/LEAKAGE THROUGH LAYER  4      0.000009        0.03365

   AVERAGE HEAD ON TOP OF LAYER  4          0.020

   MAXIMUM HEAD ON TOP OF LAYER  4          0.053

   LOCATION OF MAXIMUM HEAD IN LAYER  3
       (DISTANCE FROM DRAIN)              0.0 FEET

   PERCOLATION/LEAKAGE THROUGH LAYER  5      0.001683        6.10911

   SNOW WATER                        0.00           0.0000


   MAXIMUM VEG. SOIL WATER (VOL/VOL)              0.4593

   MINIMUM VEG. SOIL WATER (VOL/VOL)              0.2650

    ***  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   30
    ------------------------------------------------------------------------
              LAYER        (INCHES)      (VOL/VOL)
              -----        ---------     ---------
                1           1.9674        0.3279

                2           5.0468        0.2804

                3           0.0025        0.0100

                4           0.0000        0.0000

                5           2.2253        0.1854

            SNOW WATER      0.000

****************************************************************************
****************************************************************************
```

ATTACHMENT 3

SPREADSHEETS FOR VERIFICATION OF HEADS USING GIROUD'S METHOD

CASE 1 – FINAL COVER SYSTEM WITH 1X10^-3 OF TOP SOIL PERMEABILITY

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.
(The indicated equation numbers correspond to the equation number in this paper)

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.

Manually input numbers in RED

For "Top Drainage Layer" using subscript "t" (same as "2" in the paper)
For "Bottom Drainage Layer" using subscript "b" (same as "1" in the paper)

Geocomposite Permeability (k1) = (kb) = 0.054 ft/sec   Geocomposite Transmissivity (θ1) = (θb) = 1.05E-04 m^2/sec   0.0011 ft^2/sec
Geocomposite Thickness (t1) = (tb) = 0.250 inches
Sand Permeability (k2) = (kt) = 3.3E-05 ft/sec   0.001 cm/sec   Check k1 or kb > k2 or kt
Slope angle = β = 18.418 degrees   0.321 radians   Slope (%) = 33.3   Check = 0.333

Drainage Length = L = 150 ft
Liquid Impingement Rate = qh = 2.37E-06 ft/sec   8,906 ft^3/ac/day   Check qh < k2 or kt < k1 or kb

Length of Upstream Section = Lu = 150.8 ft   (Eqn 18)
Characteristic Parameter = λ1 = λb   0.000   (Eqn 7)
Characteristic Parameter = λ2 = λt   0.650   (Eqn 17)
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

Conservative Approach:

Is applicable when λ < 0.01; Is an acceptable approximation when t max < one tenth the height of the drainage layer; and
Is rarely valid for granular drainage layers on a relatively flat slope.

For bottom drainage layer:		For top drainage layer:		
t maxb = (qh x L)/(kb x sinβ) =	0.25 inches	t maxt = qh (L-Lu)/(kt x sinβ) =	N/A inches	(Eqns 20 & 29)
h maxb = (t maxb) cosβ =	0.24 inches	h maxt = (t maxt) cosβ =	N/A inches	(Eqn 14)

Rigorous Approach:

Modifying Factor = j2 = jt =	0.880	(Eqn 26)
t max (top) = t max2 =	N/A inches	(Eqn 25)

For Lu > L, flow is in the bottom drainage layer (geocomposite) only and the conservative approach is applicable.

Is conservative approach applicable	Yes	Therefore,	t max = t maxb =	**0.25** inches	(Eqn 20)
for the bottom drainage layer?		and	h max = (t max)cosβ =	**0.24** inches	(Eqn 14)

For Lu < L and λt < 0.01, flow is in both the drainage layers and the conservative approach is applicable.

Is conservative approach applicable	No	Therefore,	t max = tb + t maxt =	**N/A** inches	(Eqn 32)
for the top drainage layer?		and	h max = (t max)cosβ =	**N/A** inches	(Eqn 14)

For Lu < L and λt > 0.01, flow is in both the drainage layers and the rigorous approach is applicable.

Is rigorous approach applicable	No	Therefore,	t max = tb + t max2 =	**N/A** inches	(Eqn 32)
for the top drainage layer?		and	h max = (t max)cosβ =	**N/A** inches	(Eqn 14)

CASE 2 – FINAL COVER SYSTEM WITH 1X10^-4 OF TOP SOIL PERMEABILITY

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.
(The indicated equation numbers correspond to the equation number in this paper)

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.

Manually input numbers in RED

For "Top Drainage Layer" using subscript "t" (same as "2" in the paper)
For "Bottom Drainage Layer" using subscript "b" (same as "1" in the paper)

Geocomposite Permeability (k1) = (kb) =		0.054	ft/sec		Geocomposite Transmissivity (θ1) = (θb) =	1.05E-04	m^2/sec	0.0011	ft^2/sec
Geocomposite Thickness (t1) = (tb) =		0.250	inches						
Sand Permeability (k2) = (kt) =		3.3E-06	ft/sec	0.0001 cm/sec	Check k1 or kb > k2 or kt				
Slope angle = β =	18.418	0.321	Slope (%) =	33.3	Check =	0.333			
	degrees	radians							
Drainage Length = L =		150	ft						
Liquid Impingement Rate = qh =		8.80E-07	ft/sec	3,311 ft^3/ac/day	Check qh < k2 or kt < k1 or kb				

Length of Upstream Section = Lu =	405.7	ft	(Eqn 18)
Characteristic Parameter = λ1 = λb	0.000		(Eqn 7)
Characteristic Parameter = λ2 = λt	2.418		(Eqn 17)

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

Conservative Approach:

Is applicable when $\lambda < 0.01$; Is an acceptable approximation when t max < one tenth the height of the drainage layer; and
Is rarely valid for granular drainage layers on a relatively flat slope.

For bottom drainage layer:		For top drainage layer:		
t maxb = (qh x L)/(kb x sinβ) =	0.09 inches	t maxt = qh (L-Lu)/(kt x sinβ) =	N/A inches	(Eqns 20 & 29)
h maxb = (t maxb) cosβ =	0.09 inches	h maxt = (t maxt) cosβ =	N/A inches	(Eqn 14)

Rigorous Approach:

Modifying Factor = j2 = jt =	0.895	(Eqn 26)
t max (top) = t max2 =	N/A inches	(Eqn 25)

For Lu > L, flow is in the bottom drainage layer (geocomposite) only and the conservative approach is applicable.

Is conservative approach applicable	Yes	Therefore,	t max = t maxb =	**0.09** inches	(Eqn 20)
for the bottom drainage layer?		and	h max = (t max)cosβ =	**0.09** inches	(Eqn 14)

For Lu < L and $\lambda t < 0.01$, flow is in both the drainage layers and the conservative approach is applicable.

Is conservative approach applicable	No	Therefore,	t max = tb + t maxt =	**N/A** inches	(Eqn 32)
for the top drainage layer?		and	h max = (t max)cosβ =	**N/A** inches	(Eqn 14)

For Lu < L and $\lambda t > 0.01$, flow is in both the drainage layers and the rigorous approach is applicable.

Is rigorous approach applicable	No	Therefore,	t max = tb + t max2 =	**N/A** inches	(Eqn 32)
for the top drainage layer?		and	h max = (t max)cosβ =	**N/A** inches	(Eqn 14)

CASE 3 – FINAL COVER SYSTEM WITH 1X10^-5 OF TOP SOIL PERMEABILITY

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.
(The indicated equation numbers correspond to the equation number in this paper)

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.

Manually input numbers in RED

For "Top Drainage Layer" using subscript "t" (same as "2" in the paper)
For "Bottom Drainage Layer" using subscript "b" (same as "1" in the paper)

Geocomposite Permeability (k1) = (kb) =		0.054 ft/sec	Geocomposite Transmissivity (θ1) = (θb) =	1.05E-04 m^2/sec	0.0011 ft^2/sec
Geocomposite Thickness (t1) = (tb) =		0.250 inches			
Sand Permeability (k2) = (kt) =		3.3E-07 ft/sec	0.00001 cm/sec	Check k1 or kb > k2 or kt	
Slope angle = β =	18.418 degrees	0.321 radians	Slope (%) = 33.3	Check = 0.333	
Drainage Length = L =		1,150 ft			
Liquid Impingement Rate = qh =		2.73E-07 ft/sec	1,027 ft^3/ac/day	Check qh < k2 or kt < k1 or kb	

Length of Upstream Section = Lu = 1,307.9 ft (Eqn 18)
Characteristic Parameter = λ1 = λb 0.000 (Eqn 7)
Characteristic Parameter = λ2 = λt 7.501 (Eqn 17)
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

Conservative Approach:

Is applicable when $\lambda < 0.01$; Is an acceptable approximation when t max < one tenth the height of the drainage layer; and
Is rarely valid for granular drainage layers on a relatively flat slope.

For bottom drainage layer:		For top drainage layer:		
t maxb = (qh x L)/(kb x sinβ) =	0.22 inches	t maxt = qh (L-Lu)/(kt x sinβ) =	N/A inches	(Eqns 20 & 29)
h maxb = (t maxb) cosβ =	0.21 inches	h maxt = (t maxt) cosβ =	N/A inches	(Eqn 14)

Rigorous Approach:

Modifying Factor = j2 = jt = 0.924 (Eqn 26)
t max (top) = t max2 = N/A inches (Eqn 25)

For Lu > L, flow is in the bottom drainage layer (geocomposite) only and the conservative approach is applicable.

Is conservative approach applicable	Yes	Therefore,	t max = t maxb =	**0.22** inches	(Eqn 20)
for the bottom drainage layer?		and	h max = (t max)cosβ =	**0.21** inches	(Eqn 14)

For Lu < L and $\lambda t < 0.01$, flow is in both the drainage layers and the conservative approach is applicable.

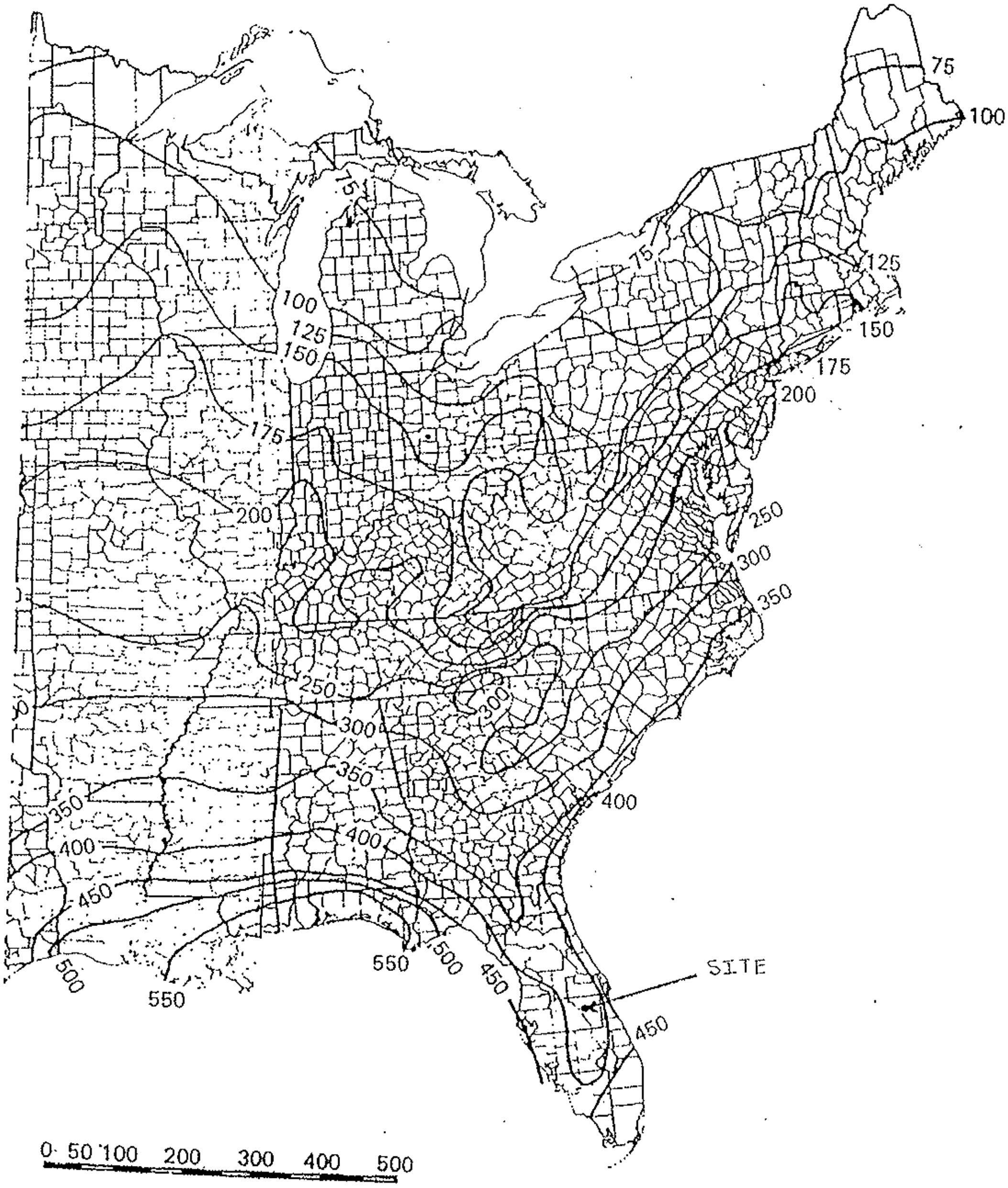
Is conservative approach applicable	No	Therefore,	t max = tb + t maxt =	**N/A** inches	(Eqn 32)
for the top drainage layer?		and	h max = (t max)cosβ =	**N/A** inches	(Eqn 14)

For Lu < L and $\lambda t > 0.01$, flow is in both the drainage layers and the rigorous approach is applicable.

Is rigorous approach applicable	No	Therefore,	t max = tb + t max2 =	**N/A** inches	(Eqn 32)
for the top drainage layer?		and	h max = (t max)cosβ =	**N/A** inches	(Eqn 14)

ATTACHMENT 4

RAINFALL AND RUNOFF EROSIVITY INDEX



Rainfall and Runoff Erosivity Index, R (Goldman, et al., 1986)

Geosyntec
consultants

COMPUTATION COVER SHEET

Client: **Vista LF, LLC** Project: **Vista Landfill – Substantial Permit Mod** Project No.: **FL1229**

Phase No.:

Title of Computations **FINAL COVER VENEER SLOPE STABILITY ANALYSIS**

Computations by:
Signature
Printed Name Sangho "Jay" Eun, E.I.T.
Title Senior Staff Engineer
Date 17 July 2007

Assumptions and Procedures Checked by: (peer reviewer)
Signature
Printed Name Ayushman Gupta, P.E.
Title Senior Engineer
Date 17 July 2007

Computations Checked by:
Signature Juan D. Quiroz
Printed Name Juan D. Quiroz, Ph.D., P.E.
Title Project Engineer
Date 19 July 2007

Computations Backchecked by: (originator)
Signature
Printed Name Sangho "Jay" Eun, E.I.T.
Title Senior Staff Engineer
Date 25 July 2007

Approved by: (pm or designate)
Signature Juan D. Quiroz
Printed Name Juan D. Quiroz, Ph.D., P.E.
Title Project Engineer
Date 27 July 2007

Approval notes:

Revisions (number and initial all revisions)

No.	Sheet	Date	By	Checked by	Approval

Written by: **Jay Eun** Date: **07/17/07** Reviewed by: **J. Quiroz** Date: **07/19/07**

Client: **Vista LF, LLC** Project: **Vista LF – Substantial** Project No.: **FL1229** Phase No.:

FINAL COVER VENEER SLOPE STABILITY ANALYSIS
VISTA CLASS III LANDFILL
APOPKA, FLORIDA

INTRODUCTION

The purpose of this calculation package is to evaluate the veneer stability of the final cover system for the Vista Class III Landfill facility located in Apopka, Florida. Analyses were performed to evaluate the veneer stability of: (i) the landfill cover system along the landfill side slopes; and (ii) the landfill cover system along the drainage swales. The subsequent sections present several aspects of the veneer stability analyses and include the following items:

- Input parameters and assumptions used for the stability analyses;
- Methodology utilized to evaluate veneer stability; and
- Results of the stability analyses for each system analyzed.

INPUT PARAMETERS AND ASSUMPTIONS

Figure 1 presents the typical cross-section of the proposed final cover system and surface water drainage swales for the Vista Class III Landfill. The following geometric parameters, material properties and assumptions were established with respect to the veneer stability analyses performed for the side slope and drainage swale configurations.

Side Slope

- Final cover system side slope is 3H:1V (33%).
- Total unit weight of final cover system soil is 110 pcf.
- Assume an internal friction angle (ϕ) of 30° and a cohesion (c) of zero for the cover system soil.
- Final cover system thickness is 2 ft.

- Maximum vertical height of the 3H:1V side slope is 50 ft.
- Assume negligible water flow thickness (i.e., no seepage forces) along the length of the 3H:1V side slopes for the cover system.
- Assume zero interface adhesion (a) along a defined slip surface.
- Assume zero tension (T) in the geosynthetics above the slip surface, if any.

Drainage Swale

- Drainage swale side slope is 2H:1V (50%). The drainage swale has a tapered thickness, see Figure 1.
- Thickness of drainage swale at the top of the swale is 6 ft.
- Thickness of drainage swale at the bottom of the swale is 2 ft.
- Average thickness of drainage swale is 4 ft.
- Total unit weight of final cover system soil is 110 pcf.
- Assume an internal friction angle (ϕ) of 30° and a cohesion (c) of zero for the cover system soil.
- Maximum vertical height of slope along the surface water drainage swale is 20 ft.
- Assume the geocomposite drainage layer (placed on top of the geomembrane) along the 3H:1V side slopes is continuous under the drainage swales.
- Assume negligible water flow thickness (i.e., no seepage forces) along the length of the 3H:1V side slopes.
- Assume zero interface adhesion (a) along a defined slip surface.
- Assume zero tension (T) in the geosynthetics above the slip surface, if any.

METHOD OF ANALYSIS

The veneer slope stability of the final cover system inclined on a 3H:1V side slope was evaluated using the method proposed by Giroud et al. (1995) for geosynthetic-soil layered systems. The factor of safety (FOS) for a layered system of uniform thickness assuming no water flow along the slope length is given by the following equation:

$$FOS = \frac{\tan\delta}{\tan\beta} + \frac{a}{\gamma\, t \sin\beta} + \frac{t}{h}\,\frac{\tan\phi\,/\,(2\sin\beta\cos^2\beta)}{1 - \tan\beta\,\tan\phi} + \frac{c}{\gamma\, h}\,\frac{1/(\sin\beta\cos\beta)}{1 - \tan\beta\,\tan\phi} + \frac{T}{\gamma\, h\, t} \quad \text{(Equation 1)}$$

where:

a = interface adhesion along the slip surface;
c = cohesion of the soil component of the layered system;
h = vertical height of the slope;
T = tension in the geosynthetics above the slip surface;
t = soil layer thickness above the geomembrane;
β = slope angle;
δ = interface friction angle along the slip surface;
ϕ = internal friction angle of the soil component of the layered system; and
γ_t = total unit weight of soil.

The veneer slope stability of the drainage swales placed on the 3H:1V side slopes was evaluated using the method proposed by Giroud et al. (1995) for tapered geosynthetic-soil layered systems. The FOS for a layered system of non-uniform (i.e., tapered) thickness assuming no water flow along the slope length is given by the following equation:

$$FOS = \frac{\tan\delta}{\tan\beta} + \frac{a}{\gamma\, t_{avg}\,\sin\beta} + \frac{t_B^2}{h\, t_{avg}}\,\frac{\tan\phi\,/\,(2\sin\beta\cos^2\beta)}{1 - \tan\beta\,\tan\phi} + \frac{c}{\gamma\, h}\,\frac{t_B}{t_{avg}}\,\frac{1/(\sin\beta\cos\beta)}{1 - \tan\beta\,\tan\phi} + \frac{T}{\gamma\, h\, t_{avg}}$$

(Equation 2)

where:

a = interface adhesion along the slip surface;
c = cohesion of the soil component of the layered system;

h = vertical height of the slope;
T = tension in the geosynthetics above the slip surface;
t_A = soil layer thickness above the geomembrane at the top of slope;
t_B = soil layer thickness above the geomembrane at the bottom of slope;
t_{avg} = average soil layer thickness above the geomembrane;
β = slope angle;
δ = interface friction angle along the slip surface;
ϕ = internal friction angle of the soil component of the layered system; and
γ_t = total unit weight of soil.

For the side slope final cover system and surface water drainage swale configuration, a parametric analysis was performed to establish the minimum interface friction angle (δ) such that the calculated veneer stability FOS is equal to or greater than 1.5, the minimum regulatory requirement for long-term slope stability. The parametric analysis was performed by calculating the FOS from Equations 1 and 2 for various values of interface friction angle.

VENEER STABILITY RESULTS

3H:1V Side Slope Final Cover System

Table 1 and Figure 2 present the parametric analysis results obtained for the 3H:1V side slope final cover system. Based on the input parameters presented above, a minimum interface friction angle of 25.8° is required to meet a FOS of 1.5, the minimum regulatory requirement for long-term slope stability.

Surface Water Drainage Swales

Table 2 and Figure 3 present the results obtained for the surface water drainage swales. Based on the input parameters presented above, a minimum interface friction angle of 25.5° is required to meet a FOS of 1.5, the minimum regulatory requirement for long-term stability. Since this calculated interface friction angle is slightly less than the 25.8° calculated for the side slope final cover system, the overall veneer stability will be governed by the side slope.

CONCLUSIONS

The overall veneer stability of the final cover system is governed by the side slope configuration. The results of the parametric stability analyses indicate that a minimum interface friction angle of 25.8° is required to achieve a factor of safety of 1.5. This value is within the range of the soil-geosynthetic and geosynthetic-geosynthetic interface friction angles reported in the literature (see Table 3).

Prior to construction of the final cover system, the interface friction angles between the actual soil and geosynthetic materials will be verified by performing site-specific interface shear strength testing.

Written by: **Jay Eun** Date: **07/17/07** Reviewed by: **J. Quiroz** Date: **07/19/07**

Client: **Vista LF, LLC** Project: **Vista LF – Substantial** Project No.: **FL1229** Phase No.:

REFERENCE

Giroud, J.P., Williams, N.D., Pelte, T., and Beech, J.F., "Stability of Geosynthetic-Soil Layered Systems on Slopes," Geosynthetics International, Vol. 2, No. 6, pp. 1115-1148, 1995.

Koerner, R.M., Designing with Geosynthetics. 4th Ed. Prentice Hall, New Jersey, 1999.

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.

Long, J. H., Daly, J. and Gilbert, R., "Structural Integrity of Geosynthetic Liner and Cover Systems for Solid Waste Landfills, Appendices A-K", Office of Solid Waste Research, Institute for Environmental Studies, University of Illinois at Urbana-Champaign, May, 1993.

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.

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.

TABLES

Table 1
3H:1V Side Slope Final Cover System Veneer Stability[1]
Vista Class III Landfill
Apopka, Florida

Cover System Parameters	Case 1	Case 2	Case 3	Case 4	Case 5
Total unit weight of soil γ_t, pcf	110	110	110	110	110
Buoyant unit weight of soil γ_b, pcf	47.6	47.6	47.6	47.6	47.6
Thickness of soil layer t, ft	2	2	2	2	2
Thickness of water flow along slope t_w, ft	0.0000	0.0000	0.0000	0.0000	0.0000
Slope angle β, degrees	18.43	18.43	18.43	18.43	18.43
Interface friction angle δ, degrees	22	24	26	28	30
Interface adhesion a, psf	0	0	0	0	0
Soil internal friction angle ϕ, degrees	30	30	30	30	30
Height of slope h, ft	50.0	50.0	50.0	50.0	50.0
Tension in geosynthetics T, lbs/ft	0	0	0	0	0
Soil cohesion c, psf	0	0	0	0	0
Factor of Safety[1]	1.26	1.39	1.51	1.65	1.78

Notes: (1) Based on Giroud (1995a) for geosynthetic-soil layered systems.

Table 2
Drainage Swale Tapered Veneer Stability[(1)]
Vista Class III Landfill
Apopka, Florida

Cover System Parameters	Case 1	Case 2	Case 3	Case 4
Total unit weight of soil γ_t, pcf	110	110	110	110
Buoyant unit weight of soil γ_b, pcf	47.6	47.6	47.6	47.6
Top thickness of soil layer t_A, ft	6	6	6	6
Bottom thickness of soil layer t_B, ft	2	2	2	2
Avg. thickness of soil layer t_{avg}, ft	4.00	4.00	4.00	4.00
Thickness of water flow along slope t_w, ft	0.0000	0.0000	0.0000	0.0000
Slope angle β, degrees	18.43	18.43	18.43	18.43
Interface friction angle δ, degrees	22	24	26	28
Interface adhesion a, psf	0	0	0	0
Soil internal friction angle ϕ, degrees	30	30	30	30
Height of slope h, ft	20	20	20	20
Tension in geosynthetics T, lbs/ft	0	0	0	0
Soil cohesion c, psf	0	0	0	0
Factor of Safety(1)	1.28	1.40	1.53	1.66

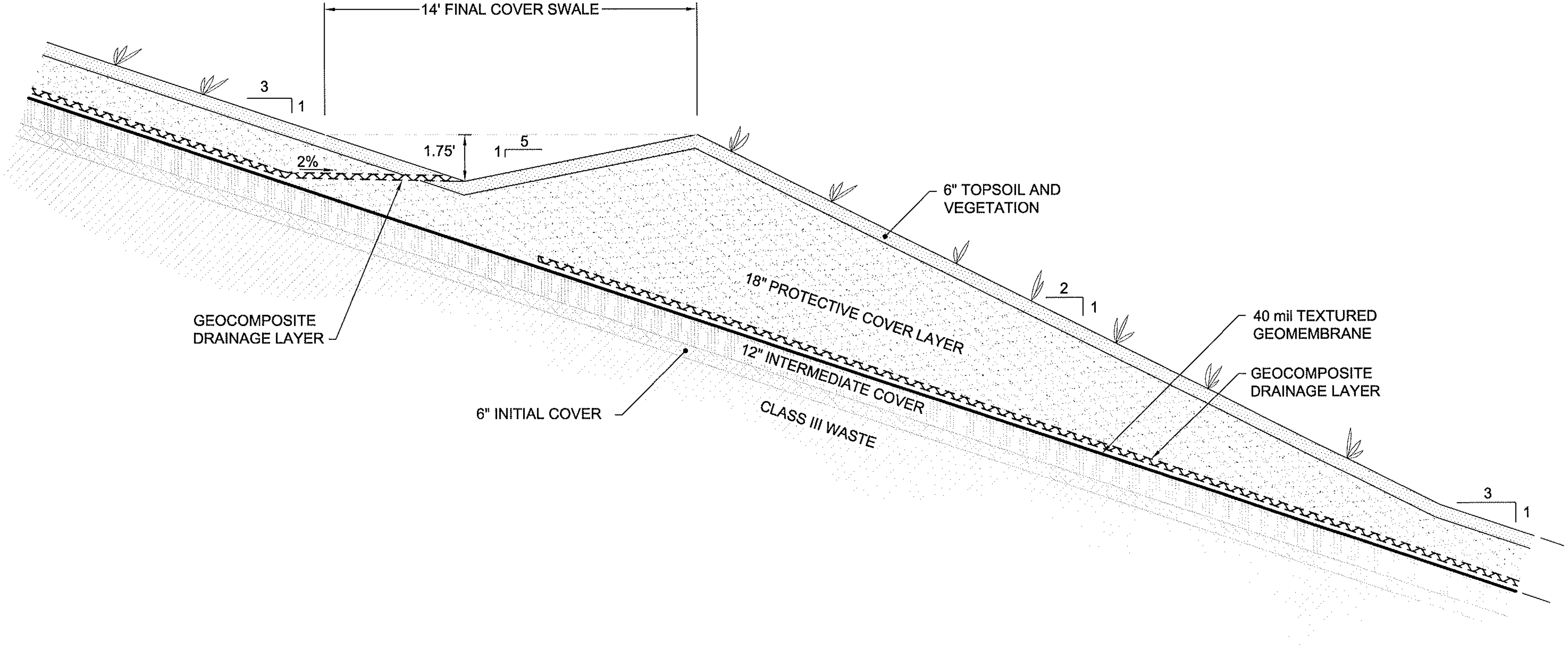
Notes: (1) Based on Giroud (1995a) for geosynthetic-soil layered systems.

Table 3
Summary of Documented Interface Friction Values
Vista Class III Landfill
Apopka, Florida

Geosynthetic / Geosynthetic	δ (°)
Textured HDPE Geomembrane / Nonwoven Geotextile	15 to 35
Textured HDPE Geomembrane / Geocomposite Drainage Layer	17 to 29
Geonet / Nonwoven Geotextile	14 to 22
Geosynthetic / Soil	**$\tan \delta / \tan \phi$**
Textured HDPE Geomembrane / Clay	0.8 to 0.9
Textured HDPE Geomembrane / Sand	0.7 to 0.8
Needle-punched Geotextile / Sand	0.8 to 1.0
Needle-punched Geotextile / Angular Gravel	0.7 to 0.9
Needle-punched Geotextile / Rounded Gravel	0.6 to 0.8
Needle-punched Geotextile / Silty Sands	0.96

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), Long et al. (1993), Koerner (1999), manufacturers literature, and unpublished results from Geosyntec Consultants.

FIGURES



Geosyntec
consultants

TAMPA, FL

DATE:	JULY 2007	FILE NO.	FL1229.02F012
PROJECT NO.	FL1229.02	FIGURE NO.	1

I:\FL1229\FL1229.02\FIGURES\FL1229.02F012.DWG (26 July 2007) cvickers

Figure 2
3H:1V Side Slope Final Cover Veneer Stability
Vista Class III Landfill
Apopka, Florida

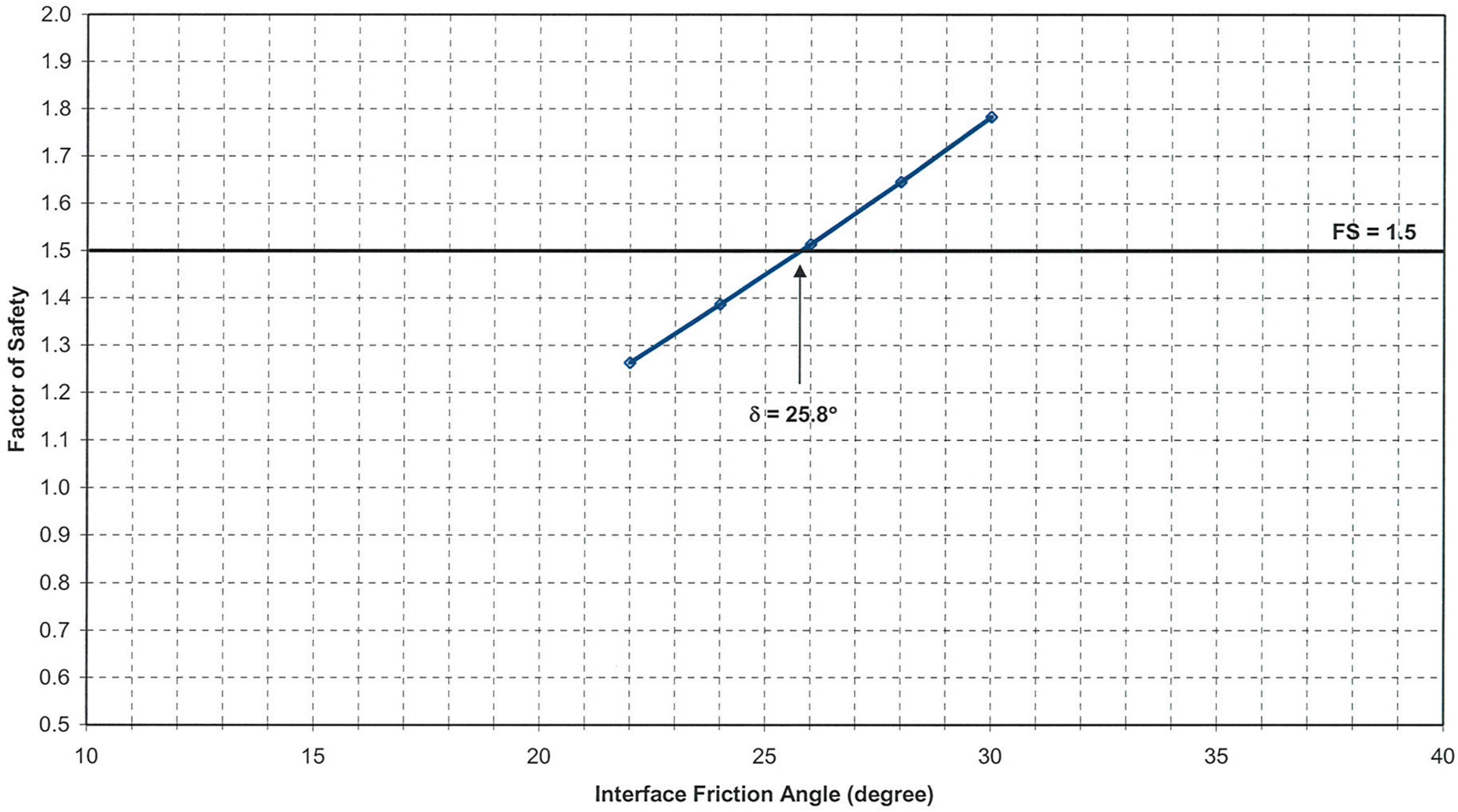
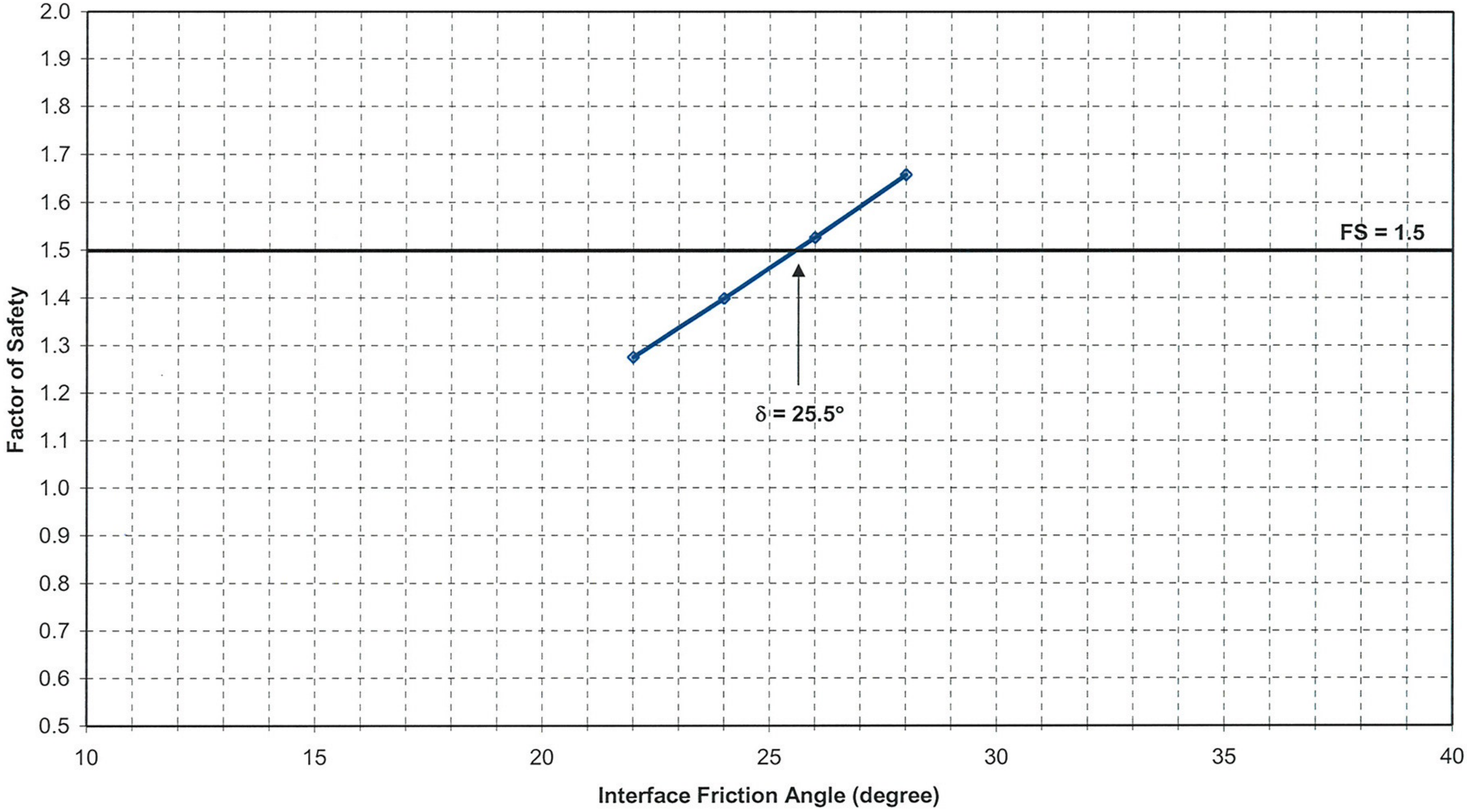


Figure 3
Drainage Swale Tapered Veneer Stability
Vista Class III Landfill
Apopka, Florida



DEP Form # 62-701.900(28)
Form Title Financial Assurance Cost Estimate Form
Effective Date 05-27-01

DEP Application No. ____________________
(Filled by DEP)

Florida Department of Environmental Protection
Twin Towers Office Bldg. • 2600 Blair Stone Road • Tallahassee, FL 32399-2400

FINANCIAL ASSURANCE COST ESTIMATE FORM

Date: 27 July 2007

Date of DEP Approval: ____________________

I. GENERAL INFORMATION:

Facility Name: Vista Landfill, Class III

WACS or GMSID #: 87081

Permit / Application No.: SO48-0165969-013

Expiration Date: 19 April 2011

Facility Address: 242 West Keene Road, Apopka, Florida 32703

Permittee: Vista Landfill, LLC

Mailing Address: Same as above

Latitude: 28 38'24.5"

Longitude: 81 30' 41.7"

or

UTM: ____________________

Solid Waste Disposal Units Included in Estimate:

Phase / Cell	Acres	Date Unit Began Accepting Waste	Design Life of Unit From Date of Initial Receipt of Waste
PH1 / 1	9.14	Proposed	
PH1 / 2	9.23	Proposed	Life of Phase I
PH1 / 3	9.54	Proposed	is approx. 5 yrs
PH1 / 4	7.39	Proposed	

Total Landfill Acreage included in this estimate. 35.3 Closure 35.3 Long-Term Care

Type of landfill: ☐ Class I ☑ Class III ☐ C&D Debris

II. TYPE OF FINANCIAL ASSURANCE DOCUMENT (Check Type)

☐ Letter of Credit*

☑ Insurance Certificate

☐ Surety Bond*

☐ Escrow Account

☐ Trust Fund Agreement

☐ Financial Test

*Indicates mechanisms that require use of a Standby Trust Fund Agreement

Northwest District
160 Governmental Center
Pensacola, FL 32501-5794
850-595-8360

Northeast District
7825 Baymeadows Way, Ste. B200
Jacksonville, FL 32256-7590
904-448-4300

Central District
3319 Maguire Blvd., Ste. 232
Orlando, FL 32803-3767
407-894-7555

Southwest District
3804 Coconut Palm Dr.
Tampa, FL 33619
813-744-6100

South District
2295 Victoria Ave., Ste. 364
Fort Myers, FL 33901-3881
941-332-6975

Southeast District
400 North Congress Ave.
West Palm Beach, FL 33401
561-681-6600

III. ESTIMATE ADJUSTMENT

40 CFR Part 264 Subpart H as adopted by reference in Rule 62-701.630, Florida Administrative Code sets forth the method of annual cost estimate adjustment. Cost estimates may be adjusted by using an inflation factor or by recalculating the maximum costs of closure in current dollars. Select one of the methods of cost estimate adjustment below.

☐ **(a) Inflation Factor Adjustment**

Inflation adjustment using an inflation factor may only be made when a Department approved closure cost estimate exists and no changes have occurred in the facility operation which would necessitate modification to the closure plan. The inflation factor is derived from the most recent Implicit Price Deflator for Gross National Product published by the U.S. Department of Commerce in its survey of Current Business. The inflation factor is the result of dividing the latest published annual Deflator by the Deflator for the previous year. The inflation factor may also be obtained from the Solid Waste Financial Coordinator at (850)-245-8732.

This adjustment is based on the Department approved closure cost estimate dated: ____________

Latest Department Approved Closure Cost Estimate:		Current Year Inflation Factor		Inflation Adjusted Closure Cost Estimate:
	X		=	$0.00

This adjustment is based on the Department approved long-term care cost estimate dated: ____________

Latest Department Approved Annual Long-Term Care Cost Estimate:		Current Year Inflation Factor		Inflation Adjusted Annual Long-Term Care Cost Estimate:
	X		=	$0.00

Number of Years of Long Term Care Remaining: X ____________

Inflation Adjusted Long-Term Care Cost Estimate: = 0.00

☑ **(b) Recalculate Estimates** (see section V)

IV. CERTIFICATION BY ENGINEER

This is to certify that the Financial Assurance Cost Estimates pertaining to the engineering features of the this solid waste management facility have been examined by me and found to conform to engineering principals applicable to such facilities. In my professional judgement, the Cost Estimates are a true, correct and complete representation of the financial liabilities for closing and long-term care of the facility and comply with the requirements of Florida Administrative Code (F.A.C.), Rule 62-701.630 and all other Department of Environmental Protection rules, and statutes of the State of Florida. It is understood that the Financial Assurance Cost Estimates shall be submitted to the Department **annually**, revised or adjusted as required by Rule 62-701.630(4), F.A.C.

Signature of Engineer	Signature of Owner/Operator
Juan Quiroz, P.E., Project Engineer	
Name & Title (please type) GeoSyntec Consultants	Name & Title (please type)
65275	
Florida Registration Number (affix seal) &Date	Telephone Number
14055 Riveredge Drive, Suite 300	
Mailing Address Tampa, FL 33637	
(813)558- 0990 Ext. 230	
Telephone Number	

V. RECALCULATE ESTIMATED CLOSING COST

For the time period in the landfill operation when the extent and manner of its operation makes closing **most expensive**.

**** Third Party Estimate / Quote must be provided for each item**

**** Costs must be for a third party providing all material and labor**

DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL
1. Proposed Monitoring Wells	(Do not include wells already in existence.)			
	EA			$0.00
2. Slope and Fill (bedding layer between waste and barrier layer):				
Excavation	CY			$0.00
Placement and Spreading	CY	57,000	$6.00	$342,000.00
Compaction	CY			$0.00
Off-Site Material	CY			$0.00
Delivery	CY			$0.00
		Subtotal Slope and Fill:		**$342,000.00**
3. Cover Material (Barrier Layer):				
Cover Protective Soil	CY	85,000	$6.00	$510,000.00
Synthetics - 40 mil (textured)	SY	170,000	$3.43	$583,100.00
Synthetics - 40 mil (smooth)	SY			$0.00
Synthetics - Geocomposite	SY	72,400	$3.93	$284,749.20
Synthetics - Other	SY			$0.00
		Subtotal Barrier Layer Cover:		**$1,377,849.20**
4. Vegetative Soil Cover:				
Off-Site Material	CY			$0.00
Delivery	CY			$0.00
Spread	CY	28,300	$6.00	$169,800.00
		Subtotal Top Soil Cover:		**$169,800.00**

DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL
5. Vegetative Layer				
Sodding	SY			$0.00
Hydroseeding	AC	35.3	$2,135.00	$75,365.50
Fertilizer	AC			$0.00
Mulch	AC			$0.00
Other	SY			$0.00
		Subtotal Vegetative Layer:		**$75,365.50**
6. Stormwater Control System:				
Earthwork	CY	10,000	$6.00	$60,000.00
Grading	SY			$0.00
Piping	LS	1	$4,200.00	$4,200.00
Ditches	LF			$0.00
Berms	LF			$0.00
Control Structures	EA	2	$2,025.00	$4,050.00
Other	LS			$0.00
		Subtotal Stormwater Controls:		**$68,250.00**
7. Gas Controls: Passive				
Wells	EA	6	$750.00	$4,500.00
Pipe and Fittings	LF			$0.00
Monitoring Probes	EA			$0.00
NSPS/Title V requirements	LS			$0.00
		Subtotal Passive Gas Control:		**$4,500.00**

DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL
8. Gas Control: Active Extraction				
Traps	EA			$0.00
Sump	EA			$0.00
Flare Assembly	EA			$0.00
Flame Arrestor	EA			$0.00
Mist Eliminator	EA			$0.00
Flow Meter	EA			$0.00
Blowers	EA			$0.00
Collection System	LS			$0.00
Other (describe)				$0.00
		Subtotal Active Gas Extraction:		**$0.00**
9. Security System:				
Fencing				$0.00
Gate(s)	LS	1	$5,000.00	$5,000.00
Sign(s)				$0.00
		Subtotal Security System:		**$5,000.00**
10. Engineering:				
Closure Plan report	LS			$25,000.00
Certified Engineer	LS			
NSPS/Title V Air Permit	LS			
Final Survey	LS			$10,000.00
Certification of Closure	LS			$18,000.00
Other (detail) Construction Drawings & Specs				$40,000.00
		Subtotal Engineering:		**$93,000.00**

11. Professional Services

	Contract Management		Quality Assurance		
	Hours	LS	Hours	LS	Total
P.E. Supervisor					$0.00
On-Site Engineer					$0.00
Office Engineer					$0.00
On-Site Technician					$0.00
Other (explain) 3% of construction cost		$64,073.00	7% of construction cost	$149,504.00	$213,577.00

DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL
Quality Assurance Testing	LS	1	$17,000.00	$17,000.00

Subtotal Professional Services: **$230,577.00**

Subtotal of 1-11 Above: **$2,366,341.70**

12. Contingency % of Total (example. enter .1 for 10%) 10%

Closing Cost Subtotal: 2,602,975.87

13. Site Specific Costs (explain)

Mobilization (3% of total construction cost)	$64,073.00
Waste Tire Facility	
Materials Recovery Facility	
Special Wastes	
Leachate Management System Modification	
Other	

Subtotal Site Specific Costs: $64,073.00

TOTAL CLOSING COSTS **$2,667,048.87**

VI. ANNUAL COST FOR LONG-TERM CARE

(Check Term Length)

☐ 5 Years ☐ 20 Years ☑ 30 Years ☐ Other

See 62-701.600(1)a.1., 62-701.620(1), 62-701.630(3)a. and 62-701.730(11)b. F.A.C. for required term length. For landfills certified closed and Department accepted, enter the remaining long-term care length as "Other" and provide years remaining.

**** Third Party Estimate / Quote must be provided for each item**
**** Costs must be for a third party providing all material and labor**

All items must be addressed. Attach a detailed explanation for all items marked not applicable (N/A)

Description	Sampling Frequency (events/yr.)	Number of Wells	$ / Well / Event	$ / Year
1. Groundwater Monitoring (62-701.510(6), and (8)(a))				
Monthly	12			$0.00
Quarterly	4			$0.00
Semi-Annual	2	18	$550.00	$19,800.00
Annual	1			$0.00
		Subtotal Groundwater Monitoring:		$19,800.00
2. Surface Water Monitoring (62-701.510(4), and (8)(b)				
Monthly	12			$0.00
Quarterly	4			$0.00
Semi-Annual	2			$0.00
Annual	1			$0.00
		Subtotal Surface Water Monitoring:		$0.00
3. Gas Monitoring				
Monthly	12			$0.00
Quarterly	4	12	$300.00	$14,400.00
Semi-Annual	2			$0.00
Annual	1			$0.00
		Subtotal Gas Monitoring:		$14,400.00

Description	Sampling Frequency (events/yr.)	Number of Locations	$/Location/Event	$ / Year
4. Leachate Monitoring (62-701.510(5), (6)(b) and 62-701.510(8)(c)				
Monthly	12			$0.00
Quarterly	4			$0.00
Semi-Annual	2			$0.00
Annual	1	1	$1,000.00	$1,000.00
Other				$0.00
			Subtotal Leachate Monitoring:	$1,000.00

DESCRIPTION	UNIT	QUANTITY	UNIT COST	ANNUAL COST
5. Leachate Collection/Treatment Systems Maintenance				
Maintenance				
Collection Pipes	LS	1	$1,500.00	$1,500.00
Sumps, Pumps	LS	1	$1,900.00	$1,900.00
Lift Stations	EA			$0.00
Cleaning	LS			$0.00
Flexible Storage Bladder	LS	1		$0.00
Impoundments				
Liner Repair	SY			$0.00
Sludge Removal	CY			$0.00
Aeration Systems	CY			$0.00
Floating Aerators	EA			$0.00
Spray Aerators	EA			$0.00
Disposal				
Off-site	gallon	200	0.12	$24.00
				$3,424.00

6. Leachate Collection/Treatment Systems Operation

Operation		Hours	$/Hour	Total
P.E. Supervisor	HR			$0.00
On-Site Engineer	HR			$0.00
Office Engineer	HR			$0.00
OnSite Technician	HR	156	$51.00	$7,956.00
Materials	LS			

Subtotal Leachate Collection/Treatment System Maintenance & Operation: $7,956.00

7. Maintenance of Groundwater Monitoring Wells

Monitoring Wells	LF			$0.00
Replacement	EA	1	$330.00	$330.00
Abandonment	EA	1	$51.00	$51.00

Subtotal Groundwater Monitoring Well Maintenance: $381.00

DESCRIPTION	UNIT	QUANTITY	UNIT COST	ANNUAL COST
8. Gas System Maintenance				
Piping, Vents	LF			$0.00
Blowers	EA			$0.00
Flaring Units	EA			$0.00
Meters, Valves	EA			$0.00
Compressors	EA			$0.00
Flame Arrestors	EA			$0.00
Total Cost for Replacement	LS			

SubTotal Gas System: $0.00

9. Landscape

Mowing	AC	35	$420.00	$14,826.00
Fertilizer	AC			$0.00

Subtotal Landscape Maintenance: $14,826.00

DESCRIPTION	UNIT	QUANTITY	UNIT COST	ANNUAL COST
10. Erosion Control & Cover Maintenance				
Sodding	SY	500	$1.00	$500.00
Regrading	AC			$0.00
Liner Repair	Event	1	$2,000.00	$2,000.00
Clay	CY			$0.00
		Subtottal Erosion Control and Cover Maintenance:		$2,500.00
11. Storm Water Management System Maintenance				
Conveyance Maintenance	LS	1	$2,500.00	$2,500.00
		Subtotal Storm Water System Maintenance:		$2,500.00
12. Security System Maintenance				
Fences	LF	100	$8.00	$800.00
Gate(s)	EA	1	$335.00	$335.00
Sign(s)	EA	2	$20.00	$40.00
		Subtotal Security System:		$1,175.00
13. Utilities	LS			$12,800.00
14. Administrative		Hours	$/Hour	Total
P.E. Supervisor	HR			$0.00
On-Site Engineer	HR			$0.00
Office Engineer	HR			$0.00
OnSite Technician	HR			$0.00
Other (explain)	LS	1	$14,000.00	$14,000.00
		Subtotal Administrative:		$14,000.00
15. Contingency	% of Total			10%
	$94,762.00	Subtotal Contingency:		$9,476.20

16. Site Specific Costs (explain)

	UNIT COST	
	LS	
	LS	
	LS	

ANNUAL LONG-TERM CARE COST ($/Year): $104,238.20

NUMBER OF YEARS OF LONG-TERM CARE 30.00

TOTAL LONG-TERM CARE COST ($) $3,127,146.00

FINANCIAL ASSURANCE COST ESTIMATE: NOTES AND CALCULATIONS
VISTA CLASS III LANDFILL
APOPKA, FLORIDA

Geosyntec Consultants (Geosyntec) has prepared this financial assurance cost estimate on behalf of Vista Landfill, L.L.C. and as part of the Substantial Permit Modification Application for Vista Class III Landfill facility located in Apopka, Florida. The information provided below presents the methods and assumptions used to estimate the cost for the items listed on the FDEP Form 62-701.900(28), *Financial Assurance Cost Estimate Form*. The estimated costs for closure and long-term care of the Vista Class III Landfill are based on Geosyntec's experience with similar landfills and recent construction projects. The section numbers noted below correspond to the item numbers on the FDEP form.

I. General Information

As noted in the Substantial Permit Modification Application and Permit Drawings, the Vista Class III Landfill consists of 12 cells (Cells 1 through 12) which will be constructed in 3 Phases (Phases 1 through 3) of landfill development. The financial assurance cost estimate presented herein is for Phase 1 only. Phase 1 landfill development consists of Cells 1 through 4 and has a design life of approximately 5 years, which corresponds to the duration of the permit issued by FDEP. Subsequent financial assurance cost estimates for future phases of landfill development will be provided during each permit renewal process (i.e., every 5 years), or as necessary.

The financial assurance cost estimate presented on the FDEP form provides the closure and long-term care costs for the 35.3 acres corresponding to the landfill footprint of Phase 1 (i.e., Cells 1 through 4) at the Vista Class III Landfill facility.

V. Recalculate Estimated Closing Cost

Closure Cost Estimates

1. Monitoring Wells

The groundwater monitoring well system for Phase I of the Vista Class III Landfill has already been installed. Therefore, no additional cost is included as part of the closure cost estimate.

2. Slope and Fill (Intermediate Cover)

During construction of Phase 1, on-site soils will be used for intermediate cover. The total estimated cubic yardage is 57,000 cy for a 1-ft thick intermediate cover layer over the waste surface. The cost per cubic yard includes excavation, hauling, placement, spreading and compaction. The estimated cost for slope and fill material is as follows:

- 57,000 cy @ $6.00/cy = $ 342,000.

3. Cover Material (Barrier Layer)

The final cover system for Phase 1 is comprised of (from bottom to top):

- 40-mil PE textured geomembrane;
- geocomposite drainage layer on 3:1 side slope only; and
- 18 inch of cover protective soil layer

Cover protective soil will consist of material obtained from on-site. Cost for cover protective soil includes excavation, hauling, placement, spreading and compaction. Cost for geosynthetics includes material and installation costs.

The estimated calculated quantities are:

- 85,000 cy soils @ $6.00/cy = $510,000
- 170,000 sy 40-mil PE textured geomembrane @ $3.43 sy = $583,100
- 72,400 sy geocomposite drainage layer @ $3.93 sy = $284,749

The total cost for cover material is $1,377,849

4. Top Soil Cover (Vegetative Soil Layer)

The vegetative soil layer consists of a 6 inch layer over the entire cover area, i.e., Phase 1. Therefore, the estimated cubic yardage is 28,300 cy. The cost per cubic yard includes hauling, placing and spreading. The estimated cost for the top soil cover is as follows:

- 28,300 cy @ $6.00/cy = $169,800

5. Vegetative layer

The final cover area will be hydro-seeded. Hydro-seeding costs include all labor and materials. The estimated calculated quantity for Phase 1 area is 35.3 acres.

- 35.3 acres @ $2,135/ acre = $75,366

6. Storm Water Control System

The perimeter and site storm water control system components will be installed as part of the landfill construction, and are therefore not included as part of the closure construction estimate.

Storm water control components for Phase 1 closure will consist of drainage swales and HDPE corrugated pipe downchutes. Drainage swales will be constructed as part of final cover protective soil placement and grading. The earthwork estimate includes excavation, backfilling and compaction. The total cost for the storm water control system is $68,250, and is itemized below.

- Earthwork: 10,000 cy @ $6.00/cy = $ 60,000
- Piping: 300 lf of 24 inch HDPE pipe @ $14/ft = $4,200
- Downchute Inlet structures: 2 @ $2,025 ea. = $4,050

7. Gas Controls:

A total of six passive gas vents are proposed for Phase 1 landfill development. Each gas vent is assumed to be 15-ft long, and the estimated cost per lineal foot of gas vent was assumed to be approximately $50/ft. Therefore, the total estimated cost for gas controls is $4,500.

8. Gas Control: Active System

No active gas system components will be installed for the Vista Class III Landfill.

9. Security System

Perimeter fencing, gates and signs will be repaired, if required for closure. A $5,000 lump sum allowance has been estimated for this work.

10. Engineering

The total cost for engineering services associated with final closure is estimated to be $93,000, and is itemized below.

- Closure permit plan and report: $25,000
- Final Survey: $ 10,000
- Certification report includes report preparation and certification by a Florida registered professional engineer: $18,000
- Other: Construction Drawings and Technical Specifications: $40,000
- Total Engineering Service: $93,000

11. Professional Services

Estimate that 3% of construction cost will be needed for contract/construction management i.e., 0.03 x $2,135,765 = $64,073

Estimate that 7% of construction cost will be needed for construction quality assurance i.e., 0.07 x $2,135,765 = $149,504

Quality assurance testing for the soil and geosynthetic components of the final cover system are based on the requirements outlined in the CQA Plan and the estimated material quantities.

12. Contingency

Estimate a contingency of 10 % of closure cost.

13. Site Specific Costs:

Contractor mobilization was estimated to be 3% of construction cost, not including professional services costs (i.e., 3% of $2,135,765 = $64,073).

Annual Costs for Long Term Care

1. Ground Water Monitoring

Eighteen (18) groundwater monitoring wells for Phase 1 of the Vista Class III Landfill have been installed. All wells are sampled on a semi-annual basis per Chapter 62-701, FAC. The cost to sample each well is estimated to be $550, and includes all labor, equipment and laboratory analyses. The estimated cost for ground water monitoring is as follows:

- 18 wells @ $550/well = $9,900 x 2 times/year = $19,800 /year

2. Surface Water Monitoring

The Vista Class III Landfill has been designed to retain all water from a 100-year storm event on-site. No off-site discharge of surface water is anticipated, therefore, no associated monitoring costs have been included.

3. Landfill Gas Monitoring

Twelve (12) landfill gas soil monitoring probes are proposed for Phase 1 development of the Vista Class III Landfill. All wells will be sampled quarterly in accordance with Chapter 62-701, FAC. The cost to sample each well is estimated to be $850, and includes all labor, equipment and laboratory analyses. The estimated cost for ground water monitoring is as follows:

- 12 wells @ $300/well = $3,600 x 4 times/year = $14,400 /year

4. Leachate Monitoring

One leachate sample will be collected from Phase 1 landfill development annually, in accordance with Chapter 62-701, FAC. The annual leachate monitoring cost is estimated to be $1,000, and includes all labor, equipment and laboratory analyses.

5. Leachate Collection/Treatment System Maintenance

For the long term care, following maintenance activities were assumed:

Leachate collection pipes: Estimate that each cell will require one cleaning within the 30-year monitoring period.

- 4 cells @ $11,000/cell = $44,000 / 30 years = $1,500 /year.

Leachate pumps: Estimate that the pumps will require annual maintenance and each cell will require one replacement pump during the 30-year monitoring period. The total estimated annual cost for pumps is $1,900, and is itemized below.

- Annual maintenance = 4 cells @ $275/cell = $1,100 /year.
- Leachate pump replacement cost = 4 pumps @ $6,000/pump/30 years = $800/year.

Leachate disposal: After closure, a leachate production rate was obtained from the HELP model analysis (i.e., Case 4) included in the calculation package titled "Leachate Collection System Analysis" of this Application. The estimated cost for the leachate disposal after closure is as follows:

- Leachate production rate = 0.75 cf/ac/year x 7.48 gal/cf x 35.3 acres = 200 gallons of leachate/year
- Leachate disposal = 200 gal/year @ $0.12/gal for transportation and treatment = $24/year.

Total leachate system maintenance = $3,424 /year.

6. Leachate Collection/Treatment Systems Operation

Estimate that the leachate system operation will be monitored on a weekly basis by an on-site technician for a total of 3 hours/week for 52 weeks/year. The hourly rate for the on-site technician was estimated to be $51 /hour. The estimated cost for leachate collection system operation is as follows:

- 3 hours/week x 52 weeks/year @ $51/hour = $7,956/year.

7. Maintenance of Groundwater Monitoring Wells

Estimate that 3 ground water monitoring wells will require abandonment and replacement within the 30-year monitoring period. The estimated total cost for ground water monitoring well maintenance is $381/year, and is itemized below:

- Abandonment cost: $510/well x 3 wells = $1,530 / 30 years = $51 /year.
- Replacement cost: 60 ft/well x $55/ft x 3 wells = $9,900 / 30 years = $330/year.

8. Gas System Maintenance

No gas extraction system will be installed for the Vista Class III Landfill. Therefore, landfill gas system maintenance will not be required.

9. Landscape

Grass will require mowing quarterly at a cost of $105 per acre. The estimated total cost for landscaping is as follows:

- Mowing/maintenance: 4 times/year x 35.3 acres @ $105/acre = $14,826/year.

10. Erosion Control and Cover Maintenance

As indicated on the attached FDEP form.

11. Storm water Management System Maintenance

As indicated on the attached FDEP form.

12. Security System Maintenance

As indicated on the attached FDEP form.

13. Utilities

Estimate that the power requirements for site equipment (i.e., pumps, lights, blowers, etc.) will be $1,020 /month for 12 months. Therefore, the total estimated cost for utilities is $12,800 /year.

14. Administrative

Estimate that the lump sum administrative/overhead costs for Phase 1 will be $14,000/year.

15. Contingency

A contingency of 10% of the total long term annual care cost was utilized which results in a cost of $9,476/year.

Geosyntec consultants

14055 Riveredge Drive, Suite 300
Tampa, FL 33637
PH 813-558-0990
FAX 813-558-9726
www.geosyntec.com

17 October 2007

Mr. R. Jay Davoll, P.E.
City Engineer
City of Apopka
120 E. Main Street
Apopka, Florida 32704

Subject: Response to Review Comments from City of Apopka
Substantial Permit Modification Application
Vista Landfill, Class III
Apopka, Florida

Dear Mr. Davoll:

On behalf of Vista Landfill, LLC (Vista Landfill), a wholly owned subsidiary of Waste Management, Inc. of Florida, Geosyntec Consultants (Geosyntec) has prepared this letter to respond to City of Apopka's (City's) review comments regarding the Substantial Modification Permit Application for Vista Landfill, Class III facility located in Apopka, Florida. The permit modification application dated 27 July 2007 was received by the City on 2 August 2007. The review comments were provided by Camp, Dresser and McKee, Inc. (CDM), the City's consultant, in a memorandum dated 15 September 2007, which is included as Attachment 1. On 17 September 2007, Vista Landfill attended a meeting with the City and CDM to discuss responses associated with these review comments.

Each comment from the City has been provided below in italic font followed by the corresponding response in normal font. In this response, deletions to the original document have been shown with a strikethrough and additions have been shown with an underline.

It is noted that Vista Landfill has recently responded to Florida Department of Environmental Protection's (FDEP's) request for additional information (RAI) dated 28 August 2007. The responses dated 26 September 2007 were received by FDEP on 27 September 2007. A copy of the responses to FDEP's RAI was also forward to the City on 26 September 2007. For informational purposes, a copy of the FDEP RAI is included in Attachment 2.

RESPONSE TO CITY COMMENTS

Comment #1

What clearance above the seasoned high water level was the liner designed to have? Verify that adequate clearance above the seasoned high GW table occurs in the NE corner of cell 4 and in the southwest corner of Cell 12. Is the liner intended to act as a basis for a waiver from the 5' separation between the bottom of the landfill and the top of the seasonal high groundwater (Sec 66-177)?

Response # 1:

Vista Landfill understands the separation requirement of 5 ft between the bottom of the landfill and the estimated seasonal high water table, as outlined in Section 66-177 of the Solid Waste Management Ordinance (SWMO). As described in the Substantial Permit Modification Application dated July 2007, the liner and leachate collection system of the Vista Landfill, Class III disposal facility has been designed to contain and manage the leachate generated within the landfill. Therefore, Vista Landfill presents the designed liner and leachate collection system as the basis for a waiver of the required 5-ft separation between the bottom of the landfill and the seasonal high water table at the site.

In accordance with Section 66-175(i) of the SWMO, Vista Landfill formally requests a waiver of the requirement for a 5-ft separation between the bottom of the landfill and the seasonal high water table. As discussed above, the basis for the waiver is the liner and leachate collection system design provided in the July 2007 Substantial Permit Modification Application. The waiver application associated with the 5-ft separation requirement between the bottom of the landfill and the seasonal high water table is provided in Attachment 3.

Comment # 2

The most recent groundwater data for Phase I is Devo's estimate in Feb. 2004. The Northern Plug was completed in April-May 2004. Because two areas of the footprint were plugged, a review of more recent water level elevation would be recommended. In addition, continued monitoring of piezometers and monitoring wells, especially in the south end of Buttrey 4, is recommended.

Response # 2:

The seasonal high ground water table elevations in Phase 1 (i.e., Cells 1 through 4) area were based on 2004 ground water data presented by Devo Engineering (Devo), as noted on Sheet 3 of the Permit Drawings titled "Permit Modification Drawings, Vista Class III Landfill," prepared by Geosyntec and dated July 2007. It is noted that 2004 was considered a historically "wet" year and corresponding high ground water table elevations were observed. Moreover, recent ground water data from the Phase 1 ground water monitoring well network installed in 2004 (including those relocated in 2006), indicate that the water levels are lower than those presented in 2004 by Devo. Vista Landfill will continue to monitor ground water levels in Phase 1 area to ensure no conflicts with those shown on Sheet 3 of the Permit Drawings.

With regard to future phases (i.e., Phases 2 and 3) of landfill development, Vista Landfill plans to install the proposed ground water monitoring wells for each phase approximately 2 years prior to waste placement in a given cell. Ground water levels will be monitored to ensure no conflicts with those shown on Sheet 3 of the Permit Drawings.

Comment # 3

Verify that the elevation of 156 for the top of the landfill does not exceed the original grades plus 50'. Does WMIF intend to request a waiver for this requirement if it is exceeded (Sec 66-177z)?

Response # 3:

The current solid waste permit approved a final landfill elevation of 150 ft, NGVD (National Geodetic Vertical Datum) based on the public need for the associated landfill disposal capacity. The revised landfill top slope grades reflecting a final elevation of 156 ft, NGVD are proposed solely to provide a uniform top slope geometry with respect to constructability, and improve storm water management during landfilling activities. As discussed in a follow-up telephone conversation between Mr. Jay Davoll of the City and Ms. Sheree Henninger of Vista Landfill, a waiver application is required to increase the final elevation of the landfill from 150 ft to 156 ft, NGVD. The waiver mechanism to increase final landfill elevations is outlined in Section 66-177(z) of the SWMO.

In accordance with Section 66-175(i) of the SWMO, Vista Landfill formally requests approval to increase in the final elevation of the Vista Landfill, Class III facility from elevation 150 ft to 156 ft, NGVD. As discussed above, the basis for the waiver is to provide a uniform top slope geometry with respect to constructability, and improve storm water management during landfilling activities. The public will not be adversely impacted by the revised landfill top slope grades reflecting a final elevation of 156 ft, NGVD. The final landfill grades are provided in the Permit Drawings of the July 2007 Substantial Permit Modification Application. The waiver application associated with increasing the final elevation of the landfill to 156 ft, NGVD is provided in Attachment 4.

Comment # 4

The final grades proposed in this submittal are different than the final grades proposed in the current permitted (former Buttrey) landfill. However, the layout of the stormwater pond cells is similar to what was proposed previously. As a result of the more uniform final grading plan that has been proposed, the stormwater loading to each cell has changed. A demonstration should be provided that the proposed system will fully retain the 100 year storm event onsite (66-176 (a) (7) f).

Response # 4:

On 17 September 2007, Vista Landfill attended a meeting with the City and CDM to discuss responses associated with this comment. During the meeting Mr. Jay Davoll, P.E. of the City and Mr. John Ladner, P.E. of CDM indicated no issue with the storm water management system for Phases 1 and 2 (i.e., Cells 1 through 8) of landfill development as presented in the Permit Drawings of the July 2007 Substantial Permit Modification Application. However, it was noted that the storm water management system of Phase 3 (i.e., Cells 9 through 12) of landfill development will need to be revised prior to approval of Phase 3 of landfill development. Given the design life of the landfill, it is anticipated that Phase 3 of landfill development will initiate construction in about 10 years.

Vista Landfill understands that the storm water management system for Phase 3 of landfill development will need to be revised to accommodate the revised top slope grades presented in the Permit Drawings. It is noted that the current Environmental Resources Permit (ERP) which includes the storm water management system design for Phase 3 of landfill development expires in 2010. Consequently, Vista Landfill plans to modify the ERP for Phase 3 prior to 2010.

[Note: The July 2007 Substantial Permit Modification Application was submitted for approval of Phase 1 (i.e., Cells 1 through 4) of landfill development only.]

Comment # 5

Downcomer pipes are shown on Sheet 12, but no pipes are shown connecting ponds. Are the pipes identical to the pipes proposed in the most recent Buttrey 4 Stormwater submittal?

Response # 5:

The pipes connecting the storm water ponds presented on Sheet 12 of the Permit Drawings of the July 2007 Substantial Permit Modification Application are identical to those presented in the most recent Buttrey Four storm water submittal (i.e., drawings titled "Construction Plans, Buttrey Development Four, LLC" prepared by GTC Engineering Corporation and dated August 2005).

Comment # 6

Verify that the City has a copy of the most recent ERP for this site.

Response # 6:

The most recent ERP for the site corresponds to Permit No. ERP48-0187635-005-EM, which expires in August 2010.

Comment # 7

Will all the solid waste Facility buildings shown on the proposed plans be constructed prior to receiving any waste in Phase 1?

Response # 7:

Vista Landfill anticipates receiving waste in Cell 1 of Phase 1 in June 2008. Before the end of 2007, the scale-house (scales) and paved roadway will be constructed. Prior to accepting waste in Phase 1, the customer drop-off and leachate management system including the leachate storage areas will be constructed. The maintenance and administration building may lag by about 12 months. However, an existing, temporary administration building is currently on-site with a temporary entrance from McQueen Road. Prior to the end of 2007, the entrance to the existing administration building will be re-routed through the proposed landfill entrance and paved roadway; and the temporary entrance from McQueen Road will be closed.

<u>Comment # 8 (Operation Plan)</u>

Section 6 Method & Sequence of Filling Wastes should be expanded to include discussion of how stormwater will be handled while the waste elevation is below natural grade.

Response # 8:

A new section, Section 6.3, on page 13 of the Operation Plan, in Appendix L, Volume 2 of 2 of the Substantial Permit Modification Application, was developed to address storm water management during waste placement activities. Accumulated storm water within a landfill cell that does not come in contact with waste will be pumped to the storm water management system (e.g., storm water perimeter ditch or storm water ponds) for the landfill. The replacement page (Page 13 of the Operation Plan) is provided in Attachment 5.

Comment # 9 (Operation Plan)

Section 8.6 The City Fire Department should be notified of any fires at the Landfill. The current plan says they will be notified, if necessary. Note that a Fire Fighting Agreement may need to be updated as well.

Response # 9:

Section 8.6, page 18 of the Operation Plan, in Appendix L, Volume 2 of 2 of the Substantial Permit Modification Application, has been updated to indicate that the City Fire Department will be notified of any fires at Vista Landfill, Class III facility. The replacement page (Page 18 of the Operation Plan) is provided in Attachment 5.

A Fire Fighting Agreement has been prepared and submitted to the City of Apopka Fire Department. A copy of the agreement will be provided to the City once the agreement is finalized.

Comment # 10 (The Proposed Leachate Collection System)

Since only one pipe is proposed for each cell, a backup plan for the leachate flow should be prepared to provide an alternative path for collection of the leachate out of the cells in case any pipes suffer clogging problems or failures. In addition, indicating that leachate pump volumes will be checked on a daily (or regular) basis and the frequency of maintenance could be considered.

Response # 10:

Several measures that prevent clogging and yield structurally stable pipes have been incorporated into the design (and maintenance) of the leachate collection system for Vista Landfill, Class III facility. A detailed discussion of the leachate collection system pipe design is included in Appendix F in Volume 2 of 2 of the Substantial Permit Modification Application.

To prevent clogging, the main leachate collection pipe is wrapped in gravel using a geotextile filter fabric. Furthermore, the lecahate collection pipe also has a clean-out pipe at both ends; thereby allowing routine inspection of the pipe from both ends. In accordance with FDEP regulations, Chapter 62-701 of the Florida Administrative Code (F.A.C.), the leachate collection pipes will be water pressure (i.e., jet) cleaned and/or inspected by video camera after construction but prior to placement of any waste. In addition, the leachate collection systems will be jet cleaned and/or inspected by video camera at the time of permit renewal, typically every 5 years.

The leachate management system for Vista Landfill, Class III facility will also include automated sump pumps within each landfill cell. These sump pumps are equipped with a high level alarm to prevent the build-up of excessive leachate levels within a given cell. The sump pump controls are also equipped with a flow meter to check flow volumes on a regular basis, and the sumps pumps are periodically inspected in accordance with manufacturer's recommendations.

CLOSURE

If you have any questions or require additional information, please do not hesitate to contact the undersigned at (813) 558-0990.

Sincerely,

Juan D. Quiroz
17 Oct. 2007

Juan D. Quiroz, Ph.D., P.E.
Project Engineer
P.E. Number 65275

Kwasi Badu-Tweneboah, Ph.D., P.E.
Associate

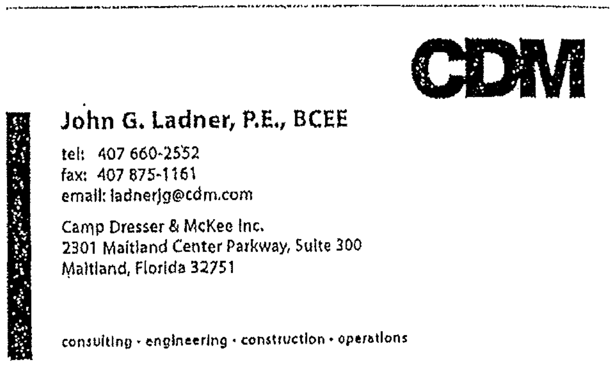
Attachments

Copies to: Sheree Henninger, Vista Landfill, LLC
Ray Chewning, Vista Landfill, LLC
John Ladner, CDM

ATTACHMENT 1

City of Apopka Comments

CDM


CDM

John G. Ladner, P.E., BCEE
tel: 407 660-2552
fax: 407 875-1161
email: ladnerjg@cdm.com

Camp Dresser & McKee Inc.
2301 Maitland Center Parkway, Suite 300
Maitland, Florida 32751

consulting · engineering · construction · operations

Memorandum

To: *File*

From: *John Ladner P.E.*

Date: *September 15, 2007*

Subject: *Vista Landfill Permit Submittal Review*

- What clearance above the seasoned high water level was the liner designed to have? Verify that adequate clearance above the seasoned high GW table occurs in the NE corner of call 4 and in the southwest corner of Cell 12. Is the liner intended to act as a basis for a waiver from the 5′ separation between the bottom of the landfill and the top of the seasonal high groundwater (Sec 66-177)?

- The most recent groundwater data for Phase I is Devo's estimate in Feb. 2004. The Northern Plug was completed in April – May 2004. Because two areas within the footprint were plugged, a review of more recent water level elevation would be recommended. In addition, continued monitoring of piezometers and monitoring wells, especially in the south end of Buttrey 4 is recommended.

- Verify that the elevation of 156 for the top of landfill does not exceed the original grades plus 50′. Does WMIF intend to request a waiver for this requirement if it is exceeded (Sec 66-177z)?

- The final grades proposed in this submittal are different than the final grades proposed in the current permitted (former Buttrey) landfill. However, the layout of the stormwater pond cells is similar to what was proposed previously. As a result of the more uniform final grading plan which has been proposed, the stormwater loading to each cell has changed. A demonstration should be provided that the proposed system will fully retain the 100 year storm event onsite (66-176 (a) (7) f).

- Downcomer pipes are shown on Sheet 12, but no pipes are shown connecting ponds. Are the pipes identical to the pipes proposed in the most recent Buttrey 4 Stormwater submittal?

- Verify that the City has a copy of the most recent ERP for this site.

- Will all the solid waste Facility buildings shown on the proposed plans be constructed prior to receiving any waste in Phase 1?

Operation Plan

- Section 6 Method & Sequence of Filling Wastes should be expanded to include discussion of how stormwater will be handled while the waste elevation is below natural grade.

- Section 8.6 The City Fire Department should be notified of any fires at the Landfill. The current plan says they will be notified, if necessary. Note that a Fire Fighting Agreement may need to be updated as well.

The Proposed Leachate Collection System

- Since only one pipe is proposed for each cell, a backup plan for the leachate flow should be prepared to provide an alternative path for collection of the leachate out of the cells in case any pipes suffer clogging problems or failures. In addition, indicating that leachate pump volumes will be checked on a daily (or regular) basis and the frequency of maintenance could be considered.

ATTACHMENT 2

FDEP RAI

Florida Department of
Environmental Protection
Central District
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Charlie Crist
Governor

Jeff Kottkamp
Lt. Governor

Michael W. Sole
Secretary

By E-Mail
apittman@wm.com

Mr. Alec Pittman
Vista Landfill, LLC
3411 North 40th Street
Tampa, FL 33605

OCD-SW-07-0352

Orange County – SW
Vista Landfill, Class III
Modification of Permit No. SO48-0165969-013
Permit Application Nos. SC48-0165969-014 & SO48-0165969-015

Dear Mr. Pittman:

Your application for permit dated July 27, 2007 and received July 30, 2007, is incomplete. Please provide the information listed on the attached sheet promptly. Evaluation of your application will be delayed until all the requested information has been received.

Pursuant to Section 120.60(2), Florida Statutes, the Department may deny an application, if the applicant, after receiving timely notice, fails to correct errors and omissions, or supply additional information within a reasonable period of time. Accordingly, please provide the additional information within 30 days of the date you receive this letter. Submit three copies of the requested information to the Department and reference the above permit application number in your correspondence.

If you have any questions, please contact me at (407) 893-3328.

Sincerely,

F. Thomas Lubozynski

F. Thomas Lubozynski, P.E.
Waste Program Administrator

Date: August 28, 2007

FTL/gc/ew
Enclosure
cc: Juan D. Quiroz, P.E. – Geosyntec Consultants jdquiroz@geosyntec.com
Ray Chewning – Vista Landfill, LLC rchewning@wm.com
Jay Davoll P. E. jdavoll@apopka.net

Note that all references to "Report" in the following text refer to the document entitled, "Substantial Permit Modification Application For A Class III Landfill, Vista Landfill, Class III, Vol. 1 of 2 and 2 of 2," Prepared by Geosyntec Consultants, Tampa, Florida.

1. The applicant is required to notify the local government having jurisdiction over the facility of the filing of the permit modification application before or on the same day of filing the application with the Department, Section 403.707(11), Florida Statutes. Submit proof of local government notification to the Department.

2. For Item A-13, DEP Form 62-701.900(1), in Appendix A, Vol. 1 of 2 in the Report, provide an anticipated date that the site will be ready to be inspected for completion.

3. For Item A-16, DEP Form 62-701.900(1), in Appendix A, Vol. 1 of 2 in the Report, provide an anticipated construction starting and completion date for the landfill.

4. Item B-8, DEP Form 62-701.900(1), in Appendix A, Vol. 1 of 2 in the Report, shows yard trash as a waste to be disposed in the Class III lined landfill. The disposal of yard trash in a lined landfill is prohibited in accordance with Rule 62-701.300 (8)(c), F.A.C. However, the proposed revision to Chapter 62-701, F.A.C. would allow yard trash in a lined Class III landfill. Please acknowledge that you understand the yard trash could not be disposed in this landfill unless the current Chapter 62-701, F.A.C. is revised to allow such disposal.

5. For Item B-10, DEP Form 62-701.900(1), in Appendix A, Vol. 1 of 2 in the Report, indicate with a check mark, if the Class III landfill has a Trained Operator.

6. Appendix L, Volume 2 of 2, Page 5 of the Operation Plan in the Report, indicates that yard trash will be accepted in the Class III lined landfill. The disposal of yard trash in a lined landfill is prohibited in accordance with Rule 62-701.300(8)(c), F.A.C. However, the proposed revision to Chapter 62-701, F.A.C. would allow yard trash in a lined Class III landfill. Please acknowledge that you understand the yard trash could not be disposed in this landfill unless the current Chapter 62-701, F.A.C. is revised to allow such disposal.

78. Appendix L, Volume 2 of 2, Page 13 of the Operation Plan in the Report, states for Final Cover the use of 6-inches of compost or topsoil capable of sustaining a good stand of grass. The use of compost is suggested at a level of 50 percent compost and 50 percent topsoil. Provide your comments.

8. Appendix L, Volume 2 of 2, Page 26 of the Operation Plan in the Report, under Hurricane Preparedness:

a) Indicate procedures that would be implemented during the period from 72 hours up to land fall. The following are example questions:

- When does the facility shut down?
- Will waste be left at the facility, either on the ground, in trucks, or other containers?

b) Indicate the procedures that will be used to re-open the facility. The following are example questions:

- Who makes the decision when the facility will re-open?
- Who inspects the facility for damage that may affect whether permit conditions can be met?
- Who notifies the Department if the damage might affect compliance with the permit and operations plan?

9. Appendix L, Volume 2 of 2, in the Operation Plan in the Report, in the pages where the Department telephone number is referenced, use both the numbers – Receptionist for Central District, 407-894-7555 and Solid Waste Section number 407-893-3328. The fax number for the Department **to be used is 407-893-3124** instead of 407-893-3167.

10. Appendix L, Volume 2 of 2, in the Operations Plan in the Report, in Section 9.1.1, include that any fires at the landfill must be reported to the Department within 24 hours (phone call, e-mail, or fax 407-893-3124) and a letter must be submitted within five days to the Department describing how the fire began, what was done to extinguish it, and what will be done to prevent future fires.

11. Appendix O in the Report referencing Financial Assurance, shows detailed closure and long-term care cost for Phase I, Cells 1 through 4. The permit application did not include a request for phased financial assurance, with the necessary provisions and constraints. A request for phased financial assurance must include specific documentation, including narrative information and drawings, signed and sealed by the Engineer of Record, to ensure that the disposal of solid waste will take place only within the designated area for which financial assurance is provided. Otherwise, revise Appendix O to include the long-term care for all 12 cells.

12. A financial mechanism must be funded in the amount of the sum of the total closure and long-term care costs specified in the approved cost estimate and accepted by the Department's Financial Coordinator before this application can be deemed complete. Financial responsibility arrangements for the facility for the approved amounts are to be made with the Financial Coordinator, Solid Waste Section, MS-4565, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400, and a **copy of the approval letter submitted to**: Department of Environmental Protection, Central District, Solid Waste Section, 3319 Maguire Boulevard, Suite 232, Orlando, Florida 32803-3767.

13. Section 2, Page 6, Item 2.1 states, "most of the items ... have not substantially changed from those items provided in the previously submitted 2006 Permit Renewal Application and Minor Modification Application ..." Please identify the specific documents that this application references or relies upon. If appropriate refer to the references listed in Appendix A of previous permits.

14. The Department agrees the entire facility (102 acre disposal area) has been permitted, but only certain cells have been authorized to be lined or to accept waste. Please identify those Phases and specific Cells that will have a bottom liner constructed during the 5-year period of this requested construction permit (SC48-0165969-014).

15. The current ground water monitoring plan is for cells 1 through 4. Please acknowledge that you understand the ground water monitoring plan will have to be changed and additional wells installed before Cells 5 through 12 are allowed to receive waste (Specific condition 12 of the current permit, SO48-0165969-011). Depending on when those cells might be used, the proposed number and location of wells may change.

16. Nineteen monitoring well type changes are requested. The following table includes the permitted designation, the requested change, the Department's proposed designation for a revised MPIS and comments:

Figure 1 Changes to Well Designations

Count #	Well	Current MPIS Type	Proposed Changes	MPIS for Modification	DEP Comment
1	MW-1A	BG		BG	
2	MW-1B	BG		BG	
3	MW-2AR	BG		BG	
4	MW-2B	BG	Detection	BG	Submittal notes this as a CO but it is a BG in MPIS
5	MW-3A	CO	Detection	CO	Wells are 50 feet from edge of fill, but are also at property line so must be compliance wells.
6	MW-3B	CO	Detection	CO	
7	MW-4A	CO	Detection	CO	
8	MW-4B	CO	Detection	CO	
9	MW-5A	CO	Detection	CO	
10	MW-5B	CO	Detection	CO	
11	MW-6AR	BG		BG	
12	MW-6BR	BG		BG	
13	MW-7A	CO	BG	BG	OK-BG as long as GWT consistent with surficial
14	MW-7B	CO	BG	CO	Does not appear to be upgradient
15	MW-8R	BG		BG	
16	MW-9A	CO	BG	CO	Not clear why these would be background wells.
17	MW-9B	CO	BG	CO	
18	MW-10A	CO	Detection	Detection	OK-50 feet
19	MW-10B	CO	Detection	Detection	OK-50 feet
20	MW-11A	CO	Detection	Detection	OK-50 feet
21	MW-11B	CO	Detection	Detection	OK-50 feet
22	MW-12A	CO		CO	
23	MW-12B	CO		CO	
24	MW-13A	CO		CO	
25	MW-13B	CO		CO	
26	MW-14A	CO		CO	
27	MW-14B	CO		CO	
28	MW-15A	CO		CO	
29	MW-15B	CO		CO	
30	MW-16A	CO		CO	
31	MW-16B	CO		CO	
32	MW-17A	CO	BG	BG	OK -Upgradient and between OCUD disposal and Vista
33	MW-17B	CO	BG	BG	OK -Upgradient and between OCUD disposal and Vista
34	MW-18A	CO		CO	
35	MW-18B	CO		CO	
36	MW-19A	CO		CO	
37	MW-19B	CO		CO	
38	MW-20A	CO		CO	
39	MW-20B	CO		CO	
40	MW-21A	CO		CO	
41	MW-21B	CO		CO	
42	MW-FL1	CO		CO	
43	MW-FL2R	CO		CO	

Count #	Well	Current MPIS Type	Proposed Changes	MPIS for Modification	DEP Comment
44	MW-FL3	CO	Detection	CO	CO-Permit Zone of Discharge does not include Floridan so this must be a compliance well.
45	MW-FL4	BG		BG	
46	MW-FL5	BG		BG	
47	MW-FL6	BG		BG	
48	MW-FL7	BG		BG	
49	MW-FL8	BG	CO	CO	OK
50	MW-FL9	BG		BG	

BG=Background Well, CO=Compliance Well

ATTACHMENT 3

Waiver Request Application Letter

Section 66-177 of SWMO

WASTE MANAGEMENT

VISTA LANDFILL, INC.
242 W. Keene Road
Apopka, FL 32703
(407) 886-2920
(407) 889-8043 Fax

18 October 2007

Mr. R. Jay Davoll, P.E.
City Engineer
City of Apopka
120 E. Main Street
Apopka, Florida 32704

Subject: Waiver Request Application Letter for Minimum 5-ft Ground Water Separation
Substantial Permit Modification Application
Vista Landfill, Class III
Apopka, Florida

Dear Mr. Davoll:

Vista Landfill, LLC (Vista Landfill) is pleased to submit this waiver request application letter regarding the minimum 5-ft separation requirement between the bottom of the landfill and the seasonal high ground water table for Vista Landfill, Class III facility located in Apopka, Florida. In accordance with Section 66-175(i) of the Sold Waste Management Ordinance (SWMO), Vista Landfill formally requests a waiver of the 5-ft separation requirement outlined in Section 66-177 of the SWMO.

The permit modification application titled "Substantial Permit Modification Application for a Class III Landfill, Vista Landfill, Class III, Apopka, Florida," prepared by Geosyntec Consultants and dated July 2007, presents the proposed liner and leachate collection system design for Vista Landfill, Class III disposal facility. The implementation of a liner and leacate collection system will augment and improve the environmental controls at the facility to ensure greater ground water protection. The proposed liner and leachate collection system for the landfill facility exceeds current regulatory requirements, and consists of (from top to bottom): a 2-ft thick liner protective layer, underlain by a double-sided geocomposite draianage layer, and underlain by a 60-mil thick high density polyethylene (HDPE) geomembrane layer. Therefore, Vista Landfill presents the designed liner and leachate collection system as the basis for a waiver of the required 5-ft separation between the bottom of the landfill and the seasonal high water table at the site.

If you or your staff have any questions or require additional information, please feel free to contact the undersigned.

Sincerely,

Sheree Henninger

Sheree Henninger
District Engineer

ATTACHMENT 4

Waiver Request Application Letter

Section 66-177(z) of SWMO

WASTE MANAGEMENT

VISTA LANDFILL, INC.
242 W. Keene Road
Apopka, FL 32703
(407) 886-2920
(407) 889-8043 Fax

18 October 2007

Mr. R. Jay Davoll, P.E.
City Engineer
City of Apopka
120 E. Main Street
Apopka, Florida 32704

Subject: Waiver Request Application Letter for Final Landfill Elevation
Substantial Permit Modification Application
Vista Landfill, Class III
Apopka, Florida

Dear Mr. Davoll:

Vista Landfill, LLC (Vista Landfill) is pleased to submit this waiver request application letter regarding final landfill elevation at the time of closure for Vista Landfill, Class III facility located in Apopka, Florida. In accordance with Section 66-175(i) of the Sold Waste Management Ordinance (SWMO), Vista Landfill formally requests a waiver to increase the final landfill elevation as outlined in Section 66-177z of the SWMO. The proposed final landfill elevation increase is from the currently permitted elevation of 150 ft to 156 ft, NGVD (National Geodetic Vertical Datum).

The current solid waste permit for Vista Landfill, Class III facility approved a final landfill elevation of 150 ft, NGVD (National Geodetic Vertical Datum), as well as the public need for the associated landfill disposal capacity. The permit modification application titled "Substantial Permit Modification Application for a Class III Landfill, Vista Landfill, Class III, Apopka, Florida," prepared by Geosyntec Consultants and dated July 2007, presents the revised landfill top slope grades with a final elevation of 156 ft, NGVD. The revised top slope grades are proposed solely to provide a uniform top slope geometry with respect to constructability, and improve storm water management during landfilling activities. As such, the public will not be adversely impacted by the revised landfill top slope grades with a final elevation of 156 ft, NGVD. In addition, the revised final landfill elevation is not in conflict with any restriction imposed by Florida Department of Environmental Protection.

If you or your staff have any questions or require additional information, please feel free to contact the undersigned.

Sincerely,

Sheree Henninger
District Engineer

ATTACHMENT 5

Operation Plan Replacement Pages

Prepared for:

WASTE MANAGEMENT

Vista Landfill, L.L.C.
242West Keene Road
Apopka, FL 32703

OPERATION PLAN

VISTA LANDFILL, CLASS III
Apopka, Florida

Prepared by:

Geosyntec
consultants

14055 Riveredge Drive, Suite 300
Tampa, FL 33637

Project No. FL1229

~~July~~ September 2007

Juan D. Quiroz
17 Oct. 2007

6.1.5.3 Final Cover

Areas of the landfill which have been filled to design dimensions shall receive final cover within 180-days after attaining final elevation or in accordance with the closure plan for the landfill. The final cover will be constructed in accordance with Section 66-177(1)t, SWMO and Rule 62-701.600(5)(g) FAC. The barrier layer to be installed will either be a geosynthetic clay liner (GCL) or 40-mil linear low-density polyethylene (LLDPE). The barrier layer will be installed over a 6-inch, minimum, soil layer, and overlain by 18-inches of cover protective soil, and 6-inches of compost or topsoil capable of sustaining a good stand of grass. A geocomposite drainage layer will be placed above all or parts of the barrier layer, depending on the specific barrier layer selected at the time of closure.

6.2 Scavenging

Uncontrolled and unauthorized scavenging is not allowed at this facility. However, controlled removal by landfill personnel of recovered material recycling may be permitted.

6.3 Storm Water Control during Waste Filling

During waste placement activities within a landfill cell, storm water that comes in contact with waste is treated as leachate and managed through the leachate collection system for the landfill. Accumulated storm water within a landfill cell that does not come in contact with waste will be pumped to the storm water management system (e.g., storm water perimeter ditch or storm water ponds) for the landfill.

Litter is policed in the immediate proximity of the landfill, as necessary, to control any problems which may arise from debris blowing from trucks traveling along West Keene Road to the landfill. Vista Landfill, Class III facility employees observe West Keene Road daily, and often several times each working day. The litter along West Keene Road is picked up at least weekly, from Clarcona Road to the facility entrance, or more often if necessary, as evaluated by employee observation. Vista Landfill understands that Vista Landfill, Class III facility is part of a community, and that litter policing is part of being a good neighbor within that community.

8.6 Fire Control

Fire protection procedures include maintaining soil stockpiles in the vicinity of the working face. The cover used in the landfill operation provides an effective firewall.

Should a fire occur at the landfill, the application of soil will be used to cut off the flow of oxygen into the burning areas. The local fire department will be contacted to assist site personnel and equipment~~, if necessary~~. Appropriate fire extinguishers are carried on the equipment at all times and can be used to control any small equipment fire that may occur. Greater detail for dealing with fires is given in Section 9.1 of this plan.

8.7 Gas Control

Vista accepts, and will continue to accept, only Class III materials which generate low levels of methane gas in comparison to generation rates at Class I landfills. The gas monitoring system will consist of 25 permanent gas monitoring probe locations in total build-out, as shown on the site plan presented in Figure 4. The gas probes are monitored on a quarterly basis for explosive gas content. Additionally, on-site structures are monitored quarterly.

Action must be taken whenever the measured methane concentration in soil monitoring probes exceeds the Lower Exposure Limit (LEL) for combustible gases at or beyond the landfill property boundary or exceeds 25% of the LEL in onsite structures. If the results of monitoring show that combustible gas levels exceed these concentrations, either the Site

Engineer or the Compliance Manager will:

1. immediately take all necessary steps to ensure protection of human health and notify the Department;
2. submit a gas remediation plan to the Department within 7 days of the exceedence;

Geosyntec consultants

14055 Riveredge Drive, Suite 300
Tampa, Florida 33637
PH 813.558.0990
FAX 813.558.9726
www.geosyntec.com

26 September 2007

Mr. Thomas Lubozynski, P.E.
Waste Program Administrator
Florida Department of Environmental Protection
Central District Office
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Subject: Response to Request for Additional Information dated 28 August 2007
Substantial Permit Modification Application
Vista Landfill, Class III
Apopka, Florida
(Permit # SC48-0165969-013)

Dear Mr. Lubozynski:

On behalf of Vista Landfill, LLC (Vista Landfill), a wholly owned subsidiary of Waste Management, Inc. of Florida, Geosyntec Consultants (Geosyntec) has prepared this letter to respond to Florida Department of Environmental Protection's (FDEP's) request for additional information (RAI) regarding the Substantial Modification Permit Application for Vista Landfill, Class III facility located in Apopka, Florida. The permit modification application dated 27 July 2007 was received by FDEP on 30 July 2007. The RAI was addressed to Mr. Alec Pittman of Vista Landfill in a letter dated 28 August 2007, which is included as Attachment 1.

Each FDEP comment has been provided below in italic font followed by the corresponding response in normal font. In this response, deletions to the original document have been shown with a strikethrough and additions have been shown with an underline.

In addition, Vista Landfill is currently responding to comments provided by the City of Apopka. For informational purposes, a copy of the RAI dated 15 September 2007 as prepared by Camp, Dresser and McKee, Inc., (CDM) (consultant to City of Apopka) is included in Attachment 2.

RESPONSE TO FDEP COMMENTS

FDEP Comment #1

The applicant is required to notify the local government having jurisdiction over the facility of the filing of the permit modification application before or on the same day of filing the application with the Department, Section 403.707(11), Florida Statutes. Submit proof of local government notification to the Department.

Response # 1:

Proof of local government notification regarding the filing of the permit modification application is provided in Attachment 3.

FDEP Comment # 2

For Item A-13, DEP Form 62-701.900(1), in Appendix A, Vol. 1 of 2 in the Report, provide an anticipated date that the site will be ready to be inspected for completion.

Response # 2:

Item A-13, FDEP Form 62-701.900(1), in Appendix A, Volume 1 of 2 of the Report, has been revised to provide the anticipated date that the site will be ready to be inspected for completion. The replacement page [Page 5 of 40, FDEP Form 62-701.900(1)] is provided in Attachment 4. The date that the site will be ready to be inspected for completion is 30 June 2008.

FDEP Comment # 3

For Item A-16, DEP form 62-701.900(1), in Appendix A, Vol. 1 of 2 in the Report, provide an anticipated construction starting and completion date for the landfill.

Response # 3:

Item A-16, FDEP Form 62-701.900(1), in Appendix A, Volume 1 of 2 of the Report, has been revised to provide the anticipated construction starting and completion date for the landfill. The replacement page [Page 5 of 40, FDEP Form 62-701.900(1)] is provided in Attachment 4. The anticipated construction starting and completion date for the landfill is October 2007 and June 2008, respectively.

<u>FDEP Comment # 4</u>

Item B-8, DEP Form 62-701.900(1), in Appendix A, Vol. 1 of 2 in the Report, shows yard trash as a waste to be disposed in the Class III lined landfill. The disposal of yard trash in a lined landfill is prohibited in accordance with Rule 62-701.300(8)(c), F.A.C. However, the proposed revision to Chapter 62-701, F.A.C. would allow yard trash in a lined Class III landfill. Please acknowledge that you understand the yard trash could not be disposed in this landfill unless the current Chapter 62-70, F.A.C. is revised to allow such disposal.

<u>Response # 4:</u>

Item B-8, FDEP Form 62-701.900(1), in Appendix A, Volume 1 of 2 of the Report, has been revised to indicate that yard trash will not be disposed in the lined Class III landfill in accordance with Rule 62-701.300(8)(c), F.A.C. The replacement page [Page 6 of 40, FDEP Form 62-701.900(1)] is provided in Attachment 4.

Vista Landfill understands that yard trash cannot be disposed in a lined Class III landfill unless the current solid waste management rules of Chapter 62-701, F.A.C. are revised to allow such disposal.

<u>FDEP Comment # 5</u>

For Item B-10, DEP Form 62-701.900(1), in Appendix A, Vol. 1 of 2 in the Report, indicate with a check mark, if the Class III landfill has a trained operator.

<u>Response # 5:</u>

Item B-10, FDEP Form 62-701.900(1), in Appendix A, Volume 1 of 2 of the Report, has been revised to indicate that the Class III landfill has a trained operator. The replacement page [Page 6 of 40, FDEP Form 62-701.900(1)] is provided in Attachment 4.

FDEP Comment # 6

Appendix L, Volume 2 of 2, Page 5 of the Operation Plan in the Report, indicates that yard trash will be accepted in the Class III lined landfill. The disposal of yard trash in a lined landfill is prohibited in accordance with Rule 62-701.300(8)(c), F.A.C. However, the proposed revision to Chapter 62-701, F.A.C. would allow yard trash in a lined Class III landfill. Please acknowledge that you understand the yard trash could not be disposed in this landfill unless the current Chapter 62-701, F.A.C. is revised to allow such disposal.

Response # 6:

Appendix L, Volume 2 of 2, page 5 of the Operation Plan in the Report, has been revised to indicate that yard trash will not be disposed in the lined Class III landfill in accordance with Rule 62-701.300(8)(c), F.A.C. The replacement page (Page 5 of the Operation Plan) is provided in Attachment 5.

Vista Landfill understands that yard trash cannot be disposed in a lined Class III landfill unless the current solid waste management rules of Chapter 62-701, F.A.C. are revised to allow such disposal.

FDEP Comment # 7

Appendix L, Volume 2 of 2, Page 13 of the Operation Plan in the Report, states for Final Cover the use of 6 inches of compost or topsoil capable of sustaining a good stand of grass. The use of compost is suggested at a level of 50 percent compost and 50 percent topsoil. Provide your comments.

Response # 7:

Vista Landfill understands that the use of compost in the vegetative support layer (i.e., uppermost 6 inches of the final cover system) is suggested at a level of 50% compost and 50% topsoil. However, it is noted that 100% compost has been used successfully as the vegetative support layer in the final cover system at Keene Road Recycling and Disposal Facility located at 255 West Keene Road, Apopka, Florida and across the street from Vista Landfill, Class III facility. If the use of 100% compost as the vegetative support layer yields inadequate results with respect to vegetation growth, then Vista Landfill will reduce the percentage of compost and move toward the suggested compost mixture of 50% compost and 50% topsoil.

FDEP Comment # 8

Appendix L, Volume 2 of 2, Page 26 of the Operation Plan in the Report, under Hurricane Preparedness:

a) *Indicate procedures that would be implemented during the period from 72 hours up to land fall. The following are example questions:*

- *When does the facility shut down?*
- *Will waste be left at the facility, either on the ground, in trucks, or other containers?*

b) *Indicate the procedures that will be used to re-open the facility. The following are example questions.*

- *Who makes the decision when the facility will re-open?*
- *Who inspects the facility for damage that may affect whether permit conditions can be met?*
- *Who notifies the Department if the damage might affect compliance with the permit and operations plan?*

Response # 8:

Section 9.2, page 26 of the Operation Plan, in Appendix L, Volume 2 of 2 of the Report, has been updated to provide additional information regarding Hurricane Preparedness procedures. A Hurricane Planning Manual has been included as an additional attachment (i.e. Attachment F) to the Operation Plan which provides key procedures in the days prior to landfall of any storm. The replacement page and additional attachment (Page 26 and Attachment F of the Operation Plan) are provided in Attachment 5.

The following responses are provided for the questions noted above:

a.) The facility will shutdown when wind speeds reach 40 mph, see Items 32 and 40 in Attachment F of the Operation Plan. Waste disposal operations will continue as permitted until wind speeds approach 40 mph, then the facility will be closed. Although weekly cover is required, when a hurricane is approaching, waste will be covered prior to closing, if possible.

b.) The District Manager or designated representative such as the Site Manager can make the decision to re-open the facility. The following activities will be performed prior to re-opening the facility: (i) inspection of the disposal facility for damage that may affect whether permit conditions can be met; and (ii) notification to the Department if the observed damage might affect compliance with the permit and Operation Plan.

FDEP Comment # 9

Appendix L, Volume 2 of 2, in the Operation Plan in the Report, in the pages where the Department telephone number is referenced, use both the numbers – Receptionist for Central District, 407-894-7555 and Solid Waste Section number 407-893-3328. The fax number for the Department to be used is 407-893-3124 instead of 407-893-3176.

Response # 9:

Appendix L, Volume 2 of 2, the Operation Plan in the Report, has been updated accordingly to reflect the appropriate Department telephone and numbers. The appropriate replacement pages (Pages 9, 10, 16, 19 and 25 of the Operation Plan) are provided in Attachment 5.

FDEP Comment # 10

Appendix L, Volume 2 of 2, in the Operations Plan in the Report, in Section 9.1.1, include that any fires at the landfill must be reported to the Department within 24 hours (phone call, e-mail, or fax 407-893-3124) and a letter must be submitted within five days to the Department describing how the fire began, what was done to extinguish it and what will be done to prevent future fires.

Response # 10:

Appendix L, Volume 2 of 2, Section 9.1.1 in the Operation Plan in the Report, has been revised to indicate that any fires any fires at the landfill must be reported to the Department within 24 hours via phone, e-mail or fax, and a letter must be submitted within five days to the Department describing how the fire began, what was done to extinguish it and what will be done to prevent future fires. The replacement page (Page 25 of the Operation Plan) is provided in Attachment 5.

FDEP Comment # 11

Appendix O in the Report referencing Financial Assurance, shows detailed closure and long-term care cost for Phase I, Cells 1 through 4. The permit application did not include a request for phased financial assurance, with the necessary provisions and constraints. A request for phased financial assurance must include specific documentation, including narrative information and drawings, signed and sealed by the Engineer of Record, to ensure that the disposal of solid waste will take place only within the designed area for which financial assurance is provided. Otherwise, revise Appendix O to include the long-term care for all 12 cells.

Response # 11:

As indicated in Response #14 below, a permit to construct and operate Phase 1, Cells 1 through 4 of landfill development is requested at this time. Accordingly, Section 7.5 (page 27) and Appendix O in the Report indicate that the financial assurance cost estimate, including detailed closure and long-term care costs, applies to Phase 1 (Cells 1 through 4) of landfill development only.

FDEP Comment # 12

A financial mechanism must be funded in the amount of the sum of the total closure and long-term care costs specified in the approved cost estimate and accepted by the Department's Financial Coordinator before this application can be deemed complete. Financial responsibility arrangements for the facility for the approved amounts are to be made with the financial Coordinator, Solid Waste Section, MS-4565, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400, and a copy of the approval letter submitted to: Department of Environmental Protection, Central District, Solid Waste Section, 3319 Maguire Boulevard, Suite 232, Orlando, Florida 32803-3767.

Response # 12:

Vista Landfill understands that a financial mechanism must be funded in the amount of the sum of the total closure and long-term care costs specified in the approved cost estimate and accepted by the Department's Financial Coordinator before this application can be deemed complete. Financial responsibility arrangements in the form of an insurance certificate for the facility for the approved amounts will be made with the financial Coordinator, Solid Waste Section, MS-4565, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400, and a copy of the approval letter will be submitted to: Department of Environmental Protection, Central District, Solid Waste Section, 3319 Maguire Boulevard, Suite 232, Orlando, Florida 32803-3767.

FDEP Comment # 13

Section 2, Page 6, Item 2.1 states, "most of the items... have not substantially changed from those items provided in the previously submitted 2006 Permit Renewal Application and Minor Modification Application..." Please identify the specific documents that this application references or relies upon. If appropriate, refer to the references listed in Appendix A of previous permits.

Response # 13:

The specific documents that this application references were identified in Section 1.3, page 2, paragraph 2 in the Report. Each document reference is provided below (see Appendix A of existing solid waste permits SC48-0165969-010, SO48-0165969-011 and SC48-0165969-012):

- 2006 Permit Renewal Application: Refers to the permit renewal application titled "Application for Renewal of Class III Landfill Construction and Operation Permits, Keene Road South Class III Landfill, Apopka, Florida," and permit renewal drawings titled "Engineering Drawings for Class III Landfill Permit Renewal, Keene Road South, Apopka, Florida," prepared by S2L, Inc. (S2Li), Matiland, Florida and dated January 2006.

- Minor Modification Application: Refers to the permit modification application titled "Minor Permit Modification Application, Keene Road South Class III Landfill, Apopka, Florida," and permit drawings titled "Minor Modification Drawings, Keene Road South

Class III Landfill, Apopka, Florida," prepared by Geosyntec, Tampa, Florida and dated November 2006.

FDEP Comment # 14

The Department agrees the entire facility (102 acre disposal area) has been permitted, but only certain cells have been authorized to be lined or to accept waste. Please identify those Phases and specific Cells that will have a bottom liner constructed during the 5-year period of this requested construction permit (SC48-0165969-014).

Response # 14:

A permit to construct and operate a liner and leachate collection system for Phase 1 of landfill development is requested at this time for Vista Landfill, Class III facility via the Substantial Permit Modification Application dated July 2007. Phase 1 includes the construction of Cells 1 through 4 as presented on Sheet 9 of the Permit Drawings titled "Permit Modification Drawings, Vista Class III Landfill," prepared by Geosyntec and dated July 2007. The anticipated design-life of Phase 1 (i.e., Cells 1 through 4) is approximately 5 years which corresponds to the 5-year period of the requested construction and operation permit.

Future landfill development consisting of Phases 2 and 3 (i.e., Cells 5 through 12) are presented on Sheets 10 and 11 of the Permit Drawings.

FDEP Comment # 15

The current ground water monitoring plan is for Cells 1 through 4. Please acknowledge that you understand the ground water monitoring plan will have to be changed and additional wells installed before Cells 5 through 12 are allowed to receive waste (Specific condition 12 of the current permit, SO48-0165969-011). Depending on when those cells might be used, the proposed number and location of wells may change.

Response # 15:

Vista Landfill understands that the currently approved ground water monitoring implementation schedule (MPIS) is for Cells 1 through 4 (i.e., Phase 1) only, as indicated in Specific Condition 12 of the current solid waste permit (Permit No. SO48-0165969-011). It is noted that the MPIS for Cells 1 through 4 was subsequently updated under a minor permit modification (Permit No. SC48-0165969-012). Furthermore, Vista Landfill understands that the MPIS will have to be modified, as needed, before future Cells 5 through 12 (i.e., Phases 2 and 3) are allowed to receive waste.

It is noted that the ground water monitoring well installation schedule for future cell construction at Vista Landfill, Class III facility is in accordance with the currently approved MPIS (see Exhibit I, Attachment A of Permit No. SC48-0165969-012). The monitoring well installation schedule for future cell construction was presented in Table 1 of the Water Quality Plan in the Report (Appendix K, Volume 2 of 2), which is included in Attachment 6.

FDEP Comment # 16

Nineteen monitoring well type changes are requested. The following table includes the permitted designation, the requested change, the Department's proposed designation for a revised MPIS and comments:

Response # 16:

See *Response* column in the subsequent table. The Water Quality Plan, in Appendix K, Volume 2 of 2 of the Report, has been updated accordingly to reflect the revised monitoring well designations. The appropriate replacement pages (Page 3 and Table 1 of the Water Quality Plan) are provided in Attachment 6.

Changes to Well Designations
Vista Landfill, Class III
Apopka, Florida

Count #	*Well*	*Current MPIS Type*	*Proposed Changes*	*MPIS for Modification*	*DEP Comment*	**Response**
1	*MW-1A*	*BG*		*BG*		
2	*MW-1B*	*BG*		*BG*		
3	*MW-2AR*	*BG*		*BG*		
4	*MW-2B*	*BG*	*Detection*	*BG*	*Submittal notes this as a CO but it is a BG in MPIS*	Vista Landfill agrees that MW-2B may be located upgradient of the landfill. As such, the proposed MPIS Background Well designation by FDEP is acceptable.
5	*MW-3A*	*CO*	*Detection*	*CO*	*Wells are 50 feet from edge of fill, but are also at property line so must be compliance wells.*	Vista Landfill understands the interpretation provided by FDEP indicating monitoring wells that are on the property line are designated as Compliance Wells. As such, the proposed MPIS Compliance Well designation by FDEP is acceptable.
6	*MW-3B*	*CO*	*Detection*	*CO*		
7	*MW-4A*	*CO*	*Detection*	*CO*		
8	*MW-4B*	*CO*	*Detection*	*CO*		
9	*MW-5A*	*CO*	*Detection*	*CO*		
10	*MW-5B*	*CO*	*Detection*	*CO*		
11	*MW-6AR*	*BG*		*BG*		
12	*MW-6BR*	*BG*		*BG*		

Count #	***Well***	***Current MPIS Type***	***Proposed Changes***	***MPIS for Modification***	***DEP Comment***	**Response**
13	*MW-7A*	*CO*	*BG*	*BG*	*OK-BG as long as GWT consistent with surficial*	No response required.
14	*MW-7B*	*CO*	*BG*	*CO*	*Does not appear to be upgradient*	Vista Landfill understands the observation provided by FDEP since measured ground water levels for MW-7B are considerably lower than those recorded for MW-7A. As such, the proposed MPIS Compliance Well designation by FDEP is acceptable.
15	*MW-8R*	*BG*		*BG*		
16	*MW-9A*	*CO*	*BG*	*CO*	*Not clear why these would be background wells*	Vista Landfill acknowledges the observation provided by FDEP. As such the proposed MPIS Compliance Well designation by FDEP is acceptable. Wells 9A and 9B will be installed in the future, during Phase 2 of landfill development. If future ground water contours in this area indicate that MW-9A and 9B are upgradient, then Vista Landfill will request re-designation of the wells to Background Wells.
17	*MW-9B*	*CO*	*BG*	*CO*		
18	*MW-10A*	*CO*	*Detection*	*Detection*	*OK-50 feet*	No response required.
19	*MW-10B*	*CO*	*Detection*	*Detection*	*OK-50 feet*	No response required.
20	*MW-11A*	*CO*	*Detection*	*Detection*	*OK-50 feet*	No response required.

Count #	*Well*	*Current MPIS Type*	*Proposed Changes*	*MPIS for Modification*	*DEP Comment*	**Response**
21	*MW-11B*	*CO*	*Detection*	*Detection*	*OK-50 feet*	No response required.
22	*MW-12A*	*CO*		*CO*		
23	*MW-12B*	*CO*		*CO*		
24	*MW-13A*	*CO*		*CO*		
25	*MW-13B*	*CO*		*CO*		
26	*MW-14A*	*CO*		*CO*		
27	*MW-14B*	*CO*		*CO*		
28	*MW-15A*	*CO*		*CO*		
29	*MW-15B*	*CO*		*CO*		
30	*MW-16A*	*CO*		*CO*		
31	*MW-16B*	*CO*		*CO*		
32	*MW-17A*	*CO*	*BG*	*BG*	*OK-Upgradient and between OCUD disposal and Vista*	No response required.
33	*MW-17B*	*CO*	*BG*	*BG*	*OK-Upgradient and between OCUD disposal and Vista*	No response required.
34	*MW-18A*	*CO*		*CO*		
35	*MW-18B*	*CO*		*CO*		
36	*MW-19A*	*CO*		*CO*		

Count #	*Well*	*Current MPIS Type*	*Proposed Changes*	*MPIS for Modification*	*DEP Comment*	**Response**
37	*MW-19B*	*CO*		*CO*		
38	*MW-20A*	*CO*		*CO*		
39	*MW-20B*	*CO*		*CO*		
40	*MW-21A*	*CO*		*CO*		
41	*MW-21B*	*CO*		*CO*		
42	*MW-FL1*	*CO*		*CO*		
43	*MW-FL2R*	*Co*		*CO*		
44	*MW-FL3*	*CO*	*Detection*	*CO*	*CO-Permit Zone of Discharge does not include Floridan, so this must be a compliance well.*	Vista Landfill understands the explanation provided by FDEP. As such, the proposed MPIS designation by FDEP as a Compliance Well is acceptable.
45	*MW-FL4*	*BG*		*BG*		
46	*MW-FL5*	*BG*		*BG*		
47	*MW-FL6*	*BG*		*BG*		
48	*MW-FL7*	*BG*		*BG*		
49	*MW-FL8*	*BG*	*CO*	*CO*	*OK*	No response required.
50	*MW-FL9*	*BG*		*BG*		

Notes: 1. BG = Background Well, CO – Compliance Well

CLOSURE

If you have any questions or require additional information, please do not hesitate to contact the undersigned at (813) 558-0990.

Sincerely,

Juan D. Quiroz
26 Sept 2007

Juan D. Quiroz, Ph.D., P.E.
Project Engineer
P.E. Number 65275

for

Kwasi Badu-Tweneboah, Ph.D., P.E.
Associate

Attachments

Copies to: Sheree Henninger, Vista Landfill, LLC
Ray Chewning, Vista Landfill, LLC
Jay Beech, Geosyntec Consultants
Jay Davoll, P.E., City of Apopka

ATTACHMENT 1

FDEP RAI dated 28 August 2007

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Florida Department of
Environmental Protection
Central District
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Charlie Crist
Governor

Jeff Kottkamp
Lt. Governor

Michael W. Sole
Secretary

By E-Mail
apittman@wm.com

Mr. Alec Pittman
Vista Landfill, LLC
3411 North 40th Street
Tampa, FL 33605

OCD-SW-07-0352

Orange County – SW
Vista Landfill, Class III
Modification of Permit No. SO48-0165969-013
Permit Application Nos. SC48-0165969-014 & SO48-0165969-015

Dear Mr. Pittman:

Your application for permit dated July 27, 2007 and received July 30, 2007, is incomplete. Please provide the information listed on the attached sheet promptly. Evaluation of your application will be delayed until all the requested information has been received.

Pursuant to Section 120.60(2), Florida Statutes, the Department may deny an application, if the applicant, after receiving timely notice, fails to correct errors and omissions, or supply additional information within a reasonable period of time. Accordingly, please provide the additional information within 30 days of the date you receive this letter. Submit three copies of the requested information to the Department and reference the above permit application number in your correspondence.

If you have any questions, please contact me at (407) 893-3328.

Sincerely,

F. Thomas Lubozynski

F. Thomas Lubozynski, P.E.
Waste Program Administrator

Date: August 28, 2007

FTL/gc/ew
Enclosure
cc: Juan D. Quiroz, P.E. – Geosyntec Consultants jdquiroz@geosyntec.com
Ray Chewning – Vista Landfill, LLC rchewning@wm.com
Jay Davoll P. E. jdavoll@apopka.net

Note that all references to "Report" in the following text refer to the document entitled, "Substantial Permit Modification Application For A Class III Landfill, Vista Landfill, Class III, Vol. 1 of 2 and 2 of 2," Prepared by Geosyntec Consultants, Tampa, Florida.

1. The applicant is required to notify the local government having jurisdiction over the facility of the filing of the permit modification application before or on the same day of filing the application with the Department, Section 403.707(11), Florida Statutes. Submit proof of local government notification to the Department.

2. For Item A-13, DEP Form 62-701.900(1), in Appendix A, Vol. 1 of 2 in the Report, provide an anticipated date that the site will be ready to be inspected for completion.

3. For Item A-16, DEP Form 62-701.900(1), in Appendix A, Vol. 1 of 2 in the Report, provide an anticipated construction starting and completion date for the landfill.

4. Item B-8, DEP Form 62-701.900(1), in Appendix A, Vol. 1 of 2 in the Report, shows yard trash as a waste to be disposed in the Class III lined landfill. The disposal of yard trash in a lined landfill is prohibited in accordance with Rule 62-701.300 (8)(c), F.A.C. However, the proposed revision to Chapter 62-701, F.A.C. would allow yard trash in a lined Class III landfill. Please acknowledge that you understand the yard trash could not be disposed in this landfill unless the current Chapter 62-701, F.A.C. is revised to allow such disposal.

5. For Item B-10, DEP Form 62-701.900(1), in Appendix A, Vol. 1 of 2 in the Report, indicate with a check mark, if the Class III landfill has a Trained Operator.

6. Appendix L, Volume 2 of 2, Page 5 of the Operation Plan in the Report, indicates that yard trash will be accepted in the Class III lined landfill. The disposal of yard trash in a lined landfill is prohibited in accordance with Rule 62-701.300(8)(c), F.A.C. However, the proposed revision to Chapter 62-701, F.A.C. would allow yard trash in a lined Class III landfill. Please acknowledge that you understand the yard trash could not be disposed in this landfill unless the current Chapter 62-701, F.A.C. is revised to allow such disposal.

78. Appendix L, Volume 2 of 2, Page 13 of the Operation Plan in the Report, states for Final Cover the use of 6-inches of compost or topsoil capable of sustaining a good stand of grass. The use of compost is suggested at a level of 50 percent compost and 50 percent topsoil. Provide your comments.

8. Appendix L, Volume 2 of 2, Page 26 of the Operation Plan in the Report, under Hurricane Preparedness:

a) Indicate procedures that would be implemented during the period from 72 hours up to land fall. The following are example questions:

- When does the facility shut down?
- Will waste be left at the facility, either on the ground, in trucks, or other containers?

b) Indicate the procedures that will be used to re-open the facility. The following are example questions:

- Who makes the decision when the facility will re-open?
- Who inspects the facility for damage that may affect whether permit conditions can be met?
- Who notifies the Department if the damage might affect compliance with the permit and operations plan?

9. Appendix L, Volume 2 of 2, in the Operation Plan in the Report, in the pages where the Department telephone number is referenced, use both the numbers – Receptionist for Central District, 407-894-7555 and Solid Waste Section number 407-893-3328. The fax number for the Department **to be used is 407-893-3124** instead of 407-893-3167.

10. Appendix L, Volume 2 of 2, in the Operations Plan in the Report, in Section 9.1.1, include that any fires at the landfill must be reported to the Department within 24 hours (phone call, e-mail, or fax 407-893-3124) and a letter must be submitted within five days to the Department describing how the fire began, what was done to extinguish it, and what will be done to prevent future fires.

11. Appendix O in the Report referencing Financial Assurance, shows detailed closure and long-term care cost for Phase I, Cells 1 through 4. The permit application did not include a request for phased financial assurance, with the necessary provisions and constraints. A request for phased financial assurance must include specific documentation, including narrative information and drawings, signed and sealed by the Engineer of Record, to ensure that the disposal of solid waste will take place only within the designated area for which financial assurance is provided. Otherwise, revise Appendix O to include the long-term care for all 12 cells.

12. A financial mechanism must be funded in the amount of the sum of the total closure and long-term care costs specified in the approved cost estimate and accepted by the Department's Financial Coordinator before this application can be deemed complete. Financial responsibility arrangements for the facility for the approved amounts are to be made with the Financial Coordinator, Solid Waste Section, MS-4565, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400, and a **copy of the approval letter submitted to**: Department of Environmental Protection, Central District, Solid Waste Section, 3319 Maguire Boulevard, Suite 232, Orlando, Florida 32803-3767.

13. Section 2, Page 6, Item 2.1 states, "most of the items ... have not substantially changed from those items provided in the previously submitted 2006 Permit Renewal Application and Minor Modification Application ..." Please identify the specific documents that this application references or relies upon. If appropriate refer to the references listed in Appendix A of previous permits.

14. The Department agrees the entire facility (102 acre disposal area) has been permitted, but only certain cells have been authorized to be lined or to accept waste. Please identify those Phases and specific Cells that will have a bottom liner constructed during the 5-year period of this requested construction permit (SC48-0165969-014).

15. The current ground water monitoring plan is for cells 1 through 4. Please acknowledge that you understand the ground water monitoring plan will have to be changed and additional wells installed before Cells 5 through 12 are allowed to receive waste (Specific condition 12 of the current permit, SO48-0165969-011). Depending on when those cells might be used, the proposed number and location of wells may change.

16. Nineteen monitoring well type changes are requested. The following table includes the permitted designation, the requested change, the Department's proposed designation for a revised MPIS and comments:

Figure 1 Changes to Well Designations

Count #	Well	Current MPIS Type	Proposed Changes	MPIS for Modification	DEP Comment
1	MW-1A	BG		BG	
2	MW-1B	BG		BG	
3	MW-2AR	BG		BG	
4	MW-2B	BG	Detection	BG	Submittal notes this as a CO but it is a BG in MPIS
5	MW-3A	CO	Detection	CO	Wells are 50 feet from edge of fill, but are also at property line so must be compliance wells.
6	MW-3B	CO	Detection	CO	
7	MW-4A	CO	Detection	CO	
8	MW-4B	CO	Detection	CO	
9	MW-5A	CO	Detection	CO	
10	MW-5B	CO	Detection	CO	
11	MW-6AR	BG		BG	
12	MW-6BR	BG		BG	
13	MW-7A	CO	BG	BG	OK-BG as long as GWT consistent with surficial
14	MW-7B	CO	BG	CO	Does not appear to be upgradient
15	MW-8R	BG		BG	
16	MW-9A	CO	BG	CO	Not clear why these would be background wells.
17	MW-9B	CO	BG	CO	
18	MW-10A	CO	Detection	Detection	OK-50 feet
19	MW-10B	CO	Detection	Detection	OK-50 feet
20	MW-11A	CO	Detection	Detection	OK-50 feet
21	MW-11B	CO	Detection	Detection	OK-50 feet
22	MW-12A	CO		CO	
23	MW-12B	CO		CO	
24	MW-13A	CO		CO	
25	MW-13B	CO		CO	
26	MW-14A	CO		CO	
27	MW-14B	CO		CO	
28	MW-15A	CO		CO	
29	MW-15B	CO		CO	
30	MW-16A	CO		CO	
31	MW-16B	CO		CO	
32	MW-17A	CO	BG	BG	OK -Upgradient and between OCUD disposal and Vista
33	MW-17B	CO	BG	BG	OK -Upgradient and between OCUD disposal and Vista
34	MW-18A	CO		CO	
35	MW-18B	CO		CO	
36	MW-19A	CO		CO	
37	MW-19B	CO		CO	
38	MW-20A	CO		CO	
39	MW-20B	CO		CO	
40	MW-21A	CO		CO	
41	MW-21B	CO		CO	
42	MW-FL1	CO		CO	
43	MW-FL2R	CO		CO	

Count #	Well	Current MPIS Type	Proposed Changes	MPIS for Modification	DEP Comment
44	MW-FL3	CO	Detection	CO	CO-Permit Zone of Discharge does not include Floridan so this must be a compliance well.
45	MW-FL4	BG		BG	
46	MW-FL5	BG		BG	
47	MW-FL6	BG		BG	
48	MW-FL7	BG		BG	
49	MW-FL8	BG	CO	CO	OK
50	MW-FL9	BG		BG	

BG=Background Well, CO=Compliance Well

ATTACHMENT 2

City of Apopka

Request for Additional Information

dated 15 September 2007

CDM

CDM

John G. Ladner, P.E., BCEE
tel: 407 660-2552
fax: 407 875-1161
email: ladnerjg@cdm.com

Camp Dresser & McKee Inc.
2301 Maitland Center Parkway, Suite 300
Maitland, Florida 32751

consulting · engineering · construction · operations

Memorandum

To: *File*

From: *John Ladner P.E.*

Date: *September 15, 2007*

Subject: *Vista Landfill Permit Submittal Review*

- What clearance above the seasoned high water level was the liner designed to have? Verify that adequate clearance above the seasoned high GW table occurs in the NE corner of call 4 and in the southwest corner of Cell 12. Is the liner intended to act as a basis for a waiver from the 5′ separation between the bottom of the landfill and the top of the seasonal high groundwater (Sec 66-177)?

- The most recent groundwater data for Phase I is Devo's estimate in Feb. 2004. The Northern Plug was completed in April – May 2004. Because two areas within the footprint were plugged, a review of more recent water level elevation would be recommended. In addition, continued monitoring of piezometers and monitoring wells, especially in the south end of Buttrey 4 is recommended.

- Verify that the elevation of 156 for the top of landfill does not exceed the original grades plus 50′. Does WMIF intend to request a waiver for this requirement if it is exceeded (Sec 66-177z)?

- The final grades proposed in this submittal are different than the final grades proposed in the current permitted (former Buttrey) landfill. However, the layout of the stormwater pond cells is similar to what was proposed previously. As a result of the more uniform final grading plan which has been proposed, the stormwater loading to each cell has changed. A demonstration should be provided that the proposed system will fully retain the 100 year storm event onsite (66-176 (a) (7) f).

- Downcomer pipes are shown on Sheet 12, but no pipes are shown connecting ponds. Are the pipes identical to the pipes proposed in the most recent Buttrey 4 Stormwater submittal?

- Verify that the City has a copy of the most recent ERP for this site.

- Will all the solid waste Facility buildings shown on the proposed plans be constructed prior to receiving any waste in Phase 1?

Operation Plan

- Section 6 Method & Sequence of Filling Wastes should be expanded to include discussion of how stormwater will be handled while the waste elevation is below natural grade.

- Section 8.6 The City Fire Department should be notified of any fires at the Landfill. The current plan says they will be notified, if necessary. Note that a Fire Fighting Agreement may need to be updated as well.

The Proposed Leachate Collection System

- Since only one pipe is proposed for each cell, a backup plan for the leachate flow should be prepared to provide an alternative path for collection of the leachate out of the cells in case any pipes suffer clogging problems or failures. In addition, indicating that leachate pump volumes will be checked on a daily (or regular) basis and the frequency of maintenance could be considered.

ATTACHMENT 3

Local Government Notification

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Sent To Mayor John Land
Street, Apt. No.; or PO Box No. 120 E. Main St.
City, State, ZIP+4 Apopka FL 32703

PS Form 3800, June 2002 See Reverse for Instructions

KEENE ROAD LANDFILL, INC.
255 W. Keene Road
Apopka, FL 32703
(407) 886-2920
(407) 889-8043 Fax

Apopka, Florida 32703

Certified Mail 7003 2260 0000 8236 0252

Subject: Substantial Permit Modification Application
Vista Class III Landfill
City of Apopka Permits 01-F24-3400, 03-A01-300 and 05-A02-102
Florida Department of Environmental Protection Permit No. SO48-0165969-13

Dear Mayor John Land:

The purpose of this letter is to provide a Notice of Application as required by Rule 62-701.320(8), F.A.C., for the subject Class III landfill modification application. Please find enclosed a copy of the Notice and the proof of publication.

The subject permit modification application proposes to further enhance the approved design to include a liner and leachate collection system. This environmental protection feature is above and beyond current regulations and will ensure greater groundwater protection.

Vista Landfill, LLC recognizes our position as a steward of the environment and has a deep commitment to making a difference to the environment.

Please note that Jay Davoll P.E., City Engineer was provided a copy of this application for his review on August 2, 2007. If you have any questions, please feel free to contact me at 407/902-1469.

Sincerely,

Sheree Henninger

Sheree Henninger
District Engineer

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Mayor John Land
120 E. Main Street
Apopka, FL 32703

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X Sandra Kerrigan ☐ Agent ☐ Addressee

B. Received by (Printed Name)

C. Date of Delivery 9.13

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☒ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (Extra Fee) ☐ Yes

2. Article Number (Transfer from service label) 7003 2260 0000 8236 0252

PS Form 3811, August 2001 Domestic Return Receipt 2ACPRI-03-P-4081

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WASTE MANAGEMENT

RECEIVED
AUG 02 2007
BY:__________

KEENE ROAD LANDFILL, INC.
255 W. Keene Road
Apopka, FL 32703
(407) 886-2920
(407) 889-8043 Fax

August 1, 2007

Mr. R. Jay Davoll, P.E., City Engineer
City of Apopka
120 E. Main Street
Apopka Florida 32704

Subject: Substantial Permit Modification Application
Vista Class III Landfill
Permits 01-F24-3400, 03-A01-300 and 05-A02-102

Dear Mr. Davoll,

Please find enclosed one original application consisting of two binders and plan set of permit drawings. Also, included is an application fee check payable to the City of Apopka in the amount of $1350.00.

An original application was hand delivered to the attention of John Ladner, P.E. of Camp, Dresser & McKee on Monday, July 30, 2007 as discussed.

The subject application prepared by Geosyntec Consultants is to construct and operate a liner and leachate collection system and consolidates the three permitted areas into one permitted area.

If you have any questions, please feel free to contact me at 407/902-1469.

Sincerely,

Sheree Henninger
District Engineer

C: Tom Luboznski, FDEP
John Ladner, CDM
Ray Chewning, WMIF

WASTE MANAGEMENT

KEENE ROAD LANDFILL, INC.
255 W. Keene Road
Apopka, FL 32703
(407) 886-2920
(407) 889-8043 Fax

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Total Postage & Fees	$	$5.

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SEP 12 2007
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ORLANDO, FL 32811

Sent To Mayor Richard Crotty
Street, Apt. No.; or PO Box No. 201 S. Rosalind Ave., 5th FL
City, State, ZIP+4 Orlando, FL 32801

PS Form 3800, June 2002 See Reverse for Instructions

7003 2260 0000 8236 0221

September 12, 2007

Mayor Richard Crotty
201 S. Rosalind Avenue
5th Floor
Orlando, Florida 32801

Certified Mail 7003 2260 0000 8236 0221

Subject: Substantial Permit Modification Application
Vista Class III Landfill
City of Apopka Permits 01-F24-3400, 03-A01-300 and 05-A02-102
Florida Department of Environmental Protection Permit No. SO48-0165969-13

Dear Mayor Richard Crotty:

The purpose of this letter is to provide a Notice of Application as required by Rule 62-701.320(8), F.A.C., for the subject Class III landfill modification application. Please find enclosed a copy of the Notice and the proof of publication.

The subject permit modification application proposes to further enhance the approved design to include a liner and leachate collection system. This environmental protection feature is above and beyond current regulations and will ensure greater groundwater protection.

Vista Landfill, LLC recognizes our position as a steward of the environment and has a deep commitment to making a difference to the environment.

Please note that Arnold Mercado, Orange County Environmental Protection Division (EPD) was provided a copy of this application for EPD review on August 28, 2007. If you have any questions, please feel free to contact me at 407/902-1469.

Sincerely,

Sheree Henninger
District Engineer

From everyday collection to

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Mayor Richard Crotty
201 S. Rosalind Avenue
5th Floor
Orlando, FL 32801

2. Article Number

COMPLETE THIS SECTION ON DELIVERY

A. Signature X P. Mat ☐ Agent ☐ Addressee

B. Received by (*Printed Name*) P. Mathew

C. Date of Delivery

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

SEP 13 2007

3. Service Type
☒ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? *(Extra Fee)* ☐ Yes

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Restricted Delivery Fee (Endorsement Required) $0.00
Total Postage & Fees $ $5.21

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ORLANDO, FL

Sent To State Rep. Bryan Nelson
Street, Apt. No.; or PO Box No. 409 S. Park Ave.
City, State, ZIP+4 Apopka, FL 32703-5261

PS Form 3800, June 2002 See Reverse for Instructions

KEENE ROAD LANDFILL, INC.
255 W. Keene Road
Apopka, FL 32703
(407) 886-2920
(407) 889-8043 Fax

State Representative Bryan Nelson
409 S. Park Avenue
Apopka Florida 32703-5261

Certified Mail 7003 2260 0000 8236 0238

Subject: Substantial Permit Modification Application
Vista Class III Landfill
City of Apopka Permits 01-F24-3400, 03-A01-300 and 05-A02-102
Florida Department of Environmental Protection Permit No. SO48-0165969-13

Dear Rep. Bryan Nelson:

The purpose of this letter is to provide a Notice of Application as required by Rule 62-701.320(8), F.A.C., for the subject Class III landfill modification application. Please find enclosed a copy of the Notice and the proof of publication.

The subject permit modification application proposes to further enhance the approved design to include a liner and leachate collection system. This environmental protection feature is above and beyond current regulations and will ensure greater groundwater protection.

Vista Landfill, LLC recognizes our position as a steward of the environment and has a deep commitment to making a difference to the environment.

If you have any questions, pleas

Sincerely,

Sheree Henninger

Sheree Henninger
District Engineer

From everyday collection to

SENDER: *COMPLETE THIS SECTION*

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- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

State Senator Daniel Webster
315 S. Dillard Street
Winter Garden, FL 34787

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X Cudy Brown ☐ Agent ☐ Addressee

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C. Date of Delivery 9/13/07

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2. Article Number
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Sent To State Senator Daniel Webster
Street, Apt. No.; or PO Box No. 315 S. Dillard St
City, State, ZIP+4 Winter Garden FL 34787

PS Form 3800, June 2002 See Reverse for Instructions

WASTE MANAGEMENT

KEENE ROAD LANDFILL, INC.
255 W. Keene Road
Apopka, FL 32703
(407) 886-2920
(407) 889-8043 Fax

September 12, 2007

State Senator Daniel Webster
315 South Dillard Street
Winter Garden, Florida 34787

Certified Mail 7003 2260 0000 8236 0245

Subject: Substantial Permit Modification Application
Vista Class III Landfill
City of Apopka Permits 01-F24-3400, 03-A01-300 and 05-A02-102
Florida Department of Environmental Protection Permit No. SO48-0165969-13

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Vista Landfill, LLC recognizes our position as a steward of the environment and has a deep commitment to making a difference to the environment.

If you have any questions, please feel free to contact me at 407/902-1469.

Sincerely,

Sheree Henninger

Sheree Henninger
District Engineer

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

State Rep. Bryan Nelson
409 S. Park Avenue
Apopka, FL 32703-5261

2. Article Number (*Transfer from service label*) 7003 2260 0000 8236 0238

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X ☒ Agent ☐ Addressee

B. Received by (*Printed Name*)

C. Date of Delivery 9/13/07

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☒ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (*Extra Fee*) ☐ Yes

PS Form 3811, August 2001 Domestic Return Receipt

ATTACHMENT 4

FDEP Form 62-701.900(1) Replacement Pages

8. Applicant name (operating authority): Vista Landfill, L.L.C.

Mailing address: 242 West Keene Road, Apopka, Florida 32703
Street or P.O. Box City State Zip

Contact person: Ray Chewning Telephone: (407) 886-2920

Title: Senior Engineer

rchewning@wm.com
E-Mail address (if available)

9. Authorized agent/Consultant: Geosyntec Consultants

Mailing address: 14055 Riveredge Drive, Suite 300, Tampa, FL 33637
Street or P.O. Box City State Zip

Contact person: Juan D. Quiroz Telephone: (813) 558-0990

Title: Project Engineer

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

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

Mailing address: N/A
Street or P.O. Box City State Zip

Contact person: N/A Telephone: (___) N/A

N/A
E-Mail address (if available)

11. Cities, towns and areas to be served: Northwest Orange County and Metro Orlando

12. Population to be served:

Current: ±100,000 Five-Year Projection: +100,000

13. Date site will be ready to be inspected for completion: 30 June 2008

14. Expected life of the facility: 17.5 years

15. Estimated costs:

Total Construction: $ N/A Closing Costs: $ N/a

16. Anticipated construction starting and completion dates:

From: October 2007 To: June 2008

17. Expected volume or weight of waste to be received:

______ yds^3/day 2,500 tons/day ______ gallons/day

B. DISPOSAL FACILITY GENERAL INFORMATION

1. Provide brief description of disposal facility design and operations planned under this application:

Vista Landfill, Class III facility, is currently permitted as an unlined Class III landfill. This substantial permit modification application is submitted for the purpose of obtaining FDEP approval to construct and operate a liner and leachate collection system for the currently permitted Class III landfill facility. The liner and leachate collection system will augment and improve the environmental controls at the landfill facility.

2. Facility site supervisor: Sheree Henniger

Title: District Engineer Telephone: (407) 886-2920

shenning@wm.com
E-Mail address (if available)

3. Disposal area: Total 102 acres; Used 0 acres; Available 102 acres.

4. Weighing scales used: ☑ Yes ☐ No

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

6. Charge for waste received: N/A $/yds^3 N/A $/ton

7. Surrounding land use, zoning:

- ☑ Residential
- ☑ Agricultural
- ☐ Commercial
- ☐ Industrial
- ☐ None
- ☑ Other Describe: Institutional, parks and recreation

8. Types of waste received:

- ☐ Residential
- ☐ Commercial
- ☐ Incinerator/WTE ash
- ☐ Treated biomedical
- ☐ Water treatment sludge
- ☐ Air treatment sludge
- ☐ Agricultural
- ☐ Asbestos
- ☐ Other Describe: ______
- ☑ C & D debris
- ☐ Shredded/cut tires
- ☐ Yard trash
- ☐ Septic tank
- ☐ Industrial
- ☐ Industrial sludge
- ☐ Domestic sludge

9. Salvaging permitted: ☐ Yes ☑ No

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

11. Spotters: Yes ☑ No ☐ Number of spotters used: ______

12. Site located in: ☐ Floodplain ☐ Wetlands ☑ Other Uplands Only

ATTACHMENT 5

Operation Plan Replacement Pages

Prepared for:

WASTE MANAGEMENT

Vista Landfill, L.L.C.
242West Keene Road
Apopka, FL 32703

OPERATION PLAN

VISTA LANDFILL, CLASS III
Apopka, Florida

Prepared by:

Geosyntec
consultants

14055 Riveredge Drive, Suite 300
Tampa, FL 33637

Project No. FL1229

~~July~~ September 2007

Juan D. Quiroz
26 Sept 2007

3. ENTRANCE PROCEDURES

3.1 Control of Incoming Waste

In accordance with Rules 62-701.200(14) and 62-701.300(8)(c), FAC, only Class III waste, defined as ~~yard trash,~~ *construction and demolition debris, processed tires, asbestos, carpet, cardboard, paper, glass, plastic, furniture other than appliances, or other materials approved by the Department that are not expected to produce leachate which poses a threat to public health or the environment,* is knowingly accepted for disposal at Vista Landfill, a lined Class III facility. Vista Landfill understands that yard trash cannot be disposed in a lined Class III landfill unless the current solid waste management rules of Chapter 62-701, F.A.C. are revised to allow such disposal.

Vista Landfill, Class III facility does not knowingly dispose of hazardous waste, putrescible waste, liquid wastes, brown goods (small appliances, electronic goods, cathode ray tubes, etc...), or any other non-Class III waste material. Unacceptable loads are rejected as described in Section 4.2. Once Class III waste has been accepted and unloaded, if any unacceptable waste is found, spotter(s) will proceed to remove unacceptable wastes to a temporary staging area for placement at the end of the working day into containers destined for other facilities properly permitted to receive such wastes. If the generator or transporter of any unacceptable waste can be identified, they may be requested to remove the unacceptable material from the landfill.

Although State and City requirements do not currently prohibit the disposal of CCA treated wood at Class III Landfills, Vista Landfill is committed to being proactive. Spotters are encouraged to identify and remove CCA treated wood, for disposal at a lined facility, to reduce the quantity of CCA treated wood being disposed at Vista Landfill, Class III facility.

3.2 Hours and Days of Operation

Typical hours for acceptance of waste are:

Monday through Friday	7:00 am to 6:00 pm
Saturday	8:00 am to 12:00 pm

The actual hours of operation are posted at the main entrance to the facility. The facility is closed on Sundays and designated holidays. Access by all vehicles shall be via a single secured site entrance. The entrance allows for safe and orderly traffic flow into and out of the facility. Public access and receipt of waste occurs only when an attendant is on duty.

The written record is signed by the inspector.

4.5 Management of Hazardous Wastes

If any regulated hazardous wastes are identified by random load-checking, or are otherwise discovered to be improperly deposited at the landfill, the operator will promptly notify the following parties:

1. Florida Department of Environmental Protection: 407-894-7555 / 407-893-3328.
2. Other agencies, as required.
3. The person responsible for shipping the wastes to the landfill.
4. The generator of the wastes, if known.

The area where the wastes are deposited will be immediately restricted from public access. If the generator or hauler cannot be identified, the District Manager (DM) or Operations Supervisor (OS) will assure the cleanup, transportation, and disposal of the waste at a permitted hazardous waste management facility. Subsequent shipments from sources found or suspected to be previously responsible for shipping regulated hazardous waste will be subject to precautionary measures prior to the facility accepting wastes.

4.6 Management of Special Wastes

Asbestos-containing materials, non-friable and friable, are accepted and disposed at Vista only under specific conditions. The asbestos waste generator/hauler must notify the DM or OS prior to transporting the asbestos waste. The asbestos is disposed of in designated and recorded areas. The asbestos is then carefully covered in a manner so that neither equipment nor personnel come in contact with the waste.

5. WASTE RECORDS

The Scale Attendant records, in tons per day, the amount of solid waste received at the site. Waste reports will be compiled monthly, and copies will be provided to the City of Apopka and FDEP quarterly.

Quarterly Waste Quantity Reports are submitted to:

Tom Lubozynski, P.E.
Solid Waste Section
Florida DEP
3319 Maguire Blvd., Suite 232
Orlando, FL 32803

R. J. "Jay" Davoll, P.E.
Community Development Dept.
City of Apopka
120 E. Main St., 2nd Floor
Apopka, FL 32704

or via electronic mail to

Tom.Lubozynski@dep.state.fl.us

jdavoll@apopka.net

or via facsimile to

~~(407) 893-3167~~ (407) 893-3124

(407) 703-1791

Tom Lubozynski, P.E.
email: Tom.Lubozynski@dep.state.fl.us
phone: ~~(407) 893-3329~~ (407) 894-7555 / (407) 893-3328
facsimile: ~~(407) 893-3167~~ (407) 893-3124
address: Florida Department of Environmental Protection
3319 Maguire Blvd., Suite 232
Orlando, FL 32803

3. complete remediation within 60 days of exceedence, unless otherwise approved by the Department.

Quarterly methane monitoring reports, using the form in Attachment B, are reviewed by the Site Engineer or Compliance Manager and submitted to the Department at the following address:

Tom Lubozynski, P.E.
Solid Waste Section
Florida Department of Environmental Protection
3319 Maguire Blvd., Suite 232
Orlando, FL 32803

or via electronic mail: Tom.Lubozynski@dep.state.fl.us or facsimile: ~~(407) 893-3167~~ (407) 893-3124.

In the event that a permanent gas probe is not available for sampling, a "bar hole" is created in the vicinity of the damaged or missing probe by hammering a 3-foot long by ½-inch diameter metal "bar" into the ground the full length of the bar (i.e., three feet), and removing it, thus creating a "hole." Methane concentration is measured in this bar hole by inserting the instrument probe into the void and aspirating sample gas through the meter for 20-30 pumps on the aspirator bulb. If methane is encountered, aspiration continues until a steady-state reading is obtained, typically within 20 pumps and always within 30 pumps. If no methane is encountered, aspiration is concluded after 30 pumps and "0%" is recorded.

Every attempt is made to replace a damaged or missing gas probe within a reasonable time frame, typically before the next quarterly sampling event. Site conditions such as construction may make this time frame impractical to achieve, however. Vista Landfill uses drilling vendors to replace permanent gas probes. One such vendor is listed below; however, other vendors may be used.

The Colinas Group
509 North Virginia Avenue
Winter Park, FL 32789
(407) 622-8176

- Type of fire or explosion
- Actions now being taken
- Injuries

c) Notify rescue squad, if necessary
d) Notify health care facility, if necessary

5. Notify Florida Department of Environmental Protection~~:~~ within 24 hours via phone (407-894-7555 / 407-893-3328), e-mail (Tom.Lubozynski@dep.state.fl.us) or fax (407-893-3124). A letter must be submitted to FDEP within five days describing how the fire began, what was done to extinguish it and what will be done to prevent future fires.

9.1.2 "Hot Load" Procedures

In the unlikely event that a "hot load" is not identified before entrance into the facility, the following procedures are implemented:

- The truck carrying the "hot load" is directed to dump the load in the landfill but away from the working face;
- The load is placed on top of intermediate cover which provides sufficient protection from the "hot load" and the underlying waste;
- Soil is then spread over the load to smother the "hot load"; and
- The "hot load" is monitored until there is no evidence of smoldering or high temperatures.

At the end of the day, or at a time when the waste has been well extinguished and cooled, the load is worked into the waste placement working face. The designated area for extinguishing the "hot loads" varies depending on the location of the working face, but is always away from the working face.

9.1.3 Fire Extinguishers

Fire extinguishers are installed in the following locations:

- Onsite buildings
- Heavy equipment.

9.2 Hurricane Preparedness

The following is a general guideline that is to be followed before, during and after any hurricane. Due to the nature of these storms, there may be some deviation from this guide. A Hurricane Planning Manual has been included in Attachment F which provides key procedures regarding landfill facility shutdown in the days prior to landfall of any storm.

The Emergency Coordinator will oversee all preparations for the incoming storm and remain aware of any pending situation by monitoring weather reports. Other Landfill personnel will report to the Emergency Coordinator as follows:

Landfill Alternate Emergency Coordinator
Shop Mechanic/Next Senior Operator
Office Senior Clerk

Adequate cover material soil will be stockpiled. All ditches will be checked and cleaned for adequate flow. All lightweight signs and equipment will be collected and stored in a secure area.

Vista Landfill also has prepared a Hurricane Preparation and Planning Emergency Supplier Response Resource Notebook to be used as a tool to aid Market Area Hurricane Response Managers in their efforts to obtain, manage, and maintain open supply lines for needed goods, materials, and services as part of their hurricane preparation and recovery plan(s). This notebook is available for review by FDEP and the City of Apopka upon request.

ATTACHMENT F

EXHIBIT B - Landfill Facility Shutdown Checklist

In the days before landfall of any storm, it is imperative that we follow key procedures to "shutdown" our facilities. Listed below are the key items to be accomplished. Based on your site, there may be other items specific to your site. You should use the space at the bottom provided at the bottom of each day to identify the specific items and track their completion.

Follow all steps of the Consolidated Hurricane Plan and the items listed below:

Item	Activity / Task	Complete By Date	Comments	Assigned To:	Completed By Initials	Date Completed
1	LF DM takes full responsibility for fuel inventory management. Fuel deliveries will be scheduled as far as possible in advance based on daily usage and storage capacity. Make sure to account for the possible need to supply employees with gasoline both immediately before and after the storm. MAFM working with Procurement will assist with logistics and deliveries.	Day 7	DM must monitor fuel supplies daily and ensure that tanks are topped off just prior to the storm.	LF DM		
2	Perform a general site assessment. Walk around the site and, at a minimum review/check: • Check all erosion issues. • Check side slopes. • Check drainage issues. • Check cap/cover issues. • Clean/Repair all storm water swales and down falls. • Check fence for overhanging trees and trim as necessary. Dispose of branches – do not leave in yard. • Check metal buildings for loose	Day 7	See Guidelines for Landfill Hurricane Preparations at the back of this exhibit. See Exhibit O - Hazardous Materials Checklist. See Exhibit V - Provisions & Safety Supplies.	LF DM		

Item	Activity / Task	Complete By Date	Comments	Assigned To:	Completed By Initials	Date Completed
	siding or loose roof panels and repair as needed. • Check all office roofs to be sure that the drainage systems are clear. • Inspect garage doors and check wind rating from manufacturer. If doors are the older type with low wind ratings, determine if some type of supports could be fabricated to keep doors from being blown out. • Inspect storm drains to insure they have been maintained and are currently functional. Repair as needed. • Check water pumps (washracks, etc) and treatment locations for proper mounting and protection from wind damage to filtration systems. Fix as required. • If oil water separator is present and receives flows from any areas other than those areas under roof, the valves associated with these areas should be closed prior to landfall • Check storage and condition of all Hazardous Materials. See Hazardous Materials Checklist (Exhibit O) and complete. Move materials to safe location if necessary. • Check to ensure that scalehouse and other temporary buildings are properly anchored.					

Item	Activity / Task	Complete By Date	Comments	Assigned To:	Completed By Initials	Date Completed
	• Insure that facilities with on-site well water serving buildings can power the pumps with a generator in the event of power loss or have portable toilets available in case of pump damage. Make plans as necessary. • Inspect hurricane supplies to insure they are complete. Check all equipment for proper operation. • Inspect storm ponds. Take any necessary actions. • Perform general housekeeping. **CLEAN THE YARD** of items that are not needed. Organize. Make note of items requiring tie-down or anchoring. • Note any other items required to be attended to prior to the storm. Use common sense.					
3	Review Emergency Plan as outlined in the site operating permit. In addition to following the steps of this plan, follow your Site Operating Permit completely.	Day 7	See Site Operating Permit	LF DM		
4	Inspect supplies to protect buildings, computers, etc. Each site should have a stock pile of goods (sheet plastic, plywood, etc) that was purchased in the spring. Review the list and purchase any supplies necessary.	Day 7	See Exhibit K - Hurricane Materials Worksheet	LF DM		

Item	Activity / Task	Complete By Date	Comments	Assigned To:	Completed By Initials	Date Completed
5	Review current inventory levels of all critical items needed to keep equipment running (parts lubricants, etc). Schedule to have any extra inventory delivered and lubricant tanks topped off within next three days.	Day 7		LF DM		
6	Make contact with local electricians. Inform them that you may need to use their services after the storm to hook-up emergency generators. Get names and contact numbers for after the storm and keep with you at all times.	Day 7		LF DM		
7	Survey your leachate storage capacity, discuss with the Market Area if there is a need to pump additional leachate. Develop plan to pump out.	Day 7		LF DM		
8	Review the Equipment and Employee Evacuation Plan that was developed for the site. Discuss with all local management employees make any final changes necessary and discuss with MAGM.	Day 7	Review Exhibit D – Equipment and Employee Evacuation Plans	LF DM		
9	Based on the review of all of the steps above, create a specific work plan/punch list of items that must be accomplished before landfall.	Day 7		LF DM		
10	Other items specific to the site:	Day 7				

Item	Activity / Task	Complete By Date	Comments	Assigned To:	Completed By Initials	Date Completed
11	If there is a need to pump/transport additional leachate, contact service providers and begin pumping/transporting.	Day 6		LF DM		
12	Follow-up on walk around inspection and punch list. Ensure that all items are being completed.	Day 6		LF DM		
13	Any other items specific to the site:	Day 6				
14	Follow-up on facility walk around inspection and punch list. Clean-up/store/secure any loose debris, materials and equipment that could become wind-blown.	Day 5		LF DM		
15	Notify all major customers and host community as to what the current plans are for closing the landfill. Scale house attendants should communicate to each truck driver what our current site closure estimate is.	Day 5	See Exhibit D – Equipment and Employee Evacuation Plans	LF DM		
16	Review the landfill SPCC and SWPPP plans discuss as necessary with the MA Environmental Protection Manager.	Day 5		LF DM		
17	Verify critical inventories (parts, lubricants) are in place and all lubricants have been topped off.	Day 5		LF DM		

Item	Activity / Task	Complete By Date	Comments	Assigned To:	Completed By Initials	Date Completed
18	Begin daily briefings with all employees. Discuss all on-going preparation plans, current status of personal preparations, work schedules, etc.	Day 5	See Exhibit D – Equipment and Employee Evacuation Plans	LF DM		
19	Any other items specific to the site:	Day 5				
20	Check status of all issues found in the facility walk around inspection and punch list. Ensure activities are on track to completion.	Day 4	See Guidelines for Landfill Hurricane Preparations at the back of this exhibit	LF DM		
21	Conduct daily briefing with all employees. Discuss all on-going preparation plans, current status of personal preparations, work schedules, etc.	Day 4	See Exhibit D – Equipment and Employee Evacuation Plans	LF DM		
22	Notify all major customers and host community as to what the current plans are for closing the landfill. Scale house attendants should communicate to each truck	Day 4	See Exhibit D – Equipment and Employee Evacuation Plans	LF DM		

Item	Activity / Task	Complete By Date	Comments	Assigned To:	Completed By Initials	Date Completed
	driver what our current site closure estimate is.					
23	Survey your leachate storage capacity, discuss with the Market Area if there is a need to pump additional leachate.	Day 4		LF DM		
24	Any other items specific to the site:	Day 4				
25	Check status of all issues found in the facility walk around inspection and punch list. Ensure activities are on track to completion.	Day 3	See Guidelines for Landfill Hurricane Preparations at the back of this exhibit	LF DM		
26	Finish all "clean-up" activities on the site. All supplies should in indoors or otherwise secured.	Day 3		LF DM		
27	Begin to install plywood or other coverings over windows and doors. Begin the process of "boarding up".	Day 3		LF DM		
28	Meet with all employees. Identify all employees who plan to evacuate area and determine their final timeline for departure. Review Wallet card, WM ID badge, communication protocols. DO NOT ALLOW any employee to evacuate without a Wallet Card, Photo ID, and safe transit	Day 3	See Exhibit D – Equipment and Employee Evacuation Plans See Exhibit F – Hurricane	LF DM		

Item	Activity / Task	Complete By Date	Comments	Assigned To:	Completed By Initials	Date Completed
	letter from Group Legal (if available). Also, be sure to update Exhibit F – Employee Phone/Address tree with contact information for employees who intend to evacuate the area.		Preparedness Contact Information, Section 14 – Employee Phone/Address Tree			
29	Notify all major customers and host community as to what the current plans are for closing the landfill. Scale house attendants should communicate to each truck driver what our current site closure estimate is.	Day 3	See Exhibit D – Equipment and Employee Evacuation Plans	LF DM		
30	Any other items specific to the site:	Day 3				
31	Complete activities identified in walk around inspection and punch list.	Day 2	See Guidelines for Landfill Hurricane Preparations at the back of this exhibit	LF DM		
32	Begin to monitor wind speeds. The site will start to shut down when wind speeds begin to exceed a safe level (note this is typically 40 MPH). Notify all major customers and host community as to what the current plans are for closing the landfill. Scale house attendants should communicate to each truck driver what our current site closure estimate is. Note: if wind speeds are approaching 40 MPH it is critical that the site begins to perform the DAY 1 activities below.	Day 2	See Exhibit D – Equipment and Employee Evacuation Plans	LF DM		

Item	Activity / Task	Complete By Date	Comments	Assigned To:	Completed By Initials	Date Completed
33	Stage any equipment not being used in its designated parking location.	Day 2	See Exhibit D – Equipment and Employee Evacuation Plans	LF DM		
34	Any other items specific to the site:	Day 2				
35	Review all activities on the list above. Insure completion.	Day 1		LF DM		
36	**Secure YELLOW IRON and other equipment. Take the following steps:** - Fully fuel (top-off) all equipment. - Move equipment to your pre-determined staging area. - Park equipment a minimum of 25 feet apart (for fire protection). - Do not park near or under power lines. - Do not park near gravel or loose rock. - Position to minimize exposure of all hydraulic cylinders. - Turn off all power and master	Day 1		LF DM		

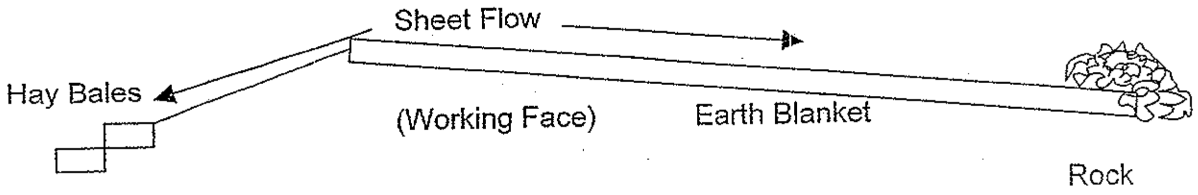
Item	Activity / Task	Complete By Date	Comments	Assigned To:	Completed By Initials	Date Completed
	switch. - Lock cab if possible.					
37	Secure all fueling equipment: Insure that all tanks are protected from possible water entry. Secure blow-off caps to insure that wind does not lift and allow water entry. Test all tanks for water using stick and paste. Record results (this will be used to provide a benchmark after the storm). Make sure all fueling nozzles are secured and locked.	Day 1		LF DM		
38	Double check and ensure that all containment area valves have been closed/locked.	Day 1		LF DM		
39	Finish boarding up the facility. Sandbag all shop doors to prevent water penetration under the doors.	Day 1		LF DM		
40	Notify all major customers and your host community as to what your current plans are for closing the landfill. For instance, you will be closing the landfill once the wind speed reaches 40 MPH. Make sure that your scale house attendants communicate to each truck driver what our current site closure estimate is.	Day 1		LF DM		
41	Hardware and files: Hardware: Fully unplug (electrical, Ethernet, etc) all computers and place on top of desks to elevate them off of the floor. Cover/wrap all computers in plastic. Move them to locations away from windows if possible.	Day 1		LF DM		

Item	Activity / Task	Complete By Date	Comments	Assigned To:	Completed By Initials	Date Completed
	Files: Secure as best as possible cover/wrap all file cabinets in plastic.					
42	Charge all batteries and spare batteries for laptops and cell phones. Take your laptop and spare batteries/chargers with you when you leave.	Day 1		LF DM		
43	Turn off all electrical breaker boxes to your buildings (only). Do NOT turn off electricity to your flares, pumps, etc unless you have made provisions for generator power and the generators are hooked-up and working. Your goal here is to protect buildings from electrical fires. If you only have one panel that controls the building and the Flares/pumps, etc. then you should leave the electricity on.	Day 1		LF DM		
44	Take this manual with you when you leave.	Day 1		LF DM		
45	Lock all buildings and secure all gates as you are leaving.	Day 1		LF DM		
46	Any other items specific to the site:	Day 1		LF DM		

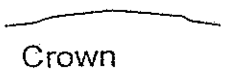
Guidelines for Landfill Hurricane Preparations
(Working Face, Roads, Slopes, and Drainage Features)

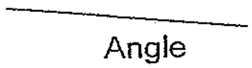
Preface: A hurricane may present conditions that can adversely effect landfill operations. The main threats are high wind, heavy rain and flooding. It is the intent of this document to provide basic guidelines that, when properly implemented, can greatly reduce the effects of these potential impacts.

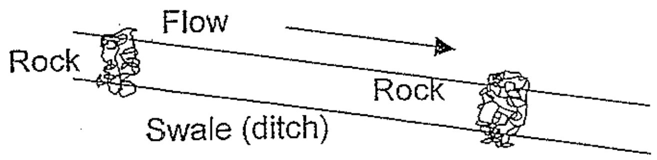
Working Face: The working face of the landfill should be protected from excess water intrusion from heavy rains. This can be done by providing proper grading and cover that promotes the shedding of water off of the working face toward drainage features. Cover should be applied a minimum or 6" thick (1 foot preferred) or as required by permit conditions at the site. Cover material should be compacted into place (walked-in) so that the soil is tightly packed. If a tarp is used it should be anchored or covered to prevent being removed by high winds. A back-up tarp may be needed if the tarp in use becomes damaged or washed/ blown away by the storm. The working face should be developed and covered to minimize steep slopes that are subject to erosion during heavy rain and to eliminate points of entry for rain and surface water. Consideration should be given to the potential for erosion areas that may develop. In steep areas benching, rock, hay bales, or other measures to discourage erosion should be installed.



Access Roads: Roadways should be graded to promote drainage and limit erosion. A slight crown or angle should be applied to the road to allow sheet flow off of the road way into drainage swales (ditches). This is epically critical on steep roads to prevent a river effect down the roadway. The drainage swales (ditches) should have periodic erosion barriers to limit the speed of flow of water within them. This is best accomplished installing gabions or check dams to absorb and dissipate the energy of the flowing water. Some examples of this are the placement of rock, hay bales, benches, concrete or other control devices placed across the swale to slow the flow of drainage.







Slopes/ Drainage Features: Sloped areas are subject to erosion when exposed to heavy rains. Ongoing efforts to establish healthy vegetation on sloped areas are needed to prevent and control the potential effects from erosion. Surface treatments such as geo-matting, sod and hydro-seeding should be considered in advance of storm events. Establishing and maintaining designed drainage features also plays an important role in keeping sloped area intact. Benching, down chutes, and down drains provide a means of conveying water from the top of the hill down. These features should be checked to ensure that they are in proper working order. If areas are bare (no vegetation) consideration should be given to the potential impact of heavy rain on the area. The placement of additional cover material, uphill diversion berms or hay bales may help protect these areas from excess erosion. A good rule of thumb is to focus on areas that have shown evidence of erosion in the past. These areas are likely to be impacted to a greater degree during a hurricane.

Drainage Features: In addition to the drainage features discussed above, other drainage features may be present at landfills. These include storm water swales, storm water ponds, outfalls and other control devices. On an ongoing basis all of these features should be maintained. The primary concern is the blockage of these features with silt, debris or vegetation. The entire storm water system should be inspected to identify and remove any such blockage so that excess storm water that may accompany a hurricane. Again, focus should be on areas that have been problematic in the past.

Rock/ Dirt Stockpile: Rock and dirt should be stockpiled for use following a storm. These materials may be needed to repair roadways, slopes and swales impacted by erosion associated with the storm. Keep in mind that the availability of cover material may also be impacted by a hurricane. Road closures, lack of fuel or damage to hauling contractors may prevent the delivery of cover material for several days or longer. The quantity of material needed is site specific and dependent on several factors. When planning stockpile needs consider the amount of material that has been needed in the past to repair roads and side slopes following heavy rain. Also consider daily cover needs. A sufficient quantity of rock or crushed concrete and soil should be available to repair expected road and slope damage. Stockpiles should be located in areas that are not subject to flooding or surface flow impact so that they can be accessed and used following the storm.

ATTACHMENT 6

Water Quality Plan Replacement Pages

Prepared for:

WASTE MANAGEMENT

Vista Landfill, L.L.C.
242 West Keene Road
Apopka, FL 32703

WATER QUALITY MONITORING PLAN

VISTA LANDFILL, CLASS III
Apopka, Florida

Prepared by:

Geosyntec
consultants

14055 Riveredge Drive, Suite 300
Tampa, FL 33637

Project No. FL1229

~~July~~ September 2007

Juan D. Quiroz
28 Sept 2007

When assigning the classification of the wells, Geosyntec was consistent with the locations presented in the approved MPIS, which were based on the hydrogeologic investigation and on site-specific conditions in accordance with Rule 62-701.510(2) and (3), FAC. ~~Twelve~~ Four (~~12~~ 4) wells located 50 feet from the landfill, within the zone of discharge, are re-designated as "Detection" wells. Additionally, an effort has been made to show the configuration of the shallow ground water flow regime in Figure 2. ~~Six~~ Three(~~6~~ 3) wells located on topographic highs and hydrogeologically upgradient of the landfill are re-designated as "Background" wells. Another well was noted to be in a downgradient location and was re-designated as a "Compliance" well. All other wells are shown in their approved locations and with their current designations as compliance or background wells. Table 2 shows the initial and re-designated classifications.

2.1.3 Future Well Construction

As noted above, the monitoring well network for Phase 1 development (i.e., Cells 1 through 4) has already been installed at the Vista Landfill facility. Additional ground water monitoring wells required for subsequent landfill development phases or future assessment of ground water quality will be installed using FDEP approved methods allowed under Chapter 62-701, FAC such as hollow stem auger (HSA) drilling methods under the direction of a qualified geologist. Additional monitoring wells will be installed so that the well screens (10 feet in length) are located to readily detect representative ground water conditions within the saturated thickness of the uppermost aquifer. Additionally, every attempt will be made to set the monitoring well screen so that the water table can be sampled at all times. Screens in the shallow well may be set 3 to 5 feet below the seasonal high water table to minimize potential changes in water quality due to air-water interactions while still allowing for collection of a sample representative of the uppermost water table.

A soil boring log will be prepared by the geologist or engineer by visually inspecting drill cuttings directly from the auger flights or samples from a standard penetration test, if used. After advancing the boring to the appropriate depth, the monitoring well will be constructed in accordance with typical details indicated in Figure 3. A probable screen size and sand pack gradation has been shown on Figure 3. Prior to installation, the design for the screen and sand pack will be checked based on soil samples in the vicinity of the new well or from the actual well cuttings. The well construction shown in Figure 3, including slot and sand pack size have been used successfully for installing existing wells at Vista Landfill and at the nearby Keene Road Landfill. Accordingly, this same configuration will be used for future wells, unless site specific or well specific conditions warrant otherwise.

The location of each well, in degrees, minutes and seconds of latitude and longitude, and the elevation of the top of the well casing to the nearest 0.01 foot, National Geodetic

Table 1: Monitoring Well Designation and Classification for the Vista Landfill

Monitoring Well Designation	Existing Classification	Proposed Classification	Installation Schedule[(1)]
MW-1A	Background	Background	Phase 1
MW-1B	Background	Background	Phase 1
MW-2AR	Background	Background	Phase 1
MW-2B	~~Compliance~~ Background	~~Detection~~ Background	Phase 1
MW-3A	Compliance	~~Detection~~ Compliance	Phase 1
MW-3B	Compliance	~~Detection~~ Compliance	Phase 1
MW-4A	Compliance	~~Detection~~ Compliance	Phase 1
MW-4B	Compliance	~~Detection~~ Compliance	Phase 1
MW-5A	Compliance	~~Detection~~ Compliance	Phase 1
MW-5B	Compliance	~~Detection~~ Compliance	Phase 1
MW-6AR	Background	Background	Phase 1
MW-6BR	Background	Background	Phase 1
MW-7A	Compliance	Background	Phase 1
MW-7B	Compliance	~~Background~~ Compliance	Phase 1
MW-8R	Background	Background	Phase 1
MW-9A	Compliance	~~Background~~ Compliance	Phase 2
MW-9B	Compliance	~~Background~~ Compliance	Phase 2
MW-10A	Compliance	Detection	Phase 3
MW-10B	Compliance	Detection	Phase 3
MW-11A	Compliance	Detection	Phase 2
MW-11B	Compliance	Detection	Phase 2
MW-12A	Compliance	Compliance	Phase 3
MW-12B	Compliance	Compliance	Phase 3
MW-13A	Compliance	Compliance	Phase 3
MW-13B	Compliance	Compliance	Phase 3
MW-14A	Compliance	Compliance	Phase 2
MW-14B	Compliance	Compliance	Phase 2
MW-15A	Compliance	Compliance	Phase 2
MW-15B	Compliance	Compliance	Phase 2
MW-16A	Compliance	Compliance	Phase 3
MW-16B	Compliance	Compliance	Phase 3
MW-17A	Compliance	Background	Phase 3
MW-17B	Compliance	Background	Phase 3
MW-18A	Compliance	Compliance	Phase 3
MW-18B	Compliance	Compliance	Phase 3
MW-19A	Compliance	Compliance	Phase 3
MW-19B	Compliance	Compliance	Phase 3
MW-20A	Compliance	Compliance	Phase 3
MW-20B	Compliance	Compliance	Phase 3
MW-21A	Compliance	Compliance	Phase 3
MW-21B	Compliance	Compliance	Phase 3

Monitoring Well Designation	**Existing Classification**	**Proposed Classification**	**Installation Schedule**$^{(1)}$
W-FL1	Compliance	Compliance	Phase 1
MW-FL2R	Compliance	Compliance	Phase 1
MW-FL3	Compliance	~~Detection~~ Compliance	Phase 1
MW-FL4	Background	Background	Phase 3
MW-FL5	Background	Background	Phase 2
MW-FL6	Background	Background	Phase 2
MW-FL7	Background	Background	Phase 3
MW-FL8	Background	Compliance	Phase 3
MW-FL9	Background	Background	Phase 3

Notes: (1) Phase 1 includes Cells 1 through 4; Phase 2 includes Cells 5 through 8; and Phase 3 includes Cells 9 through 12.

Prepared for

WASTE MANAGEMENT

VISTA LANDFILL, L.L.C
242 West Keene Road
Apopka, Florida 32703

SUBSTANTIAL PERMIT MODIFICATION APPLICATION FOR A CLASS III LANDFILL

VISTA LANDFILL, CLASS III
Apopka, Florida

Prepared by

Geosyntec
consultants

14055 Riveredge Drive, Suite 300
Tampa, Florida 33637

Project No. FL1229

July 2007

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FIGURES

APPENDICES

1. INTRODUCTION

1.1 Terms of Reference

Geosyntec Consultants (Geosyntec) has prepared this substantial permit modification application for the construction and operation of a liner and leachate collection system at Vista Landfill, Class III facility located in Apopka, Florida. The proposed leachate and liner collection system will augment and improve the environmental control systems at Vista Landfill, Class III facility which was previously permitted as an unlined facility. The Substantial Permit Modification Application is submitted to the Florida Department of Environmental Protection, Central District (FDEP) on behalf of Vista Landfill, L.L.C. (Vista Landfill), a wholly owned subsidiary of Waste Management Inc., of Florida (WMIF). The Substantial Permit Modification Application has been prepared to comply with the requirements of Chapter 62-701 of the Florida Administrative Code (FAC). FDEP Form 62-701.900(1), *Application for a Permit to Construct, Operate, Modify or Close a Solid Waste Management Facility* has been used to verify the completeness of this Substantial Permit Modification Application, and is included as Appendix A to this permit application.

Individual Environmental Resource Permits (ERPs) have been issued by FDEP for the phased construction and operation of the surface water management system at Vista Landfill, Class III. The most recent Individual ERP (Permit No. ERP48-0111044-005-EM), addressing storm water management details at Vista Landfill, Class III was issued by FDEP on 30 August 2005.

Implementation of a liner and leachate collection system at Vista Landfill, Class III requires modification of the cell floor grades and associated layout details, specifically those related to the leachate management system. The permitted surface water management system (i.e., storm water management ponds) will not be modified.

Permit Drawings titled “Permit Modification Drawings, Vista Class III Landfill” are an integral part of this Substantial Permit Modification Application. The Permit Drawings show plans, sections, and details of the proposed liner and leachate collection system and are included as Appendix P to this permit application. These Permit Drawings are intended to provide sufficient detail for permit approval. Additional detail will be provided in construction drawings for the Class III landfill prior to construction. The construction drawings will be issued later for the purpose of bidding and will be used for construction.

The Substantial Permit Modification Application was prepared under the responsible charge of Dr. Juan D. Quiroz, P.E., of Geosyntec. Professional engineer certification of this Substantial Permit Modification Application is provided on the cover sheet of this engineering report, on the FDEP Form 62-701.900(6), on the cover page of each calculation package, and on each sheet of the Permit Drawings.

1.2 Location

The Vista Landfill, Class III facility is located on 242 West Keene Road in Apopka, Florida. The facility is located within Section 28 of Township 21 South, Range 28 East in Orange County, Florida. The site location is shown in Figure 1. The main entrance of the facility is located at latitude 28° 38’ 24.5”, longitude 81° 30’ 41.7” on West Keene Road, Apopka, Florida. Coordinates of the main entrance are a Northing of 1,565,820 and an Easting of 492,067 in the Florida State Plane Coordinate System.

1.3 Site Description

The Vista Landfill, Class III facility is located on a 150-acre property at the southeast quadrant of the intersection between West Keene Road and McQueen Road in Apopka, Florida. The site was previously owned by Buttrey Development, L.L.C and was used as a borrow pit. Vista Landfill, Class III facility is currently permitted as an unlined disposal facility, and will consist of 12 cells (Cells 1 through 12) to be constructed in three phases (Phases 1 through 3) with a total footprint of approximately 102 acres. Sheet 4 of the Permit Drawings presents the proposed Site Development Plan for the Vista Landfill, Class III facility.

The existing Class III solid waste permit (Permit Nos. SC48-0165969-010 and SO48-0165969-011) to construct and operate an unlined landfill at the site was issued by FDEP in July 2006 based on permit renewal drawings titled “Engineering Drawings for Class III Landfill Permit Renewal, Keene Road South, Apopka, Florida,” dated January 2006. In addition, a minor permit modification (Permit No. SC48-0165969-012) for minor infrastructural layout changes to the landfill entrance area was issued by FDEP in February 2007 based on permit drawings titled “Minor Permit Modification Drawings, Keene Road South Class III Landfill,” dated November 2006. A change of permittee and name of facility was approved by FDEP on 26 March 2007; the new permittee name is Vista Landfill, L.L.C. (a wholly owned subsidiary of Waste Management, Inc. of Florida) and the new facility name is Vista Landfill, Class III.

1.4 Purpose and Scope

This Substantial Permit Modification Application has been prepared for the purpose of obtaining FDEP approval to construct and operate a liner and leachate collection system for a permitted Class III landfill facility. The Vista Landfill, Class III disposal facility footprint, proposed base grades, and leachate transmission system are shown in Figure 2.

This Substantial Permit Modification Application discusses the methodology and approach for the design, construction, operation, closure, and post-closure care of the facility. It is the intent of this permit application to address all applicable parts of the FDEP Form 62-701.900(1) in accordance with all applicable provisions of Chapter 62-701, FAC. This permit application provides the following:

- engineering report;
- technical specifications;
- construction quality assurance (CQA) plan;
- water quality plan;
- operation plan;
- financial assurance documentation; and
- landfill closure information.

Although a final cover system design is included in the Permit Drawings, this Substantial Permit Modification Application is for construction and operation of the proposed liner and lechate collection system, and not for closure. A separate permit application for closure will be submitted to FDEP in accordance with applicable sections of Chapter 62-701, FAC, prior to final closure construction activities being performed. As such, a closure plan and closure report required by Rule 62-701.600(3) and (4), FAC, are not submitted at this time. Details of the final cover system design including erosion control and conceptual storm-water management features are submitted with this permit application for the purpose of showing how the proposed liner and leachate collection system fit into the design for facility build-out. It should be noted that Vista Landfill intends to construct final cover in specific sections of the landfill as areas are brought to final waste elevations.

1.5 Organization of the Permit Application

To address the requirements of Chapter 62-701, FAC, this Substantial Permit Modification Application is organized as follows:

- *Section 1 – Introduction:* This section provides the terms of reference, site description and discusses the scope and organization of the permit application.
- *Section 2 – General Information:* This section addresses applicable parts of FDEP Form 62-701.900(1) not otherwise addressed in the narrative portion of this document or in the attached appendices.
- *Section 3 – Geotechnical Design:* This section reports the results of analyses for global foundation and liner-waste block slope stability, and subgrade settlement for the Class III landfill.
- *Section 4 – Leachate Management System:* This section describes the liner and leachate collection systems, and reports the results of design analyses for the Class III landfill.
- *Section 5 – Technical Specifications and Quality Assurance Plan:* This section describes the technical specifications and quality assurance plan with respect to the construction materials and construction practices established for the Class III landfill.
- *Section 6 – Water Quality Monitoring Plan and Operation Plan:* This section describes the water quality monitoring plan with respect to the ground water and leachate monitoring programs established for the site, and the operation plan with respect to daily operations, including contingency operations and a landfill gas monitoring plan for the Class III landfill.
- *Section 7 – Landfill Closure:* This section discusses the closure design, closure procedures, closure schedule, closure operations, long-term care, and financial responsibilities as a result of the proposed liner and leachate collection system.

The following appendices are attached to this Substantial Permit Modification Application:

- *Appendix A: FDEP Form 62-701.900(1)*
- *Appendix B: Site Geotechnical Model*
- *Appendix C: Foundation Stability Analysis*

- *Appendix D: Liner-Waste Block Slope Stability*
- *Appendix E: Subgrade Settlement Analyses*
- *Appendix F: Leachate Collection System Analysis*
- *Appendix G: Leachate Pumsp and Conveyance System Design*
- *Appendix H: Liner System Stability*
- *Appendix I: Technical Specifications*
- *Appendix J: Construction Quality Assurance (CQA) Plan*
- *Appendix K: Water Quality Monitoring Plan*
- *Appendix L: Operation Plan*
- *Appendix M: Final Cover System Performance Evaluation*
- *Appendix N: Final Cover Veneer Slope Stability Analysis*
- *Appendix O: Financial Assurance*
- *Appendix P: Permit Drawings*

2. GENERAL INFORMATION

2.1 Purpose

The purpose of this section is to present and address landfill permit general requirements of Chapter 62-701, FAC, not specifically addressed in other sections or appendices of this Substantial Permit Modification Application. This section is specifically organized to provide information keyed to applicable parts of FDEP Form 62-701.900(1) for the construction and operation of a liner and leachate collection system at Vista Landfill, Class III facility. Since this is a permit modification application, most of the responses required by the FDEP form are not applicable and have not substantially changed from those provided in the previously submitted 2006 Permit Renewal Application and Minor Permit Modification Application (these documents are on file with FDEP and, as such, are not reproduced in this Substantial Permit Modification Application). Therefore, those items for which responses are not applicable have been marked accordingly on the application form in Appendix A of this permit application.

2.2 Public Notification

After the Substantial Permit Modification Application is submitted, Vista Landfill will promptly publish a Notice of Application in a newspaper of general circulation in the area where the landfill facility is located. Proof of publication will be forwarded to FDEP Central District office. The publication of this notice will respond to Part E-13 of Form 62-701.900(1), Rule 62-701.320(8)(a), FAC.

Notice will also be sent to the Chair of the Board of Orange County Commissioners, the mayor of the City of Apopka, and the state Senator and Representative serving the area where the project is located. These notices will satisfy the requirements of Rule 62-701.320(8)(b), FAC.

2.3 Landfill Information

Pertinent landfill information as required by Rule 62-701.330(3)(e), F.A.C, is presented below. This information responds to Part F-5 of Form 62-701.900(1).

2.3.1 Anticipated Facility Life

Calculations were performed by Geosyntec to estimate the total airspace and facility life resulting from the proposed liner and leachate collection system configuration. The proposed modifications will yield approximately 10,300,000 cubic yards of landfill capacity. The currently permitted disposal rate for the Vista Landfill, Class III facility is 2,500 tons per day; however, actual operating rates may vary depending upon business conditions. For an assumed average disposal rate of 1,500 tons per day the estimated life of the facility is approximately 17.5 years. Therefore, final closure of the facility is anticipated to be initiated in 2025.

3. GEOTECHNICAL DESIGN

3.1 Overview

Information and analyses presented in this section are based on findings from both the hydrogeological and geotechnical investigations required by Rule 62-701.410, FAC. The hydrogeological and geotechnical investigation requirements, per Rules 62-701.410(1) and (2), FAC, for the Vista Landfill, Class III facility were documented in previous permit application reports prepared by Bishop and Buttrey, Inc. located in Orlando, Florida. These items have not changed and therefore been noted as "N/C" ("No Change") on the application form in Appendix A of this permit application.

The results of the geotechnical investigations were used to establish the Site Geotechnical Model as presented in Appendix B of this application. Once the generalized subsurface profile and corresponding material properties were defined, global foundation and liner-waste block stability analyses were performed for the geotechnical design of the Vista Landfill, Class III facility. In addition, landfill settlement analyses were performed to evaluate differential settlement effects on the proposed liner and leachate collection system.

The remainder of this section is organized as follows:

- Section 3.2, *Landfill Liner and Leachate Collection System Description*, presents a description of the landfill liner and leachate collection system configuration utilized in the stability analyses;
- Section 3.3, *Landfill Stability Analyses*, provides a summary of the global foundation and liner-waste block stability analyses; and
- Section 3.4, *Landfill Subgrade Settlement Analyses*, provides a summary of the settlement analyses performed to evaluate the effects of the waste grades loading on the proposed leachate collection system pipes.

3.2 Landfill Liner and Leachate Collection System Description

3.2.1 Landfill and Liner Base Grades

As previously mentioned (see Sheet 4 of the Permit Drawings), the permitted Vista Landfill, Class III facility will consist of 12 cells (Cells 1 through 12) to be constructed in three phases (Phases 1 through 3). The maximum elevation of the landfill is 156 ft, NGVD. The landfill side slopes and top slopes will be inclined at 3H:1V and 4 percent, respectively. In addition, the liner and leachate collection system side slopes from the anchor trench (located along the perimeter of the landfill footprint) to the cell floor base grades are inclined at 3H:1V. The base grades for the Vista Landfill, Class III facility are shown on Sheet 5 of the Permit Drawings. The base grades consist of: (i) a leachate collection corridor along the center of each landfill cell with a slope of 1.5% for Cells 3 and 4, and a slope of 1% for Cells 1 and 2 and Cells 5 through 12; and (ii) a cell floor with a cross slope of 2%.

As shown on Sheet 3 of the Permit Drawings, a composite seasonal high ground water table surface was developed to set the base grade elevations for the Vista Landfill, Class III facility. The composite seasonal high ground water table contours are based on hydrogeologic investigations conducted for previous permit applications for the landfill site, as performed by Devo Engineering of Orlando, Florida and noted on Sheet 3. The base grades were established such that they are above of the seasonal high ground water table contours. As such, within a given cell, the elevation and location of the low point (or sump) for the base grades vary depending on the maximum elevation of the composite seasonal high ground water table. It is noted that Vista Landfill will monitor ground water elevations for future phases of landfill development in an effort to refine the seasonal high ground water elevation contours and thereby potentially re-establish base grade elevations for future cells.

A brief description of the proposed liner and leachate collection system underlying the Vista Landfill, Class III facility is provided below, from top to bottom (see Figure 3).

- 2-ft thick liner protective layer;
- Double-sided drainage geocomposite layer;
- 60-mil thick textured high density polyethylene (HDPE) geomembrane; and
- 6-inch thick compacted subbase layer.

A more detailed description of the liner and leachate collection system components proposed for the Vista Landfill, Class III facility will be provided in Section 4 of this permit application.

3.3 Landfill Stability Analyses

3.3.1 General

As required by Rule 62-701.410(2) and (3), FAC, the results of the stability analyses during the active life and post-closure period of the landfill are presented below. The stability analyses include (i) global foundation slope stability of the landfill or bearing capacity of the foundation soils; and (ii) global liner-waste block stability.

3.3.2 Foundation Stability and Bearing Capacity

Foundation stability analyses were conducted as part of the design of the landfill liner system to demonstrate adequate stability. Since potential failure surfaces pass through the foundation soils, the resulting stability analyses thereby address both bearing capacity of the foundation soils as well as global landfill stability. A minimum regulatory factor of safety requirement of 1.5 was utilized for post-closure (long-term) foundation slope stability. A minimum factor of safety of 1.3 was utilized for construction (short-term) foundation slope stability. The detailed slope stability analyses are presented in the calculation package titled “Foundation Stability” included as Appendix C to this permit application.

Global foundation stability analyses were performed for two (long- and short-term) representative cross sections that represent critical landfill slope configurations with respect to the elevation of the maximum waste grades for the Vista Landfill, Class III facility. The results of the foundation slope stability analyses indicate that the subsurface soils beneath the proposed landfill footprint provide adequate foundation support. The calculated foundation slope stability factor of safety values for long-term and short-term foundation slope stability exceeded the minimum factor of safety requirements of 1.5 and 1.3, respectively.

3.3.3 Liner-Waste Block Stability

Liner-waste block slope stability analyses were conducted as part of the design of the Class III landfill to demonstrate adequate stability. Since the assumed failure surface is expected to occur along a defined path (i.e., within the liner system), sliding block failure analyses were used to calculate the minimum factor of safety for each critical cross-section. For post-closure (long-term) conditions, the minimum regulatory slope stability factor of safety requirement is 1.5. A minimum factor of safety of 1.3 was utilized for construction (short-term) slope stability. The detailed liner-waste block slope stability analyses are presented in the calculation package titled "Liner-Waste Block Slope Stability" included as Appendix D to this permit application.

Three critical cross-sections were analyzed. Two were analyzed for post-closure (long-term) conditions, and one for construction (short-term) conditions. For each landfill configuration analyzed, a parametric or sensitivity analysis was performed to establish the minimum liner system interface friction angle (δ) such that the calculated liner-waste block slope stability factor of safety is equal to or greater than the minimum requirement for slope stability as described above. The sensitivity analysis was performed by calculating the liner-waste block slope stability factor of safety for various values of interface friction angle.

The minimum interface friction angles required to achieve a factor of safety of 1.5 for long-term conditions and 1.3 for short-term conditions are presented in Appendix D. It is noted that these required interface friction angles are within the range of (or less than) typical soil-geosynthetic and geosynthetic-geosynthetic interface friction angles reported in the literature. Prior to construction, the interface friction angles between the actual soil and geosynthetic materials will be verified by performing site-specific interface shear strength testing.

3.4 Landfill Subgrade Settlement Analyses

3.4.1 General

Both total and differential subgrade (foundation) settlements have been evaluated in accordance with Rule 62-701.410(2), FAC. The results of the total settlement analyses are used to evaluate the impact of anticipated settlements on the performance of the leachate collection system and the proposed liner system to maintain positive drainage (i.e., drainage towards the leachate collection sump). The total subgrade settlements are calculated using conventional elastic deformation and consolidation theories for sandy and clayey soils, respectively. Detailed subgrade settlement calculations are presented in the calculation package titled "Subgrade Settlement Analyses" attached as Appendix E to this permit application.

The results of the subgrade settlement analyses indicate that the maximum total calculated settlement is approximately 14 inches or less, and corresponds to a point beneath the maximum waste height. In addition, under post-settlement conditions, the leachate collection system pipes will adequately convey leachate to the sumps and experience no grade reversals along the length of the pipes.

4. LEACHATE MANAGEMENT SYSTEM

4.1 Overview

4.1.1 Purpose and Scope

This section describes the leachate management system for the Vista Landfill, Class III facility. The section also describes the procedures for collection and conveyance of the leachate from the landfill as well as maintenance and operation of the leachate management facilities as required by Rules 62-701.400 and 62-701.500(8), FAC.

4.1.2 Organization

The remainder of this section is organized to:

- provide a description of the liner and leachate collection systems;
- summarize the leachate production rate analysis;
- discuss the design of the liner system; and
- discuss the design of the leachate collection system.

4.2 Description of the Liner and Leachate Collection Systems

4.2.1 General Description

The permitted footprint of the Vista Landfill, Class III facility occupies an area of approximately 102 acres and consists of 12 cells. As presented in Figure 3, the liner and leachate collection system consists of the following components, from top to bottom: (i) a 2-ft thick liner protective layer; (ii) a double-sided geocomposite drainage layer; (iii) a 60-mil thick textured HDPE geomembrane; and (iv) a 6-inch thick compacted subbase layer.

Sheet 6 of the Permit Drawings presents a layout of the leachate management system. Leachate within each landfill cell will be collected along the cell floor base grades and directed to a central leachate collection corridor containing a 6-inch diameter perforated HDPE leachate collection header pipe wrapped in gravel, which conveys the leachate to the sumps (low points) located along the outer perimeter of the cell floor base grades. From the sumps the leachate will be pumped via leachate sump riser pipes to a 6-inch diameter HDPE leachate transmission line running along the perimeter of the landfill footprint. It is noted that a dual containment leachate transimission line (with a 6-inch diameter HDPE primary pipe) will be utilized to convey leachate. The leachate transmission line will convey leachate to the auxiliary leachate storage tanks, which will act as a lift station. From the leachate storage tanks a leachate transmission line will then tie-in to a 16-inch diameter sanitary sewer forcemain owned by the City of Apopka. The tie-in is located at the northwest corner of the landfill site along West Keene Road. From the tie-in location, leachate will be conveyed approximately 2 miles northeast of the landfill site to the City of Apopka Waste Water Treatment Plant for final treatment and disposal.

As a precautionary measure, in the event that direct leachate conveyance from the landfill to the waste water treatment plant is not possible, auxiliary leachate storage tanks will be provided on-site by rigid above-ground leachate storage tanks. Two leachate storage tanks with a combined storage capacity of approximately 160,000 gallons will specified in accordance with Rule 62-701.400(6). Secondary containment for the storage tanks will be provided. The quantity of auxiliary leachate storage was estimated from the leachate generation analyses as presented in the calculation package titled “Leachate Collection System Analysis” included as Appendix F to this permit application.

4.2.2 Leachate Collection System Maintenance

The leachate collection system includes a 6-inch diameter perforated HDPE pipe along the leachate collection corridor of the cell floor of the landfill and 6-inch diameter solid HDPE cleanout pipes. In accordance with Rule 62.701.500(8), new leachate collection systems will be water pressure cleaned or inspected by video recording after construction but prior to initial acceptance of waste. The leachate collection pipes will be cleaned and maintained, as necessary, through the manifold cleanout pipes.

4.3 Leachate Production Rates

4.3.1 General

Leachate production rates for the proposed liner and leachate collection system were estimated using an analytical model. Modeling of leachate production was carried out using the Hydrologic Evaluation of Landfill Performance (HELP) model, Version 3.07, developed for the U.S. Environmental Protection Agency. The HELP model is a water balance calculator commonly used to estimate leachate production rates for landfills. A detailed description of the analyses and subsequent validations is included in the calculation package titled “Leachate Collection System Analysis,” attached as Appendix F to this permit application.

4.3.2 Estimated Leachate Generation Rates

The HELP model was used to calculate leachate production rates for three basic cases, each representative of a different stage in the development of the Class III landfill. A brief description of the results for the three basic cases is as follows:

- Case 1: initial stage with 10 feet of waste;
- Case 2: intermediate stage with 50 ft of waste; and
- Case 3: intermediate stage with (maximum) 90 ft of waste before construction of the final cover system.

The post-closure condition case was also analyzed, which represents the lowest potential for leachate generation. A summary of the results of the HELP model for these cases is included in the calculation package titled "Leachate Collection System Analysis" included in Appendix F of this permit application.

The results of the HELP model prediction were used to design and evaluate the performance of the various components of the leachate collection system, specifically: (i) the proposed leachate collection system lateral drainage layer (i.e., drainage geocomposite); (ii) the maximum hydraulic head of leachate above the geomembrane liner (i.e., head-on-liner); and (iii) the flow capacity of the piping system within landfill area. Detailed descriptions of these evaluations are also included in the calculation package titled "Leachate Collection System Analysis" included in Appendix F of this permit application.

The results of the HELP model prediction were also used to design the leachate pump and conveyance system, specifically: (i) the leachate sump pumps within each landfill cell; and (ii) the leachate transmission line along the perimeter of the landfill. Detailed design calculations are provided in the calculation package titled "Leachate Pumps and Conveyance System Design" included in Appendix G of this permit application.

4.4 Liner System Materials

4.4.2 Liner Protective Layer

The liner protective layer is a 2-ft thick layer of soil having the physical and performance properties as specified in Section 02240 of the "Technical Specifications" attached as Appendix I to this permit application.

4.4.3 Geocomposite Drainage Layer

The material specified for the geocomposite drainage layer consists of a polyethylene geonet core with a needle punched non-woven geotextile heat laminated to each side. The geonet core is to be manufactured of HDPE and is, therefore, chemically resistant to landfill leachate in accordance with Rule 62-701.400(4)(a)(1), FAC. The geocomposite drainage layer was designed to meet specific requirements for hydraulic transmissivity under a specific hydraulic gradient and compressive strength. A geocomposite will be used having physical and performance properties as specified in Section 02740 of the "Technical Specifications" attached as Appendix I to this permit application. The parameters specified are designed to limit the accumulated head on the liner to less than 12 inches.

Design calculations to support the selection of the specified geocomposite properties are presented in the calculation package entitled "Leachate Collection System Analysis" attached as Appendix F to this permit application. The specifications require appropriate laboratory testing to confirm that the selected geocomposite has the specified properties. This testing includes hydraulic transmissivity tests conducted at the design compressive stress and gradient and using the appropriate boundary conditions (i.e. the geocomposite is tested with the adjacent materials corresponding to those used in the field). Testing the geocomposite at the design compressive stress not only provides appropriate hydraulic properties, it also confirms that the geonet has sufficient compressive strength to prevent collapse [see Rule 62-701.400 (4)(a)(2), FAC].

4.4.4 Liner Geomembrane

The specified geomembrane liner is a 60-mil thick textured HDPE geomembrane as required by Rule 62-701.400(3)(b)(1), FAC. An HDPE geomembrane has the appropriate physical, chemical, and mechanical properties to be resistant to leachate in accordance with Rule 62-701.400(3)(a)(1), FAC. The 60-mil thick HDPE geomembrane provides a good balance between flexibility and seamability and is therefore appropriate from the viewpoint of installation considerations. The requirements for the geomembrane specified for this design are included as Section 02770 of the "Technical Specifications" attached as Appendix I to this permit application.

4.5 Leachate Collection Pipe Design

4.5.1 General

The function of the leachate collection pipes is to assist the conveyance of leachate collected across the cell floor base grades to the leachate collection sump. Collection pipes must have adequate flow capacity to convey the leachate and adequate structural resistance to withstand the applied loads. This section presents an evaluation of the flow capacity and structural stability of the proposed leachate collection pipes. A detailed discussion of the design calculations are provided in the calculation package titled "Leachate Collection System Analysis" included as Appendix F to this permit application.

4.5.2 Pipe Flow Capacity Design

The flow capacity of the proposed 6-in. diameter leachate collection system pipe in the landfill area was evaluated using the peak daily leachate generation rate from the Help model results presented in the calculation package titled "Leachate Collection System Analysis" included as Appendix F to this application. This corresponding flow rate represents the worst-case condition for precipitation and waste deposition. The calculations indicate that the proposed 6-in. diameter HDPE pipe will have sufficient flow capacity to handle the peak leachate flow.

4.5.3 Pipe Structural Stability

The leachate collection pipe must be able to withstand the loads applied to it. Four pipe failure mechanisms are generally considered when designing a buried plastic pipe:

- wall crushing;
- wall buckling;
- excessive ring deflection; and
- bending strain.

A detailed discussion of the failure mechanisms, loading conditions and design calculations are presented in the calculation package titled "Leachate Collection System Analysis" included as Appendix F to this application. Based on the results of these calculations, the existing pipes within the Class III landfill will meet or exceed the minimum acceptable values recommended by the pipe manufacturers.

4.6 Liner and Leachate Collection System Stability

4.6.1 General

This section presents the stability analysis of the liner system with respect to anchor trench pullout design and landfill side slope veneer stability. A detailed discussion of the design calculations are provided in the calculation packages titled "Anchor Trench Design Evaluation" and "Liner System Veneer Slope Stability" included in Appendix H of this permit application.

4.6.2 Anchor Trench Design Evaluation

The adequacy of the anchor trench design along the landfill footprint perimeter and adjacent to the landfill liner side slope was evaluated. The anchor trench will be constructed to hold in-place the geosynthetics utilized for the liner system as described above. A detailed discussion of the anchor trench pullout analysis is provided in the calculation package titled "Anchor Trench Design Evaluation" provided as Appendix H1 to this permit application.

For the typical anchor trench configuration presented in the Permit Drawings, the results of the anchor trench design evaluation indicate that the proposed depth of the anchor trench is adequate relative to pullout resistance.

4.6.3 Liner System Veneer Slope Stability

The veneer stability of the liner system was evaluated for the given landfill side slope configuration presented in the Permit Drawings. Since the assumed failure surface is expected to occur along a defined path along the critical interface of the liner system, sliding block failure analyses were used to calculate the minimum factor of safety. The veneer stability calculations address the construction (short-term) conditions of the liner system during waste filling activities. As such a minimum factor of safety requirement of 1.3 was utilized for short-term conditions. A detailed discussion of the veneer stability analysis is provided in the calculation package titled "Liner System Veneer Slope Stability" provided as Appendix H2 to this permit application.

For the side slope configuration analyzed, a parametric or sensitivity analysis was performed to establish the minimum liner system interface friction angle (δ) such that the calculated slope stability factor of safety is equal to or greater than the minimum requirement for slope stability as described above. The sensitivity analysis was performed by calculating the veneer slope stability factor of safety for various values of interface friction angle.

The minimum interface friction angles required to achieve a factor of safety of 1.3 for short-term conditions is presented in Appendix H2. It is noted that these required interface friction angles are within the range of (or less than) typical soil-geosynthetic and geosynthetic-geosynthetic interface friction angles reported in the literature. Prior to construction, the interface friction angles between the actual soil and geosynthetic materials will be verified by performing site-specific interface shear strength testing.

5. TECHNICAL SPECIFICATIONS AND CONSTRUCTION QUALITY ASSURANCE PLAN

5.1 Technical Specifications

It is assumed that the Vista Landfill, Class III facility will be constructed with quality materials. The technical specifications for all construction materials, especially the liner and leachate collection system geosynthetics are presented in Appendix I of this permit application.

5.2 Construction Quality Assurance Plan

It is assumed that the Vista Landfill, Class III facility will be constructed using very good construction practices and that a very good construction quality assurance (CQA) program will be implemented. The CQA Plan for all construction activities, especially liner and leachate collection system construction are presented in Appendix J of this permit application.

6. WATER QUALITY MONITORING PLAN AND OPERATION PLAN

6.1 Water Quality Monitoring Plan

The Water Quality Monitoring Plan has been updated to include leachate monitoring requirements in accordance with Rule 62-701.510(5) and (6). As such, the updated Water Quality Plan for the Vista Landfill, Class III facility describes the: (i) ground water monitoring program; (ii) leachate monitoring program; (iii) sampling and analytical methodologies; and (iv) reporting procedures.

The Water Quality Monitoring Plan addresses the requirements of Rule 62-701.510, FAC, and is included as Appendix K to this permit application.

6.2 Operation Plan

The Operation Plan provides a detailed description of the daily operations of the Vista Landfill, Class III facility, including contingency operations as required by Rules 62-701.320(7)(e)(1) and (2), and 62-701.500 of the FAC. A landfill gas monitoring plan, in accordance with Rule 62-701-530(2), is also included in the Operation Plan. The primary purpose of the Operation Plan is to describe the framework to operate and manage the Vista Landfill, Class III facility so that the landfill is operated and maintained in a condition that protects the public health and the environment. The Operation Plan is provided as Appendix L to this permit application.

7. LANDFILL CLOSURE

7.1 Introduction

This section describes the methodology and approach for closure of the Vista Landfill, Class III facility. The purpose of this section is to describe how the closure requirements of Chapter 62-701, FAC, will be met.

The remainder of this section is organized to:

- describe the closure schedule;
- describe the closure report;
- present the final cover system design;
- describe the closure operation;
- describe the closure procedures;
- present the long-term care procedures; and
- discuss financial responsibility.

7.2 Closure Schedule

7.2.1 Introduction

The footprint of the proposed Class III landfill is approximately 102 acres, with a top elevation at closure of approximately 156 ft, NGVD. Each portion of the proposed landfill will be closed as it reaches the maximum design height on a close-as-you-go basis. The estimated life of the Vista Landfill, Class III facility at build-out, is approximately 17.5 years, assuming an initial daily waste acceptance rate of 1,500 tons/day.

7.2.2 Notice to Appropriate Agencies

In accordance with Rule 62-701.600(2)(a), FAC, at least one year prior to the projected date when waste will no longer be accepted, Vista Landfill will provide to the FDEP a written notice with a schedule for cessation of waste acceptance and closure of the landfill facility. However, if unforeseen circumstances do not allow the one-year notification, notice will be provided as soon as the need to close the facility becomes apparent.

7.2.3 Notice to Users

In accordance with Rule 62-701.600(2)(b), F.A.C, at least 120 days prior to the date when wastes will no longer be accepted at the landfill, Vista Landfill will advise users of the intent to close the landfill facility by posting signs at the entrance of the facility giving the date of closing, the location of alternative disposal facilities, and the name of the person responsible for closing the landfill. These signs will be maintained throughout the closing period. However, if unforeseen circumstances do not allow the 120 day notice, notice will be provided as soon as the need to close the facility becomes apparent.

7.2.4 Notice to the Public

In accordance with Rule 62-701.600(2)(c), FAC, within 10 days prior to the date when wastes will no longer be accepted at the Vista Landfill, Class III facility, a notice of the intent to close the facility will be published in the legal advertising section of a newspaper of general circulation in Apopka, Florida. Proof of publication in the newspaper will then be provided to FDEP within seven days of the publication.

7.2.5 Placement of Final Cover

The partial closure approach for the landfill (i.e., close-as-you-go) is proposed to minimize leachate generation in the landfill. Partial closure will be accomplished concurrent with waste placement in the landfill. Areas that have reached final elevations will receive the final cover system within 180 days of reaching the final elevation, or a 12-inch thick intermediate cover will be placed over the area.

7.3 Closure Report

This Substantial Permit Modification Application requests authorization for construction and operation of a liner and leachate collection system at Vista Landfill, Class III facility. A closure report will be prepared at the time a closure permit from FDEP is requested. A closure permit application will be submitted to FDEP a minimum of 180 days prior to the initiation of closure construction.

7.4 Final Cover System Design

7.4.1 Introduction

The final cover system of the Vista Landfill, Class III facility will be constructed after final waste elevations are achieved (i.e., close-as-you-go). The landfill will have side slopes graded at 3H: to 1V, and top slopes graded at 4 percent to maximize runoff and minimize erosion. Drainage swales will be constructed on the final cover system to collect and divert surface runoff via downdrains to the storm water ponds and ditches at the toe of the landfill. This will help to minimize erosion at the surface of the final cover system. The maximum final elevation of the landfill before settlement will be 156 ft, NGVD. The plans and details for the proposed final cover system are provided in the Permit Drawings. The various components of the final cover system are discussed in the remainder of this section.

7.4.2 Final Cover System Components

The final cover system on the landfill top slopes graded at 4 percent is indicated on the Permit Drawings and consists of, from top to bottom:

- 0.5-ft thick vegetative layer;
- 1.5-ft thick cover protective layer;
- 40-mil thick smooth linear low density polyethylene (LLDPE) geomembrane; and
- 1-ft thick (minimum) intermediate cover layer over the compacted waste.

The final cover system on the 3H:1V side slopes of the landfill as indicated on the Permit Drawings consists of, from top to bottom:

- 0.5-ft thick vegetative layer;
- 1.5-ft thick cap protective layer;
- Double-sided geocomposite drainage layer;
- 40-mil thick textured LLDPE geomembrane; and
- 1-ft thick (minimum) intermediate cover layer over the compacted waste.

7.4.3 Final Cover System Materials

7.4.3.1 Vegetation

The surface of the final cover system will be vegetated either by seeding or sodding. The grass seed will have a high tolerance to drought. The sod will be of firm texture, having a compacted growth and good root development. The minimum requirements of the grass seed and sod are presented in the "Technical Specifications" attached as Appendix I to this permit application.

7.4.3.2 Vegetative and Cap Protective Layers

The upper 6 inches of the final cover system will consist of loosely placed vegetative layer and will be vegetated to minimize erosion. The cover protective layer below the vegetative layer will consist of 18 inches of on-site soil (or approved equal). The cover protective layer will be compacted in the upper 6 inches during construction to inhibit root penetration into the drainage layer underlying the cap protective layer on the side slopes.

7.4.3.3 Geocomposite Drainage Layer

A geocomposite drainage layer consisting of a geotextile filter, a geonet drainage layer, and a geotextile friction layer will be placed beneath the cove protective layer on the 3H:1V side slopes. The geotextile filter, the geonet drainage layer, and the geotextile friction layer are bonded together to form the double-sided geocomposite drainage layer. The function of the proposed geotextile filter is to prevent soil particles of the overlying cap protective layer from penetrating and clogging the underlying geonet drainage layer. The purpose of the drainage layer is to remove the storm water reaching the geonet and to minimize the potential of pore water pressure build-up in the overlying cap protective layer. The purpose of the geotextile friction layer is to increase the interface friction between the geomembrane and the geonet and thereby increase the stability of the final cover system.

7.4.3.4 Geomembrane

A geomembrane is proposed as a component of the final cover system to reduce infiltration of storm water through the final cover system into the waste. The specified geomembrane is a 40-mil thick textured LLDPE geomembrane. The texturing is necessary to increase the stability of the final cover system. Specified property values for the final cover geomembrane are provided in the "Technical Specifications" attached as Appendix I to this permit application. The specified geomembrane meets the requirements of Rule 62-701.600(5)(g)(4), FAC.

7.4.4 Final Cover System Construction Procedure

The surface of the intermediate cover will be graded and compacted to prepare a smooth base for the final cover geomembrane. The geomembrane and the geocomposite drainage layer will be terminated at the toe of the waste slope along the landfill perimeter. At the termination point, the final cover geomembrane will be welded to the geomembrane in the bottom liner system to seal the landfill. The geocomposite drainage layer will discharge into the drainage swales. The details of the final cover geomembrane and the geocomposite drainage layer termination are presented in the Permit Drawings.

7.4.5 Final Cover System Stability

A potential failure surface within the final cover system on the side slopes of the landfill was evaluated using the veneer slope stability analysis discussed in the calculation package titled "Final Cover Veneer Slope Stability Analysis" included in Appendix N of this permit application.

A parametric or sensitivity analysis was performed to establish the minimum interface friction angle (δ) such that the calculated veneer stability factor of safety is equal to or greater than 1.5, an acceptable requirement in accordance with the state-of-practice for landfill covers. The parametric analysis was performed by calculating the factor of safety for various values of interface friction angle.

The results of the parametric stability analyses indicate that the minimum interface friction angle required to achieve a factor of safety of 1.5 is typical of the soil-geosynthetic and geosynthetic-geosynthetic interface friction angles reported in the literature. Prior to construction of the final cover system, the interface friction angles between the actual soil and geosynthetic materials will be verified by performing site-specific interface shear strength testing.

7.4.6 Final Cover Drainage System Design

The final cover drainage system on the side slopes is designed to control seepage forces in the vegetative layer and is necessary for the stability of the vegetative layer. The final cover drainage system primarily consists of a geocomposite drainage layer placed on top of the geomembrane barrier layer of the final cover system. This geocomposite collects the water that percolates through the overlying vegetative layer and conveys the water to the drainage swales. Details of the final cover drainage system are presented in the Permit Drawings. Computations for maximum hydraulic head in the geocomposite drainage layer are discussed in the calculation package titled "Final Cover System Performance Evaluation" attached as Appendix M to this permit application.

7.4.7 Surface-Water Drainage System

The Permit Drawings present a conceptual storm water management plan for the landfill facility. The storm water drainage swales and drainage sub-basins were kept substantially consistent with the storm water management designs presented in the current Environmental Resource Permits (ERPs) for the site.

In general, drainage swales will be incorporated in the final cover system on the side slopes of the landfill as indicated in the Permit Drawings to collect and convey surface-water runoff at non-erosive velocities and limit the length of sheet flow on the final cover to minimize the formation of erosion rills and gullies in the vegetative layer. The downdrain pipes will convey storm water from the landfill top slopes to the storm water ponds and ditches at the toe of the landfill. The downdrain pipes will be 15-, 18-, or 24-in. diameter double wall corrugated HDPE pipes (smooth inside) buried within the 2 ft thick vegetative layer of the final cover.

7.4.8 Erosional Stability

A calculation to predict erosion soil loss in the cover is presented in the calculation package titled "Final Cover System Performance Evaluation" attached as Appendix M to this permit application. The results of this calculation indicate that the vegetation and cover swales adequately control erosion of the cover, meeting the requirements of Rule 62-701.430(2)(c)2 and Rule 62-701.600(5)(f), FAC.

7.5 Financial Responsibilities

Vista Landfill will execute a financial funding mechanism for the current estimate of closure and long-term care of the Vista Landfill, Class III facility prior to the acceptance of waste. To comply with the requirements of Rule 62-701.630(4), FAC, Vista Landfill will submit annual adjustments to the FDEP of the cost estimates for the closure and long-term care of the landfill. Vista Landfill will also revise the cost estimate for closure and long-term-care of the landfill. A Financial Assurance Cost Estimate Form, FDEP Form 62-701.900(28), is included with this permit application as Appendix O.

The Vista Landfill, Class III facility consists of 12 cells (Cells 1 through 12) which will be constructed in three phases (Phases 1 through 3) of landfill development. Each phase of landfill development has a design life of approximately 5 years. As such, the financial assurance cost estimate presented herein is for Phase 1 only which corresponds to the duration of the current permit issued by FDEP. Subsequent, revised financial assurance cost estimates for future phases of landfill development will be provided during each permit renewal process (i.e., every 5 years), or as necessary.

APPENDIX A

FDEP FORM 62-701.900(1)

APPENDIX B

SITE GEOTECHNICAL MODEL

APPENDIX C

FOUNDATION STABILITY ANALYSIS

APPENDIX D

LINER-WASTE BLOCK SLOPE STABILITY

APPENDIX E

SUBGRADE SETTLEMENT ANALYSES

APPENDIX F

LEACHATE COLLECTION SYSTEM ANALYSIS

APPENDIX G

LEACHATE PUMPS AND CONVEYANCE SYSTEM DESIGN

APPENDIX H

LINER SYSTEM STABILITY

APPENDIX H-1

ANCHOR TRENCH DESIGN EVALUATION

APPENDIX H-2

LINER SYSTEM VENEER SLOPE STABILITY

APPENDIX I

TECHNICAL SPECIFICATIONS

APPENDIX J

CONSTRUCTION QUALITY ASSURANCE PLAN

APPENDIX K

WATER QUALITY MONITORING PLAN

APPENDIX L

OPERATION PLAN

APPENDIX M

FINAL COVER SYSTEM

PERFORMANCE EVALUATION

APPENDIX N

FINAL COVER VENEER SLOPE

STABILITY ANALYSIS

APPENDIX O

FINANCIAL ASSURANCE

APPENDIX P

PERMIT DRAWINGS

THE PERMIT DRAWINGS ARE REPRODUCED IN D-SIZE (24-INCH BY 36-INCH) AND SUBMITTED UNDER SEPARATE COVER AS PART OF THE SUBSTANTIAL PERMIT MODIFICATION APPLICATION