Construction and Operation Permit Applications for

TOMOKA FARMS ROAD LANDFILL NORTH CELL VOLUSIA COUNTY, FLORIDA

August, 1992

VC 92067-6

BRILEY, WILD AND ASSOCIATES

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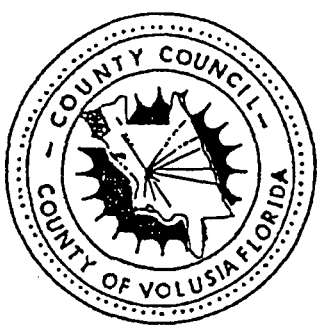

August, 1992

VC 92067-6

BWA
BRILEY, WILD
AND ASSOCIATES

LAP

County of Volusia

Department of Solid Waste Management
123 West Indiana Avenue • DeLand, Florida 32720-4617
Telephone (904) 736-5982, 257-6021, 423-3862

August 28, 1992

Mr. Richard Tedder, P.E.
Solid Waste Program Manager
Florida Department of Environmental Regulation
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803

RE: Tomoka Landfill Expansion
Permit Application
Construction Permit Fee

Dear Mr. Tedder:

Attached are six (6) sets of plans and executed permit applications for the Tomoka Landfill Expansion. Also enclosed is a check in the amount of $10,000 for the Construction Permit Fee.

If additional information or actions are required, please advise.

Yours truly,

James L. Griffin
Director of Solid Waste Management

JLG:lm

Attachments

c: Richard M. Kelton, Assistant County Manager for Development and Operations
Bill Gilley, Assistant Director of Solid Waste Management
Susan Gaze, Environmental Specialist, Solid Waste
Lee Powell, P.E., Briley, Wild and Associates, P. O. Box 607, Ormond Beach, Florida 32175

WP51\SW\GRIFFIN\TEDDER

(#1) LAP

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STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

CENTRAL FLORIDA DISTRICT
3319 MAGUIRE BOULEVARD
SUITE 232
ORLANDO, FLORIDA 32803-3767

APPLICATION FOR PERMIT TO CONSTRUCT [X] OPERATE [ ]

A SOLID WASTE RESOURCE RECOVERY AND MANAGEMENT FACILITY

GENERAL REQUIREMENTS

Solid Waste Resource Recovery and Management Facilities shall be permitted pursuant to Section 403.707, Florida Statutes, and in accordance with Florida Administrative Code Rule 17-7. A minimum of six copies of the application shall be submitted to the Department District Office having jurisdiction over the facility. Complete appropriate sections for the type of facility for which application is made. Entries should be typed or printed in ink. All blanks should be filled in or marked not applicable. The application shall include all information, drawings, and reports necessary to evaluate the facility. Information required to support the application is listed on the attached pages of this form.

Facility Type: Existing ___ Proposed X

Sanitary Landfill:
- X Class I,
- __ Class II,
- __ Class III: Trash/yard Trash
- __ Class III: Yard Trash Composting

Volume Reduction:
- __ Composting
- __ Shredder
- __ Incinerator/Trench Burner
- __ Resource Recovery:
  - __ Energy __ Materials

Sludge Landspreading:
- __ Grade I
- __ Grade II
- __ Grade III
- __ Septage/Food Service

FACILITY NAME: Tomoka Farms Road Landfill - North Cell / (DER ID Number)

FACILITY LOCATION (main entrance): 1990 Tomoka Farms Road

S 4 (section), T 16S (township), R 32E (range) / Latitude 29 ° 08 ' 10 " Longitude 81 ° 06 ' 06 "

Applicant Name (operating authority): Volusia County Dept of Solid Waste Management

Street Address & P. O. Box: 123 West Indiana Avenue DeLand (City) Volusia (County) 32720 (Zip)

Contact Person: James L. Griffin, Director (Name) 904/736-5982 (Phone Number)

Authorized Agent/Consultant: Briley, Wild & Associates (Name) 904/672-5660 (Phone Number)

Contact Person: Lee Powell (Name) 1040 N. U.S. 1 (Street) 607 (P. O. Box) 904/672-5660 (Phone Number)

Ormond Beach (City) Volusia (County) Florida (State) 32174 (Zip)

Landowner (if different than applicant): Volusia County

Address of Landowner: same (Street, P. O. Box) (City) (State) (Zip)

Cities, Towns and Areas to be Served: All of Volusia County

Current and Projected Population to Served: 370,712 (1990) 473,133 (2000)

Acres within Waste Site Boundary: 50 Acres within Property Boundary: 2629

Volume of Solid Waste to be received: 1000 ~~cubic yards/day~~ tons/day ~~gallons/day~~

Date Site Ready to Received Solid Waste: June 1993 Estimated Life of Facility 5 years

Estimated Cost of Construction, Total: $ 4 million Estimated cost of Closing: $ 1.1 million

Anticipated Construction Starting and Completion Dates
From: Jan. 1993 To: June 1993

REQUIRED ATTACHEMENTS FOR CONSTRUCTION/OPERATION PERMIT FOR A RESOURCE RECOVERY AND MANAGEMENT FACILITY

GENERAL

Permit application and supporting information shall include the following (17-7.030(2), F.A.C.):

	Completeness Check
1. A letter of transmittal to the Department; (17-7.030(3)(a) F.A.C.)	X
2. A table of contents listing the main sections of the application: (17-7.030(3)(b), F.A.C.)	X
3. The permit fee specified in Florida Aministrative Code Rule 17-4.05 in check or money order payable to the Department: (17-7.030(3)(c), F.A.C.)	X
4. Six copies, at minimum, of the completed application form, all supporting data, and reports; (17-7.030(2), F.A.C.)	X
5. Engineer seal; (17-7.030(2)(d), F.A.C.)	X
6. Engineer's letter of appointment if applicable; (17-7.030(3)(e), F.A.C)	N/A
7. Copy of any lease agreement, transfer of property agreement with right of entry for long-term care, or any other agreement between operator and property owner by which the closing and long-term care of the facility may be affected; (17-7.030(3)(h)	N/A
8. Proof of publication of notice of application for the proposed activity in a newspaper of general circulation; (17-7.03(4), F.A.C)	

SPECIFICATION ATTACHMENT ITEMS

The following information items must be included in the application or an explanation given if they are not applicable.

Construction Permits:

A. Landfills - Submit items 1, 2, 3, 4, 5, 6, 7, 8, 10.
B. Volume Reduction - Submit items 1, 2, 3, 4, 5, 6, 7, 9, 10.
C. Sludge Landspreading - Submit items 2, 3, 4, 5, 6, 8, 10.

Operation Permits:

A. Landfills - All the items above.
B. Volume Reduction - All the items above.
C. Sludge Landspreading - All the items above.

NOTE: For facilities that have been satisfactorily constructed in accordance with their construction permit the information required for A, B, and C type facilities does not have to be resubmitted for an operation permit if the information has not changed during the construction period.

1. A foundation analysis (17-7.050(2)(b), F.A.C.)	Appendix A
2. Evidence that the facility is in conformance with local zoning (17-7.050(2)(c)4, F.A.C)	Section 2
3. Facility Design (17-7.050(3), F.A.C.:	

NOTE: All maps, plan sheets, drawings, isometrics, cross-sections, or aerial photographs shall be legible; be signed and sealed by the registered professional engineer responsible for their preparation; be of appripriate scale to show clearly all required details; be numbered, referenced to narrative, titled, have a legend of symbols used, contain horizontal and vertical scales (where applicable), and specify drafting or origination dates; and use uniform scales as much as possible, contain a north arrow, and use NGVD for all elevations.

	Completeness Check
a. A map or aerial photograph of the area, no more than 1 year old, showing land use and zoning within 1 mile of the facility. (17-7.050(3)(a), F.A.C.)	Sheet 2
b. Plot Plan (17-7.050(3)(b), F.A.C.)	Section 3
NOTE: The plot plan on a scale not greater than 200 feet to the inch showing the following:	
(1) Dimensions and Legal Description of the site	Section 3
(2) Location and depth (NGVD) of soil borings	Appendix B, page 5
(3) Plan for trenching or disposal areas	Sheet 5
(4) Fencing or other measures to restrict access	Sheet 3
(5) Cross sections showing both original and propsed fill elevations	Sheet 7
(6) Location, depth, and construction details of monitoring wells	Appendix B, page 45
c. Topographic Maps (17-7.050(3)(c), F.A.C.)	—
NOTE: The topographic maps, which may be combined with the plot plan (item 4b), on a scale not greater than 200 feet to the inch showing the following:	
(1) Five foot contour intervals	Sheet 3
(2) Proposed fill areas	Sheet 3
(3) Borrow areas	Sheet 3
(4) Access roads	Sheet 3, 8
(5) Grades required for proper drainage	Sheet 6
(6) Typical cross sections of disposal site including lifts, borrow areas and drainage controls	Sheet 7
(7) Special drainage devices	Sheet 9
(8) Fencing	Sheet 3
(9) Equipment facilities	Sheet 3
(10) Other pertinent information based on intended use of facility	—
d. Report (17-7.050(3)(d), F.A.C.)	
(1) Estimated population and area served by the proposed site with basis for the estimate	Section 3d
(2) Anticipated type, annual quantity, and source of solid waste	Section 3d
(3) Anticipated life of site	Section 3d
(4) Source and characteristics of cover material	Appendix B
e. Ground Water Monitoring Plan (17-7.050(3)(e), F.A.C.)	
(1) Plan and hydrogeological survey, including foundation analysis, in accordance with 17-4.245(6), 17-7.030, and 17-7.050 F.A.C.; or	—
(2) A copy of a Department letter of approval of a previously submitted plan, if applicable.	N/A

	Completeness Check
4. Landfill Performance and Design Standards (17-7.050(4), F.A.C.)	
a. Liner performance (17-7.050(4)(a)(b), F.A.C.)	Section 4a
(1) Material type (soil, synthetic, other)	Section 4a
(2) Adequate base support	Section 4a
(3) Planned installation adequate to cover all surrounding earth	Appendix C
(4) Equivalency to design standards	Appendix D
b. Liner quality control plan (17-7.050(4)(c), F.A.C.)	Appendix D
(1) Specifications	Appendix D
(2) Construction/installation methods	Appendix D
(3) Sampling and testing	Appendix D
(4) Manufacturer's specifications and recommendations	Section 4c
c. Leachate control and removal system performance (17-7.050(4)(e), F.A.C.)	Section 4c
(1) Construction materials	Section 4c
(2) Strength and thickness	Section 4c
(3) Measures to prevent clogging	Section 4c
(4) Central collection point for treatment and disposal	Section 4c
(5) Leachate depth not to exceed one foot	Section 4c
(6) Equivalency to design standards	Section 4c
d. Surface water management system performance (17-7.050(4)(g), F.A.C)	Section 4d
(1) Prevention of surface water flow onto waste-filled areas	Section 4d
(2) Stormwater run-off controls; retention, detention ponds	Section 4d
(3) Equivalency to design standards	Section 4d
(4) Water management district approval	
e. Gas control system performance (17-7.050(4)(i), F.A.C.)	Section 4c
(1) Prevention of methane migration	Section 4c
(2) Prevention of damage to vegetation	Section 4c
(3) Prevention of objectionable odors off site	Section 4c
(4) Equivalency to design standards	Section 4c
5. Operations Plan (17-7.050(5)(b),(c)(d) & (e), F.A.C.)	Section 5
a. Designation of responsible person(s)	Section 5
b. Contingency operations	Section 5
c. Controlling the type of waste received at the site:	Section 5

	Completeness Check
d. Weighing or measuring incoming waste	Section 5
e. Vehicle traffic control and unloading	Section 5
f. Method and sequence of filling waste	Section 5
g. Waste compaction and application of cover	Section 5
h. Operations of gas, leachate, and storm water controls	Section 5
i. Ground water monitoring	Section 5
j. All weather access roads	Section 5
k. Effective barrier	Section 5
l. Signs indicating name of operating authority, traffic flow, hours of operation, and charges for disposal (if any)	Section 5
m. Dust control methods	Section 5
n. Litter control devices	Section 5
o. Fire protection and fire fighting facilities	Section 5
p. Attendant	Section 5
q. Communication facilities	Section 5
r. Adequate in-service and reserve equipment	Section 5
s. Safety devices on equipment to shield and protect operators	Section 5
6. Water Quality Standards (17-7.050(5)(g) & (h), F.A.C.)	Section 6
Describe how surface runoff and leachate will be handled to meet water quality standards of Florida Administrative Code Rules 17-3 and 17-4.	
7. Closure (17-7.070(2), F.A.C.)	
a. Closure plan (17-7.073, F.A.C.)	Section 7
(1) Design	Section 7a
(2) Final use	Section 7b
(3) Closure operations	Section 7c
(4) Post-closure (17-7.075, F.A.C.)	Section 7d
(5) Financial responsibility(17-7.071, F.A.C.)	Section 7e
b. Closure plan schedule (17-7.071, F.A.C)	Section 7f
8. Solid Waste Disposal Facility Data Form	X
9. Solid Waste-Volume Reduction and Resource Recovery Facility Data Form	N/A
10. Certification by Applicant and Engineer or Public Officer	X

SOLID WASTE DISPOSAL FACILITY DATA FORM

Date Form Completed: _____

Permit No.: _____ Issue Date: _____ Expires: _____

DER ACTION: ___ Add ___ Delete ___ Change ___ Deactivate Site

1. DER IDENTIFICATION NUMBER	2. SITE NAME Tomoka Farms Road Landfill - North Cell
3. COUNTY Volusia	4. FACILITY ADDRESS (Road, cross road, street) 1990 Tomoka Farms Road
4a. Facility Phone Number: 904/239-7766	4b. Facility Site Supervisor Mr. Gene Palmetier
5a. 29 ° 08 ' 10 " (Latitude) 81 ° 06 ' 06 " (Longitude)	5b. 16S (Township) 32E (Range) 4 (Section)
6. Operating Authority Name Volusia County Department of Solid Waste Management 7. Phone Number 904/736-5982	8. Operating Authority Address 123 W. Indiana Avenue DeLand, FL 32720
9. Owner of Site Property (if different from operator) Same 10. Phone Number of Owner Same	11. Address of Owner Same

12. Facility Type
- X Class I, Sanitary Landfill
- __ Class II, Sanitary Landfill
- __ Class III, Trash/Yard Trash
- __ Class III Yard trash comp.

Sludge Landspreading:
- __ Grade I
- __ Grade II
- __ Grade III
- __ Septage

Type
- __ Other Facility

13. Month Year Begun Not yet started	14. Disposal Area 30 Acres	15. Population Served 370,712
16. Expected Useful Lifetime 5 Years	17. Weighing Scales X Yes __ No	18. Security to Prevent Unauthorized Used X Yes __ No
19. Depth of Water Table 26.0m Ft. (NGVD)	20. Quantity of Waste/Day 1,000 tons or Yd^3	21. Charge $ 25.00 ~~yd~~/ton

22. Surrounding Land Use Zoning
__ Residential __ None X Agricultural __ Commercial __ Industrial __ Other

23. Types of Waste Received

X Residential	X Agricultural	__ Yard Trash/Trash	__ Other: _____
X Commercial	__ Septic Tank	__ Sewage Sludge	
__ Incinerator Residue	X Industrial	__ Industrial Sludge	
__ Pathological/Infectious	__ Water/Air Treat Sludge	__ Hospital	

24. Number of Monitoring Wells 14, existing, 16 proposed 25. Number of Surface Monitoring Points 5

26. Gas Control / Recovery X Yes __ No / __ Yes X No	27. Salvaging Permitted __ Yes X No	28. Attendant X Yes __ No

29. Leachate Control Method - Liner Type: __ Natural __ Emplaced Clay X Synthetic __ None __ Other_____		
Collection Mehtod: __ Well Point __ Perimeter Ditch __ None X Under Site Drains __ Other_____		
Treatment Method: X Oxidation X Recirculated __ Chemical __ Advanced __ None __ Other_____		
30. Leachate Discharge __ Yes X No		Class of Receiving Water N/A
31. Site Located in __ Floodplain __ Wetlands X Other: Flatwoods - Uplands		
32. Surface Runoff Collected X Yes __ No	Type of Runoff Treatment Retention	Class of Receiving Waters III
33. Property Recoreded as a Solid waste Disposal Site in County Land Records X Yes __ No		
34. Days of Operation 7	Days of Cover 7	Hours of Operation See Below
35. Name, Title and Phone Number of Person Completing Form Lee A. Powell, P.E. 904/672-5660		

NOTE: All blanks must be filled or marked as not applicable.

Hours of Operation

Mon - Fri 7:00 a.m. - 5:30 p.m.
Sat - Sun 8:00 a.m. - 2:30 p.m.

SOLID WASTE VOLUME REDUCTION AND RESOURCE RECOVERY FACILITY DATA FORM

Permit No.: _____ Issue Date: _____ Expires: _____

Facility No. (DER Identification): _____

DER ACTION: ☐ Add ☐ Delete ☐ Change ☐ Deactivate Site ☐ Other

1. County	2. Site Name
3. Date Form Completed	4. Facility Address
4a. Facility Phone No.	4b. Facility Site Supervisor
5a. ° ' " ° ' " Latitude Longitude	5b. Township Range Section
6. Operating Authority Name	8. Operating Authority Address
7. Phone Number	
9. Owner of Site Property (if different from Operator)	11. Address of Owner
10. Phone Number of Owner	

12. Facility Type (check one or more)
☐ Incinerator Only ☐ Biomass Gas Production ☐ Pyrolysis ☐ Other:
☐ Sludge Concentration ☐ Baler (compactor) ☐ Composting Plant
☐ Transfer Station ☐ Waterwall Incinerator ☐ Shredder (pulverizer)

13. Month/Year Begun	14. Disposal Area Acres	15. Population Served
16. Expected Useful Lifetime Years	17. Weighing Scales ☐ Yes ☐ No	18. Waste Processed Per Operational Day tons/gal/yd
19. Charge/_____	20. Days Operated S M T W T F S	21. Hours/Day Operated

22. Maximum Processing Rate _____ tons/day

23. Material Recovered, Tons/Week
_____ Paper _____ Glass Other:
_____ Ferrous Metals _____ Non-Ferrous Metals
_____ Aluminum _____ Plastics

24. Energy Recovery, in units shown
_____ High Pressure Steam-lb/hr _____ Chilled Water-gal/hr _____ Gas-ft³/hr
_____ Low Pressure Steam-lb/hr _____ Oil-gal/hr _____ Gas-BTU/hr
_____ Electricity-kw/hr _____ Oil-BTU/hr Other:

25. Process Water Recycled ☐ Yes ☐ No	Treatment Method Used
Discharged to: ☐ Surface Waters ☐ Underground	Class Receiving Water
26. Final Residue is % of waste intake	Residue is disposed of at (Site Name)

27. Supplementary Fuel Used

Type	Quantity Used/Hour

28. Estimated Operating Costs Material – Energy Revenue $	Total Cost/Ton $	Net Cost/Ton $

29. Number of Staff	30. State Pollution Control Bond Financing Amount $	31. Estimated Amount of Tax Exemptions that will be Requested $

32. Name and Title of Person Completing Form

Note: All blanks must be filled or marked as not applicable.

CERTIFICATION BY APPLICANT AND ENGINEER OR PUBLIC OFFICER

A. Applicant

The undersigned applicant or authorized representative of Volusia County is aware that statements made in this form and attached information are an application for a Construction and Operation Permit from the Florida Department of Environmental Regulation and certifies that the information in this application is true, correct and complete to the best of his 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

Name and Title

Date:

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

B. Professional Engineer Registered in Florida or Public Officer as Required in Section 403.707 and 403.7075, Florida Statutes

This is to certify that the engineering features of this resource reocvery and management facility have been designed/examined by me and found to conform to engineering principals applicable to such facilities. In my professional judgement, 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

Lee A. Powell, P.E.
Name and title (please type)

35992
Florida Registration Number
(please affix seal)

1040 N. U.S. Highway 1
Mailing Address

Ormond Beach, FL 32174
City, State, Zip Code

904/672-5660
Telephone Number

Date:

Construction Cost Estimate:

Permit Number: Issue Date:

Review Date: Expiration Date:

1.0 FOUNDATION ANALYSIS

A foundation analysis was performed by Bechtol Engineering and Testing and is included in Appendix A.

2.0 ZONING

Existing zoning within a one mile radius of the proposed landfill is shown on Sheet 2 of the drawings. The County owned site and most of the adjacent area is zoned A-2 Agricultural. Volusia County does not have a separate zoning for landfill activity, but all landfill sites must be approved by the County Council. The Council approved the Tomoka Farms Road site for landfill activities in 1969. There is no incompatibility between agricultural activities and landfill activities.

3.0 FACILITY DESIGN

a. Aerial Photo

Sheet 2 of the drawings included in this application is an aerial photo taken in March, 1992. The aerial photo shows land use and zoning within one mile of the proposed facility, as well as property boundary. Following is a legal description of the site:

LEGAL DESCRIPTION

N 1/2 of Section 10; and all of the NE 1/4 of Section 9; and that part of the NW 1/4 of said Section 9, lying East of the Florida Power and Light Company power line right of way; and that part of the S 1/2 of Section 4, lying East of the said Florida Power and Light Company power line right of way; and that part of Section 3, lying West of a straight line drawn between the Southeast corner of the SW 1/4 of said Section 3 (being also the Northwest corner of the NE 1/4 of Section 10) and running Northwesterly to the point of intersection of the West line of said Section 3 with the Southeasterly right of way line of Interstate Highway #4 (S.R. 400); and the South 200 feet of the NW 1/4 of Section 11, lying West of the centerline of Tomoka Farms Road as now used.

All the foregoing being in Township 16 South, Range 32 East, Volusia County, Florida, and being more particularly described as:

Commencing at the concrete monument (Moody) marking the Northeast corner of Section 4, Township 16 South, Range 32 East, thence S 00°51'40" E, along the East line of said Section 4, a distance of 1076.35 feet to a point on the Southeasterly right of way line of Interstate Highway #4 (S.R. #400), said point being POINT OF BEGINNING; run thence continuing S 00°51'40" E, along said East line of Section 4, a distance of 1631.43 feet to the Northeast corner of the S 1/2 of said Section 4; thence S 88°52'54" W, along the North line of said S 1/2 of Section 4, a distance of 3190.12 feet to its intersection with the East right of way line of a 305 foot wide Florida Power and Light Company Easement (Official Records Book 678, page 605 also see Official Records Book 308, page 322); thence S 00°34'18" E, along said East right of way line of the Florida Power and Light Company Easement, a distance of 2671.94 feet to a point in the South line of said Section 4 that is S 89°17'43" W, a distance of 548.16 feet, from the concrete monument (Moody) marking the Southeast corner of the SW 1/4 of said Section 4; thence continuing S 00°34'18" E, along the said East line of the power line easement, a distance of 1111.44 feet to an intersection with the Easterly right of way line of a 170 foot wide Florida Power and Light Company Easement (Official Records Book 756, page 67); thence S 29°15'33" E, along the Easterly line of said Florida Power and Light Company Easement, a distance of 1160.31 feet, to its intersection with the West line of the NE 1/4 of Section 9, Township 16 South, Range 32 East; thence S 00°48'32" E, along said West line of the NE 1/4 of Section 9, a distance of 581.07 feet to a one inch iron pipe marking the center of said Section 9, being also the Southwest corner of the NE 1/4 of said Section 9; thence N 89°56'54" E, along the South line of said NE 1/4 of Section 9, a distance of 2633.40 feet to a concrete monument (Moody) marking the Southeast corner of said NE 1/4 of Section 9; thence N 86°26'59" E, along the South line of the N 1/2 of Section 10, Township 16 South, Range 32 East, a distance of 2659.75 feet to a half inch iron pipe; thence N 86°26'23" E, continuing along the South line of the N 1/2 of said Section 10, a distance of 2639.74 feet to the Southeast corner thereof; thence N 89°27'20" E, along the South line of the NW 1/4 of Section 11, Township 16 South, Range 32 East, a distance of 1135.08 feet to an intersection with the centerline of Tomoka Farms Road, as now laid out and used; thence N 17°23'11" W, along said centerline of Tomoka Farms Road, a distance of 208.96 feet to an intersection with a line that is 200 feet Northerly of, and parallel with, the said South line of the NW 1/4 of Section 11; thence S 89°27'20" W, along said last described line, a distance of 1074.06 feet to an intersection with the East line of the NE 1/4 of Section 10, Township 16 South, Range 32 East; thence N 00°24'26" W, along the said East line of the NE 1/4 of Section 10, a distance of 2440.79 feet to a two and one-half inch iron pipe marking the Northeast corner thereof; thence S 87°24'59" W, along the North line of said NE 1/4 of Section 10, a distance of 2643.84 feet to a six inch cypress post marking the Northwest corner thereof; thence N 32°43'54" W, a distance of 5013.52 feet, more or less, (through the W 1/2 of Section 3, Township 16 South, Range 32 East) to the POINT OF BEGINNING.

PARCEL "A"

A PORTION OF SECTION 11, TOWNSHIP 16 SOUTH, RANGE 32 EAST, VOLUSIA COUNTY, FLORIDA, DESCRIBED AS FOLLOWS: FROM THE NORTHWEST CORNER OF SAID SECTION 11, AS THE POINT OF BEGINNING, RUN NORTH 88 DEGREES 46 MINUTES 25 SECONDS EAST, ALONG THE NORTH LINE OF SAID SECTION 11, A DISTANCE OF 298.89 FEET TO THE MAINTAINED WESTERLY RIGHT-OF-WAY LINE OF TOMOKA FARMS ROAD; THENCE ALONG SAID MAINTAINED RIGHT-OF-WAY LINE, RUN SOUTH 16 DEGREES 22 MINUTES 16 SECONDS EAST, A DISTANCE OF 190.06 FEET TO THE POINT OF CURVATURE OF A CURVE, CONCAVE NORTHEAST, HAVING A RADIUS OF 33320.93 FEET, A CENTRAL ANGLE OF 01 DEGREES 44 MINUTES 50 SECONDS, AND A CHORD BEARING OF SOUTH 17 DEGREES 14 MINUTES 41 SECONDS EAST; THENCE RUN SOUTHERLY ALONG THE ARC OF SAID CURVE, A DISTANCE OF 1016.06 FEET; THENCE SOUTH 18 DEGREES 07 MINUTES 06 SECONDS EAST, A DISTANCE OF 1335.88 FEET; THENCE, DEPARTING SAID MAINTAINED RIGHT-OF-WAY LINE, RUN SOUTH 88 DEGREES 35 MINUTES 09 SECONDS WEST, A DISTANCE OF 1021.53 FEET TO THE WEST LINE OF SAID SECTION 11, THENCE NORTH 01 DEGREES 07 MINUTES 19 SECONDS WEST, ALONG THE WEST LINE OF SAID SECTION 11, A DISTANCE OF 2441.63 FEET TO THE POINT OF BEGINNING.

CONTAINING 36.57 ACRES.

SUBJECT TO: A 30 FOOT WIDE EASEMENT FOR NATURAL GAS TRANSMISSION LINE PER OFFICIAL RECORDS BOOK 669, PAGE 2, OF THE PUBLIC RECORDS OF VOLUSIA COUNTY, FLORIDA.

A PORTION OF SECTIONS 4, 5, 8, 9, 10, 11, 15 AND 16, TOWNSHIP 16 SOUTH, RANGE 32 EAST, VOLUSIA COUNTY, FLORIDA, DESCRIBED AS FOLLOWS; FROM THE NORTHWEST CORNER OF SAID SECTION 11, RUN NORTH 88 DEGREES 46 MINUTES 25 SECONDS EAST, ALONG THE NORTH LINE OF SAID SECTION 11, A DISTANCE OF 298.89 FEET TO THE MAINTAINED WESTERLY RIGHT-OF-WAY LINE OF TOMOKA FARMS ROAD; THENCE ALONG SAID MAINTAINED RIGHT-OF-WAY LINE, RUN SOUTH 16 DEGREES 22 MINUTES 16 SECONDS EAST, A DISTANCE OF 190.06 FEET TO THE POINT OF CURVATURE OF A CURVE, CONCAVE NORTHEAST, HAVING A RADIUS OF 33320.93 FEET, A CENTRAL ANGLE OF 01 DEGREES 44 MINUTES 50 SECONDS, AND A CHORD BEARING OF SOUTH 17 DEGREES 14 MINUTES 41 SECONDS EAST; THENCE RUN SOUTHERLY ALONG THE ARC OF SAID CURVE, A DISTANCE OF 1016.06 FEET; THENCE SOUTH 18 DEGREES 07 MINUTES 06 SECONDS EAST, A DISTANCE OF 1544.70 FEET TO THE POINT OF BEGINNING; THENCE CONTINUE ALONG SAID MAINTAINED RIGHT-OF-WAY LINE, SOUTH 18 DEGREES 07 MINUTES 06 SECONDS EAST, A DISTANCE OF 1272.87 FEET TO THE NORTHERLY RIGHT-OF-WAY LINE OF SHUNZ ROAD, A 200.00 FOOT RIGHT-OF-WAY, AS DESCRIBED IN OFFICAL RECORD BOOK 2806, PAGE 1370, OF THE PUBLIC RECORDS OF VOLUSIA COUNTY, FLORIDA; THENCE RUN ALONG SAID NORTHERLY RIGHT-OF-WAY LINE THE FOLLOWING COURSES AND DISTANCES; SOUTH 88 DEGREES 45 MINUTES 25 SECONDS WEST, A DISTANCE OF 1625.50 FEET TO THE POINT OF CURVATURE OF A CURVE, CONCAVE SOUTHEAST, HAVING A RADIUS OF 2100.00 FEET, A CENTRAL ANGLE OF 47 DEGREES 55 MINUTES 13 SECONDS, AND A CHORD BEARING OF SOUTH 64 DEGREES 47 MINUTES 48.5 SECONDS WEST; THENCE RUN WESTERLY ALONG THE ARC OF SAID CURVE, A DISTANCE OF 1756.36 FEET; THENCE SOUTH 40 DEGREES 50 MINUTES 13 SECONDS WEST, A DISTANCE OF 4479.76 FEET TO THE POINT OF CURVATURE OF A CURVE, CONCAVE NORTHWEST, HAVING A RADIUS OF 1900.00 FEET, A CENTRAL ANGLE OF 36 DEGREES 08 MINUTES 05 SECONDS, AND A CHORD BEARING OF SOUTH 58 DEGREES 54 MINUTES 14.5 SECONDS WEST; THENCE RUN WESTERLY ALONG THE ARC OF SAID CURVE, A DISTANCE OF 1198.27 FEET; THENCE SOUTH 76 DEGREES 58 MINUTES 17 SECONDS WEST, A DISTANCE OF 1787.41 FEET TO THE POINT OF CURVATURE OF A CURVE, CONCAVE NORTHWEST, HAVING A RADIUS OF 2100.00 FEET, A CENTRAL ANGLE OF 15 DEGREES 53 MINUTES 15 SECONDS, AND A CHORD BEARING OF SOUTH 84 DEGREES 54 MINUTES 54.5 SECONDS WEST; THENCE RUN WESTERLY ALONG THE ARC OF SAID CURVE, A DISTANCE OF 582.31 FEET; THENCE NORTH 87 DEGREES 08 MINUTES 28 SECONDS WEST, A DISTANCE OF 2475.99 FEET TO THE WEST LINE OF SAID SECTION 16; THENCE NORTH 01 DEGREES 54 MINUTES 16 SECONDS WEST, ALONG THE WEST LINE OF SAID SECTION 16, A DISTANCE OF 3118.32 FEET TO THE NORTHWEST CORNER THEREOF; THENCE SOUTH 88 DEGREES 42 MINUTES 23 SECONDS WEST, ALONG THE SOUTH LINE OF SAID SECTION 8, A DISTANCE OF 2630.86 FEET; THENCE NORTH 01 DEGREES 15 MINUTES 35 SECONDS WEST, ALONG THE WEST LINE OF THE EAST 1/2 OF SAID SECTION 8, A DISTANCE OF 5336.69 FEET; THENCE NORTH 02 DEGREES 20 MINUTES 05 SECONDS WEST ALONG THE WEST LINE OF THE EAST 1/2 OF SAID SECTION 5, A DISTANCE OF 285.75 FEET TO THE SOUTHERLY RIGHT-OF-WAY LINE OF INTERSTATE NO. 4 (S.R. NO. 400), AND A POINT ON THE ARC OF A CURVE, CONCAVE SOUTHEAST, HAVING A RADIUS OF 8970.88 FEET (8952.75 D.O.T.), A CENTRAL ANGLE OF 15 DEGREES 51 MINUTES

29 SECONDS, AND A CHORD BEARING OF NORTH 55 DEGREES 37 MINUTES 22.5 SECONDS EAST; THENCE RUN NORTHERLY ALONG THE ARC OF SAID CURVE, AND SAID RIGHT-OF-WAY LINE, A DISTANCE OF 2482.90 FEET; THENCE NORTH 63 DEGREES 33 MINUTES 07 SECONDS EAST, ALONG SAID RIGHT-OF-WAY LINE, A DISTANCE OF 2513.95 FEET TO THE NORTH LINE OF THE SOUTH 1/2 OF SAID SECTION 4; THENCE NORTH 88 DEGREES 04 MINUTES 28 SECONDS EAST, ALONG THE NORTH LINE OF THE SOUTH 1/2 OF SAID SECTION 4, A DISTANCE OF 390.88 FEET TO THE EASTERLY EASEMENT LINE OF A 305.00 FEET WIDE FLORIDA POWER & LIGHT COMPANY EASEMENT AS DESCRIBED IN OFFICIAL RECORD BOOK 678, PAGE 605, OF THE PUBLIC RECORDS OF VOLUSIA COUNTY, FLORIDA; THENCE SOUTH 01 DEGREES 18 MINUTES 08 SECONDS EAST, ALONG SAID EASEMENT LINE, A DISTANCE OF 5783.65 FEET; THENCE SOUTH 30 DEGREES 00 MINUTES 42 SECONDS EAST, ALONG THE EASTERLY EASEMENT LINE OF A 170.00 FOOT WIDE FLORIDA POWER & LIGHT COMPANY EASEMENT AS DESCRIBED IN OFFICIAL RECORD BOOK 756, PAGE 67, OF THE PUBLIC RECORDS OF VOLUSIA COUNTY, FLORIDA, A DISTANCE OF 1160.33 FEET TO THE EAST LINE OF THE NORTHWEST 1/4 OF SAID SECTION 9; THENCE SOUTH 01 DEGREES 35 MINUTES 31 SECONDS EAST, ALONG THE EAST LINE OF THE NORTHWEST 1/4 OF SAID SECTION 9, A DISTANCE OF 560.82 FEET TO THE CENTER OF SAID SECTION 9; THENCE NORTH 89 DEGREES 12 MINUTES 07 SECONDS EAST, ALONG THE NORTH LINE OF THE SOUTHEAST 1/4 OF SAID SECTION 9, A DISTANCE OF 2633.10 FEET TO THE EAST 1/4 CORNER OF SAID SECTION 9; THENCE NORTH 85 DEGREES 42 MINUTES 46 SECONDS EAST, ALONG THE NORTH LINE OF THE SOUTH 1/2 OF SAID SECTION 10, A DISTANCE OF 2658.95 FEET; THENCE NORTH 85 DEGREES 42 MINUTES 28 SECONDS EAST, ALONG THE NORTH LINE OF THE SOUTH 1/2 OF SAID SECTION 10, A DISTANCE OF 2640.42 FEET TO THE EAST 1/4 CORNER OF SAID SECTION 10; THENCE NORTH 88 DEGREES 35 MINUTES 09 SECONDS EAST, ALONG THE NORTH LINE OF THE SOUTH 1/2 OF SAID SECTION 11, A DISTANCE OF 1082.57 FEET TO THE POINT OF BEGINNING.

CONTAINING 1746.57 ACRES.

SUBJECT TO: FLORIDA POWER AND LIGHT COMPANY EASEMENTS AS FOLLOWS: A 305 FOOT EASEMENT PER OFFICIAL RECORDS BOOK 678, PAGE 605; A 170 FOOT EASEMENT PER OFFICIAL RECORDS BOOK 678, PAGE 605, AND OFFICIAL RECORDS BOOK 238, PAGE 539; A 170 FOOT EASEMENT PER OFFICIAL RECORDS BOOK 756, PAGE 67, AND A 170 FOOT EASEMENT PER OFFICIAL RECORDS BOOK 1664, PAGE 448, ALL OF THE PUBLIC RECORDS OF VOLUSIA COUNTY, FLORIDA.

b. Plot Plan

The drawings attached to this application show existing and proposed elevations and features, including fencing, monitor well locations, borrow areas, access roads, equipment maintenance facilities, and other pertinent information based on the intended use of the facility.

c. Topographic Map

The drawings attached to this application show existing and proposed elevations and features, including fencing, monitor well locations, borrow areas, access roads, equipment maintenance facilities, and other pertinent information based on the intended use of the facility.

d. Report

(1) Estimated Population to be Served:

The proposed landfill will be the only Class 1 landfill serving Volusia County. For design purposes, the landfill's service area was assumed to be all of Volusia County. Out-of-county wastes are accepted at the landfill, but we have not attempted to assign an equivalent population to represent these waste sources.

The 1990 census reported the population of Volusia County to be 370,712. According to the University of Florida Population Program, Volusia County's population is anticipated to grow as follows:

1991	376,695
1995	425,887
2000	473,133
2005	518,326
2010	561,121

(2) Anticipated Waste Loading:

The quantity of waste to be disposed of in the proposed landfill is dependent on the: 1) population and character of the service area; 2) solid waste management practices; and 3) economic conditions.

The service area for the proposed landfill is Volusia County. The projected population growth for Volusia County was discussed previously.

In recent years there have been several significant changes in Volusia County's solid waste management, including initiation of curbside recycling and separation of yard debris from household waste. These changes have reduced the quantity of waste that would otherwise be disposed of in the Class 1 landfill.

Economic conditions also effect the total quantity of solid waste that is generated.

Based on County records, we have estimated the amount of waste disposed of in the existing Class 1 landfill over a recent ten-month period to be as follows:

Month	**Tons/Month**
May 1991	28,709.16
June 1991	26,774.05
July 1991	29,829.47
Aug. 1991	27,438.71
Sept. 1991	23,767.18
Oct. 1991	25,877.73
Nov. 1991	22,126.59
Dec. 1991	23,193.06
Jan. 1992	23,181.69
Feb. 1992	23,013.10
Total	**253,910.74**
Average	**25,391.00 tons/month**

Using the University of Florida population projections previously reported and the above solid waste quantities, we have estimated the total solid waste loading to be as follows:

Year	Population	Solid Waste (tons)
1991	376,695	304,692
1992	388,993	314,639
1993	401,291	324,587
1994	413,589	334,534
1995	425,887	344,481
1996	435,336	354,124
1997	444,785	359,767
1998	454,235	367,411
1999	463,683	375,053
2000	473,133	382,696

An increase in the percent of solid waste that is recycled will result in lower quantities of solid waste to be disposed of in the proposed landfill. A reduction in the per capita solid waste generation rate or an economic downturn would also lower the actual quantities of solid waste generated.

(3) Anticipated Life of Site:

The proposed landfill will have a total volume of approximately 2.26 million cubic yards. Assuming 20 percent of this is used for daily and final cover, 1.8 million cubic yards would be available for solid waste. Assuming an in place density of 1,000 lb. per cubic yard and an average loading of 334,000 tons per year results in an estimate of the life of the proposed lined cell of 2.7 years.

The above landfill volume is based on the County constructing a pyramid as shown on the drawings. As adjacent areas are permitted and developed, the volume of solid waste that would be placed over the liner and facilities constructed under this permit will increase, and we estimate that the actual site life will be in excess of 5 years.

(4) Source and Characteristics of Cover Material:

Soil used for daily, intermediate, and final cover is taken from borrow areas adjacent to the landfill that are located on County property. The County proposes to construct a new borrow area north of the proposed landfill as shown on the site plan. Future borrow areas may be located west of the landfill on County-owned property.

The borrow areas are constructed to a depth of 15 feet below land surface. The on-site soils consist of a few feet of fine sand underlain by a silty and clayey sand.

e. Groundwater Monitoring Plan

The proposed groundwater monitoring plan is described in Dr. David Gomberg's May, 1992 report, included as Appendix B.

4.0 Landfill Performance and Design Standards

a. Liner System

The liner system for the proposed landfill is a composite liner consisting of three components: native soil, a bentonite geosynthetic, and a high density polyethylene (HDPE) geo membrane.

Native Soil - As indicated in Dr. Gomberg's September 1986 "Hydrologic Evaluation of a 53-Acre Section of Tomoka Landfill", the soil underlying the proposed landfill is clayey sand with a permeability of 2.1×10^{-7} cm/sec. The area was previously excavated to approximately 14-feet below grade for use as a borrow pit. Due to the low permeability of the soil, pumping for dewatering was infrequent, except following substantial rainfall. Construction of the landfill with subsequent leachate removal will cause an inward hydraulic gradient, further preventing leachate from escaping to groundwater.

Geosynthetic Clay Liner - A layer of prefabricated clay blankets will be constructed over the compacted subgrade. These blankets, marketed under trade names such as Bentomat and Claymax, are factory manufactured dry bentonite clay layers sandwiched between geotextiles or attached to a geomembrane. This layer is approximately 0.2 inches thick with hydraulic conductivity of $3 \times 10^{-}$

10^{-5} cm/sec. As demonstrated in Appendix C, this layer is hydraulically equivalent to a three foot clay layer with a hydraulic conductivity of 1×10^{-7} cm/sec.

Geomembrane - The upper portion of the composite liner is a 60 mil HDPE liner with a maximum water vapor transmission rate of 0.003 grams per hour per square meter (ASTM E96).

b. Liner Quality Control Plan

The Construction Quality Assurance Plan for the liner systems proposed for the landfill and for the leachate holding ponds is included in Appendix D. The Plan includes specifications and testing requirements. After the project is bid and the Contractor is selected, this plan will be revised to include the name of the Contractor, the manufacturer, the installer and the independent quality assurance inspector.

c. Leachate System

The leachate system consists of three components: the leachate collection system, the leachate storage system, and the leachate disposal system.

Leachate Collection - The purpose of the leachate collection system is to collect and remove leachate that collects on the liner to prevent the hydraulic head on the liner from exceeding 12-inches. The system begins with the 24-inch thick sand drainage layer and the profiled mesh high density polyethylene geonet. The high transmissivity geonet is placed directly above the HDPE geomembrane liner. The liner slopes at a 2% grade to direct leachate through the geonet to the perforated leachate collection laterals. The laterals are six inch diameter perforated HDPE pipe wrapped with filter sock, with a slope of approximately one percent to the eight-inch diameter leachate main. The leachate header mains are located on the north and south edges of the landfill and drain into two leachate sumps located on the west side of the landfill. At each sump, a 10 Hp 400 gpm submersible leachate pump will remove the leachate that collects in the sumps and direct it into either of two lined storage basins.

All leachate pipes buried in the landfill will have cleanouts at each end to permit mechanical cleaning.

Leachate Storage - Each of the two leachate basins is constructed with a double liner and a leak detection system. The lower liner is a composite clay/HDPE liner to further assure that leachate will not escape into the groundwater. Each basin has a normal storage capacity of 3.3 million gallons, when filled to the normal high water level of 32.0. An additional three feet of freeboard is available in the basin. Approximately 11-inches of this freeboard will be used to retain the 25 year 24 hour design storm, leaving over two feet of freeboard remaining.

Two basins will be constructed so that either basin may be taken out of service for inspection and repair. The bottom of the basin will be at elevation 25.0, the high groundwater level, to prevent uplift of the liner.

Leachate Disposal - The HELP Model (Appendix E) indicates that very little leachate will be generated after the site is closed and a low permeability clay cap is constructed. The greatest demand on the leachate disposal system will occur when the landfill is newly constructed. Before solid waste is placed the rainwater falling on the sand drainage layer may be pumped to the stormwater system. When the first layer of solid waste has been placed, evaporation will take place on the surface of the exposed solid waste and on the daily and intermediate soil cover. Some precipitation will also be adsorbed by the solid waste. The remaining water will percolate through the solid waste and be collected as leachate in the leachate collection system. This flow is estimated to be 23,000 gallons per day. Three methods for disposing of this leachate are proposed: leachate evaporation, leachate recirculation, and off-site treatment.

Leachate Evaporation - A certain amount of leachate will evaporate from the leachate basins. Unfortunately the average annual evaporation rate is ten inches less than the average annual precipitation, and the evaporation rate applies only to the area of water surface whereas the precipitation will fall on the entire area of lined basin. To increase the amount of water that will be evaporated in the basin a spray irrigation system including a 480 gpm 40 horsepower submersible leachate pump will be installed along the outside of the basins to irrigate the exposed portion of the basin liner. This will increase the surface exposed for evaporation and will help reduce thermal expansion of the liner during exposure to direct sunlight. The total losses expected to be achieved in the basin are dependent on the amount of precipitation, the number of sunny days, and the number of hours the spray irrigation system is operated. Assuming operation for 8 hours per day, 150 days per year, the net loss to evaporation in the basins is estimated to be up to 9.2 million gallons per year.

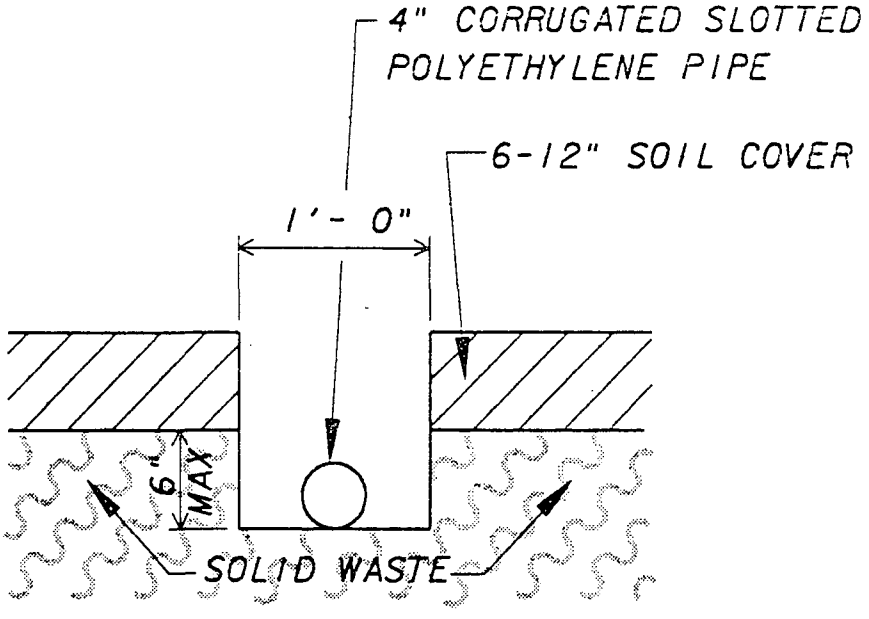
Leachate Recirculation - Although the leachate basins are designed to evaporate more than the total estimated annual leachate production, there will be rainy periods when evaporation will not be practical and when it will be necessary to draw down the leachate basins. During these periods leachate will be recirculated back over the landfill.

Recirculating leachate to bring the moisture content of the buried waste to an optimum level promotes and accelerates the natural decomposition of the waste. It allows the landfill to stabilize more rapidly reducing post closure settlement, and allows leachate production to be maximized when the liner system is new.

To prevent recirculated leachate from damaging vegetative growth or being concentrated in surface areas where it could become mingled with stormwater runoff it is proposed to add the recirculated leachate directly to the solid waste through perforated pipe. Shallow trenches 6-12 inches deep will be constructed (as shown on Figure 1) through the daily or intermediate soil cover in areas removed from the active face. The recirculated leachate will be pumped from the leachate basin to a moveable HDPE manhole placed on top of the ground in the area where the leachate is to be applied (as shown on Figure 2). Four-inch diameter corrugated slotted polyethylene pipe will drain the leachate from the manhole along the length of the trench. As the working face advances across the landfill the leachate recirculation piping will be relocated to avoid interference with landfill operations. The leachate may also be trucked to areas of the landfill for recirculation.

The constructed landfill is non-uniform in solid waste material distribution, density, and moisture content, and the quantity of recirculated leachate to be applied to any specific area will vary. The leachate recirculation trenches will not always be constructed at a uniform grade and it is anticipated that some areas will receive more leachate than others. It will be up to the operator to ensure that the leachate is applied reasonably evenly over the entire landfill and that parts of the landfill are not allowed to become super-saturated. If too much leachate is applied to an area the excess leachate will percolate through the saturated solid waste and be collected in the leachate collection system.

Off-site Treatment - If necessary, leachate from the basins may be trucked to an off-site treatment facility for treatment and disposal.



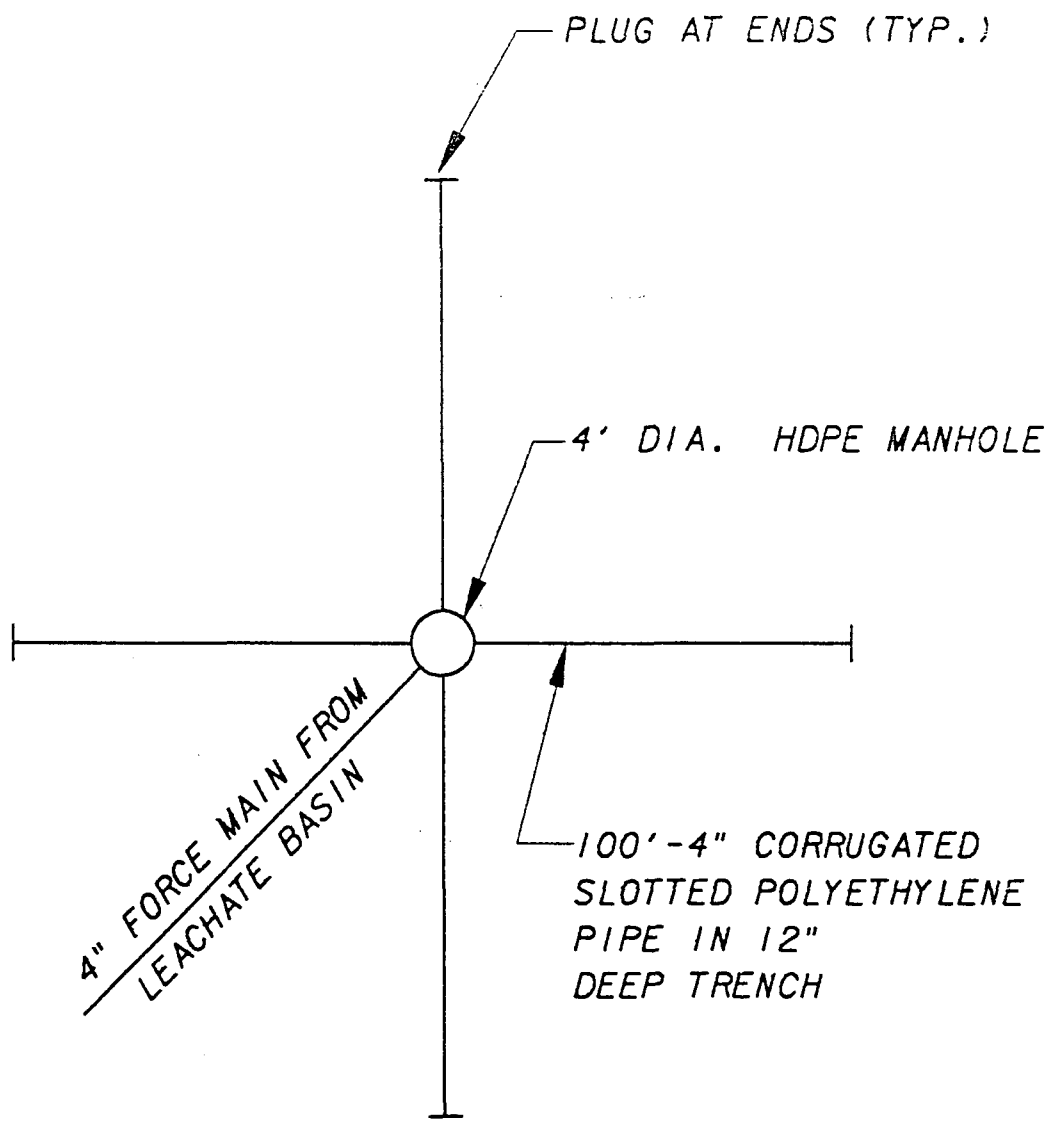
TEMPORARY LANDFILL IRRIGATION PIPE DETAIL

SCALE 1" = 1'-0"

Prepared by
BRILEY, WILD & ASSOCIATES, INC.
Consulting Engineers & Planners

FIGURE 1

VC 92067-6E



PLAN

TEMPORARY LANDFILL IRRIGATION SYSTEM

R-932

Prepared by
BRILEY, WILD & ASSOCIATES, INC.
Consulting Engineers & Planners

FIGURE 2

d. Surface Water Management System

Surface runoff will be collected in a retention pond that will surround the proposed landfill. Surface runoff from the landfill will be kept separate from runoff from other parts of the overall site, and from leachate.

The retention pond is designed to retain the runoff from both the 25 year 24 hour storm, and the 100 year storm as shown in Appendix F.

e. Gas Control System

The proposed landfill is a high rise composite lined landfill surrounded by stormwater ditches which extend to the base of the fill. It is not possible for gas formed in the landfill to migrate off site. During landfill construction, gas will be vented naturally through the landfill soil cover. The site is remote and odors attributable to landfill gas have not been a problem in areas adjacent to the existing landfill.

As the proposed clay cap is installed for final cover over closed out portions of the landfill, the natural venting of gas will be restricted. To prevent the buildup of gas which could cause fissures in the clay cap and damage to vegetation, gas vents will be installed on 200-foot centers. These are shown on the drawings.

The County is actively investigating uses for the landfill gas, and it is anticipated that a program of extracting the gas and processing it for beneficial uses will be proposed in the near future.

5.0 OPERATION PLAN

The purpose of this Operation Plan is to provide a written description of the daily operation of the landfill, in accordance to the requirements of Chapter 17-701.050 (5) (b) of the Florida Administrative Code.

The Tomoka Farms Road Landfill is a solid waste management facility including the following operations:

A Class I landfill
A construction and demolition debris disposal site
A tire and white goods storage facility
A municipal wastewater sludge storage facility
A recycling drop off facility
A household hazardous waste collection facility
A sludge land farming operation

This Operation Plan describes the operation of the proposed new Class I landfill.

It is recognized that landfills are dynamic systems under constant development. Changes in the type of material brought to the site, the quantity and rate of refuse delivery, surface topography of the landfill, and administrative and regulatory requirements may all result in changes in the way the landfill may be best operated to conserve landfill space, protect the environment, and provide safe and efficient operation for users of the landfill. It is the intent of this Operation Plan to be kept as an accurate description of the actual operation and procedures. This plan should be modified as required to reflect changes in the landfill operation as they occur.

a. Designation of Responsible Persons

A Foreman IV has been assigned supervisory responsibility over both the Tomoka Farms Road Landfill and the Plymouth Avenue Landfill in DeLand. Routine operation of the Tomoka Landfill is under the direction of a Foreman III. When he is absent from the site, a Foreman II or a Foreman I is designated as being in charge of the site. A Foreman is present at all times during the hours of operation.

At the beginning of each working day the site foreman tells the spotter at the working face where the various types of waste (refuse, sludge, tires) should be placed that day. The spotter is responsible for telling each customer where to dump his waste.

b. Contingency Operations

The landfill has four compactors, seven dozers, six four wheel drive dump trucks, one water wagon, two backhoes, one grader, two front end loaders, and two mowing tractors. Should any one piece of equipment be disabled the landfill could continue to operate. In addition, Volusia County's Roads and Bridges Section has equipment which could be loaned to the Solid Waste Department for use during an emergency.

The landfill is large enough that if a portion of the site had to be closed due to emergency (fire, chemical spill, storm damage, etc.) it is likely that some other area of the site could remain open. If on-site roads became impassable the County has an agreement with private contractors to provide roll-off containers near the scale.

c. Controlling the Type of Waste Received at the Site

The landfill specifically excludes hazardous wastes, toxic waste, pathological/infectious wastes, and liquid or chemical wastes. The first defense against these wastes is the clerk at the scale house. Normally, these wastes are not allowed to enter the site. The second line of defense is the spotters at the working face. The third line of defense is the equipment operators who spread, compact, and cover the waste.

An on-site household hazardous waste facility is provided to accommodate Volusia County homeowners. This service is free of charge to the homeowner to encourage separation of this material from the household waste.

All employees have been trained to look for liquid waste, drums, waste in sealed containers, waste with unusual odors or fumes, and waste with an unusual appearance such as hospital waste or waste with strange markings. Waste with suspicious appearance is kept on the trucks until the site environmentalist has approved its dumping. If the material has already been dumped it is kept separate from other wastes. If the material is suspicious to the site foreman he is instructed to call on-site environmental specialist, who will identify the material and determine its suitability for landfilling.

The ultimate decision on whether to accept or reject the material is made by the site environmentalist.

d. Weighing or Measuring Waste

All vehicles taking waste to the landfill are weighed at the scale house. After dumping their wastes the vehicles are again weighed on their way out. Those vehicles whose tare weights are on record are weighed entering the landfill but are not required to weigh when leaving.

Not all vehicles are charged based on weight. Cars and pickup trucks are charged a standard per load charge and many larger vehicles are charged based on their cubic yard capacity. Regardless of how the charges are made all refuse is weighed on entering.

e. Vehicle Traffic Control and Unloading

Signs clearly indicate the way to the working face. A spotter assists in directing vehicles to the active area and in screening wastes. A second spotter at the working face tells each driver where to unload. The working face is approximately 100-feet wide and is organized to allow smooth flow of traffic for vehicles arriving, unloading, and departing. The on-site roads are adequate for two-way traffic and speed limits are clearly marked.

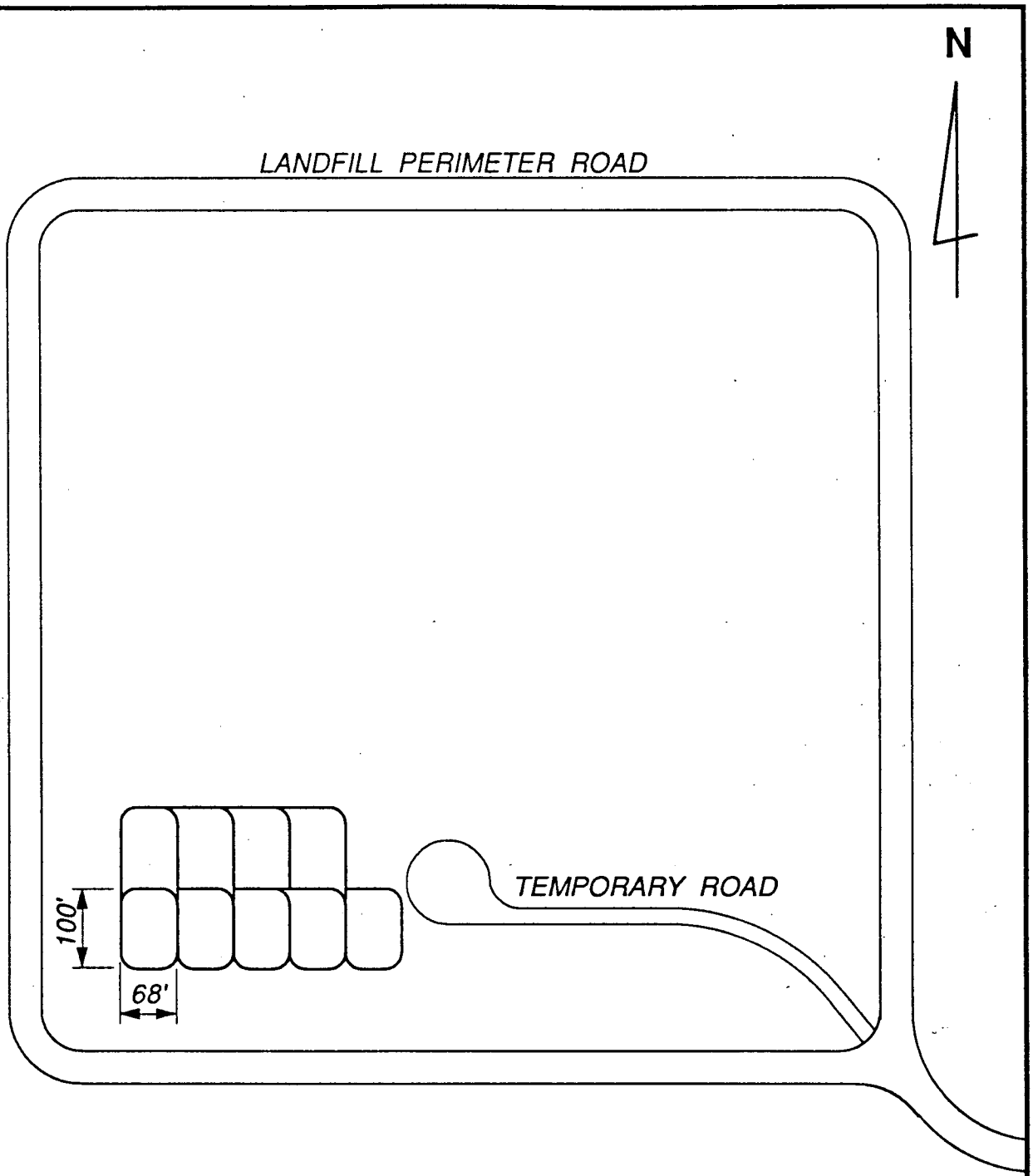
Traffic control on the on-site roads and at the working face is the responsibility of the spotters.

Scavenging, the uncontrolled retrieval of materials at the working face by individuals, is strictly forbidden and is prevented by the spotters.

f. Method and Sequence of Filling Waste

The site is operated as a vertical, "high rise" landfill with wastes being placed, spread, compacted, and covered with material from the adjacent borrow pit. County surveyors are used to provide spot elevations to measure the landfill's progress.

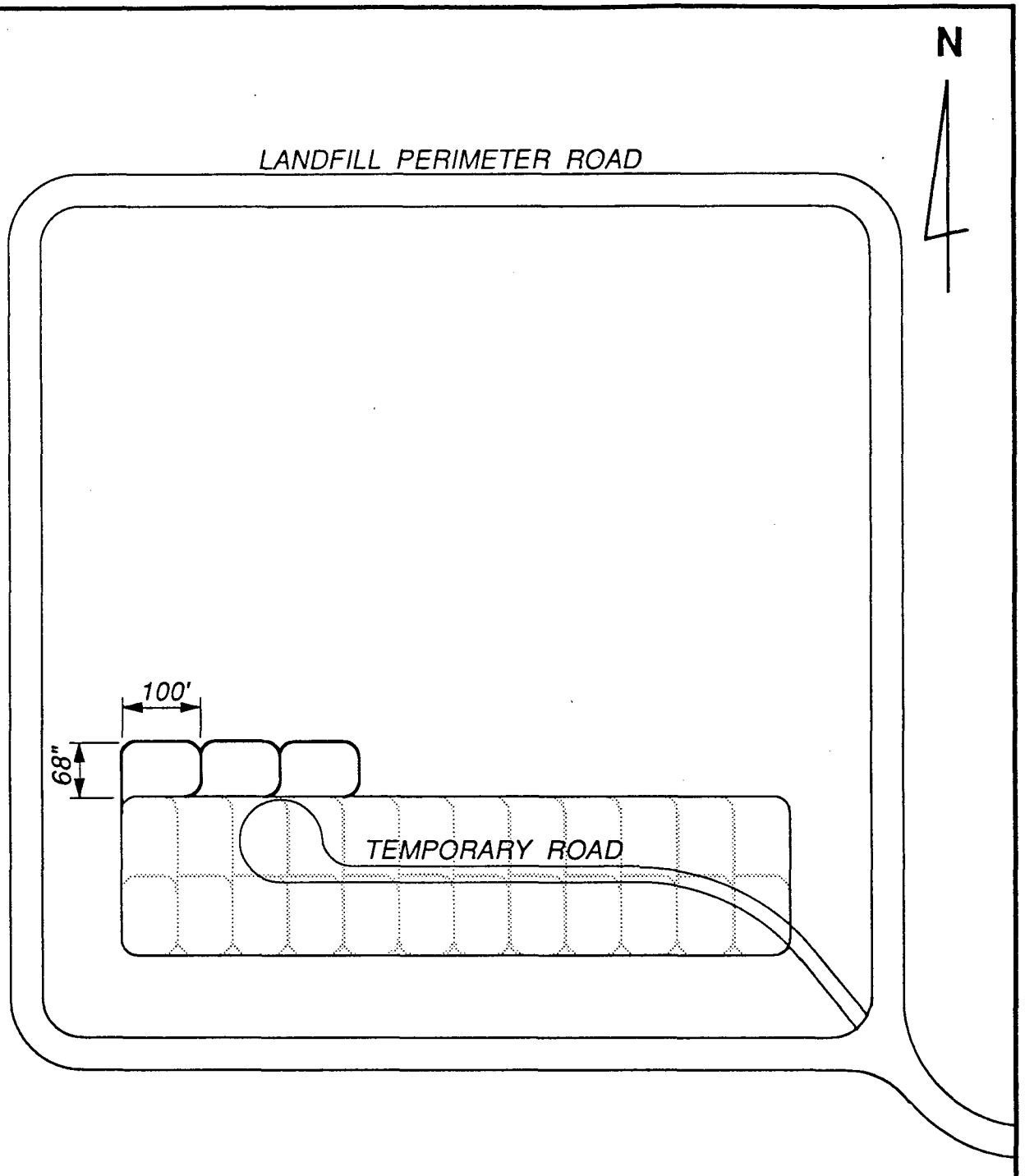
The site foreman is responsible for selecting the location of each day's working face based on the approved design and on the most efficient utilization of available space. Lifts of 10-feet are placed so as to best utilize on-site roads, provide adequate working room for refuse and landfill vehicles, and to provide drainage of surface water away from the working face.



INITIAL CELL DEVELOPMENT

Prepared by
Briley, Wild & Associates, Inc.
Consulting Engineers & Planners

Figure No. 5 -1



CONTINUING CELL DEVELOPMENT

Prepared by
Briley, Wild & Associates, Inc.
Consulting Engineers & Planners

Figure No. 5 -2

g. Waste Compaction and Application of Cover

The incoming waste is deposited at the working face as directed by the spotters. The working face is approximately 100-feet wide and 10-feet high. The refuse is spread into thin layers approximately 1-foot thick by the dozers, and then compacted by the compactors. At the end of the day cover material is spread by the dozers until 6-inch (minimum) layer of compacted soil completely covers the completed cell. On Saturdays, and Sundays very little material is placed and the cover is often completed on Monday.

Cover material is taken from the borrow pit, north of the landfill and hauled to the working face with four wheel drive dump trucks.

h. Gas, Leachate, and Stormwater Control

The site environmentalist is responsible for proper operation of gas, leachate and stormwater control systems.

The landfill is a high-rise landfill with a liner, and is surrounded by stormwater ditches which extend to the base of the fill. It is not possible for gas formed in the landfill to migrate off the site. Initially, the gas will escape out through the cover material and be dissipated in the atmosphere.

Leachate is collected by a network of perforated leachate collection pipes located directly above the liner. The collected leachate is pumped to lined holding basins west of the landfill. The leachate collection system is designed to keep the level of leachate collected in the landfill from rising to higher than one foot above the liner.

Leachate in the lined leachate holding basins is allowed to evaporate to reduce the volume of leachate to be disposed of. Leachate is also pumped back to the lined landfill to be added to the solid waste. Wetting the buried waste over the liner helps to promote more rapid degradation of the solid waste and further reduces the quantity of leachate to be disposed of. Leachate not removed by evaporation or recirculation is transported by tanker truck to off-site wastewater treatment and disposal facilities.

i. Ground Water Monitoring

Ground water is monitored at the site to ensure that the landfill operations are not adversely affecting ground water resources. Monitoring requirements were presented in the operating permit issued by the State in August 5, 1981. This monitoring program has been modified by subsequent changes in the rules and regulations governing ground water monitoring and by the Department of Environmental Regulation modifications to the County permit.

At the present time 12 shallow wells and two Floridan wells are sampled for water quality analysis. The wells, screened intervals, and DER numbers are listed below.

Existing Monitoring Wells

Well	Year Installed	Screened or Open Interval (ft.)	DER Number
B-1B	1987	28-33	3064A14965
B-2	1980	19-24	3064A12081
B-3B	1987	17-22	3064A14966
B-4	1980	20-25	3064A12087
B-5	1980	18-23	3064A12082
B-6	1980	25-30	3064A12090
B-7	1980	27-32	3064A14970
B-8	1987	43-48	3064A14971
B-9	1987	28-33	3064A14972
B-10	1988	15-25	3064A15206
B-11	1990	4-10	3064A15502
MO5B	1987	27-32	3064A14964
FA-1B	1987	91-92	3064A14968
FA-2C	1991	94-100	3064A14969

j. All Weather Access Roads

The on-site roads from the entrance gate to the landfill are paved roads. The roads on the landfill used as haul roads for transporting cover material from the borrow pit, and for service roads for the refuse vehicles are well build, well drained, heavy duty roads built of construction

debris and shell. The roads are slightly elevated above surrounding grade and are crowned to assist in providing good drainage.

Shell and construction debris suitable for road construction are stockpiled separately. This material is available at the site for the landfill staff to use to repair, maintain or relocate on-site access roads.

k. Effective Barrier

The entire property is surrounded by a fence and patrol road to prevent unauthorized entry to the site. Vehicular traffic must pass the scale house to get to the landfill. When the landfill is not in operation, the gates are kept locked and a night watchman assists in preventing unauthorized entry.

l. Signs

A large sign at the entrance gate proclaims the landfill to be run by Volusia County and gives the hours of operation.

There are many signs throughout the landfill to indicate traffic flow, where specific wastes may be placed, safety instructions, etc.

m. Dust Control

During dry periods it is occasionally necessary to control dust on the unpaved haul roads utilized by the refuse vehicles and by the vehicles hauling cover material. When the site foreman determines that dust control is required, water from the external stormwater ditch is pumping into a 7,000 gallon tank trailer, equipped with spray nozzles. This trailer is used to spray down the roads requiring dust control. As these roads are all on-site, any runoff from this operation is captured in the stormwater and leachate collection systems.

n. Litter Control

Litter at landfills is caused by: a) refuse being unloaded at the working face or refuse previously unloaded at the working face, but not yet covered, being caught by the wind and transported away from the working face; b) refuse falling from improperly covered refuse vehicles; and c) dumping of refuse in unauthorized locations.

To control wind borne litter refuse unloaded at the working face is spread and compacted continuously throughout the working day. Proper orientation of the working face by the site foreman also reduces the incidence of wind blown litter. On windy days refuse could be placed at the bottom of the working face to shield it from the wind. During times of high wind some litter does escape from the working face. This fugitive litter is collected along the sides of the stormwater ditches that surround the landfill and does not leave the property. Work-release parties from the correctional institute are utilized in retrieving and collecting this material.

Transporting refuse in an open truck with the tailgate down or without proper cover is against County ordinances. Spotters and the gate house clerk report vehicles in violation to the litter control officer, who issues the appropriate citations.

With signs clearly indicating the way to the appropriate working face and with spotters enforcing traffic control and directing the unloading of refuse from vehicles, improper dumping is kept under control.

o. Fire Protection and Fire Fighting Facilities

Landfill fires are particularly hazardous, due to the presence of methane gas, Chemicals in the waste, such as discarded cleansers, gasoline cans, etc., can also make landfill fires particularly dangerous. Fires may be caused by spontaneous combustion in refuse containers or refuse vehicles, by reaction of waste fuel, or chemicals, or by hot coals or ashes. Daily cover assists in preventing the fire from spreading from cell to cell.

If a fire is observed during operating hours, the burning material is separated from other refuse and is covered with soil. In addition, each vehicle and building is equipped with fire extinguishers to allow small fires to be dealt with as they occur. Whenever a fire does take place, the landfill staff calls the Florida State Division of Forestry, which classifies landfill fires as brush fires. The Division of Forestry notifies the County Sheriff and the Halifax Fire Department.The Halifax Fire Department is trained to deal with landfill fires and is equipped with self contained breathing devices and chemical masks which could be needed.

Fires that occur outside of the normal hours of operation are considerably more difficult to control due to the fact that the fire could be well developed before it is reported. Nighttime visibility restrictions also make these fires considerably more dangerous than daytime fires. In the event that a fire is observed or reported during the hours the landfill is closed, the Sheriff's office and 911 are

instructed to call the Division of Forestry. The Division of Forestry notifies the Halifax Fire Department and will call the landfill staff members who are on call at that time.

p. Attendant

A clerk is present at the scale house during all hours the landfill is open. Spotters and equipment operators are also present. During evening hours when the landfill is not in operation, a night watchman helps restrict unauthorized access to the site.

q. Communication Facilities

The scale house and the office/maintenance building are equipped with telephones. The two spotters and supervisory personnel are assigned vehicles with radios that communicate with the County's Central Control network. Through this network, the spotters can communicate directly with each other and with the site foreman, and can relay messages to the Sheriff's office and other emergency services.

r. In-Service and Reserve Equipment

The landfill has two compactors, three dozers, and two four wheel drive dump trucks. Also at the landfill are 1 dragline, 1 backhoe, 1 loader, and 1 grader. Should any one piece of equipment be disabled the landfill could continue to operate. In addition, the Volusia County Department of Public Works Division of Roads and Bridges also has equipment which could be loaned to the Division of Solid Waste for use during an emergency.

s. Safety Devices

All landfill vehicles are equipped with roll bars to protect operators. Each vehicle also is equipped with fire extinguishers to assist in preventing small fires from spreading out of control. Site employees are also equipped with safety boots, rain gear, gloves, and goggles for personal protection while working at the landfill.

6.0 Water Quality Standards

Surface runoff from the site is retained in a perimeter pond that surrounds the proposed landfill. The pond is designed to hold the runoff from both the 25 year and the 100 year design

storms. During rainfall events exceeding the 100 year storm surface runoff will overflow to the flatwoods east of the landfill.

The landfill will be constructed with a composite liner to restrict leachate from escaping to groundwater. The landfill will also have a leachate collection system designed to keep the level of leachate in the landfill from exceeding 12-inches. The groundwater level outside the landfill will be several feet higher than the landfill liner, and leaks in the liner will result in groundwater flowing into the landfill, not leachate flowing out into groundwater.

Leachate will be disposed of on-site by evaporation, recirculation into the landfill, or by trucking off-site for treatment and disposal.

7.0 Closure Plan

a. Design

In accordance with the requirements of 17-701.071, a closure schedule will be submitted to the DER one year prior to cessation of waste acceptance. The proposed final configuration of the landfill is shown on the plans accompanying this application. Side slopes are 4:1 with 20-foot wide terraces located after every 20-foot of rise. Final cover shall include a minimum of 6-inches of daily cover, 6-inches of compacted clay, 6-inches of protective soil cover, and 6-inches of top soil to provide a root zone for the vegetative growth. Much of this final cover will be placed prior to the time of closure as individual portions of the landfill are compacted.

b. Final Use

It is the County's intent to utilize Tomoka Farms Road site for the processing and disposal of solid waste throughout the foreseeable future. As long as the site is active, closed out portions of the landfill will be used to provide screening and buffer for the portions of the site that remain active. When the site is no longer active as a solid waste site, current plans call for the site to be available for passive recreation.

c. Closure Operations

1. Construct landfill to the grades shown on the approved drawings and the construction permit issued by the FDER.

2. Install final cover as shown on the approved drawings, including the low permeability clay cap. Much of this cover may already be in place at the time of closure.
3. Install gas vents as shown on the approved drawings.
4. Properly seed and mulch to establish a vegetative cover over the closed landfill.

All required ditches, retention areas, groundwater monitor wells, and fencing will be in place prior to placing the landfill in operation and no other work is expected to be required at the time of closure.

d. Post Closure

Post closure responsibilities include continuing with the approved groundwater monitoring plan, maintenance of the surface water and leachate collection and disposal system, maintenance of vegetative cover, repair of erosion and other damage to the final cover, and gas monitoring.

e. Financial Responsibility

Probable costs for closure and post-closure costs are presented in the following tables.

Table 1
Estimate of Probable Closure Cost
Tomoka Farms Road Landfill

1.	Grading and Surface Preparation 145,000 sy x $0.50/sy	$72,500.00
2.	Clay Layer (six inches) 145,000 sy x $3.50/sy	507,500.00
3.	Soil Cover (six inches) 145,000 sy x $0.65/sy	94,250.00
4.	Topsoil (six inches) 145,000 sy x $1.50/sy	217,500.00
5.	Seeding and Mulching 145,000 sy x $0.30/sy	43,500.00
6.	Gas Vents 25 vents x $1,000/vent	25,000.00
7.	Miscellaneous Closure Costs Survey, signs, etc.	17,500.00
	Subtotal	$977,750.00
	Contingency	146,250.00
	TOTAL	$1,124,000.00

Table 2
Estimate of Probable Post-Closure
Annual Cost
Tomoka Farms Road Landfill

Ground and Surface Water Monitoring 6 sites x 4 qtr/yr x $800.00	$19,200.00
Inspection and Gas Monitoring	1,600.00
Final Cover Repair and Reseeding	7,500.00
Mowing and Groundskeeping	4,000.00
Leachate Pumping	15,000.00
TOTAL ANNUAL COST	$47,300.00

f. Closure Plan Schedule

The following is an estimated closure schedule and list of closure operations:

1 Year Prior to Cessation of Accepting Waste:
- notify DER
- prepare schedule for closing

120 Days Prior to Cessation of Accepting Waste
- advise users by posting signs

90 Days Prior to Cessation of Accepting Waste
- submit closure permit application

10 Days Prior to Cessation of Accepting Waste
- publish a legal notice of proposed closure

180 Days After Cessation of Accepting Waste
- place final cover

After Completion of Closure
- install concrete survey monuments
- final survey and as-built report
- file a "declaration to the public"

10 Years After Closure
- County may request DER to reduce long term care period

20 Years After Closure
- end of long term care period

APPENDIX A
FOUNDATION ANALYSIS

BECHTOL ENGINEERING
AND TESTING, inc.

May 31, 1992
Project No. 92100

TO: LEE POWELL, P.E.
BRILEY, WILD & ASSOCIATES
P.O. BOX 607
ORMOND BEACH, FL 32175-0607

RE: General Geotechnical Evaluations, Tomoka Landfill, Volusia County, Florida.

Dear Mr. Powell:

As requested, we have conducted general geotechnical evaluations relative to existing and proposed expansions of refuse embankment fills at the subject site.

The following report summarizes the background of the site, proposed expansions, and general site subsurface conditions, and provides general geotechnical related evaluations and discussion.

For the purpose of this report, we have relied solely on subsurface information and landfill design data published by other entities noted herein. No site-specific subsurface data was compiled by Bechtol Engineering and Testing, Inc.. The following report is intended only to provide general geotechnical related evaluations, and should not be construed as a comprehensive geotechnical study. We do trust however, that the information presented is sufficient for your immediate needs.

Bechtol Engineering and Testing, inc. appreciates the opportunity to provide our services on this project. In the event you should have any questions, or require any additional services, please do not hesitate to call.

Respectfully,

Bechtol Engineering and Testing, inc.

5/31/92

Thomas Bechtol, P.E.
President
Florida Registration No. 38538
TB/rr
0766

3 cc: Client

Consulting Geotechnical and Construction Materials Testing Engineers
114A S. Alabama Avenue • DeLand, FL 32724-5524 • Telephone (904) 734-8444
FAX (904) 734-8541

SITE BACKGROUND

The Tomoka Landfill property consists of nearly 850 acres located west of Tomoka Farms Road and the Tomoka River, and south of Interstate No. 4 in Sections 3,4,9, and 10, Township 16 South, Range 32 East, Volusia County, Florida. According to various sources, the County of Volusia has operated a refuse landfill on this property, or portions thereof, for over 20 years.

The active portion of the landfill consists of a generally rectangular area, about 2500' x 2000' in size, located in the southwest portion of the site, or more specifically in the northeast quadrant of Section 9, Township 16 South, Range 32 East. Prior to it's inception as a landfill, we envision that the site existed primarily as pine/palmetto flatwoods, with average ground surface elevations on the order of +27' NGVD, and average groundwater levels within a few feet of ground surface.

We understand that all or portions of the active landfill area may have been excavated to about elevation +15' NGVD prior to refuse filling, in order to provide cover material for other landfill areas on site. In reference to Tomoka Farms Road Landfill Report (Briley, Wild & Associates, August, 1980), the fill design for the area was based on compacted refuse lifts of 8 feet in thickness with a 6-inch soil cover. Currently, the existing refuse embankment is being filled, with proposed finish top-of-embankment elevation on the order of +110' NGVD. Average side slopes are estimated to be about 6 horizontal to 1 vertical.

PROPOSED EXPANSION

As discussed with Lee Powell, P.E., it is proposed to expand the active portion of the landfill area. The proposed area of expansion includes a 1,400'± x 700'± borrow area (lake) and an adjacent 1,400'± x 700'± partially excavated area, located north of, and adjacent to the existing active landfill embankment. We understand that the bottom of the existing borrow area is at about +15' NGVD and that the remainder of the proposed embankment area will be excavated to a similar bottom elevation. Proposed top-of-embankment elevation is reported to be +134' NGVD. We envision that the fill design will be generally consistent with the existing embankment. Proposed average side slopes for the new embankment are reported to be 4 horizontal to 1 vertical.

GENERAL SITE SUBSURFACE CONDITIONS

In reference to a recent Hydrogeologic Evaluation (David N. Gomberg, Ph.D., September, 1986) a generalized hydrogeologic cross section below the active landfill can be summarized as follows:

ELEVATION (NGVD)	PREDOMINANT SOIL DESCRIPTION	HYDROGEOLOGIC FORMATION
+27 to +15	*Sands, Silty Sands	Shallow Non-Artesian Aquifer
+15 to +6	Clayey Sands	Semi-Confining Layer
+6 to -2	Sands	Semi-Unconfined Layer
-2 to -12	Sandy Clays	Confining Layer

ELEVATION (NGVD)	PREDOMINANT SOIL DESCRIPTION	HYDROGEOLOGIC FORMATION
-12 to -26	Sands and Shell	Secondary Artesian Aquifer
-26 to -36	Clay	Confining Layer
-36 to -53	Silty Sands and Shell	Upper Artesian Aquifer
-53 to -300+	Limestone	Artesian (Floridan) Aquifer

* May be partially or completely excavated and replaced with refuse fill.

Based on our previous experience in the site vicinity, we envision that the various deposits of sand, silty sand, clayey sand and sand/shell underlying the site are relatively dense. Testing of clay deposits similar to those anticipated below the site indicate that these deposits generally are normally consolidated and exist in a medium stiff to stiff condition.

Normal average groundwater levels associated with the shallow non-artesian aquifer would be expected at elevations on the order of +25' NGVD when not artificially lowered. Actual groundwater elevations may be substantially lower due to artificial drainage or dewatering which may be associated with the landfill operations. Recent USGS Potentiometric Surface Maps (May, 1989) indicate the piezometric surface level of the Floridan Aquifer below the site to be on the order of +10' NGVD.

GEOTECHNICAL EVALUATIONS

From a geotechnical standpoint, the primary concerns associated with the proposed landfill embankment construction are:

1. Bearing capacity of the underlying geologic formations for support of the induced embankment surcharge loading.

2. Consolidation of refuse fill and underlying geologic sediments.

3. Slope stability of the refuse embankment.

Bearing Capacity

Based on an estimated compacted refuse density of 1000 pcy, a cover material density of 100 pcf, the proposed average 12' excavation, the fill design of 6-inch cover for 8 feet of refuse, and the proposed top-of-embankment elevation of +134' NGVD, the average net surcharge loading imposed by the refuse fill on the underlying materials would be on the order of 4,500 psf or 2.25 tsf. With respect to the overall lateral limits of the refuse embankment fill and conservative estimates of subsurface soil properties, calculations using Terzaghi, Meyerhoh, and Hansen bearing capacity equations all indicate ultimate bearing capacity of the subsurface formations to be well in excess of 50 tsf. We therefore feel there is essentially no risk of shear failure or bearing capacity failure due to the existing or proposed refuse embankment.

Consolidation and Settlement

The proposed refuse embankment will induce soils stresses nearly equal to the total surcharge loading throughout the thickness of the geological formations overlying bedrock (limestones of the Floridan Aquifer). Due to these induced soil stresses, a certain degree of consolidation of these formations, and subsequent settlement of the overlying refuse embankment, can be expected.

Certain degrees of both short-term elastic settlement due primarily to deformation and compression of granular deposits, and long-term plastic settlement due primarily to compression of plastic clay deposits are likely. Short-term and long-term settlement can be expected with additional refuse application. Insufficient data is available to provide specific calculations of potential consolidation of the subsurface deposits, however, we envision that overall long-term consolidation of 1 to 2 feet is not unlikely.

In addition, certain degrees of additional settlement are likely due to consolidation of the refuse fill itself due to stresses induced by overlying refuse applications and decomposition within. Refuse consolidation may vary dramatically throughout the embankment fill area, and average long-term settlement of several feet is possible. Potential settlements should be carefully considered for any future developments associated with planned recreational facilities.

Slope Stability

Due to the potential variability of refuse characteristics, placement of refuse and cover material and drainage characteristics, the ultimate stability of refuse embankment slopes may vary widely. Generally, if the average 4:1 side slopes are maintained throughout, we envision that the potential for significant slope failure is very low. Past performance of existing slopes should provide insight as to potential stability problems which may exist. If deemed necessary, certain methods such as slope flattening, benching, ditching, and construction of fill buttresses may be considered. Effective means of surface and subsurface drainage and surface treatment such as seeding or geotextile application may be a consideration in order to minimize potential erosion and seepage related problems.

APPENDIX B
GROUNDWATER MONITORING PLAN

APPENDIX B

The proposed Groundwater Monitoring Plan for this site was prepared by Dr. David Gomberg and submitted to the Department of Environmental Regulation for review on May 26, 1992.

The DER prepared a comment letter dated June 23, 1992. We are now in the process of addressing those comments. The revised Grondwater Monitoring Plan will be submitted after those comments have been addressed.

APPENDIX C
CLAY LINER EQUIVALENCY CALCULATIONS

APPENDIX C

CLAY LINER EQUIVALENCY CALCULATIONS

Florida regulations FAC 17-701.050 (5) requires the clay portion of a composite liner system to be a minimum of 18-inches thick and to have a maximum hydraulic conductivity of 1×10^{-7} cm/sec. In the proposed new regulations, FAC 17-701.400, the required thickness of the clay is determined by its hydraulic conductivity of 1×17^{-7} cm/sec three feet is required. Two feet of clay with a hydraulic conductivity of 5×10^{-8} or one foot of clay with a hydraulic conductivity of 1×10^{-8} cm/sec are also allowed.

To determine the equivalency of the proposed geosynthetic clay liner to the ones described in the regulations it is necessary to calculate the seepage rate through each of the two clay layers.

Steady-state seepage calculations for fluid flow through a clay layer are performed using Darcy's equation: $q = k\,i$ Brownian!

where: q = steady-state flow per unit area in ft/s; k = hydraulic conductivity in ft/s; and i = hydraulic gradient (dimensionless).

The hydraulic gradient i, is defined by: $i = (h + T)/T$

where h = head of liquid on top of clay layer in ft. and T = thickness of clay layer in ft. Combining the equations gives: $q = k\,(h + T)/T$

For the basic case of a hydraulic head, h, of 1 ft on a clay layer which has thickness, T, of 3 ft and a hydraulic conductivity, k, of 1×10^{-7} cm/s (3.28×10^{-9} ft/s) (i.e., the reference clay layer), the calculation of steady-state flow per unit area is as follows:

$$q = k\,(h + T)/T$$
$$q = 3.28 \times 10^{-9} \times (1 + 3)\,/3$$
$$= 4.373 \times 10^{-9} \text{ ft/s}$$
$$= 0.138 \text{ ft/year}$$

Therefore, the steady-state flow per unit area for the basic case is 0.138 ft/year.

Substituting a geosynthetic clay layer with a thickness, T, of 0.2 in. (0.0167 ft) and a hydraulic conductivity of 3×10^{-10} cm/s (9.843×10^{-12} ft/s) in place of the 3 ft. of clay in the above calculation gives:

$q = k (h + T) / T$
$q = 9.843 \times 10^{-12} (1 + 0.0167) / 0.0167$
$q = 6.0 \times 10^{-10}$ ft/s
$q = 0.0189$ ft/year

Therefore, the steady-state flow per unit area when the proposed clay layer is used instead of the 3 ft. of clay is 0.0189 ft/year.

The properties of the proposed geosynthetic clay liner used in the above calculation were based on a confining stress of 30 psi which is considered representative of the average confining stress that the layer would be subjected to during the active life of a typical landfill. A more conservative approach would be to select properties that are based on a confining stress on the order of 2 psi which is considered representative of the confining stress that the layer would be subjected to prior to waste placement. For this case, the selected properties of the proposed geosynthetic liner are a thickness of 0.35 in. (0.029 ft) and a hydraulic conductivity of 2×10^{-9} cm/s (6.56×10^{-11} ft/s) and the calculation of steady-state flow per unit is as follows:

$q = k (h + T) / T$
$q = 6.56 \times 10^{-11} (1 + 0.029) / 0.029$
$q = 2.328 \times 10^{-9}$ ft/s
$q = 0.073$ ft/year

Therefore, when more conservative properties for the proposed geosynthetic clay liner are used, the steady-state flow per unit area is calculated to be 0.073 ft/year.

The analysis shows that for the basic case of a hydraulic head of 1 ft. on the reference clay layer (3 ft. thick with a hydraulic conductivity of 1×10^{-7} cm/s) the calculated steady-state flow per unit area is 0.138 ft/year. When a geosynthetic clay liner is substituted for the 3 ft. of clay, the calculated steady-state flow per unit area with the same 1 ft. hydraulic head is 0.0189 ft/year which is a seven-fold reduction in calculated steady-state flow when compared to the basic case. Even if the most conservative property values for the geosynthetic clay liner are used in the analysis, the

calculated steady-state flow per unit area is 0.073 ft/year which is one-half of the calculated steady-state flow for the basic case.

In conclusion, the flow rate through the geosynthetic clay liner is less than through the reference clay layer. Therefore, the analysis clearly demonstrates the equivalency of the geosynthetic clay liner to the reference clay layer in terms of steady-state flow per unit area.

APPENDIX D
CONSTRUCTION QUALITY ASSURANCE PLAN

APPENDIX D

TOMOKA LANDFILL
CONSTRUCTION QUALITY ASSURANCE PLAN

TABLE OF CONTENTS

1.0 GENERAL

1.1 Purpose

The purpose of this construction Quality Assurance Plan is to provide the construction quality assurance personnel with adequate information to achieve continuous compliance with the liner construction requirements of this Project.

1.2 Description of the Project

This Project consists of the construction of a 30 acre composite landfill liner and two double lined two acre leachate holding basins.

The landfill liner is a composite liner, with 60 mil high density polyethylene (HDPE) membrane overlaying geosynthetic clay liner (GCL).

The leachate pond double liner system consists a 60 mil HDPE membrane overlaying a geonet drainage layer and leak detection system, a secondary 60 mil HDPE membrane, and a geosynthetic clay liner.

2.0 RESPONSIBILITY

The Owner, Volusia County, is responsible for complying with the provisions and conditions of the permits issued to the County by the regulatory agencies, and with any applicable laws and regulations.

The Contractor will be selected using the County's procedures for competitive bidding, with the lowest responsible bidder being selected as the Contractor. A construction contract will be entered into with the selected Contractor to complete the Project in accordance with the plans and specifications.

The Contractor is responsible for constructing the liner in accordance with the requirements of the plans and specifications, including all quality control measures needed for successful completion of the Project. He is also responsible for complying with applicable codes, ordinances, and regulations of all governing bodies.

The Owner shall hire an independent quality assurance firm to provide an Inspector to observe all quality control procedures. The Inspector will check material certifications, observe all testing, and monitor construction compliance with the plans and specifications. The Inspector will conduct field testing procedures and will arrange for independent laboratory testing where required. He will also prepare daily logs of all construction activity, including the time, location, identification, number, and results of all field tests and samples.

The firm to be selected to provide quality assurance inspection shall be a professional firm having quality assurance inspection as a significant part of their regular professional practice. The firm shall have at least two years of experience in construction quality assurance, testing and shall employ licensed professional engineers.

3.0 SPECIFICATIONS

The specifications for the HDPE membrane liner and for the geosynthetic clay liner are attached at the back of this section.

4.0 SUBGRADE PREPARATION QUALITY ASSURANCE

The Inspector shall provide field density tests using ASTM D2922 at a frequency of one per acre to verify the compaction of the subgrade. The Inspector shall visually observe the subgrade during GCL installation to confirm that the surface on which the liner is to be placed is maintained in a firm, clean, and smooth condition, free of standing water, during liner installation.

5.0 GEOSYNTHETIC CLAY LINER QUALITY ASSURANCE

5.1 Off-Site Quality Assurance

The GCL manufacturer shall allow the Inspector to visit the manufacturing facility in order to:

- observe the quality control testing facilities;
- meet and review the manufacturer's quality control and production personnel;
- observe that the quality control procedures being followed are in strict accordance wit those outlined in the manufacturer's Quality Control Manual;

- arrange for a sample or samples to be sent to an independent laboratory for testing.

5.2 On-Site Quality Assurance

The Inspector shall cut a one-foot wide sample from delivered rolls of GCL for independent testing to confirm compliance with the project specifications.

Each day the installer's superintendent and the Owner's Inspector shall inspect and the installer shall provide written certification that the subgrade for the GCL has been prepared in accordance with the specifications and the manufacturer's.

As each panel is being deployed, the installer superintendent and Owner's Inspector shall provide 100% inspection of the installation. Inspection should consist of:

- the recording of each roll number and lot number as panels are deployed, along with a general description of the location of each panel;
- inspection of overlap;
- visual inspection of geotextile quality, bentonite uniformity, and the degree of hydration, if any, on the clay. Mark any areas as appropriate for repair;
- inspection of anchoring and sealing around penetrations and structures.

6.0 HDPE LINER QUALITY ASSURANCE

6.1 Off-Site Quality Assurance

The HDPE membrane manufacturer shall allow the Owner's Inspector to visit the manufacturing facility in order to:

- observe the quality control testing facilities;
- meet and interview the manufacturers quality control and production personnel;

- observe that the quality control procedures being followed are in strict accordance with those outlined in the manufacturer's quality control manual;

- arrange for a sample or samples to be sent to an independent laboratory for testing.

6.2 On-Site Quality Assurance

Subgrade

Each day, the installer's superintendent and the Owner's Inspector shall inspect and the installer shall provide written certification that the subgrade for the HDPE liner has been prepared in accordance with the specifications and the manufacturer's recommendations.

Material

The Inspector shall be present when rolls are off-loaded at the site. Damaged rolls will be stored separately and inspected to determine acceptability. The Inspector will receive the manufacturer's certifications for all rolls delivered to the site. The Inspector shall observe all areas of the installed liner for defects, holes, blisters, or contamination.

Seams

With the Inspector present, the installer will conduct field test seams on the liner to verify that seaming conditions are satisfactory. Test seams shall be conducted at the beginning of each clay, and at least once each 4 hours, for each seaming apparatus used that day.

All test seams shall be made at a location selected by the Inspector in the area of the seaming and in contact with the subgrade. The test seam samples shall be 10-feet long for hot shoe welding and 3-feet long for extrusion welding with the seam centered lengthwise. Specimens 1-inch wide shall be cut form each opposite end of the test seam by the Inspector. The Inspector shall use a tensionmeter to test these specimens for shear and peel. If a test seam fails to meet field seam specifications, the seaming apparatus and/or seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive successful full test seams are achieved.

The Inspector shall conduct non-destructive tests on all field seams over the full length. In addition, Installer shall provide the Inspector with a minimum of one destructive test sample per 500-feet of seam length from a location specified by the Inspector. The Installer shall not be informed in advance of the sample location.

Sampling Procedure

In order to obtain test results prior to completion of liner installation, samples shall be cut by the Installer as the seaming progresses. Sampling times and locations shall be determined by the Inspector. The Inspector must witness the obtainment of all field test samples and the Installer shall mark all samples with their location roll and seam number. The Installer shall also record in written form the date, time, location, roll seam number, ambient temperatures, and pass or fail description. A copy of the information must be attached to each sample portion. All holes in the geomembrane resulting from obtaining the seam samples shall be immediately repaired. All patches shall be vacuum tested.

Size and Disposition of Samples

The samples shall be 12-inches wide by 24-inches long with the seam centered lengthwise. The sample shall be cut into two equal length pieces, half to be given to the Inspector and the other half to be given to the Owner's Representative. If the Installer desires a sample the size should be increased to 12-inches wide by 36-inches long.

Field Laboratory Testing

The Inspector shall cut ten 1-inch wide replicate specimens from his sample and these shall be tested by the Inspector. The Inspector shall test five specimens for seam strength and five for peel strength. To be acceptable, four out of the five replicate test specimens must pass. Any specimen that fails through the weld or by adhesion at the weldsheet interface is a non-film tear break.

7.0 FINAL REPORT

The Inspector shall prepare a Final Quality Assurance Summary Report certifying that the liner system has been installed in substantial conformance with the plans and specifications for the liner system. The report shall include testing results, record drawings, and the location of repairs and patches.

SECTION 02776
GEOSYNTHETIC CLAY LINER

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

Furnish all labor, materials, equipment and incidentals required to install the geosynthetic clay liner.

Related Work Specified Elsewhere.

Section 02200 - Earthwork
Section 02777 - High Density Polyethylene Liner

1.02 QUALITY ASSURANCE

The liner manufacturer shall provide a qualified representative to observe the installation of the liner. The representative shall remain on site during construction until, in his opinion, the Contractor can adequately complete the installation in strict accordance with these Specifications and manufacturers installation procedures.

The Owners quality assurance inspector will be on site during construction to observe the installation procedures.

Available Manufacturers. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work are limited to the following:

American Colloid Co. "Bentomat"
Gundle Lining Systems, Inc. "Gundseal"
James Clem Corp. "Claymax"
National Seal Co. "Bentofix"

1.03 SUBMITTALS

Include at least the following:

Certificate of Compliance

Manufacturer's quality control program and manual or descriptive documentation (submit to Engineer for submission to DER);

a set of installation drawings indicating the layout of the liner, as well as any variance or additional details which deviate from the Drawings shall be submitted for installation inspection and Record purposes; and

record drawings showing actual layout of sheets and locations of field seams.

1.04 PRODUCT HANDLING

The rolls or panels of liner shall be packaged and shipped by appropriate means so that no damage is caused. Transportation shall be the responsibility of the Contractor.

Materials shall be shipped and delivered to the site only after the required submittals have been received and approved by the Engineer. Off-loading and storage of the liner is the responsibility of the Contractor. The Contractor shall be responsible for replacing any damaged or unacceptable material at no cost to the Owner. No off-loading shall be done unless the Inspector is present. Damage during off-loading shall be documented by the Inspector and Contractor. The Engineer shall be the final authority on determination of damage.

The liner shall be stored so as to be protected from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat, or other damage.

The Contractor will be allocated sufficient space by the Owner to store the liner upon its arrival. On-site handling of the liner is the responsibility of the Contractor. Appropriate handling equipment shall be used when loading or moving rolled liner from one place to another. Appropriate equipment includes spreader and roll bars for deployment, cloth chokers and spreader bar for off-loading. Procedures for handling the liner shall be approved by the Inspector.

Liner damaged during transit, off-loading, handling, etc., shall be so identified and set aside. During the unrolling of the liner, the Contractor shall visually inspect the liner surface in the presence of the Inspector. Faulty or suspect areas shall be marked for testing and/or repair, as determined by the Inspector. Liner stock that is faulty (requires more than one patch per 5,000 square feet), shall be replaced by the Contractor at the Contractor's expense.

PART 2 - MATERIALS AND EQUIPMENT

2.01 MATERIAL SPECIFICATIONS

Liner Material. The clay liner shall be manufactured with not less than one pound per square foot of sodium bentonite adhered to a support fabric.

The liner material shall be so produced as to be free of holes, thin areas, damage, or any sign of contamination by foreign matter.

The lining material shall be manufactured to a minimum of 12-ft. width. Labels on the roll shall identify the product name, name of the manufacturer, lot number, and time of production.

The liner material shall meet the following physical characteristics:

Clay Mass/Unit Area	1.0 lb/ft.^{2}
Clay Thickness (Dry)	± 5mm
Hydraulic Conductivity	1 x 10 $^{-9}$ cm/sec (max)
Roll Width	12-ft. (min.)
Roll Length	82-ft. (min.)
Moisture Content	12 percent (max.)
Tensile Strength of Backing	78 lb/in. (min.)

2.02 FACTORY QUALITY

Raw Material. The manufacturer shall test the bentonite clay to ensure the consistency of the raw material quality. The manufacturer shall test for the following properties:

Montmorillonite Content
Moisture Content (ASTM D4643)
Percent Passing No. 200 Sieve
Swell USP-NF-XVII

The manufacturer shall also test the fabric backing for:

Mass Per Unit Area (ASTM D3776)
Thickness (ASTM D1777)
Grab Tensile Strength (ASTM D4632)
Trapezoidal Tear Strength (ASTM D4533)
Puncture Resistance (ASTM D4833)
Burst Strength (ASTM D3786)

As a result of this testing, the manufacturer shall certify as to the quality of the raw material as defined by the physical specifications.

PART 3 - EXECUTION

3.01 SUBGRADE PREPARATION

Surfaces to be lined shall be smooth and free of all rocks, stones, sticks, roots, sharp objects or debris of any kind. The surface shall provide a firm, unyielding foundation for the liner with no sudden sharp or abrupt changes or breaks.

The subgrade shall be compacted to a minimum of 90 percent modified proctor density (ASTM D1557) and sealed with a smooth drum or vibratory roller.

The installer shall certify in writing that the surface on which the liner will be installed is acceptable. After the supporting soil has been accepted by the manufacturer, it shall be the installer's responsibility to indicate to the Engineer any change in the supporting soil condition caused by natural conditions or occurrences that may require repair work. The installer shall provide for dewatering and for drying of the subgrade, as required during construction. Special care shall be taken to maintain the prepared soil surface. Any damage to the subgrade caused by this installation shall be repaired by the Contractor in accordance with the requirements of the applicable Earthwork specifications.

3.02 INSTALLATION

The installer shall be responsible for inspection of the panel rolls at the job site. Should rolls show damage from transit, they will be so identified and set aside. During the unrolling of the panel rolls, the installer shall visually inspect the sheet surface. Any faulty areas shall be marked and repaired in an approved manner by the installer.

The method used to unroll the panels shall not cause damage to the liner or to the supporting soil.

The method used to place the panels shall minimize wrinkles (especially differential wrinkles between adjacent panels). Wrinkles shall be identified as to proper location and compensation shall be identified on the Contractor's and Inspector's drawings. Ballast shall be used to prevent relocation of the compensating wrinkles by wind.

Adequate loading (e.g. sand bags, tires, or similar items that will not damage the liner) shall be placed to prevent uplift by wind (in case of high winds, continuous loading is recommended along edges of panels to minimize risk of wind flow under the panels).

Direct contact with the liner shall be minimized, i.e., in traffic areas it shall be protected by extra liner or other suitable materials.

Liner Placement and Layout. The panels shall be laid out according to approved engineering plans and shall not deviate from the approved plans except with the prior approval of the Owner and the Engineer. Panels shall be overlapped as required for seaming.

The number of panels to be deployed in any day shall be limited to the number of panels which can be anchored, inspected, repaired, and covered with High Density Polyethylene Liner (HDPE) that same day. The panels must be dry when installed and dry when covered.

No equipment used shall damage the liner by handling, trafficking, wetting, or other means.

No personnel working on the liner shall smoke, wear damaging shoes, or engage in other activities that could damage the liner.

Liner clamps or other metal tools shall be padded, must have rounded corners, and shall never be tossed or thrown.

Field Seaming. Once the first run has been laid, adjoining runs shall be laid with a 6-inch minimum overlap on longitudinal seams, and 12-inches on the panel end seams. All dirt, gravel or other debris shall be removed from the overlap area of the liner.

Seam overlaps shall be placed such that the direction of flow is from the top sheet to the bottom sheet to form a shingle effect.

The free end at the crest shall be locked into the anchor trench as shown on the drawings.

If "Bentomat" or "Bentofix" is used, a 2-inch wide continuous strip of bentonite powder or granules shall be placed on top of the unrolled mat approximately 4-inches from the edge prior to completing the overlap seam. The bentonite shall be applied at the rate of 1/4 lb. per linear foot.

Patching and Repairs. Irregular shapes, cuts, or tears in installed bentonite liner should be covered with sufficient liner to provide a 12-inch overlap on all adjoining liner.

3.03 ACCEPTANCE

The Contractor shall retain all ownership and responsibility for the liner until acceptance by the Owner and Engineer.

END OF SECTION

SECTION 02777
HIGH DENSITY POLYETHYLENE LINER

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

Furnish all labor, materials, equipment and incidentals required to install the high density polyethylene liner.

Related Work Specified Elsewhere.

Section 02200 - Earthwork
Section 02710 - Subdrainage System
Section 03300 - Concrete
Section 02776 - Geosynthetic Clay Liner

1.02 QUALITY ASSURANCE

The liner shall be installed by the manufacturer or manufacturer approved Contractor under the direction of a qualified supervisor and who shall be in absolute charge of this installation and responsible for the work performed.

Available Manufacturers. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work are limited to following:

Gundle Lining Systems, Inc.
SLT
National Seal Co.
PolyAmerica, Inc.

1.03 SUBMITTALS

Include at least the following:

Certificate of Compliance

Manufacturer's quality control program and manual or descriptive documentation (submit to Engineer for submission to DER);

a set of installation drawings indicating the layout of the liner, as well as any variance or additional details which deviate from the Drawings shall be submitted for installation inspection and Record purposes; and

record drawings showing actual layout of sheets and locations of field seams.

1.04 PRODUCT HANDLING

The rolls or panels of liner shall be packaged and shipped by appropriate means so that no damage is caused. Transportation shall be the responsibility of the Contractor.

Materials shall be shipped and delivered to the site only after the required submittals have been received and approved by the Engineer. Off-loading and storage of the liner is the responsibility of the Contractor. The Contractor shall be responsible for replacing any damaged or unacceptable material at no cost to the Owner. No off-loading shall be done unless the Inspector is present. Damage during off-loading shall be documented by the Inspector and Contractor. The Engineer shall be the final authority on determination of damage.

The liner shall be stored so as to be protected from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat, or other damage.

The Contractor will be allocated sufficient space by the Owner to store the liner upon its arrival. On-site handling of the liner is the responsibility of the Contractor. Appropriate handling equipment shall be used when loading or moving rolled liner from one place to another. Appropriate equipment includes spreader and roll bars for deployment, cloth chokers and spreader bar for off-loading. Procedures for handling the liner shall be approved by the Inspector.

Liner damaged during transit, off-loading, handling, etc., shall be so identified and set aside. During the unrolling of the liner, the Contractor shall visually inspect the sheet surface in the presence of the Inspector. Faulty or suspect areas shall be marked for testing and/or repair, as determined by the Inspector. Liner stock that is faulty (requires more than one patch per 5,000 square feet), shall be replaced by the Contractor at the Contractor's expense.

1.05 WARRANTY

A written warranty shall be obtained from the Contractor as part of the contract documents. This document shall warrant both the quality of the material and workmanship. The Contractor shall certify in writing that the installed liner product meets the requirements of these specifications and the project plans and under normal weathering the sheet material is warranted for a period of 20 years and that the sheet will not fail due to seam failure, environmental stress cracking, or flex fatigue within 20 years of installation.

PART 2 - MATERIALS AND EQUIPMENT

2.01 MATERIAL SPECIFICATIONS

Liner Material. The membrane liner shall comprise HDPE material manufactured of new, first-quality products designed and manufactured specifically for the purpose of liquid containment in hydraulic structures.

The liner material shall be so produced as to be free of holes, blisters, undispersed raw materials, or any sign of contamination by foreign matter. Any such defect shall be repaired using the extrusion welding technique in accordance with the manufacturer's recommendations.

The lining material shall be manufactured to a minimum of 22-ft. width. Labels on the roll shall identify the thickness, length, width, and manufacturer's mark number. There shall be no factory seams.

The fabricated seams (if applicable) and field seams shall meet the following specifications:

Shear Strength	(ASTM D3083)	Minimum 90% of Film Tear Bond
Peel Strength	(ASTM D413	Minimum of 50% of Film Tear Bond

The liner material shall meet the following typical physical characteristics:

Density	(ASTM D1505)	0.940 G/cc Min.
Melt Index	(ASTM D1238)	0.4 G/10 min. Max.
Sheet Thickness, 60 mil	(ASTM D1593)	±10%
Tensile Strength (Yield)	(ASTM D638)	140 lb./in.
Tensile Strength (Break)	(ASTM D 638)	240 lb./in.
Elongation at Yield	(ASTM D638)	13%
Elongation at Break	(ASTM D638)	700%
Modulus of Elasticity	(ASTM D638)	90,000 psi
Tear Resistance, Min.	(ASTM D1004 DIE C)	45 lb.
Puncture Resistance	(FTMS 101 Method 2065)	80 lb.
Resistance to Soil Burial Max. Change	(ASTM D3083)	± 10%

Dimensional Stability (Each Direction Max. Change)	(ASTM D1204 212 Deg. F, 15 Min.)	± 3%
Environmental Stress Carbon Black Content	(ASTM D1693)	1,500 hours (ASTM D1603) 2-3%

Extrusion Resin. Resin used for extrusion welding shall be HDPE produced from the same material as the liner resin. Physical properties shall be the same as those of the resin used in the manufacture of the HDPE liner. Extrusion resin shall be supplied in black.

2.02 FACTORY QUALITY

Raw Material. The manufacturer shall test the resin to ensure the consistency of the raw material quality. The manufacturer shall test for the following properties:

Density	(ASTM D1505)	1/resin batch
Melt Index	(ASTM D1238)	1/resin batch

The results of this testing shall be evaluated and, if the physical specifications are not satisfied, the resin batch in question shall not be accepted for extruding the liner. As a result of this testing, the manufacturer/installer shall be prepared to certify as to the quality of the raw material as defined by the physical specifications.

Fabrication. The carbon black for ultraviolet protection shall be added to the otherwise pure HDPE resin as part of the sheet extrusion process. The manufacturer/installer shall perform testing to maintain the specific carbon black content and to determine if adequate dispersion is being achieved.

Automatic monitoring of controlling parameters shall be an integral part of the extrusion process. Surface appearance and sheet thickness shall be monitored continuously during the extrusion process. The sheet thickness shall be continuously monitored by electronic methods and/or periodically inspected manually. An acceptable sheet thickness shall be ± 10% of the specified thickness. Sheets in excess of +10% of the specified thickness shall be acceptable; those in excess of -10% of the specified thickness shall be rejected.

Finished goods shall be periodically tested to evaluate its stress-deformation characteristics.

The following test program shall be conducted at least twice per shift:

Tensile and Elongation property
Thickness of Material
Carbon Black content
Environmental Stress Cracking test
Puncture Resistance

The above tests shall be conducted in accordance with ASTM methods as listed in Paragraph 2.01 - MATERIAL SPECIFICATIONS, to ensure that the finished products meet the minimum Specifications. Finished products shall be sampled at least twice per shift. Samples shall be taken even if they cannot be tested until a later date. Sampling shall be done by production personnel.

All factory control tests shall be properly recorded and shall be made available to the Engineer for his review, if required.

PART 3 - EXECUTION

3.01 SUBGRADE PREPARATION

Surfaces to be lined shall be smooth and free of all rocks, stones, sticks, roots, sharp objects or debris of any kind. The surface shall provide a firm, unyielding foundation for the liner with no sudden sharp or abrupt changes or breaks.

The installer shall certify in writing that the surface on which the liner will be installed is acceptable. After the supporting soil has been accepted by the installer, it shall be the installer's responsibility to indicate to the Engineer any change in the supporting soil condition caused by natural conditions or occurrences that may require repair work. The installer shall provide for dewatering and for drying of the subgrade, as required during construction. Special care shall be taken to maintain the prepared soil surface. Any damage to the subgrade caused by this installation shall be repaired at the installer's expense in accordance with the requirements of the applicable Earthwork specifications.

3.02 INSTALLATION

Installation of liner shall be performed by the liner manufacturer or certified installer. The installer shall be responsible for inspection of the panel rolls at the jobsite. Should rolls show damage from transit, they will be so identified by the installer and set aside. During the unrolling of the panel rolls, the installer shall visually inspect the sheet surface. Any faulty areas shall be marked and repaired in an approved manner by the installer.

The method used to unroll the panels shall not cause scratches or crimps in the liner and shall not damage the supporting soil.

The method used to place the panels shall minimize wrinkles (especially differential wrinkles between adjacent panels). Wrinkles shall be identified as to proper location and compensation shall be identified on the Contractor's and Inspector's drawings. Ballast shall be used to prevent relocation of the compensating wrinkles by wind.

Adequate loading (e.g. sand bags, tires, or similar items that will not damage the liner) shall be placed to prevent uplift by wind (in case of high winds, continuous loading is recommended along edges of panels to minimize risk of wind flow under the panels).

Direct contact with the liner shall be minimized, i.e., in traffic areas it shall be protected by extra liner or other suitable materials.

Liner Placement and Layout. The HDPE panels shall be laid out according to approved engineering plans and shall not deviate from the approved plans except with the prior approval of the Owner and the Engineer. Panels shall be overlapped sufficiently to permit welding without having to splice small sections of materials.

The number of panels to be deployed in any day shall be limited to the number of panels which can be seamed.

No equipment used shall damage the liner by handling, trafficking, leakage of hydrocarbons, or other means.

No personnel working on the liner shall smoke, wear damaging shoes, or engage in other activities that could damage the liner.

Liner clamps or other metal tools shall be padded, must have rounded corners, and shall never be tossed or thrown.

Field Seaming. All areas to be seamed shall be cleaned of dust and dirt and completely dry prior to seaming.

All sheeting shall be welded together by means of the manufacturer's approved method, including hot wedge, hot shoe, or extrusion welding process. The composition of extrudate shall be identical to the lining material.

All seams on side slope shall run vertically to the center line of the dike. Seams parallel with center line of the dike on the side slope shall not be allowed.

No "fish mouths" shall be allowed within the seam area. Where "fish mouths" occur, the material shall be cut, overlapped, and an overlap extrusion weld shall be applied. All welds on completion of the work shall be tightly bonded. Any membrane area showing injury due to excessive scuffing, puncture, or distress from any cause shall be replaced or repaired with an additional piece of HDPE membrane.

Unless authorized in writing by the Engineer, welding shall be performed between 20°F and 104°F as measured 6-inches above liner surface. No welding shall be performed in the presence of free moisture.

Between 20°F and 40°F, seaming shall be allowed if the liner is preheated by a hot air device and if there is not excessive cooling resulting from wind.

Seam Tests, Sampling and Quality Control. A test weld three-feet long from each welding machine shall be made twice during each shift. Samples from weld shall be tested in shear and peel, and no welder may start work until sample weld has been approved. The test weld shall be marked with date, ambient temperature, and welding machine number.

Specimens of weld 1/2-inch to 1-inch wide shall be cut from the test weld and tested in shear and peel. Shear and peel test shall be based on ASTM D638 test standards.

Random weld samples shall be removed from the installed welded sheeting at a frequency of one sample per 400-feet weld. All weld samples shall be marked with their location roll and seam number. The installer shall also record in written form, the date, time, ambient temperature, seaming unit, number, name of seamer, welding apparatus, temperatures and pressures. Destructive shear and peel tests shall be done on weld samples based on ASTM D638 test standards.

In addition to random weld sampling, visual examination of the seam shall be conducted by the installer to detect any suspect areas, breaks, or holes in the weld for ensuring watertightness.

As required by the Engineer to verify the factory seam quality, non-destructive air pressure test and/or vacuum test shall be conducted by the installer to test up to 20% of factory seams and field seams. Defective seams shall be marked and repaired in accordance with repair procedure approved by the Engineer.

All field installation quality control tests shall be properly recorded and shall be made available for Engineer's review, if required.

3.03 ACCEPTANCE

The Contractor shall retain all ownership and responsibility for the liner until acceptance by the Owner and Engineer.

END OF SECTION
02777-5

APPENDIX E
LEACHATE FLOW CALCULATIONS

APPENDIX E

DESCRIPTION OF THE HELP PROGRAM
(Hydrologic Evaluation of Landfill Performance)

The Hydrologic Evaluation of Landfill Performance (HELP) model was developed to help hazardous waste landfill designers and regulators evaluate the hydrologic performance of proposed landfill designs. This quasi-two-dimensional deterministic water-budget model was adapted from the HSSWDS (Hydrologic Simulation Model for Estimating Percolation at Solid Waste Disposal Sites) model of the U.S. Environmental Protection Agency (Perrier and Gibson, 1980; Schroeder and Gibson, 1982) and the CREAMS (Chemical Runoff and Erosion from Agricultural Management Systems) and SWRRB (Simulator for Water Resources in Rural Basins) models of the U.S. Agricultural Research Service (Knisel, 1980; Arnold et al., 1986). From daily climatological data, the HELP model computes daily runoff, evapotranspiration, percolation, and lateral drainage for the landfill (cap, waste cell, leachate collection system and liner). Results are expressed as daily, monthly, annual and long-term average water budgets.

The HELP program simulates daily water movement into, through and out of a landfill. In general, the hydrologic processes modelled by the program can be divided into two categories: surface processes and subsurface processes. The surface processess modelled is, interception of rainfall by vegetation, surface runoff and surface evaporation. The subsurface processes modelled are soil evaporation, plant transpiration, vertical unsaturated drainage, barrier-layer percolation and lateral saturated drainage.

Daily infiltration into the landfill is determined indirectly from a surface-water balance. Each day, infiltration is assumed to equal the sum of rainfall and snowmelt, minus the sum or runoff and surface evaporation. No liquid water is held in surface storage from one day to the next. A rainfall-runoff relationship is used to determine the runoff resulting from the combined snowmelt and rainfall. Surface evaporation is then computed. Surface evaporation is not allowed to exceed the intercepted rainfall. The rainfall that does not run off or evaporate is assumed to infiltrate into the landfill.

The first subsurface processes considered are soil evaporation and plant transpiration from the evaporative zone of the upper subprofile. These are computed on a daily basis. The evapotranspirative demand is distributed among the seven modelling segments in the evaporative zone.

The other subsurface processes are modelled one subprofile at a time, from top to bottom, using a six-hour time step. If the subprofile contains a barrier layer, the sum of the lateral drainage and barrier-layer percolation is first estimated. A storage-routing procedure is then used to redistribute the soil water among the modelling segments that comprise the subprofile. This procedure accounts for the external inflows and outflows computed or estimated previously (infiltration or percolation into the top segment, evaporatranspiration from the segments in the evaporative zone, lateral drainage and barrier-layer percolation) and vertical unsaturated drainage within the sub-profile. The routing calculations, which proceed from top to bottom, yield estimates of lateral drainage and barrier-layer percolation. If the sum of these two outflows is not sufficiently close to the initial estimate, then the routing calculations are repeated using the improved estimate. Iteration continues until acceptable convergence is achieved. If the subprofile contains no barrier layer, lateral drainage and percolation are zero, so no iteration is needed.

For this project the following data was used as input to the computer model:

Precipitation - The climatological data was obtained from the National Oceanic and Atmospheric Administration (NOAA). The data used was from the Daytona Beach AP station. This station is only a few miles from the landfill site.

Manual options were used for the Tomoka Landfill as follows:

Layer #1: Top soil, 6-inch thick, vertical percolation layer type.
Layer #2: Sandy drainage, 6-inch thick, lateral drainage layer type.
Layer #3: Compacted clay, 6-inch thick, barrier soil liner layer type.
Layer #4: Soil 6-inch thick, vertical percolation layer type.
Layer #5: Solid Waste, 1,308-inches thick, vertical percolation layer type.
Layer #6: Sandy drainage, 24-inches thick layer type, vertical percolation layer type.
Layer #7: Geonet, 1/8-inch thick layer type, lateral drainage layer type.
Layer #8: Liner HDPE/Clay Composite, 60 mil barrier liner with a flexible membrane liner.

The default options were used for the following:

Runoff curve number.
Soil testure class and characteristics.
Initial soil water content.

Leakage fraction for synthetic membrane.

Summary of results from the HELP program is as follows:

Peak daily values for years 87 through 91		
SCS runoff curve number	=	63.71
Precipitation	=	5.27 inches
Runoff	=	4.31 inches
Percolation from layer 3	=	0.0010 inches
Percolation from layer 8	=	0.0000 inches
Head on layer 8	=	0.0 inches

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VOLUSIA COUNTY
TOMOKA LANDFILL EXPANSION
5-19-92

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1309 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1309 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.003000000026 CM/SEC

LAYER 2

LATERAL DRAINAGE LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.3339 VOL/VOL
FIELD CAPACITY	=	0.0529 VOL/VOL
WILTING POINT	=	0.0245 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0529 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000289999996 CM/SEC
SLOPE	=	4.00 PERCENT
DRAINAGE LENGTH	=	550.0 FEET

LAYER 3

BARRIER SOIL LINER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4000 VOL/VOL
FIELD CAPACITY	=	0.3560 VOL/VOL
WILTING POINT	=	0.2899 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4000 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000010000 CM/SEC

LAYER 4

VERTICAL PERCOLATION LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.3808 VOL/VOL
FIELD CAPACITY	=	0.1924 VOL/VOL
WILTING POINT	=	0.1043 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1924 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000026000000 CM/SEC

LAYER 5

VERTICAL PERCOLATION LAYER

THICKNESS	=	1308.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2324 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 6

LATERAL DRAINAGE LAYER

THICKNESS	=	24.00 INCHES
POROSITY	=	0.3339 VOL/VOL
FIELD CAPACITY	=	0.0529 VOL/VOL
WILTING POINT	=	0.0245 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0529 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000289999996 CM/SEC

LAYER 7

LATERAL DRAINAGE LAYER

THICKNESS	=	0.12 INCHES
POROSITY	=	0.4370 VOL/VOL
FIELD CAPACITY	=	0.0624 VOL/VOL
WILTING POINT	=	0.0245 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0624 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.005799999926 CM/SEC
SLOPE	=	4.00 PERCENT
DRAINAGE LENGTH	=	550.0 FEET

LAYER 8

BARRIER SOIL LINER WITH FLEXIBLE MEMBRANE LINER

THICKNESS	=	0.25 INCHES
POROSITY	=	0.4000 VOL/VOL
FIELD CAPACITY	=	0.3560 VOL/VOL
WILTING POINT	=	0.2899 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4000 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000010000 CM/SEC
LINER LEAKAGE FRACTION	=	0.00001000

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	63.71
TOTAL AREA OF COVER	=	1263240. SQ FT
EVAPORATIVE ZONE DEPTH	=	22.00 INCHES
UPPER LIMIT VEG. STORAGE	=	4.7454 INCHES
INITIAL VEG. STORAGE	=	3.6909 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	310.0520 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND SOLAR RADIATION FOR DAYTONA FLORIDA

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	0
END OF GROWING SEASON (JULIAN DATE)	=	367

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
65.20	65.60	70.10	73.80	77.60	80.40
82.00	82.50	81.40	77.30	71.60	67.00

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 87 THROUGH 91

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.81	1.70	1.16	8.66	6.28
	5.22	5.13	8.73	5.69	5.31	3.90
STD. DEVIATIONS	3.08	1.75	0.80	0.39	5.73	2.54
	3.73	2.43	3.86	2.95	3.82	2.42
RUNOFF						
TOTALS	1.529	0.067	0.052	0.000	1.376	0.402
	0.000	0.000	2.192	0.721	1.710	1.458
STD. DEVIATIONS	2.505	0.150	0.116	0.000	1.887	0.554
	0.000	0.000	3.190	1.272	3.779	1.867
EVAPOTRANSPIRATION						
TOTALS	1.407	1.962	3.609	1.814	5.045	6.547
	5.926	4.793	5.344	4.724	3.012	2.431
STD. DEVIATIONS	0.616	0.609	0.825	0.761	2.200	1.072
	3.005	2.015	0.777	0.312	0.217	0.806
LATERAL DRAINAGE FROM LAYER 2						
TOTALS	0.0681	0.0470	0.0294	0.0014	0.0150	0.0232
	0.0134	0.0139	0.0423	0.0507	0.0559	0.0666
STD. DEVIATIONS	0.0309	0.0213	0.0242	0.0016	0.0245	0.0242
	0.0158	0.0241	0.0373	0.0218	0.0317	0.0391
PERCOLATION FROM LAYER 3						
TOTALS	0.0252	0.0214	0.0188	0.0027	0.0071	0.0129
	0.0111	0.0085	0.0167	0.0224	0.0219	0.0249
STD. DEVIATIONS	0.0030	0.0026	0.0053	0.0029	0.0089	0.0085
	0.0092	0.0105	0.0076	0.0023	0.0063	0.0045
LATERAL DRAINAGE FROM LAYER 7						
TOTALS	0.0007	0.0007	0.0008	0.0008	0.0008	0.0008
	0.0009	0.0010	0.0010	0.0010	0.0010	0.0011
STD. DEVIATIONS	0.0006	0.0006	0.0006	0.0006	0.0007	0.0007
	0.0007	0.0008	0.0008	0.0008	0.0008	0.0009
PERCOLATION 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	0.0000	0.0000	0.0000	0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 87 THROUGH 91

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	56.93	(7.808)	5992599.	100.00
RUNOFF	9.507	(5.243)	1000838.	16.70
EVAPOTRANSPIRATION	46.615	(3.995)	4907127.	81.89
LATERAL DRAINAGE FROM LAYER 2	0.4268	(0.0901)	44931.	0.75
PERCOLATION FROM LAYER 3	0.1935	(0.0087)	20374.	0.34
LATERAL DRAINAGE FROM LAYER 7	0.0107	(0.0086)	1122.	0.02
PERCOLATION FROM LAYER 8	0.0000	(0.0000)	0.	0.00
CHANGE IN WATER STORAGE	0.366	(1.207)	38581.	0.64

PEAK DAILY VALUES FOR YEARS 87 THROUGH 91

	(INCHES)	(CU. FT.)
PRECIPITATION	5.27	554772.9
RUNOFF	4.311	453857.7
LATERAL DRAINAGE FROM LAYER 2	0.0043	452.9
PERCOLATION FROM LAYER 3	0.0010	109.7
HEAD ON LAYER 3	12.7	
LATERAL DRAINAGE FROM LAYER 7	0.0001	8.3
PERCOLATION FROM LAYER 8	0.0000	0.0
HEAD ON LAYER 8	0.0	
SNOW WATER	0.00	0.0

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3954

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0401

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FINAL WATER STORAGE AT END OF YEAR 91

LAYER	(INCHES)	(VOL/VOL)
1	2.60	0.4331
2	2.00	0.3339
3	2.40	0.4000
4	1.34	0.2233
5	304.38	0.2327
6	1.84	0.0767
7	0.02	0.1657
8	0.10	0.4000
SNOW WATER	0.00	

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SCS PROGRAM

PROJECT NAME . . . . :TOMOKA LANDFILL INITIAL EXPANSION
REVIEWER . . . . . :MIGUEL B. DELGADO
PROJECT AREA . . . . : 45.19 ACRES
GROUND STORAGE . . . : 5.00 INCHES
TERMINATION DISCHARGE : .01 CFS
DISTRIBUTION TYPE . . : ORANGE COUNTY
RETURN FREQUENCY . . . : 25.00 YEARS
RAINFALL DURATION . . : 1-DAY
24-HOUR RAINFALL . . . : 9.00 INCHES
REPORTING SEQUENCE . . : INCREMENTAL

STAGE (FT)	STORAGE (AF)
19.00	.00
25.00	138.10

PUMP NO.	PUMP ON ELEVATION (FEET)	PUMP OFF ELEVATION (FEET)	PUMP DISCHARGE (GPM)	PUMP DESCRIPTION
1	19.80	19.80	800.00	LEACHATE PUMP

TIME (HR)	RAIN FALL (IN)	ACCUM. RUNOFF (IN)	BASIN DISCHGE (CFS)	ACCUM. INFLOW (AF)	RESERVOIR VOLUME (AF)	RESERVOIR ACCUM. OUTFLOW (AF)	RESERVOIR INSTANT DISCHGE (CFS)	RESERVOIR AVERAGE DISCHGE (CFS)	RESERVOIR STAGE (FT)
.00	.00	.00	.0	.0	.0	.0	.0	.0	19.00
.50	.01	.00	.0	.0	.0	.0	.0	.0	19.00
1.00	.02	.00	.0	.0	.0	.0	.0	.0	19.00
1.50	.04	.00	.0	.0	.0	.0	.0	.0	19.00
2.00	.06	.00	.0	.0	.0	.0	.0	.0	19.00
2.50	.12	.00	.0	.0	.0	.0	.0	.0	19.00
3.00	.19	.00	.0	.0	.0	.0	.0	.0	19.00
3.50	.31	.00	.0	.0	.0	.0	.0	.0	19.00
4.00	.44	.00	.0	.0	.0	.0	.0	.0	19.00
4.50	.63	.00	.0	.0	.0	.0	.0	.0	19.00
5.00	.82	.00	.0	.0	.0	.0	.0	.0	19.00
5.50	1.02	.00	.0	.0	.0	.0	.0	.0	19.00
6.00	1.22	.01	1.2	.0	.0	.0	.0	.0	19.00
6.50	1.77	.10	10.7	.4	.4	.0	.0	.0	19.02
7.00	2.32	.28	17.5	1.1	1.1	.0	.0	.0	19.06
7.50	2.90	.52	24.0	2.0	2.0	.0	.0	.0	19.13
8.00	3.47	.82	28.4	3.1	3.1	.0	.0	.0	19.20
8.50	4.41	1.38	54.0	5.3	5.3	.0	.0	.0	19.34
9.00	4.81	1.54	24.5	6.3	6.3	.0	.0	.0	19.44
9.50	5.99	2.50	90.3	9.5	9.5	.0	.0	.0	19.63
10.00	6.62	2.98	44.8	11.3	11.3	.0	.0	.0	19.79

TIME (HR)	RAIN FALL (IN)	ACCUM. RUNOFF (IN)	BASIN DISCHRGE (CFS)	ACCUM. INFLOW (AF)	RESERVOIR VOLUME (AF)	RESERVOIR ACCUM. OUTFLOW (AF)	RESERVOIR INSTANT DISCHRGE (CFS)	RESERVOIR AVERAGE DISCHRGE (CFS)	RESERVOIR STAGE (FT)
10.50	6.55	3.23	23.5	12.3	12.3	.0	1.0	1.0	19.97
11.00	7.28	3.58	26.6	13.3	13.2	.1	1.0	1.0	19.94
11.50	7.49	3.66	15.4	14.0	13.8	.2	1.0	1.0	19.99
12.00	7.69	3.83	14.7	14.1	14.3	.3	1.0	1.0	20.02
12.50	7.88	3.99	13.9	15.2	14.9	.3	1.0	1.0	20.06
13.00	8.06	4.15	15.1	15.9	15.4	.4	1.0	1.0	20.10
13.50	8.22	4.26	10.3	16.2	15.8	.4	1.0	1.0	20.13
14.00	8.34	4.37	5.7	16.6	16.2	.5	1.0	1.0	20.15
14.50	8.40	4.41	4.2	16.8	16.3	.5	1.0	1.0	20.17
15.00	8.45	4.46	4.2	17.0	16.5	.7	1.0	1.0	20.18
15.50	8.50	4.50	3.5	17.1	16.3	.8	1.0	1.0	20.18
16.00	8.54	4.53	3.5	17.3	16.4	.9	1.0	1.0	20.19
16.50	8.58	4.56	2.8	17.4	16.5	.9	1.0	1.0	20.19
17.00	8.62	4.60	3.5	17.5	16.5	1.0	1.0	1.0	20.19
17.50	8.67	4.64	3.5	17.7	16.6	1.1	1.0	1.0	20.20
18.00	8.71	4.68	3.5	17.8	16.7	1.1	1.0	1.0	20.20
18.50	8.75	4.71	2.8	17.9	16.7	1.2	1.0	1.0	20.21
19.00	8.78	4.74	2.8	18.0	16.8	1.2	1.0	1.0	20.21
19.50	8.81	4.76	2.1	18.1	16.8	1.3	1.0	1.0	20.22
20.00	8.85	4.79	2.8	18.2	16.8	1.4	1.0	1.0	20.22
20.50	8.86	4.81	1.4	18.3	16.8	1.5	1.0	1.0	20.22
21.00	8.89	4.83	2.1	18.4	16.8	1.6	1.0	1.0	20.22
21.50	8.91	4.85	1.4	18.5	16.8	1.7	1.0	1.0	20.22
22.00	8.94	4.87	2.1	18.5	16.8	1.7	1.0	1.0	20.22
22.50	8.96	4.88	1.4	18.6	16.8	1.8	1.0	1.0	20.22
23.00	8.98	4.91	2.1	18.7	16.8	1.9	1.0	1.0	20.22
23.50	8.99	4.92	.7	18.7	16.8	1.9	1.0	1.0	20.21
24.00	9.00	4.92	.7	18.7	16.7	2.0	1.0	1.0	20.21
24.50	9.00	4.92	.0	18.7	16.6	2.1	1.0	1.0	20.21
25.00	9.00	4.92	.0	18.7	16.6	2.1	1.0	1.0	20.20
25.50	9.00	4.92	.0	18.7	16.5	2.2	1.0	1.0	20.19
26.00	9.00	4.92	.0	18.7	16.4	2.3	1.0	1.0	20.19
26.50	9.00	4.92	.0	18.7	16.4	2.3	1.0	1.0	20.18
27.00	9.00	4.92	.0	18.7	16.3	2.4	1.0	1.0	20.18
27.50	9.00	4.92	.0	18.7	16.2	2.5	1.0	1.0	20.17
28.00	9.00	4.92	.0	18.7	16.1	2.6	1.0	1.0	20.17
28.50	9.00	4.92	.0	18.7	16.1	2.6	1.0	1.0	20.16
29.00	9.00	4.92	.0	18.7	16.0	2.7	1.0	1.0	20.16
29.50	9.00	4.92	.0	18.7	15.9	2.8	1.0	1.0	20.15
30.00	9.00	4.92	.0	18.7	15.8	2.9	1.0	1.0	20.15
30.50	9.00	4.92	.0	18.7	15.8	2.9	1.0	1.0	20.14
31.00	9.00	4.92	.0	18.7	15.7	3.0	1.0	1.0	20.14
31.50	9.00	4.92	.0	18.7	15.6	3.1	1.0	1.0	20.13
32.00	9.00	4.92	.0	18.7	15.5	3.2	1.0	1.0	20.13

TIME (HR)	RAIN FALL (IN)	ACCUM. RUNOFF (IN)	BASIN DISCHRGE (CFS)	ACCUM. INFLOW (AF)	RESERVOIR VOLUME (AF)	RESERVOIR ACCUM. OUTFLOW (AF)	RESERVOIR INSTANT DISCHRGE (CFS)	RESERVOIR AVERAGE DISCHRGE (CFS)	RESERVOIR STAGE (FT)
32.50	9.00	4.92	.0	18.7	15.5	3.2	1.0	1.0	20.12
33.00	9.00	4.92	.0	18.7	15.4	3.3	1.0	1.0	20.11
33.50	9.00	4.92	.0	18.7	15.3	3.4	1.0	1.0	20.11
34.00	9.00	4.92	.0	18.7	15.2	3.4	1.0	1.0	20.10
34.50	9.00	4.92	.0	18.7	15.2	3.5	1.0	1.0	20.10
35.00	9.00	4.92	.0	18.7	15.1	3.5	1.0	1.0	20.09
35.50	9.00	4.92	.0	18.7	15.0	3.7	1.0	1.0	20.09
36.00	9.00	4.92	.0	18.7	14.9	3.7	1.0	1.0	20.08
36.50	9.00	4.92	.0	18.7	14.9	3.8	1.0	1.0	20.08
37.00	9.00	4.92	.0	18.7	14.8	3.9	1.0	1.0	20.07
37.50	9.00	4.92	.0	18.7	14.7	4.0	1.0	1.0	20.07
38.00	9.00	4.92	.0	18.7	14.7	4.0	1.0	1.0	20.06
38.50	9.00	4.92	.0	18.7	14.6	4.1	1.0	1.0	20.06
39.00	9.00	4.92	.0	18.7	14.5	4.2	1.0	1.0	20.05
39.50	9.00	4.92	.0	18.7	14.4	4.3	1.0	1.0	20.05
40.00	9.00	4.92	.0	18.7	14.4	4.3	1.0	1.0	20.04
40.50	9.00	4.92	.0	18.7	14.3	4.4	1.0	1.0	20.03
41.00	9.00	4.92	.0	18.7	14.2	4.5	1.0	1.0	20.03
41.50	9.00	4.92	.0	18.7	14.1	4.6	1.0	1.0	20.02
42.00	9.00	4.92	.0	18.7	14.1	4.6	1.0	1.0	20.02
42.50	9.00	4.92	.0	18.7	14.0	4.7	1.0	1.0	20.01
43.00	9.00	4.92	.0	18.7	13.9	4.8	1.0	1.0	20.01
43.50	9.00	4.92	.0	18.7	13.8	4.9	1.0	1.0	20.00
44.00	9.00	4.92	.0	18.7	13.8	4.9	1.0	1.0	20.00
44.50	9.00	4.92	.0	18.7	13.7	5.0	1.0	1.0	19.99
45.00	9.00	4.92	.0	18.7	13.6	5.1	1.0	1.0	19.99
45.50	9.00	4.92	.0	18.7	13.6	5.1	1.0	1.0	19.98
46.00	9.00	4.92	.0	18.7	13.5	5.2	1.0	1.0	19.98
46.50	9.00	4.92	.0	18.7	13.4	5.3	1.0	1.0	19.97
47.00	9.00	4.92	.0	18.7	13.3	5.4	1.0	1.0	19.97
47.50	9.00	4.92	.0	18.7	13.3	5.4	1.0	1.0	19.96
48.00	9.00	4.92	.0	18.7	13.2	5.5	1.0	1.0	19.95
48.50	9.00	4.92	.0	18.7	13.1	5.6	1.0	1.0	19.95
49.00	9.00	4.92	.0	18.7	13.0	5.7	1.0	1.0	19.94
49.50	9.00	4.92	.0	18.7	13.0	5.7	1.0	1.0	19.94
50.00	9.00	4.92	.0	18.7	12.9	5.8	1.0	1.0	19.93
50.50	9.00	4.92	.0	18.7	12.8	5.9	1.0	1.0	19.93
51.00	9.00	4.92	.0	18.7	12.7	6.0	1.0	1.0	19.92
51.50	9.00	4.92	.0	18.7	12.7	6.0	1.0	1.0	19.92
52.00	9.00	4.92	.0	18.7	12.6	6.1	1.0	1.0	19.91
52.50	9.00	4.92	.0	18.7	12.5	6.2	1.0	1.0	19.91
53.00	9.00	4.92	.0	18.7	12.4	6.3	1.0	1.0	19.90
53.50	9.00	4.92	.0	18.7	12.4	6.3	1.0	1.0	19.90
54.00	9.00	4.92	.0	18.7	12.3	6.4	1.0	1.0	19.89

TIME (HR)	RAIN FALL (IN)	ACCUM. RUNOFF (IN)	BASIN DISCHRGE (CFS)	ACCUM. INFLOW (AF)	RESERVOIR VOLUME (AF)	ACCUM. OUTFLOW (AF)	INSTANT DISCHRGE (CFS)	AVERAGE DISCHRGE (CFS)	STAGE (FT)
54.50	9.00	4.92	.0	18.7	12.2	6.5	1.0	1.0	19.89
55.00	9.00	4.92	.0	18.7	12.2	6.5	1.0	1.0	19.89
55.50	9.00	4.92	.0	18.7	12.1	6.6	1.0	1.0	19.87
56.00	9.00	4.92	.0	18.7	12.0	6.7	1.0	1.0	19.87
56.50	9.00	4.92	.0	18.7	11.9	6.8	1.0	1.0	19.86
57.00	9.00	4.92	.0	18.7	11.9	6.9	1.0	1.0	19.86
57.50	9.00	4.92	.0	18.7	11.8	6.9	1.0	1.0	19.85
58.00	9.00	4.92	.0	18.7	11.7	7.0	1.0	1.0	19.85
58.50	9.00	4.92	.0	18.7	11.6	7.1	1.0	1.0	19.84
59.00	9.00	4.92	.0	18.7	11.5	7.1	1.0	1.0	19.84
59.50	9.00	4.92	.0	18.7	11.5	7.2	1.0	1.0	19.83
60.00	9.00	4.92	.0	18.7	11.4	7.3	1.0	1.0	19.83
60.50	9.00	4.92	.0	18.7	11.3	7.4	1.0	1.0	19.82
61.00	9.00	4.92	.0	18.7	11.3	7.4	1.0	1.0	19.82
61.50	9.00	4.92	.0	18.7	11.2	7.5	1.0	1.0	19.81
62.00	9.00	4.92	.0	18.7	11.1	7.6	1.0	1.0	19.81
62.50	9.00	4.92	.0	18.7	11.0	7.7	.0	1.0	19.80

SUMMARY INFORMATION

MAXIMUM STAGE WAS 20.22 FEET AT 20.25 HOURS
MAXIMUM DISCHARGE WAS 1.8 CFS AT 10.25 HOURS

PUMPING HISTORY

PUMP 1 "ON " AT 10.25 HOURS
PUMP 1 "OFF" AT 62.50 HOURS

APPENDIX F
STORMWATER FLOW CALCULATIONS

APPENDIX F

STORMWATER FLOW CALCULATIONS

The drainage facilities for this project were designed to keep surface runoff from the proposed landfill separate from runoff from other parts of the site and to provide complete retention of stormwater on-site.

The proposed landfill will be constructed with side slopes not greater than 4 to 1 and with terraces after every 20-feet of vertical rise. The maximum runoff will occur when the landfill has been closed and a clay cap constructed. The clay layer will be covered with soil and grass. The landfill will be surrounded by a perimeter retention pond. The pond will be designed to regain full capacity for a design storm within 72 hours of the onset of the storm by percolation.

The computer program used in this application is titled "Basin Runoff Networking" (BRN), created by James J. Boyd, Dade City, Florida. This program is being used by several engineering firms and applications with data generated by this program have been used by F.D.E.R., SJRWMD, SWFWMD, Hillsborough County, FDOT, Sarasota County, Pinellas County, Pasco County, Hernando County and other regulatory agencies.

All computer modeling and hand calculations required in the design analysis are contained in this report.

Assumptions:

1. Curve number for capped landfill is 89.16. This curve number is reflective of the impermeable cover and 12-inch of top soil with grass. This situation is not directly referenced in the SJRWMD Technical Publication No. SJ 85-5, but was assumed based on previous landfill design.

2. Ground water elevation data was gathered from several months of monitoring and the seasonal high water table was determined to be at el. 23.0 NGVD.

3. The design storm used in the design of the proposed stormwater facilities is a 25 year, 24-hour 9-inch intensity using SCS Type II (Florida Modified) distribution curve.

The following calculations show that the 25 year storm will raise the water level in the retention pond to 28.09, well below the overflow elevation. They also show that the 100 year 24 hour storm of 11-inches will raise the water level to 28.56. By setting the overflow weir elevation at 28.6 the runoff from both the 25 year storm and the 100 year storm will be retained on site.

TOMOKA LANDFILL EXPANSION
DRAINAGE CALCULATIONS

Proposed Conditions - 25 yr. storm, 24-hour duration, 9-inch rainfall
(Refer to proposed drainage plan)

Contributing Areas:	1	Pond
Acreage:	31.77	18.07
Length (ft.)	1,100	N/A
ground slope (%)	12.91	N/A

	AREA	% Area	CN	CN
Proposed Landfill	31.77	63.74	83	52.90
Proposed Pond	18.07	36.26	100	36.26
	49.84	100.00		89.16

$S = 1000/89.16 - 10 = 1.22$ $\quad Q = (9 - .2 \times 1.22)^2/(9 + .8 \times 1.22) = 7.69"$

Total Storage Volume Required $\quad \frac{7.69"}{12}(49.84) = 31.94$ ac. ft.

Design High Water (DHW) EL. 29.0

Pre-Development Discharge

Contributing Areas:	1
Acreage:	49.84
Length (ft.)	1,100
Ground Slope (%)	0.70
Curve Number:	69

Composite Discharge: 132.31 CFS

Pond Drawdown Calculations

Soil Permeabilities

Soil Type	Depth (feet)	k permeability (cm/sec.)
Brown to Gray fine sand	2 - 10	10^{-2} to 10^{-4}
Gray silty sand	3 - 20	1.7×10^{-5}
Olive-Gray Clayey sand	0 - 19	2.5×10^{-5}
Olive-Gray to Yellow Gray very fine sand	0 - 14	2.6×10^{-4}

Average K (min.) = 2.58×10^{-3} cm/sec (0.30 ft/hr)

Use one third of permeability rate to account for saturated conditions
i.e. K = 0.10 ft/hr

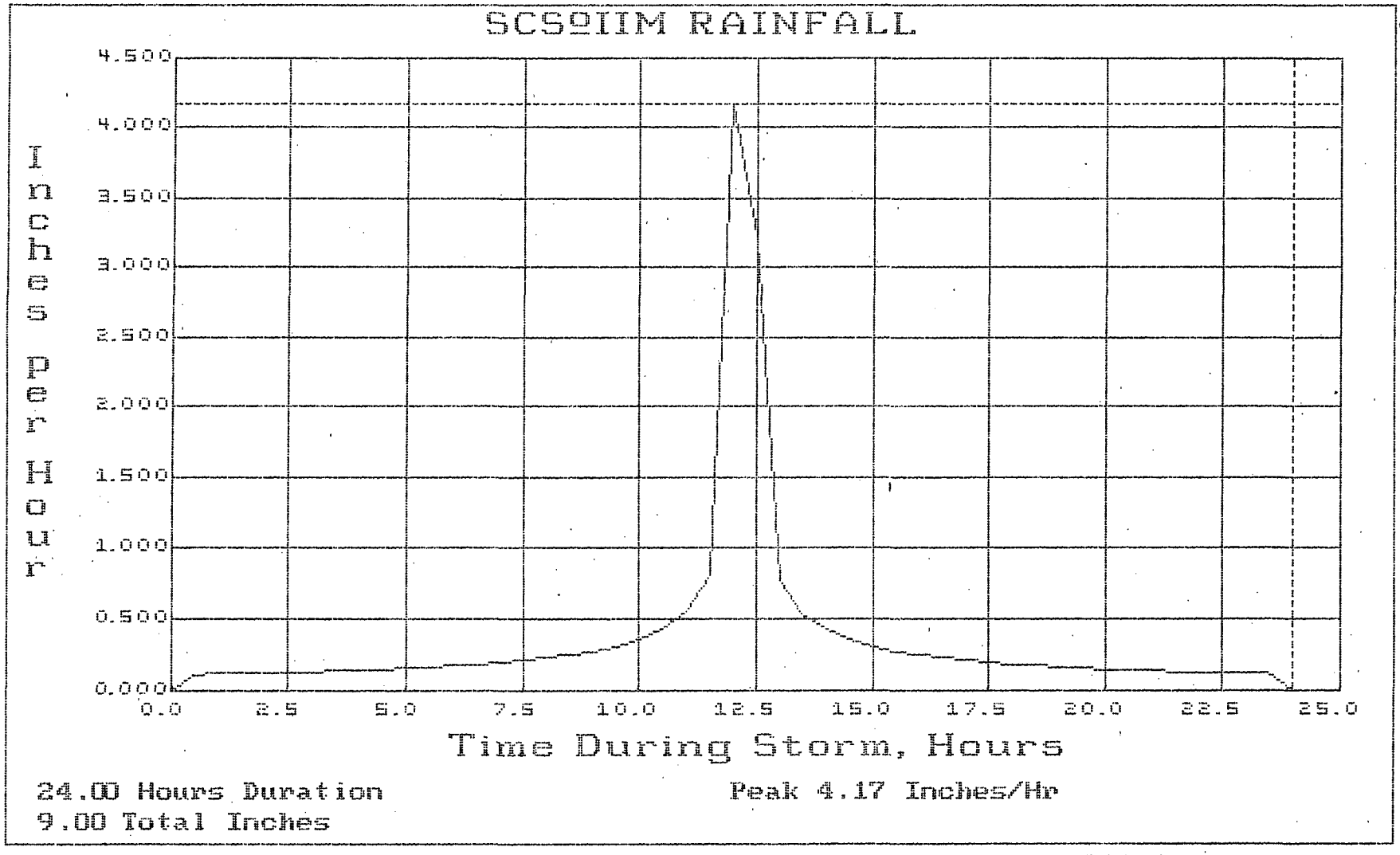
Criteria: Retention basins shall again provide the capacity for the given volume of stormwater within 72-hours following the storm event. (SJRWMD A.H.)

Retention Volume = 31.94 ac. ft. x 43560 $ft.^2/ac$ = 1,391,306.40 $ft.^3$

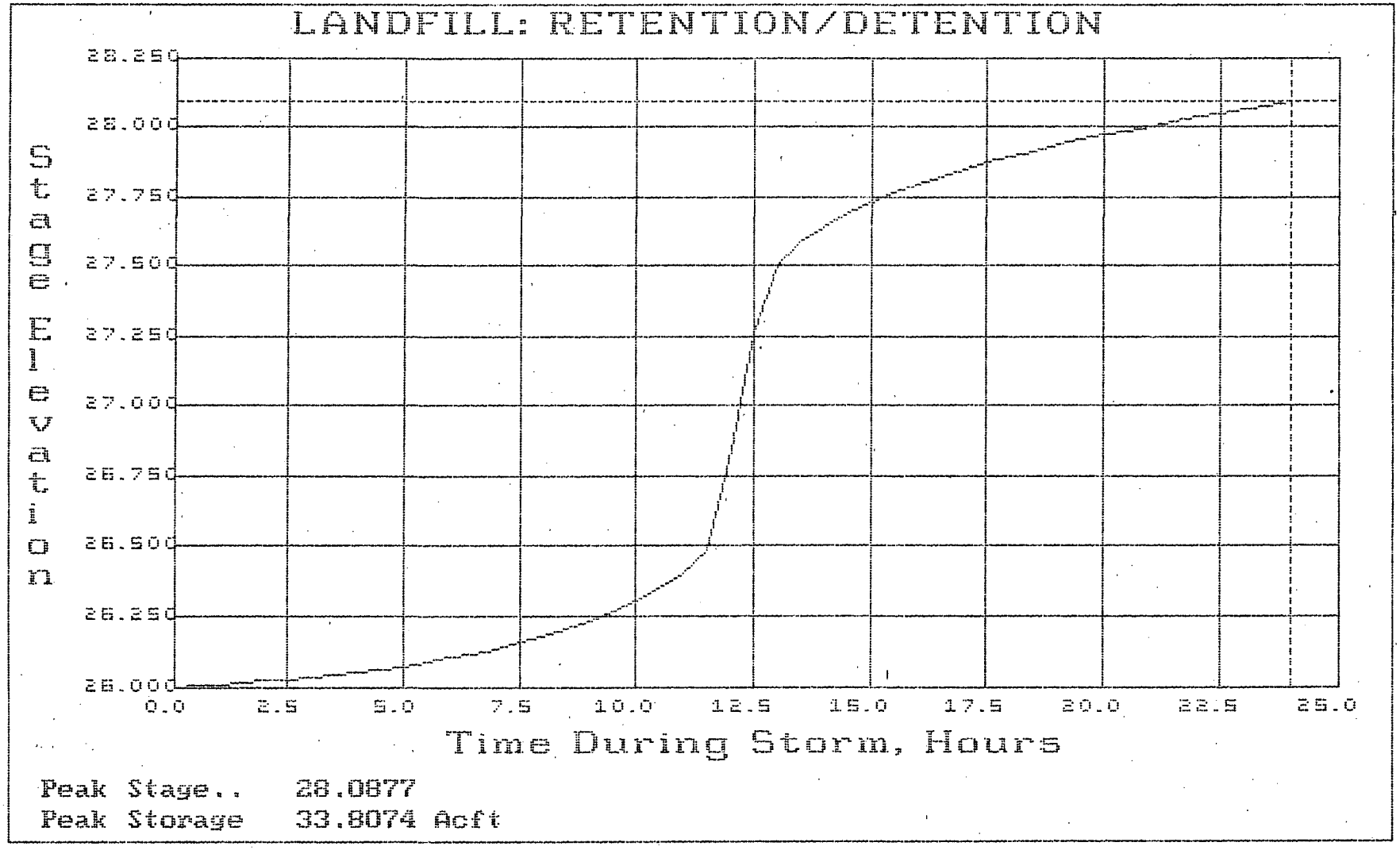
Surface area of pond bottom = 661,676.40 $ft.^2$ at El. 26.0

Pond drawdown capacity
0.10 ft/hr x 661,676.40 $ft.^2$ = 66,167.64 $ft.^3/hr$

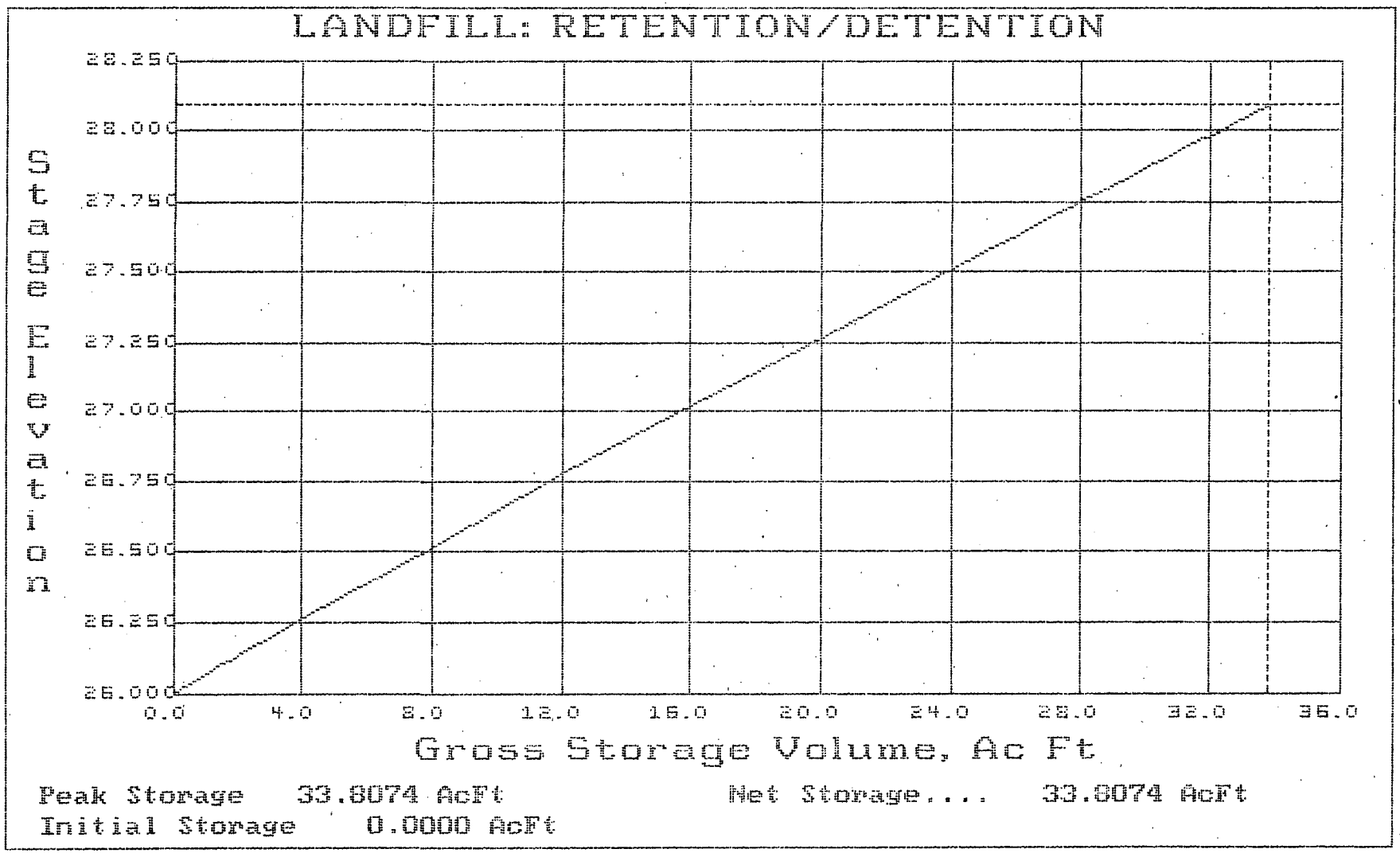
$$Tp \text{ (ponding time)} = \frac{1,391,306.40}{66,167.64} = 21.03 \text{ hours} << 72 \text{ hours}$$



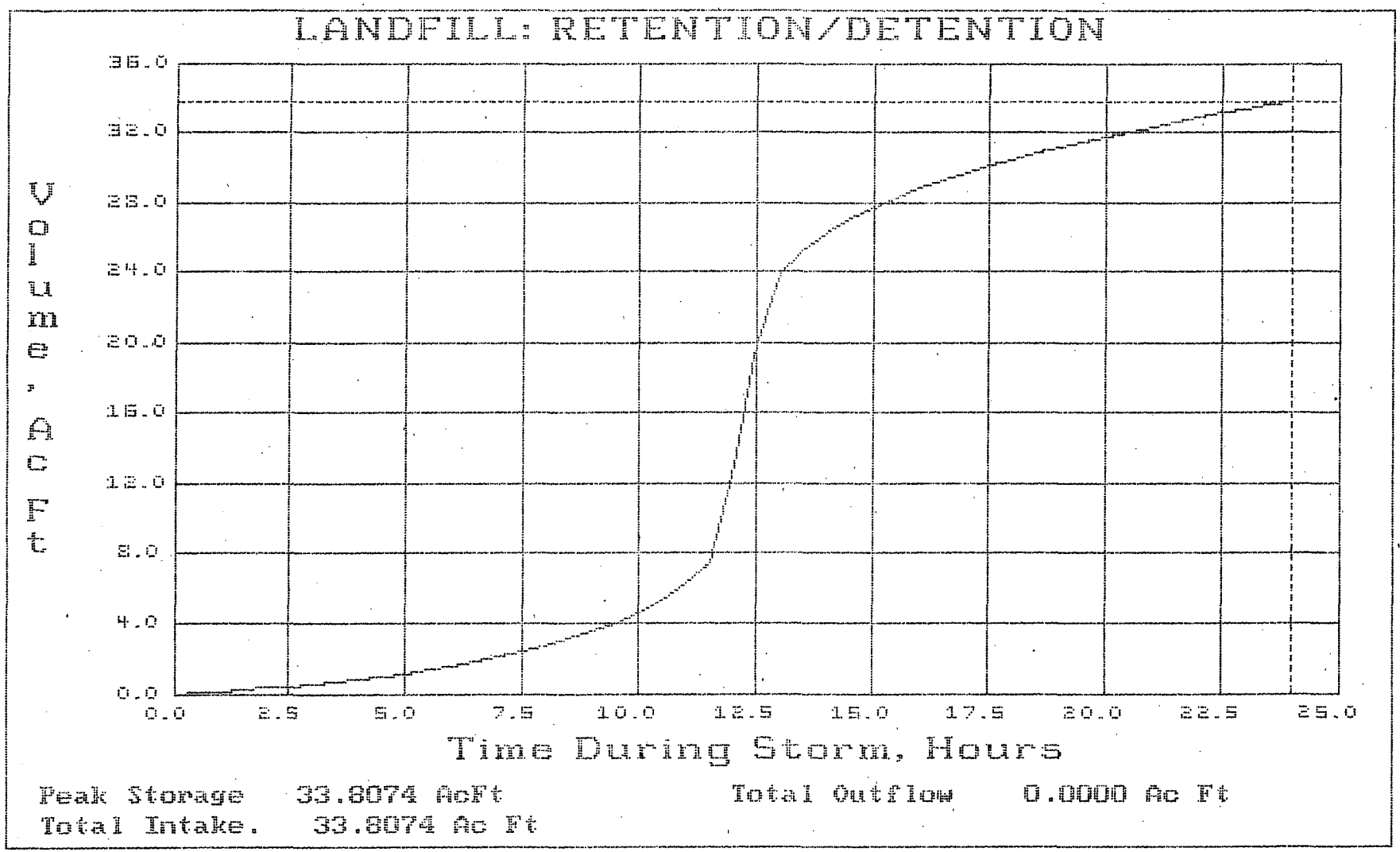
BRN 2.3: PROJECT BY BRILEY, WILD & ASSOCIATES



BRN 2.3: PROJECT BY BRILEY, WILD & ASSOCIATES



BRN 2.3: PROJECT BY BRILEY, WILD & ASSOCIATES



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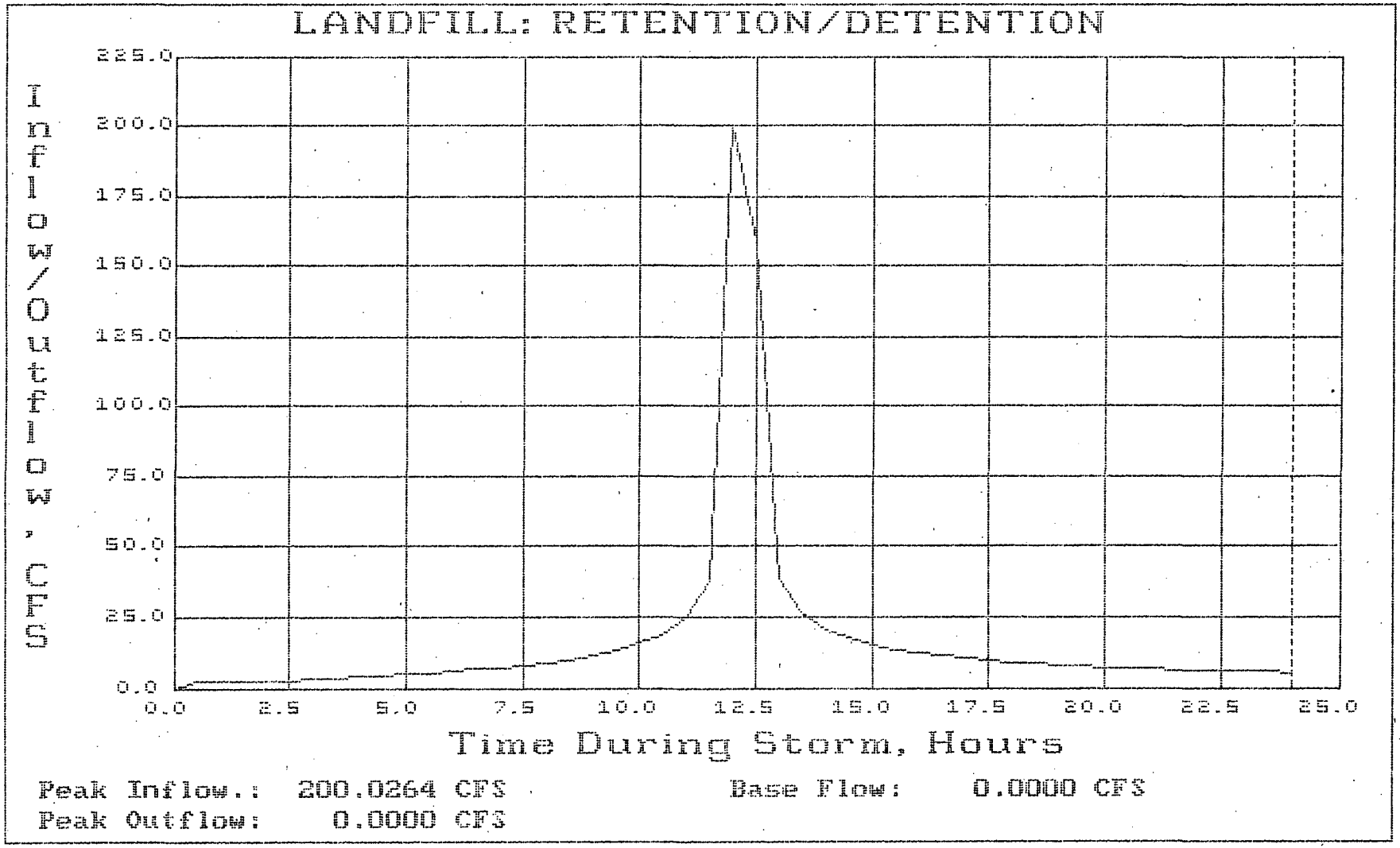

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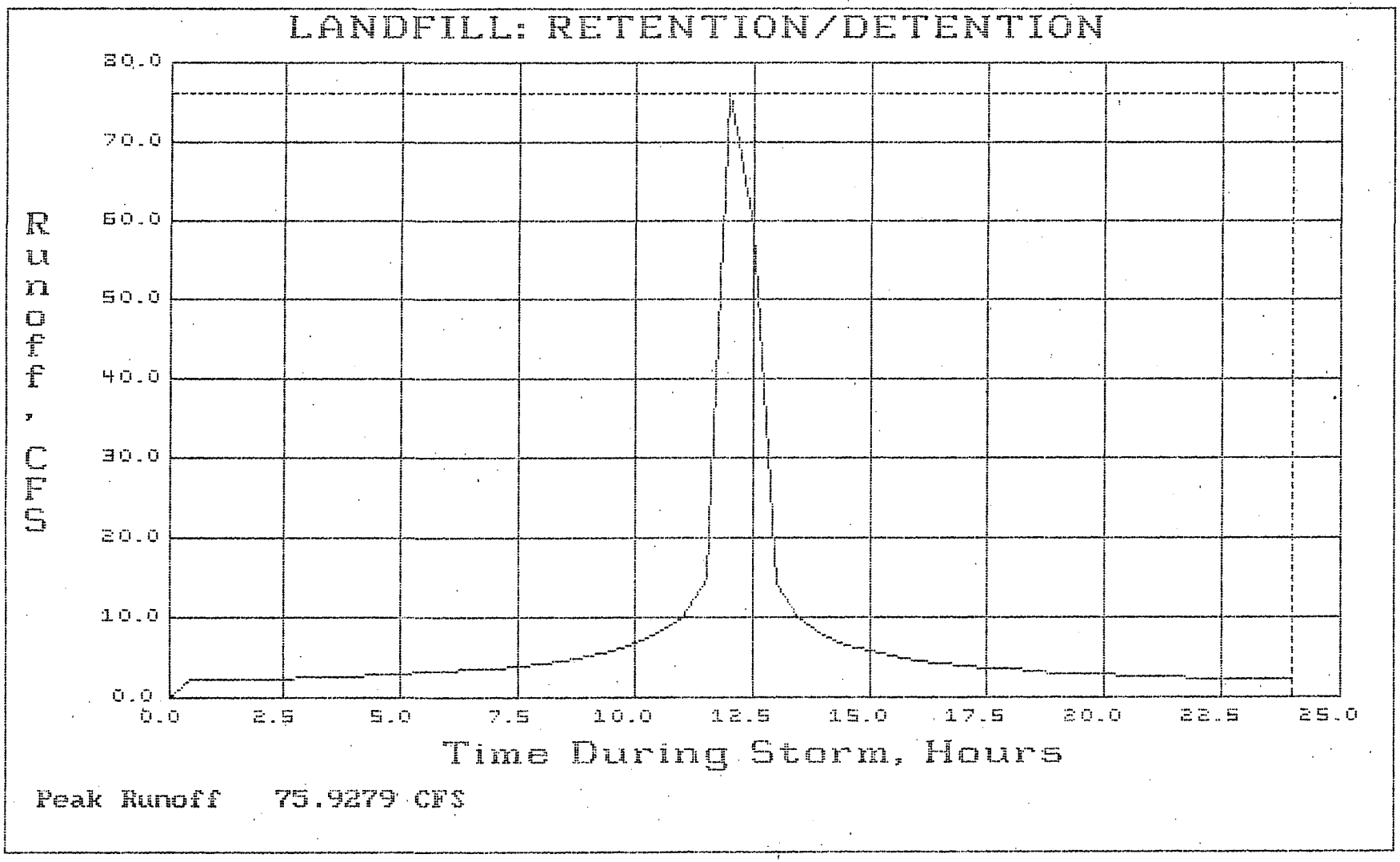

BRN 2.3: PROJECT BY BRILEY, WILD & ASSOCIATES

LANDFILL: RETENTION/DETENTION, [POND]

Time	Rain	Runoff	Stage	CFS In	CFS Out	ACFT In	Storage	ACFT Out
0.000	0.000	0.000	26.000	0.000	0.000	0.000	0.000	0.000
0.500	0.053	1.946	26.003	1.946	0.000	0.040	0.040	0.000
1.000	0.108	2.000	26.008	2.008	0.000	0.122	0.122	0.000
1.500	0.165	2.075	26.013	2.075	0.000	0.206	0.206	0.000
2.000	0.224	2.147	26.019	2.147	0.000	0.293	0.293	0.000
2.500	0.285	2.226	26.025	2.317	0.000	0.386	0.386	0.000
3.000	0.349	2.312	26.032	2.763	0.000	0.491	0.491	0.000
3.500	0.415	2.407	26.040	3.228	0.000	0.614	0.614	0.000
4.000	0.484	2.512	26.050	3.698	0.000	0.758	0.758	0.000
4.500	0.556	2.628	26.060	4.181	0.000	0.920	0.920	0.000
5.000	0.632	2.758	26.072	4.684	0.000	1.103	1.103	0.000
5.500	0.711	2.904	26.086	5.216	0.000	1.308	1.308	0.000
6.000	0.796	3.070	26.100	5.789	0.000	1.535	1.535	0.000
6.500	0.885	3.261	26.117	6.415	0.000	1.788	1.788	0.000
7.000	0.981	3.483	26.135	7.113	0.000	2.067	2.067	0.000
7.500	1.083	3.745	26.156	7.907	0.000	2.377	2.377	0.000
8.000	1.195	4.059	26.178	8.830	0.000	2.723	2.723	0.000
8.500	1.317	4.446	26.203	9.935	0.000	3.111	3.111	0.000
9.000	1.452	4.934	26.232	11.300	0.000	3.550	3.550	0.000
9.500	1.605	5.572	26.264	13.055	0.000	4.053	4.053	0.000
10.000	1.782	6.453	26.302	15.440	0.000	4.642	4.642	0.000
10.500	1.995	7.765	26.348	18.952	0.000	5.352	5.352	0.000
11.000	2.269	9.976	26.407	24.827	0.000	6.257	6.257	0.000
11.500	2.675	14.796	26.489	37.566	0.000	7.546	7.546	0.000
12.000	4.759	75.928	26.800	200.026	0.000	12.455	12.455	0.000
12.500	6.371	58.774	27.257	158.515	0.000	19.863	19.863	0.000
13.000	6.757	14.057	27.503	38.136	0.000	23.926	23.926	0.000
13.500	7.023	9.687	27.583	26.317	0.000	25.257	25.257	0.000
14.000	7.232	7.604	27.641	20.677	0.000	26.228	26.228	0.000
14.500	7.406	6.350	27.688	17.279	0.000	27.012	27.012	0.000
15.000	7.557	5.499	27.728	14.972	0.000	27.679	27.679	0.000
15.500	7.691	4.879	27.762	13.288	0.000	28.263	28.263	0.000
16.000	7.812	-4.403	27.793	11.996	0.000	28.785	28.785	0.000
16.500	7.922	-4.025	27.821	10.971	0.000	29.260	29.260	0.000
17.000	8.024	3.717	27.847	10.132	0.000	29.696	29.696	0.000
17.500	8.119	3.459	27.871	9.433	0.000	30.100	30.100	0.000
18.000	8.208	3.240	27.893	8.839	0.000	30.477	30.477	0.000
18.500	8.292	3.052	27.914	8.328	0.000	30.832	30.832	0.000
19.000	8.371	2.888	27.933	7.881	0.000	31.167	31.167	0.000
19.500	8.446	2.744	27.952	7.488	0.000	31.485	31.485	0.000
20.000	8.518	2.616	27.970	7.140	0.000	31.787	31.787	0.000
20.500	8.587	2.500	27.987	6.827	0.000	32.075	32.075	0.000
21.000	8.652	2.397	28.003	6.545	0.000	32.352	32.352	0.000
21.500	8.716	2.303	28.018	6.290	0.000	32.617	32.617	0.000
22.000	8.776	2.218	28.033	6.058	0.000	32.872	32.872	0.000
22.500	8.835	2.139	28.048	5.844	0.000	33.118	33.118	0.000
23.000	8.892	2.068	28.061	5.649	0.000	33.355	33.355	0.000
23.500	8.947	2.001	28.075	5.467	0.000	33.585	33.585	0.000
24.000	9.000	1.940	28.088	5.300	0.000	33.807	33.807	0.000

Node	Name	Type	Inflow	Outflow	Stage	Storage
# 1	LANDFILL EXPANSION	SUBAREA	124.099	124.099	25.000	0.000
# 2	RETENTION/DETENTION	POND	200.026	0.000	28.088	33.807

Project File: LANDFILL, NETWORK TOKENS

```
00001: Number of Paths   1
00002: Path Number   1
00003: From Node..   1
00004: To Node....   2
00005: Path Type..   1
00006: *
00007: Number of Flow Controls.          0
00008: ************************************
00009: Number of Nodes   2
00010: Node   1
00011: LANDFILL EXPANSION
00012: Type 1
00013: SCS_484
00014: Total acres.............    31.7700
00015: Weighted curve number...    89.1600
00016: Hydraulic length, feet..   400.0000
00017: Ground slope, percent...     4.0000
00018: Percent impervious cover    90.0000
00019: Initial abstraction k...     0.2000
00020: Flood elevation.........    40.0000
00021: Dry Weather Base CFS....     0.0000
00022: Initial Water Elevation.    25.0000
00023: ************************************
00024: Node   2
00025: RETENTION/DETENTION
00026: Type 2
00027: Number of data points...          2
00028: Stage    29.0000  Acres    18.0700
00029: Stage    26.0000  Acres    15.1900
00030: Rational coefficient....     1.0000
00031: Initial water...........    25.0000
00032: Dry Weather Base CFS....     0.0000
00033: ************************************
00034: Checksum 3
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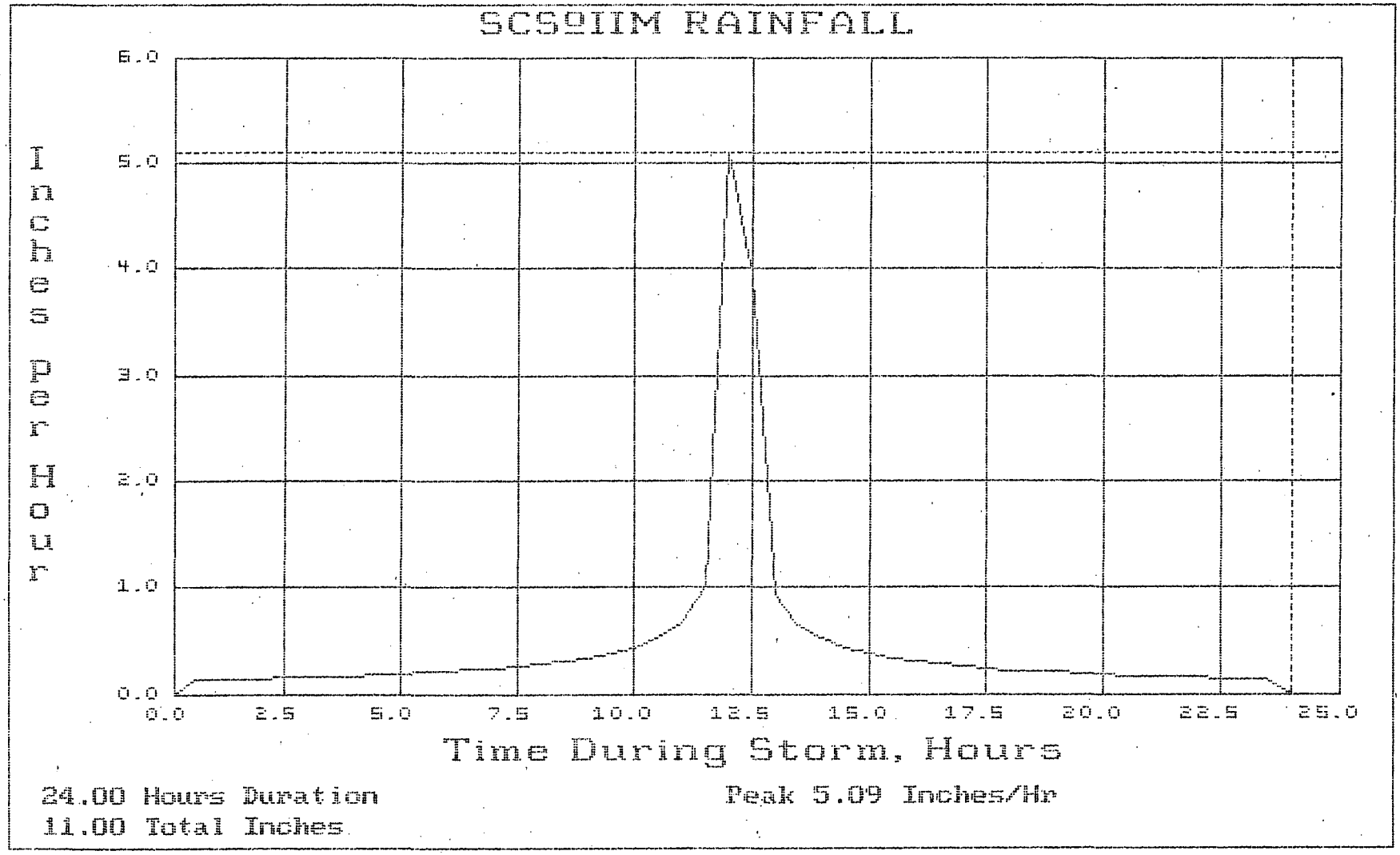
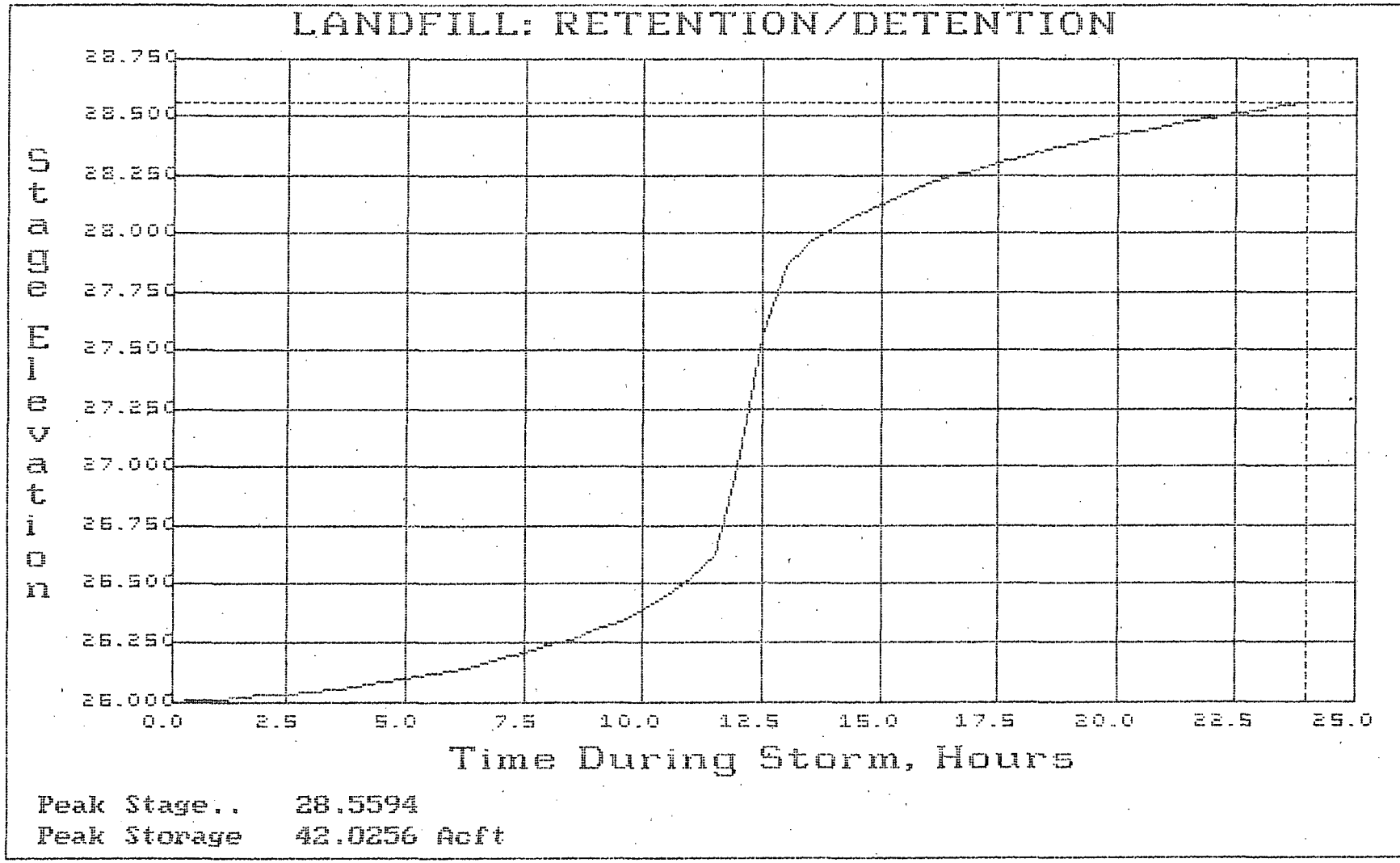


BRN 2.3: PROJECT BY BRILEY, WILD & ASSOCIATES



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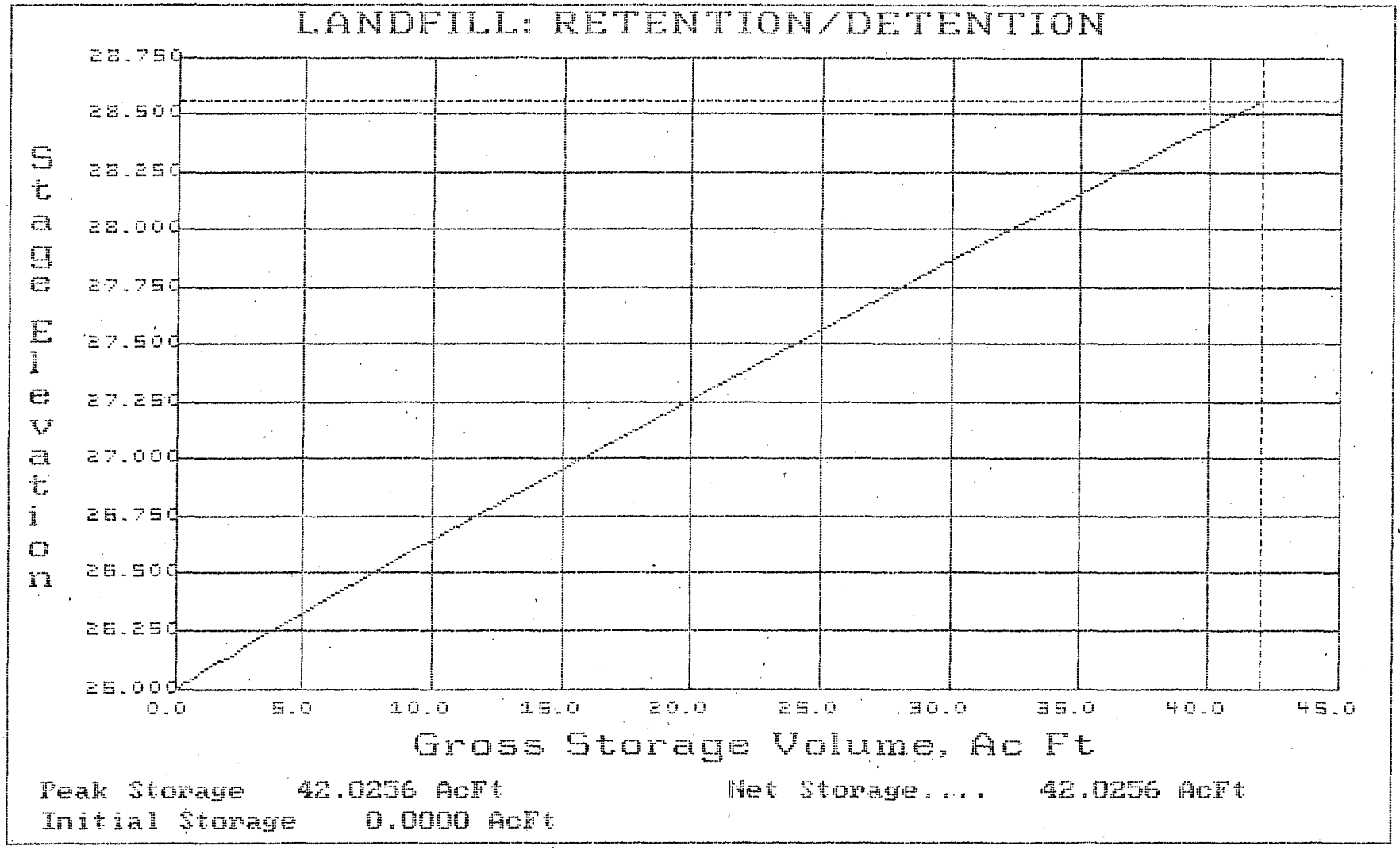

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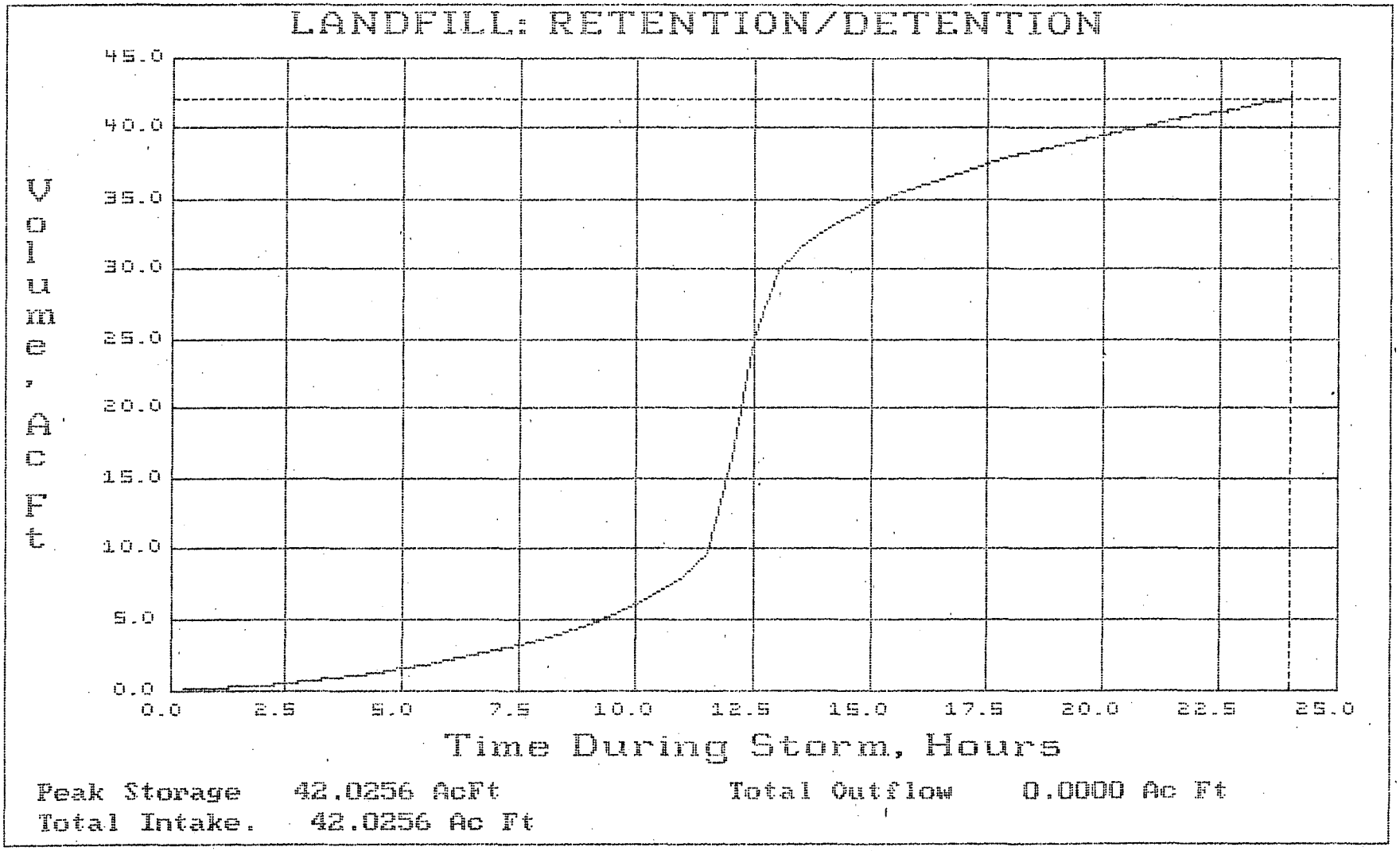

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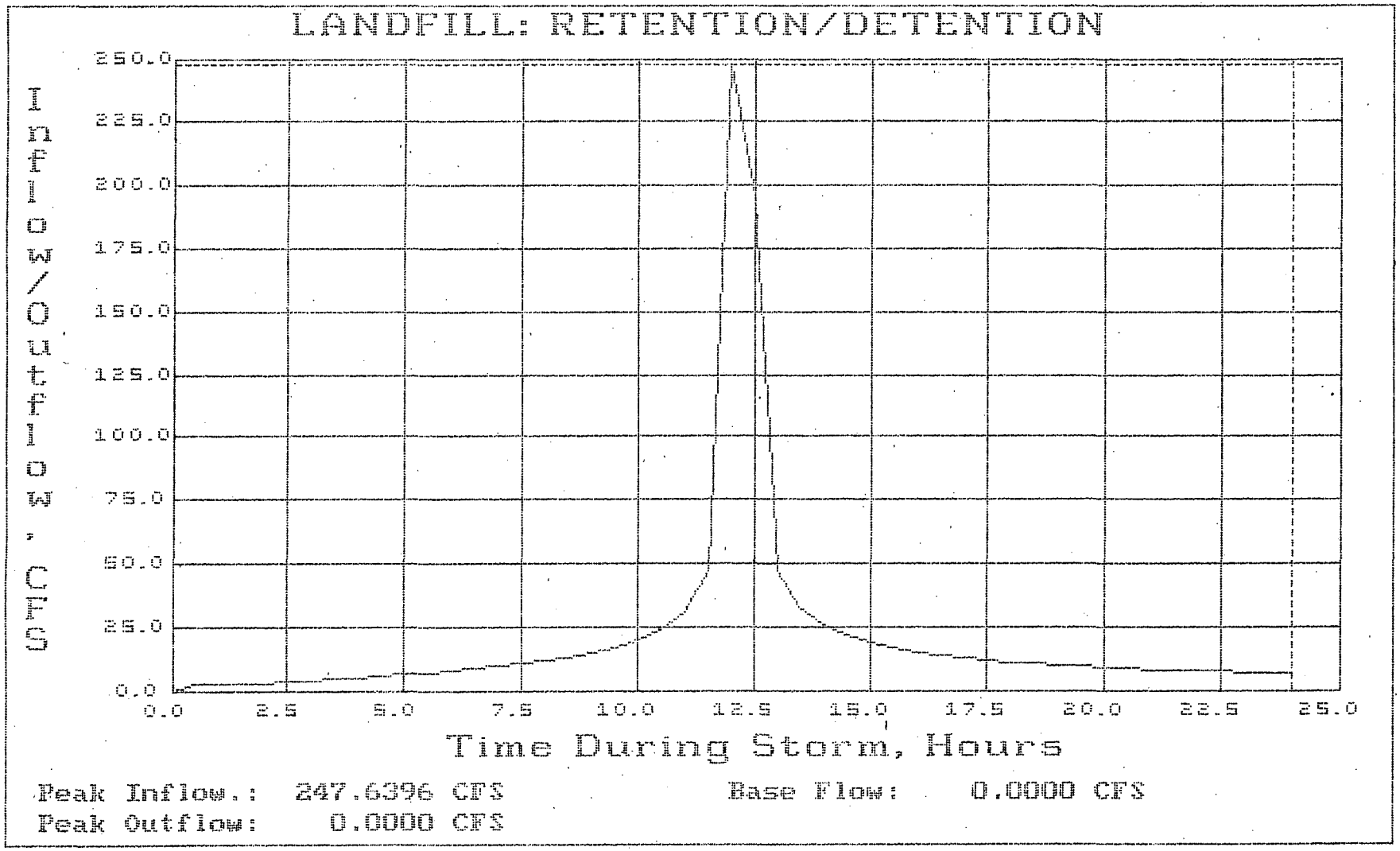

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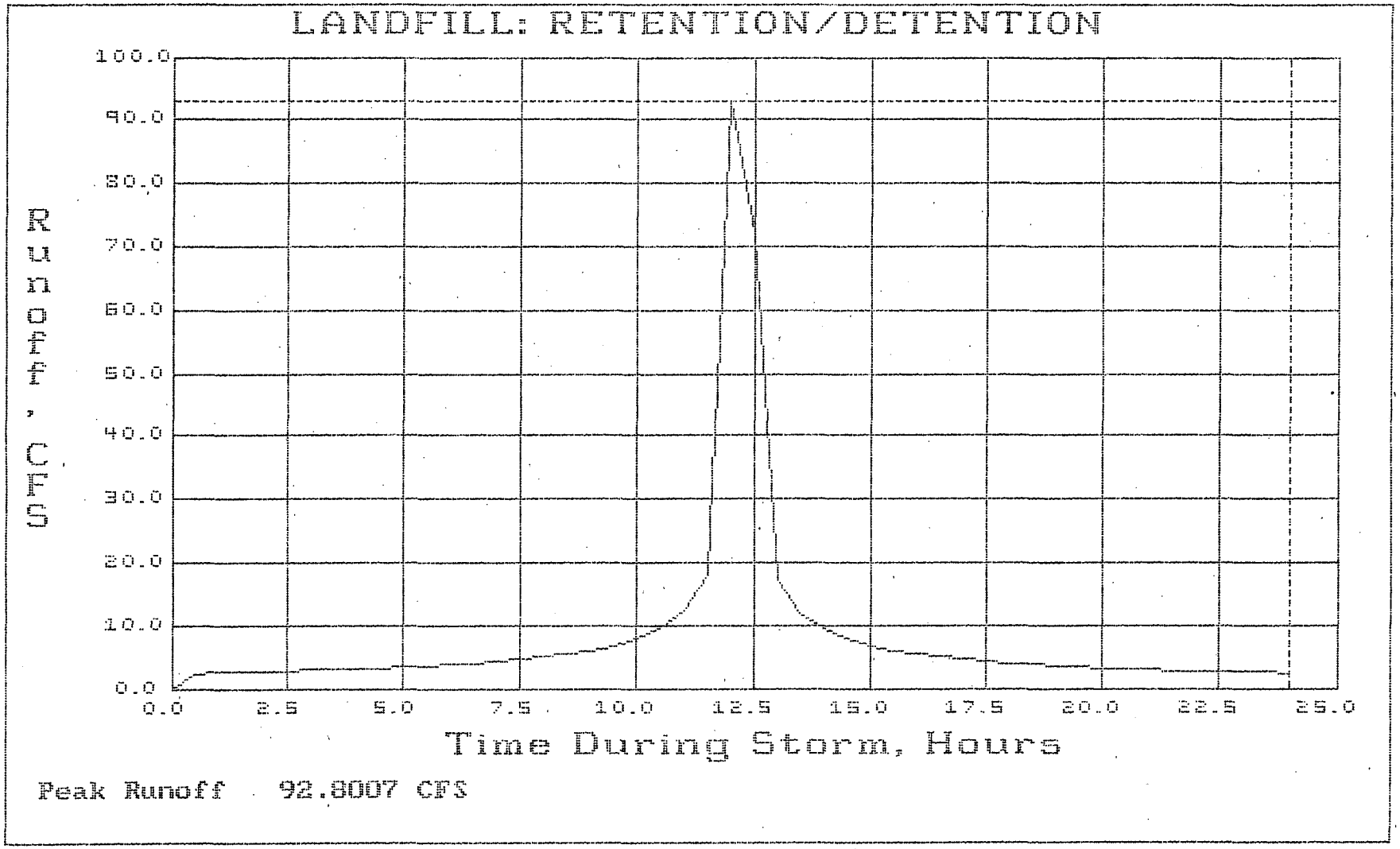

BRN 2.3: PROJECT BY BRILEY, WILD & ASSOCIATES

LANDFILL: RETENTION/DETENTION, [POND]

Time	Rain	Runoff	Stage	CFS In	CFS Out	ACFT In	Storage	ACFT Out
0.000	0.000	0.000	26.000	0.000	0.000	0.000	0.000	0.000
0.500	0.065	2.378	26.003	2.378	0.000	0.049	0.049	0.000
1.000	0.133	2.454	26.010	2.454	0.000	0.149	0.149	0.000
1.500	0.202	2.536	26.017	2.536	0.000	0.252	0.252	0.000
2.000	0.274	2.624	26.023	2.673	0.000	0.360	0.360	0.000
2.500	0.349	2.721	26.032	3.213	0.000	0.481	0.481	0.000
3.000	0.426	2.826	26.041	3.822	0.000	0.627	0.627	0.000
3.500	0.507	2.942	26.052	4.422	0.000	0.797	0.797	0.000
4.000	0.591	3.070	26.065	5.020	0.000	0.992	0.992	0.000
4.500	0.679	3.212	26.079	5.629	0.000	1.212	1.212	0.000
5.000	0.772	3.370	26.095	6.258	0.000	1.458	1.458	0.000
5.500	0.869	3.549	26.113	6.919	0.000	1.730	1.730	0.000
6.000	0.972	3.752	26.133	7.628	0.000	2.031	2.031	0.000
6.500	1.082	3.986	26.154	8.402	0.000	2.362	2.362	0.000
7.000	1.199	4.257	26.178	9.262	0.000	2.727	2.727	0.000
7.500	1.324	4.577	26.205	10.241	0.000	3.130	3.130	0.000
8.000	1.460	4.961	26.234	11.379	0.000	3.576	3.576	0.000
8.500	1.609	5.434	26.266	12.741	0.000	4.075	4.075	0.000
9.000	1.775	6.030	26.302	14.426	0.000	4.636	4.636	0.000
9.500	1.962	6.810	26.343	16.592	0.000	5.277	5.277	0.000
10.000	2.178	7.887	26.392	19.541	0.000	6.023	6.023	0.000
10.500	2.439	9.490	26.449	23.886	0.000	6.921	6.921	0.000
11.000	2.773	12.194	26.522	31.158	0.000	8.058	8.058	0.000
11.500	3.269	18.084	26.624	46.931	0.000	9.671	9.671	0.000
12.000	5.816	92.801	27.005	247.640	0.000	15.758	15.758	0.000
12.500	7.787	71.835	27.562	195.037	0.000	24.904	24.904	0.000
13.000	8.259	17.180	27.859	46.845	0.000	29.901	29.901	0.000
13.500	8.584	11.840	27.955	32.314	0.000	31.537	31.537	0.000
14.000	8.839	9.294	28.025	25.383	0.000	32.729	32.729	0.000
14.500	9.052	7.762	28.081	21.208	0.000	33.692	33.692	0.000
15.000	9.236	6.721	28.128	18.372	0.000	34.509	34.509	0.000
15.500	9.400	5.963	28.170	16.304	0.000	35.226	35.226	0.000
16.000	9.547	5.381	28.207	14.718	0.000	35.867	35.867	0.000
16.500	9.682	4.920	28.241	13.458	0.000	36.449	36.449	0.000
17.000	9.807	4.542	28.271	12.429	0.000	36.984	36.984	0.000
17.500	9.923	4.228	28.300	11.570	0.000	37.480	37.480	0.000
18.000	10.032	3.960	28.327	10.840	0.000	37.943	37.943	0.000
18.500	10.134	3.731	28.352	10.213	0.000	38.378	38.378	0.000
19.000	10.231	3.530	28.375	9.664	0.000	38.788	38.788	0.000
19.500	10.323	3.354	28.397	9.183	0.000	39.178	39.178	0.000
20.000	10.411	3.197	28.419	8.755	0.000	39.548	39.548	0.000
20.500	10.495	3.056	28.438	8.370	0.000	39.902	39.902	0.000
21.000	10.575	2.930	28.458	8.025	0.000	40.241	40.241	0.000
21.500	10.652	2.815	28.476	7.712	0.000	40.566	40.566	0.000
22.000	10.727	2.711	28.494	7.427	0.000	40.879	40.879	0.000
22.500	10.798	2.615	28.511	7.164	0.000	41.180	41.180	0.000
23.000	10.868	2.527	28.528	6.925	0.000	41.471	41.471	0.000
23.500	10.935	2.446	28.544	6.702	0.000	41.753	41.753	0.000
24.000	11.000	2.371	28.559	6.497	0.000	42.026	42.026	0.000

Node	Name	Type	Inflow	Outflow	Stage	Storage
# 1	LANDFILL EXPANSION	SUBAREA	154.839	154.839	25.000	0.000
# 2	RETENTION/DETENTION	POND	247.640	0.000	28.559	42.026

Project File: LANDFILL, NETWORK TOKENS

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00001: Number of Paths    1
00002: Path Number    1
00003: From Node..    1
00004: To Node....    2
00005: Path Type..    1
00006: *
00007: Number of Flow Controls.          0
00008: ************************************
00009: Number of Nodes   2
00010: Node    1
00011: LANDFILL EXPANSION
00012: Type 1
00013: SCS_484
00014: Total acres.............    31.7700
00015: Weighted curve number...    89.1600
00016: Hydraulic length, feet..   400.0000
00017: Ground slope, percent...    12.9100
00018: Percent impervious cover    90.0000
00019: Initial abstraction k...     0.2000
00020: Flood elevation.........    40.0000
00021: Dry Weather Base CFS....     0.0000
00022: Initial Water Elevation.    25.0000
00023: ************************************
00024: Node    2
00025: RETENTION/DETENTION
00026: Type 2
00027: Number of data points...          2
00028: Stage    29.0000  Acres    18.0700
00029: Stage    26.0000  Acres    15.1900
00030: Rational coefficient....     1.0000
00031: Initial water...........    25.0000
00032: Dry Weather Base CFS....     0.0000
00033: ************************************
00034: Checksum 3
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APPENDIX G
DRAWINGS

Post Application Submittals

LAP

Florida Department of Environmental Regulation

Central District • 3319 Maguire Boulevard, Suite 232 • Orlando, Florida 32803-3767

Lawton Chiles, Governor

Carol M. Browner, Secretary

September 8, 1992

Volusia County Department
of Solid Waste Management
123 West Indiana Avenue
Deland, FL 32120

OCD-SW-92-0356

Attention: Mr. James L. Griffin,
Director

Volusia County - SW
Tomoka Farms Road Landfill - North Cell, Class I
Notice of Permit Application
SC64-218367

Dear Mr. Griffin:

Pursuant to Section 403.815, Florida Statutes and DER Rule 17-103.150, F.A.C., you (the applicant) are required to publish at your own expense the enclosed Notice of Application. The notice shall be published one time only within 14 days, in the legal ad section of a newspaper of general circulation in the area affected. For the purpose of this rule, "publication in a newspaper of general circulation in the area affected" means publication in newspaper meeting the requirements of Section 50.011 and 50.031, F.S., in the county where the activity is to take place. Where there is more than one newspaper of general circulation in the county, the newspaper used must be one with significant circulation in the area that may be affected by the permit. If you are uncertain that a newspaper meets these requirement, please contact the undersigned at the address or telephone number listed below.

The applicant shall provide proof of publication to the Department, at the Department of Environmental Regulation, 3319 Maguire Boulevard, Suite 232, Orlando, Florida 32803-3767 (Telephone (407) 894-7555) within seven days of publication. Failure to publish the notice and provide proof of publication within the allotted time may result in the denial of the permit.

Sincerely,

George Hicks

~~for~~ A. Alexander, P.E.
District Director

RBT/me

cc: Lee Powell, P.E.
Briley, Wild & Associates

(#7) LAP

State of Florida
Department of Environmental Regulation
Notice of Application

The Department announces receipt of an application for permit from Volusia County Department of Solid Waste Management to construct the Tomoka Farms Road Landfill - North Cell, Class I. This facility will be located at 1990 Tomoka Farms Road in Volusia County, Florida.

The application is available for public inspection during normal business hours, 8:00 a.m. to 5:00 p.m., Monday through Friday, except legal holidays, at the Department of Environmental Regulation, 3319 Maguire Boulevard, Suite 232, Orlando, Florida. Any comments or objections should be filed in writing with the Department at this address. Comments or objections should be submitted as soon as possible to insure that there is adequate time for them to be considered in the Department's decision on the application.

LAP

Department of Solid Waste Management
123 West Indiana Avenue • DeLand, Florida 32720-4617
Telephone (904) 736-5982, 257-6021, 423-3862

September 24, 1992

Mr. A. Alexander, P.E.
District Director
Florida Department of Environmental Regulation
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

RE: Volusia County - SW
Tomoka Farms Road Landfill - North Cell, Class I
Notice of Permit Application
SC64-218367

Dear Mr. Alexander:

Attached is the certified Proof of Publication of Volusia County's application for permit to construct Tomoka Farms Road Landfill - North Cell, Class I.

If additional information or action is required, please advise this office.

Very truly yours,

J. L. Griffin

James L. Griffin
Director of Solid Waste Management

JLG:lm

Attachment

c: Richard Tedder, P.E., Florida Department of Environmental Regulation, 3319 Maguire Blvd, Suite 232, Orlando, FL
Lee Powell, P.E., Briley, Wild and Associates, Inc., P.O. Box 607, Ormond Beach, Florida 32174-0607
Bill Gilley, Assistant Director of Solid Waste Management

WP51\SW\GRIFFIN\ALEXANDE

($10) LAP

Florida Department of Environmental Regulation

Central District • 3319 Maguire Boulevard, Suite 232 • Orlando, Florida 32803-3767

Lawton Chiles, Governor — Carol M. Browner, Secretary

September 21, 1992

CERTIFIED
Return Receipt Requested
P-810 426 713

Volusia County Department of Solid Waste Management — OCD-SW-92-0366
123 West Indiana Avenue
DeLand, Florida 32720

Attention: Mr. James L. Griffin, Director

Volusia County - SW
Tomoka Farms Road Landfill -
North Cell, Class I
Permit Application No. SC64-218367

Dear Mr. Griffin:

This is to acknowledge receipt of your application submitted August 28, 1992 for the subject facility. The status of your application is as follows:

(X) Your application for permit 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.

( ) The additional information received on _____ was reviewed, however, the items listed on the attached sheet remain incomplete. Evaluation of your application will continue to be delayed until we receive all requested information.

In order to expedite the review of your application, please use the application number referenced above on all correspondence, and submit three (3) copies of all requested information unless otherwise indicated by a specific information request.

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, omissions or supply additional information within a reasonable period of time.

(#1) LAP

If you have any questions, please contact me at 407/894-7555.

Sincerely,

Richard B. Tedder, P.E.
Program Manager
Solid Waste

RBT/ew

Enclosures

cc: Bret LeRoux, P.G. - FDER - Waste Cleanup
Lee Powell, P.E. - Briley, Wild and Associates - Ormond Beach, FL
Mike Bateman, P.E. - FDER - MSSW/Stormwater Management

Volusia County - SW
Tomoka Farms Landfill North Cell, Class I
Permit Application No. SC64-218367

1. Provide page numbers for the Table of Contents for the application report Tomoka Farms Landfill North Cell dated August 1992.

2. The permit fee of $10,000.00 submitted August 28, 1992 has been applied towards the construction of the Class I landfill. Page 1 of 10 of DER Form 17-7.130(1) needs to be revised and the revised copies submitted to indicate that the application is for a permit to construct and not operate.

3. The proof of publication of notice of application for the proposed activity in a newspaper of general circulation as required in Item 8 on Page 3 of 10 of DER Form 17-7.130(1), needs to be submitted.

4. Since the total land area of the project exceeds 40 acres, a Management and Storage of Surface Water Permit will be required. Please contact Mr. Mike Bateman, P.E. at 407/894-7555 for more details.

5. Page 1 of 10 of DER Form 17-7.130(1) shows acres within waste site boundary as 50 acres. Item 14 on Page 7 of 10 DER Form 17-7.130(1) shows the disposal area as 30 acres. Please explain this discrepancy.

6. The ground water monitoring plan for the site is still being prepared by Dr. Gomberg (See Appendix B). This application will remain incomplete until an adequate ground water monitoring plan for the site has been developed.

7. Page 15 of the application report "Tomoka Farms Road Landfill North Cell" dated August 1992 indicates that the Tomoka Farms Road Landfill is a solid waste management facility that includes a tire storage facility. If the tires are processed at the facility by means of a County owned tire cutter on a daily basis, the County will need to submit a Waste Tire Processing Facility Permit Application. No permit fee will be required. A copy of the Waste Tire Processing Facility Permit Application, DER Form 17-711.900(6) and a copy of the Waste Tire Rule 17-711, F.A.C., is attached for your convenience.

8. If waste oil is collected and stored at the facility, provide information to indicate the maximum gallons of waste oil that would be collected and stored at the facility before it is removed from the facility by a contractor.

9. Submit information to show how operations at this facility will comply with the materials recycling program required by Chapter 88-130, Section 403.706(1) and (2), Florida Statutes, (F.S.).

10. Provide information as to how the applicant will demonstrate financial responsibility for the closing and long-term care of the landfill, Rule 17-701.030(5)(i), F.A.C.

11. Since the maximum design landfill elevation is approximately 131 feet NGVD, please provide slope stability analysis calculations and factor of safety for slippage to insure that the landfill with 4:1 slopes will be stable during its active life and after closure.

12. Please provide interface friction angles and calculations for the shear forces between the liner systems under load (i.e., geotextile to geonet, geotextile/geonet to HDPE, HDPE to geosynthetic)

13. Please provide justification for the waste density of 4,500 pounds per square foot used in the bearing capacity calculations of the foundation analysis (page 5 of Appendix A).

14. Please provide the bearing capacity calculations referenced in the foundation analysis (page 5 of Appendix A) indicating the bearing capacity of the subsurface formations are in excess of 50 tons/square feet.

15. Assuming a settlement of 1 of 2 feet due to insufficient data to perform calculations is not adequate (see page 6 of Appendix A). Please conduct the tests and calculations necessary to adequately evaluate settlement of the landfill subgrade. This could impact design of the leachate collection system.

16. Dr. Gomberg's report entitled "Hydrologic Evaluation of a 53-Acre Section of Tomoka Landfill" dated September 1986, is referenced on page 8 of the application report. Please provide a copy of this report for Department review. We have not been able to locate it in our files.

17. Please provide historical data to show the natural fluctuation of the water table elevation for the site. The bottom of the liner must be designed to be in the ground water at all times.

18. No information has been provided to describe how the landfill liner will be installed below the water table. Please provide detailed plans and calculations for dewatering the site prior to construction. How will this be maintained during construction? What impacts or problems are expected for seaming the HDPE liner?

19. How long will the dewatering system be maintained during operation? Provide calculations showing the Operation Plan for the landfill will be adequate to protect the liner from maximum potential uplift possible at the site. The Plan should also provide reasonable assurance that the bottom liner will not be adversely impacted by fluctuations of the ground water.

20. The proposed composite liner for the landfill using 60 mil HDPE on top of Claymax or other geosynthetic material is not an approved design by Rule 17-701.050(5)(d)1.a., F.A.C. since the lower component of the composite liner is not at least 18 inches thick. In order to use this design, the applicant must apply for an Alternate Procedures Approval in accordance with Rule 17-701.078, F.A.C.

21. No calculations were provided for the leachate collection system for the landfill. According to page 12 of the application report, the design appears to be based on a maximum leachate head of 12 inches. For composite liner systems, the drainage layer must be designed to reduce the leachate head on the liner to one inch within one week following a design 25 year, 24 hour storm event. Please provide leachate head calculations. These should be based upon the worst case scenario assuming the first lift of waste with no cover and then the peak flow of precipitation recorded for any one month of a year. In addition, the leachate head calculations must include estimated leakage inward through the bottom liner since it is being designed in the water table. Calculations for this inward leakage must also be provided assuming a minimum hole size of 1 cm^2 and a minimum hole frequency of 1 defect per acre. The head calculations should be used to design the leachate collection system.

22. The HELP model should be run again for the case described in item #21. Also, Appendix E shows the slope for the geonet in layer 7 to be 4%. The application report on page 9 states the slope will be 2%. This needs to be corrected.

23. Please provide performance and physical specifications for the geonet used in the leak detection systems. Test data should be provided to show the geonet will perform adequately under the maximum load expected for the landfill at closure. Also, please provide supporting documentation for the geonet porosity, field capacity, wilting point and saturated hydraulic conductivity used for the HELP model.

24. The use of a filter fabric sock around the leachate collection pipes as is shown on sheets 7 of 14 and 11 of 14 is not acceptable. The fabric will likely clog with fines from the sand drainage layer. No calculations were provided to justify the use of the filter fabric sock. Please provide an alternate design with supporting specifications and calculations or criteria to justify the type of filter used.

25. To minimize the quantity of leachate generated and to control erosion of partially finished side slopes, the final cover should be completed on a close as you go basis. Portions of the outer slope and the associated terrace should be capped, covered with soil and vegetated when fill reaches the elevation of the terrace.

26. Sheet 7 of 14 and page 25 of the application report indicate the final cover for the landfill will consist of a 6 inch compacted clay barrier layer and no saturated hydraulic conductivity was specified. This is not an acceptable closure design. The final cover barrier layer should be at least 18 inches thick with a maximum permeability of $1x10^{-5}$ cm/sec. Please revise the Closure Plan and closure cost estimates to reflect this change in the barrier layer of the final cover.

27. Provide calculations showing the leachate collection pipes are sized properly for the expected flow capacities. Also, provide calculations showing that the pipes have adequate structural stability to withstand loads expected at closure and to withstand maximum deflections the pipes are likely to experience.

28. Sheet 10 of 14, Landfill Leachate Header Detail, shows the 8 inch perforated HDPE header pipe exposed directly to the 24 inch sand drainage layer. What will keep the sand from clogging the header pipes? Please clarify.

29. Please provide pump curve/system information and calculations

showing the selected leachate pumps are sized adequately.

30. What emergency backup power systems are available to keep the leachate pumps operational should a power outage occur? Will backup pumps be available?

31. How will stormwater be conveyed off the landfill? Please provide detailed drawings and calculations showing how the stormwater will be controlled to insure the 20 foot wide terraces and the final cover will be protected. Also include information on the erosion control plan for the landfill.

32. Page 10 of the application report states the estimated evaporation rate from the leachate evaporation ponds is 9.2 million gallons per year. Please provide supporting calculations to justify this evaporation rate.

33. Please provide calculations for the estimated leakage rate to the detection layer of the leachate ponds. The detection layer must be sized according to the expected flows. Leakage should be based on a minimum leachate head of 8 feet using a minimum geomembrane hole size and frequency of 1 cm^2 per acre.

34. What will be the compacted thickness of the sub-base for the leachate basin liner systems? Please clarify on the drawings and in the application report.

35. Provide a plan for daily leakage checks of the liner in the leachate ponds. What criteria will be used to determine if the liner is leaking, and what steps will be taken to correct this problem should it occur?

36. Page 11 of the application report states leachate may be recirculated to leachate trenches in the landfill. What steps will be taken to insure the leachate trenches do not overflow and contaminate the stormwater ditches?

37. Please provide more detail on the design and operation of the "moveable HDPE manhole" described in page 11 of the application report.

38. How will leachate be removed from the leachate basins and trucked for off-site disposal if needed? Please provide more details in the drawings and application report. What facility will be used if leachate is transported off-site?

39. What protection is planned to prevent leachate seeps to the stormwater system if leachate is to be recirculated to the landfill?

40. Please provide material specifications and supporting calculations or criteria used to design the geotextile filters proposed for the landfill leachate collection system and the leachate holding ponds.

41. The GCL Specifications in Appendix D, page 02776-1, state available products could be Claymax or Gundseal. How will these GCLs be seamed in the field?

42. Page 4 of the CQA Plan in Appendix D states "each day" the inspector will conduct inspections. The CQA engineer or his designee must be on-site at all times during construction to monitor construction activities. Please clarify this matter in the CQA Plan.

43. Sheet 14 of 14 shows the gas vent design with a 6 inch borehole backfilled with sand. Please provide justification for this design. The department prefers a minimum borehole size of 12 inches backfilled with 1 inch diameter or larger gravel.

BRILEY, WILD
AND ASSOCIATES

November 10, 1992

VC 92067-6CE

Mr. Richard B. Tedder, P.E.
Solid Waste Program Manager
Florida Department of Environmental Regulation
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Re: Volusia County
Tomoka Farms Road Landfill - North Cell
Application No.: SC64-218367

Dear Mr. Tedder:

We have received your letter of September 21, 1992 on the subject project. Enclosed are the following revised design details addressing concerns raised in your letter:

1. Landfill anchor trench details, showing the use of textured HDPE, needle punched GCL, and geonet with geotextile head bonded to both sides.

2. Leachate Basin Bottom and Side Slope Line Details, showing the use of textured HDPE and geonet with heat bonded geotextile on side slopes.

3. Leak Detection Pipe Cleanout Detail showing use of textured HDPE and geonet with heat bonded geotextile on sideslopes.

4. Landfill Leachate Lateral Collection Detail showing elimination of filter sock.

5. Landfill Leachate Header Detail showing 12-inch header pipe and elimination of filter sock.

6. Leachate Basin Liner Detail showing elimination of filter sock.

7. Leachate Sump Detail showing elimination of filter sock.

8. Gas Management Well Detail showing 12-inch borehole.

9. Erosion Control Plan Details.

Briley, Wild and Associates, Inc.
Consulting Engineers and Planners
1040 North U S Highway One
PO Box 607
Ormond Beach, FL 32175
904/672-5660 • FAX 904/673-8264
Offices in Bradenton, Clearwater,
Daytona Beach, Orlando & Ormond Beach, FL

10. Typical Downpipe Discharge Detail.

11. Leak Detection Manhole Plan.

The comments in your September 21, 1992 letter are addressed on the attached sheets.

It is our intent to incorporate the design details enclosed in this submittal into the project drawings. If there is any further information required, please let me know.

Very truly yours,

BRILEY, WILD & ASSOCIATES, INC.
CONSULTING ENGINEERS & PLANNERS

Lee A. Rowell, P.E.
Assistant Director of Engineering

LAP/lhm
Enclosure

1. Attached is a Table of Contents with page numbers added.

2. Enclosed is a revised page 1 of 10 of DER Form 17-7.130(1) indicating that the application is for a permit to construct and not operate.

3. Proof of publication was submitted to the DER by the County on September 24, 1992.

4. The County has applied for a Management and Storage of Surface Waters Permit.

5. The site boundary of 50 acres includes the surrounding stormwater retention area and access road. The 30 acre disposal area includes only the lined area where solid waste will be placed.

6. No comment required.

7. The County does not own a tire cutter. The tires are not shredded on a daily basis. A contract tire cutter is periodically brought to the landfill site to shred tires.

8. The County has oil recycling igloos at various locations including one at Tomoka Landfill. The igloo holds 250 gallons and is emptied approximately once a month.

9. Volusia County has a recycling program in place to comply with Florida Statutes.

10. This information will be submitted directly by the County.

11. Adjacent borrow areas will provide the soil used for daily and final cover. This sandy material has a soil friction angle of 26° to 30° or approximately 2H:1V. The landfill is to be constructed with side slopes of 4H:1V and slope stability during construction is not anticipated to be a problem.

    At closure the landfill will be covered with 6-inches of clay with a permeability of 1×10^{-8} cm/sec and covered with 12-inches of soil suitable for supporting vegetative growth. With horizontal terraces after every 20-feet of vertical rise, the maximum side slope length is 82.5 ft.

    The strength of the interface between the 12-inch of soil cover and the clay is determined by the following equation:

$$S = Z * \cos(B) * \tan(F) + C$$

Where S = Interface strength per unit slope length (lbs/sf)
Z = Loading of soil cover (lbs/sf)
B = Slope angle (degrees)
F = Friction angle (degrees)
C = Long term cohesion or adhesion (lbs/sf)

The 12-inches of soil cover with a density of 110 lbs/cf will exert a loading of 110 lbs/sf. The slope angle for a 4H:1V slope is 14.0 degrees. The soil to clay friction angle is 30 degrees. The long term adhesion of the clay to soil is estimated to be zero. The interface strength was then calculated to be:

$$S = 110 \cos(14.0) * \tan(30)$$
$$= 61.6 \text{ (lbs/ft.)}$$
$$SF = \frac{T + S * L}{L * Z * \sin B}$$

Where SF = Safety factor

T = Long term tensile strength of the material directly above the interface

L = Length of slope

In the sandy cover material T is assumed equal to zero. The safety factor is then calculated to be:

$$\frac{61.6}{110 \text{ SIN } (14)} = 2.31 > 1.25$$

The side slopes should therefore be stable during the landfill's active life and after closure.

12. The proposed landfill design includes a portion below grade constructed at a slope of 3H:1V with multiple geosynthetic materials. In order to determine if the proposed slope design is stable it is necessary to determine if failure will occur as a result of inadequate frictional (shear) resistance between two adjacent materials, or internally within the sand or clay layers.

The proposed side slope has a maximum length of 39-feet and includes the following layers: (See Figure No. 1 and Figure No. 2):

1. Two feet of drainage sand with a density of 110 lbs/cf.
2. A geonet with nonwoven geotextile fabric heat laminated to both sides.
3. A 60 mil HDPE liner, textured on top and bottom.
4. A needle punched geosynthetic clay liner (GCL) such as Claymax "Shear Pro", Bentomat, or Bentofix.
5. Native sandy soil.

The strength of the interface between two layers is determined by the following equation:

$$S = Z * \text{COS } (B) * \text{TAN } (F) + C$$

Where S = Interface strength per unit slope length (lbs/sf)

Z = Loading of soil cover (lbs/sf)

B = Slope angle (degrees)

F = Friction angle (degrees)

C = Long term cohesion or adhesion (lbs/sf)

The initial cover on the slope will be two feet of sand with a density of 110 lbs/cf. This material produces a loading of 220 lbs/sf. The slope angle for a 3H:1V slope is 18.43 degrees. Using published data for friction angles, internal cohesion, and adhesion results in the following calculated values for S:

Interface	F Friction Angle (Degrees)	C Adhesion or Cohesion (lb/sf)	S Interface Strength Per Unit Length (lb/sf)
Soil to Soil	33	0	136
Soil to Geotextile	30	0	121
Geotextile to HDPE	32	360	490

Interface	F Friction Angle (Degrees)	C Adhesion or Cohesion (lb/sf)	S Interface Strength Per Unit Length (lb/sf)
HDPE to GCL	24	30	123
GCL to GCL	0	550	550
GCL to Soil	31	0	125

From the above analysis the weakest interface is the one between the sand and the geotextile. The safety factor (SF) for this critical interface may calculated:

$$SF = \frac{T + S * L}{L * Z * \text{SIN } B}$$

Where T = Long term tensile strength of the material directly above the interface (lb/ft)

L = Length of slope

In the sand layer T = O

$$SF = \frac{(121 \text{ lb/sf})(39 \text{ ft})}{(39 \text{ ft})(220 \text{ lb/sf})(\text{SIN } 18.43)}$$

$$= 1.74 > 1.25$$

The synthetic layers are supported at the top of the slope by the anchor trench, further reducing the possibility of slope failure.

13. Bechtol Engineering and Testing, Inc., computed the bearing pressure to be 4,500 psf on computation sheet 1 of 5 in the attached Bechtol Engineering memo dated October 22, 1992.

14. Bechtol Engineering and Testing, Inc., computed an allowable bearing capacity by three different methods. The allowable bearing capacity ranged from a low of 105,099 psf to a high of 188,709 psf. See computation sheet 2 of 5 of the attached Bechtol Engineering memo dated October 22, 1992.

15. The total settlement of the subgrade layers was computed to be 2.8 feet. See computation sheets 3, 4 and 5 of the attached Bechtol Engineering memo dated October 22, 1992. The slope of the leachate collection system has been adjusted to allow for 2-8 feet total settlement.

16. Enclosed are three copies of Dr. Gomberg's 1986 report.

17. Enclosed are copies of pages 122 and 123 of Dr. Gomberg's proposed groundwater monitoring plan, previously submitted. The table shows groundwater levels at wells B-7, B-8, & B-9 located near the proposed landfill. Well B-8 is located adjacent to the borrow pit and is impacted by borrow pit dewatering. Wells B-7 and B-9 show that the minimum level recorded is 20.7. Ninety-four percent of the readings are above 22.1, the bottom of the proposed liner. There is no evidence of seasonal fluctuations below elevation 22.1. The groundwater level under the landfill will be affected by the water level in the perimeter ditch. By keeping the water level above 23.0 the water level under the landfill is not likely to drop below the level of the liner.

18. The borrow pits were originally dewatered by constructing a perimeter ditch around the outside of the excavated area and pumping the water that accumulated in this ditch to an overland flow disposal area under a permit from the St. Johns River Water Management District. Because of the tightness of the native soils, there was very little lateral groundwater

flow into the borrow pit and it was not necessary to pump continually to keep the borrow pit dry. Sheet 5 of the plans show that by keeping the perimeter ditch dewatered to elevation 10.0 a dry working surface of 12.6 has been maintained in the borrow pit. With the exception of the two leachate sumps, which bottom out at elevation 11.0, all of the liner should be able to be installed in dry conditions. Localized dewatering during construction may be necessary in the two leachate sump areas.

19. In the two sump areas the liner will be covered with approximately six feet of rock and drainage layer sand at an average weight of 110 lb/cf. Figure 7 shows the sand and rock fill. This would produce a force resisting uplift in the sump area of 660 lb/sf. If the water level adjacent to the sump were to rise to an elevation of 22.0, the uplift on the dewatered sump would be 11 ft. or 686 lb/sf. Until the first lift of refuse is place over the sumps the water level in the perimeter ditch must be kept below 22.0. The first lift of refuse, assuming eight feet of refuse at 1000 lb/cy would provide an additional 296 lb/sf allowing the water level in the perimeter ditch to be raised to 26.3 without uplifting the liner.

    As discussed under Item 17, maintaining the water level in the perimeter ditch above 22.1 will prevent the groundwater level from dropping below the level of the liner.

20. We will be submitting the application for an Alternate Procedures Approval under separate cover.

21. Much of the information required is provided in Response to Item 27 of your September 21, 1992 letter.

    The estimated leakage rate through a hole in a membrane liner is calculated with the following formula:

$$q = 0.21\ h^{0.9}\ a^{0.1}\ k_s^{0.74}$$

    Where q = flow rate in m^3/sec
    h = depth of liquid (m)
    a = area of hole (m^2)
    k_s = hydraulic conductivity of layer beneath liner (m/sec)

    In the proposed landfill, the maximum head on the liner occurs when the groundwater outside the landfill is at elevation 26.0. The head across the liner would be 26.0 - 13.5 or 12.5 feet (3.8 M). The hydraulic conductivity of the clay beneath the membrane is 1×10^{-9} cm/sec or 1×10^{-11} m/sec. Using an estimate hole size of 1 cm^2 and a frequency of 1 hole per acre results in an estimated inward leakage of:

$$= (0.21)\ (3.8)^{0.9}\ (.0001)^{0.1}\ (1 \times 10^{-11})^{0.74}$$
$$= 2 \times 10^{-9}\ M^3/s = 0.046\ gpd/acre$$
$$= 1.38\ gpd$$

22. The HELP model has been run for the case described in your letter, i.e., with one lift of waste and with daily cover only, and with the bottom slope corrected to 2 percent. The printout is enclosed with this submittal.

23. The geonet used in the landfill drainage layer and in the leachate basin leak detection layer will be a high density polyethylene geonet such as Polynet PN 3000 or Gundnet XL-14. Following are the performance and physical specifications for this project:

Weight lb/ft^2	0.16 - 0.2 lb/ft^2
Thickness (min)	0.2 - 0.265 inch
Polymer Density (min)	0.94 gm/cm^3
Percent Carbon Black (min)	2%
Porosity (typical)	80%
Transmissivity at 10,000 psf, unit gradient	1 x 10^{-3} m^2/sec (landfill)
Transmissivity at 2,000 psf, unit gradient	4 x 10^{-3} m^2/sec (leachate basin)

The geonet in the landfill will have a 6 oz. non-woven geotextile heat bonded to the upper surface. The geonet on the landfill and leachate basin sideslopes will have a 6 oz. non-woven geotextile heat bonded on both the upper and lower surfaces.Enclosed are transmissivity charts for Polynet PN 3000, with and without the geotextile, for pressures up to 20,000 psf.

In the HELP model the porosity of 80% was taken from the manufacturer's literature. Field capacity is defined as the water content after prolonged draining. In the HELP model we assumed that after prolonged drainage only 6 percent water would remain adhering to the geonet. The wilting point is the lowest water content that can be achieved by plant transpiration. Although plant transpiration is not a factor in the drainage layer, the HELP model requires that a number less than the field capacity be entered so a value of 2 percent was used for calculations. Saturated hydraulic conductivity is the transmissivity divided by the thickness of the geonet. With a transmissivity of 1.0 x 10^{-3} m^2/sec and a thickness of 0.2-inches, the saturated hydraulic conductivity is 19.685 cm/sec. These values were also discussed with Mr. Paul Schroeder, P.E., at the Corps of Engineers Environmental Laboratory in Vicksburg, Miss. He agreed that the valves used are reasonable.

24. We have revised the design of the leachate collection pipes to eliminate the sock around the perforated pipe, as shown in Figures 4, 5 & 6. The only filter fabric will be the needle punched non-woven geotextile that is heat bonded to the geonet drainage material. Following are typical properties of the geotextile:

Fabric Material	Polyester
Fabric Weight	6.0 oz/yard^2
Thickness	90 mils
Water Flow Rate	170 gpm/ft^2
Permeability	0.52 cm/sec
Apparent Opening Size	0.210 - 0.149 mm

To prevent clogging of the geotextile, the hydraulic conductivity of the geotextile should be greater than ten times the hydraulic conductivity of the overlying soil. The overlying soil is sand with a hydraulic conductivity of 1 x 10^{-3} cm/sec. The proposed geotextile has a hydraulic conductivity of 0.5 cm/sec, approximately 500 times greater.

25. The final cover will be installed on portions of the landfill that have reached the final proposed contours.

26. We have used six inches of clay with a permeability of 5 x 10^{-8} for the barrier layer on a number of Florida landfills and it is believed that such a closure design does meet current regulations. On 4H:1V side slopes an 18-inch thick barrier layer cannot be justified.

27. The leachate collection pipes will experience the highest flows when the sand drainage layer is exposed to precipitation prior to the placement of solid waste. The 25 year storm of nine

inches would place 980,100 cubic feet or 7,332,128 gallons over the entire landfill. The two leachate pumps operating at 400 gpm each would remove all of this water in 153 hours or 6.4 days.

The 12-inch leachate header pipes have a capacity flowing full of 532 gpm. They will therefore allow the leachate pumps to pump at design capacity provided sufficient leachate is supplied by the lateral collection pipes.

The six inch lateral collection pipes each have a capacity flowing full of 270 gpm, at the initial installed slope of 1%. Each header pipe is supplied by seven lateral collection pipes. The 6-inch lateral pipes and the 12-inch header pipes are therefore adequately sized to allow the leachate pumps to pump at a design capacity of 400 gpm each, provided sufficient leachate is available from the leachate drainage layer.

With the transmissivity of 1×10^{-3} m^2/sec per unit gradient and a slope of 2%, the geonet has a flow per width of 2×10^{-5} m^2/sec, or 0.0966 gallons per minute per foot width. The 550 feet of lateral would be fed from both sides for a total flow of 106 gallons per minute. Additional water would drain from the sandy drainage layer directly over the leachate lateral collection trenches. From the geonet drainage alone however, the seven laterals would supply the leachate pumps with sufficient flow to pump out the 25 year storm within one week.

Because the geonet has a much higher transmissivity than the overlying sand layer, leachate percolating through the sand layer will not accumulate and saturate the geonet. Unless the geonet is fully saturated, the leachate head on the liner will be less than the thickness of the geonet or 0.2 inches. Therefore it may be concluded that the leachate head on the liner will be reduced to one inch or less within one week following a design 25 year 24 hour storm event.

Our geotechnical consultant, Bechtol Engineering & Testing, has estimated that up to 2.8-feet of settlement may occur in the soil underlying the landfill. This settlement would be most likely to occur in the central portion of the site where the fill height is greatest. The effect of this settlement would be to reduce the slope on the leachate laterals from 1% to 0.49%. As shown on the enclosed table, the 6-inch pipe at 0.49 percent slope has a capacity flowing full of 184 gpm, more than enough to convey the 107 gpm drained through the geonet.

Enclosed with the calculations are the structural design calculations for the leachate collection pipes.

28. The landfill leachate header detail has been clarified as shown on the enclosed Figure 5.

29. Enclosed are the calculations and pump curves for the leachate pumps.

30. An outlet will be provided to allow connection of a portable generator.

31. During construction of the landfill and during the early years after closure, differential landfill settlement will continually modify the drainage pattern over the landfill. It is necessary therefore to design flexibility into the landfill drainage and erosion control system.

When the first terrace level is reached a temporary diversion dike will be constructed around the top of the landfill. Eighteen inch diameter corrugated polyethylene down pipes will be placed at approximately 400-foot centers to drain water to the perimeter ditch, as shown on the attached drawing. This pipe is flexible and will not be damaged by landfill settlement. As the landfill continues to be built up, the temporary dike will be removed and re-constructed at the next terrace level and new down pipes constructed as shown on the attached Figure 9.

The capacity of the pipe when flowing full may be determined by the Manning equation:

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

Where Q = pipe capacity, cfs

n = Manning's "n", 0.020

A = cross-sectional flow area of the pipe 1.767 ft^2

R = hydraulic radius; 1/4 the diameter for full-flowing pipe conditions 0.375 ft

S = pipe slope (0.25 ft/ft)

Q = 34.1 cfs flowing full

= 22 MGD per pipe

The velocity in the pipe would be 19.3 fps flowing full, so energy dissipation would be required, as shown on Figure 10.

After the landfill has been closed the downpipes may be buried to form a more permanent drainage system.

32. The estimated annual precipitation to the leachate basins is 56.9-inches per year, with an estimated annual evaporation of 46.6-inches per year. The precipitation rate applies to the entire lined area but the evaporation rate only applies to the water surface area. With the proposed spray system the exposed liner above the water level will be wetted, making the area for precipitation and evaporation the same. Using the above estimates for precipitation and rainfall results in excess precipitation over evaporation of 0.6 million gallons per year per basin.

The leachate spray pumps will be operated during positive evaporation conditions when leachate is available. At 480 gallons per minute and assuming the system operates 8 hours per day and 150 days per year with a 15% water loss to evaporation, the evaporative losses are estimated to be 5.2 million gallons per year per basin. Subtracting the 0.6 million gallons per year of precipitation yields a net loss of 4.6 million gallons per year per basin, or a total of 9.2 million gallons per year. If necessary, the pumps could be operated for more than 8 hours per day and for more than 150 days per year to achieve the required evaporation.

33. A hole in the upper liner of the leachate basin would function as an orifice. The flow through the orifice is calculated with the following formula:

$$Q = 19.636\ c d^2\ h^{.5}$$

Where Q = flow through the orifice in gpm

c = discharge coefficient (0.61 for a sharp puncture)

d = diameter of the hole in inches

h = head at orifice, in feet

A 1 cm^2 hole has a diameter of 0.4443 in.. Assuming the hole was on the bottom of the liner, the maximum head would be 8 ft. The leakage through the hole would then be:

$$Q = 19.636 * 0.61 * (0.4443)^2 * (8)^{.5}$$

$$= 6.6878 \text{ gpm.}$$

At a leachate depth of 8-feet the surface area of the wetted liner is 83,456 square feet or approximately two acres. Two holes at 1 cm^2/hole would produce a leakage rate of 13.4 gpm. The design maximum high water level in the basins is 7-feet and the anticipated normal leachate depth will be substantially less around 3 to 4-feet. The normal leakage is therefore anticipated to be substantially less than 13.4 gpm.

34. The subbase will be compacted to 90% of Proctor to a depth of 12-inches.

35. In order to determine if excessive leakage is occurring, it is necessary to keep the water level in the leak detection layer below the level of leachate in the basin. As previously noted, 13.4 gpm of leakage is the upper limit of "acceptable" leakage when the basin is filled to a depth of 8-feet. At lower levels the following leakage rates are considered "acceptable" with a hole size and frequency of 1 cm^2 per acre:

Depth of Leachate (feet)	Leakage Rate (GPM)	Time for 1-ft. Rise (min)
1	4.7	20.00
2	6.7	14.03
3	8.2	11.46
4	9.5	9.89
5	10.6	8.87
6	11.6	8.10
7	12.5	7.52
8	13.4	7.01

To make it easier for the operator to measure the leakage we have replaced one of the cleanouts on each basin with 4-foot diameter manhole, as shown in Figure 11.

To determine the leakage rate the operator should measure and record the water level in each leachate basin and in the leak detection manhole each day. The leak detection manhole should then be pumped or baled, depending on the quantity of water. The water level in the manhole should be measured at the low level and as the water level in the cleanout rises. The time required for the water level to rise 1-foot is related to the leakage rate as indicated in the above table.

Any leaks in the liner that are identified should be patched, regardless of the measured leakage rate. When the leakage rate in either basin exceeds the maximum level identified above, it should be taken out of service and the leaks located and repaired.

36. When the County elects to recirculate leachate, a shallow trench will be constructed through the cover material into the solid waste. This trench should be located away from the side slopes in an area where solid waste has been placed and where truck traffic or solid waste placement is not expected for several weeks. Solid waste is not homogeneous and it is not possible to determine the adsorptive capacity of a particular trench until it has been constructed. Landfill slopes will vary, and the slopes of the trenches will also vary. In any one trench the slope will vary along the length of the trench. It will be necessary for the operator to visually monitor the recirculation flow in the trench to ensure that overloading or overflow does not take place.

37. The HDPE manhole will be a 4-foot diameter manhole, as manufactured by ADS or Spirolite Leachate to be recirculated to the landfill will be pumped to the manhole. From the manhole the leachate will flow to one or more leachate trenches. The purpose of the manhole is to allow the operator split the leachate recirculation flow among multiple trenches. The manhole

will be kept in one location as long as practical, with leachate trenches being extended and relocated around it. When necessary it will be picked up and placed at a new location on the landfill.

38. The City of Daytona Beach has agreed to take leachate if needed. Tanker trucks with pumps will be used to remove leachate. The truck suction hose would be placed near the sump.

39. The leachate recirculation trenches will be observed by an operator. Before a trench was allowed to overflow the pumps would be turned off and appropriate adjustments made including relocating or extending the trench. If a small overflow occurred it would be cleaned up by placing the contaminated soil into the trench. The trenches are to be located away from side slopes which will further reduce the chances of contaminating stormwater runoff.

40. This question has been addressed in Item 24.

41. The first three paragraphs of Appendix D, page 02776-4 describe how Claymax or Gundseal will be seamed in the field. Claymax has an open weave woven polypropylene cover fabric which allows the bentonite to push through and seal to the overlapped section upon hydration. Gundseal has a direct bentonite to HDPE seal when the panels are overlapped. Bentomat and Bentofix have a non-woven fabric cover and additional bentonite must be placed at seams, as described in paragraph 4 on Appendix D page 02776-4.

42. Page 4 of the CQA Plan states that each day the subgrade shall be inspected and written certification provided by the installer. Page 3 indicates that the inspector shall "visually observe the subgrade during GCL installation". We have modified the first paragraph on Page 3 to indicate that the inspector will be on-site at all times during construction to monitor construction activities.

43. We have used 6-inch (min.) boreholes at other landfill sites for gas vents but we have modified the design as to show a 12-inch borehole with 1-inch diameter backfill. Shown on the enclosed Figure 8.

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Permit Application Form
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BECHTOL ENGINEERING
AND TESTING, Inc.

October 22, 1992
Project No. 92100

TO: LEE POWELL, P.E.
BRILEY, WILD & ASSOCIATES
P.O. BOX 607
ORMOND BEACH, FL 32175-0607

RE: Tomoka Farms Landfill North Cell, Volusia County, Florida.
(FDER Permit Application No. SC64-218367)

Dear Mr. Powell:

As requested, we have reviewed items 13, 14, and 15 of FDER's request for additional information which was forwarded to our office via FAX on 9/30/92, and offer the following responses:

Item 13: Please provide justification for the waste density of 4,500 pounds per square foot used in the bearing capacity calculations of the foundation analysis (page 5 of Appendix A).

Response: See attached Sheet 1 of 5.

Item 14: Please provide the bearing capacity calculations referenced in the foundation analysis (page 5 of Appendix A) indicating the bearing capacity of the subsurface formations are in excess of 50 tons/square foot.

Response: See attached Sheet 2 of 5.

Consulting Geotechnical and Construction Materials Testing Engineers
114A S. Alabama Avenue • DeLand, FL 32724-5524 • Telephone (904) 734-8444
FAX (904) 734-8541

Item 15: Assuming a settlement of 1 of 2 feet due to insufficient data to perform calculations is not adequate (see page 6 of Appendix A). Please conduct the tests and calculations necessary to adequately evaluate settlement of the landfill subgrade. This could impact design of the leachate collection system.

Response: See attached Sheets 3 through 5 of 5.

We trust this information is sufficient for your needs, however, if you should have any questions or if we may be of further service, please feel free to call.

Respectfully,

Bechtol Engineering and Testing, inc.

Thomas Bechtol, P.E.
President
Florida Registration No. 38538
TB/rr
0872

3 cc: Lee Powell

ESTIMATION OF WASTE BEARING PRESSURE

(Tomoka Farms Landfill - North Cell)

Waste Density

Estimate Waste Density = 1,000 lb/cu.yd. = 37 pcf

Estimated Cover Density = 100 pcf

Design Fill Section: 8' waste/6" cover

$$\text{Average Density} = \frac{(8)(37)+(0.5)(100)}{8.5} = 41 \text{ pcf}$$

Bearing Pressure

Estimate Groundwater Elevation = +25'

Effective (submerged) Weight of Waste Below Groundwater Elevation = 54-62.4 ≈ 0

Design Top-of-Embankment Elevation = +134'

Bearing Pressure = (134'-25')(41 pcf) = 4,469 psf

USE 4,500 psf

ALLOWABLE SUBGRADE SOIL BEARING CAPACITY

Angle of Internal Friction (deg)	? 20	Soil Cohesion	? 500
Depth of Water Table from Base	? 0	Depth of Footing	? 0
Effective Soil Unit Weight above Water Table		? 60	
Saturated Soil Unit Weight below Water Table		60	

1. Footing Round 2. Footing Square 3. Footing Rectangular ? 3

Smaller Dimension = ? 2000 Larger Dimension = ? 2500

Is Load Vertical (Y/N)? Y

Load Inclination From Vertical

Surface inclination From Horizontal

Footing Base Inclination From Horizontal

Load Magnitude Factor of safety ? 2

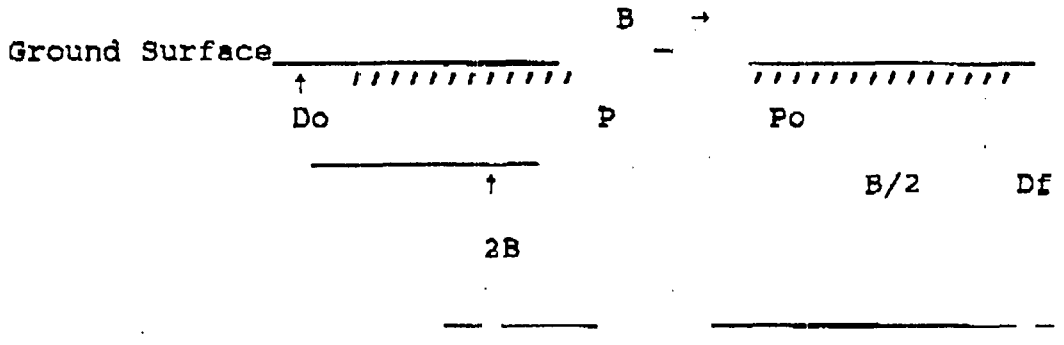
NOTE: Enter -0- if unknown

	Terzaghi N - Values	Meyerhof N - Values	Hansen N - Values
Nc	17.69027	14.8347	14.8347
Nq	7.43873	6.399389	6.399389
Ng	6.142892	2.870906	2.947825
Ultimate Bearing Capacity	377418.7	210198.7	215566.9
Allowable Bearing Capacity	188709.3	105099.4	107783.5

Ref: GEOTEK Ver. 1.0

ESTIMATED ELASTIC SETTLEMENT OF SAND SUBGRADE LAYERS

Footing Width B (ft)	? 2000
Depth of Footing Do (ft)	? 0
E.O.B. at Footing Base Po (TSF)	? 0
Contact Pressure P (TSF)	? 2.25
Number of Years	? 10



Number of Soil Layers To 4000 = 6

1) Silts,sandy silts, slightly cohesive silt-sand mixtures
2) Clean, fine to medium sands, and slightly silty sands
3) Coarse sands and sands with little gravel
4) Sandy gravel and gravel
5) Bedrock/Clay

No.	Soil Type	Depth from Ground	Blow Count
1	? 1	? 27	? 10
2	? 5	? 37	? 5
3	? 3	? 51	? 30
4	? 5	? 61	? 5
5	? 2	? 78	? 15
6	? 5	? 300	? 50

ESTIMATED ELASTIC SETTLEMENT OF SAND SUBGRADE LAYERS

Layer No.	Settlement	Layer No.	Settlement
1	.0054675		
2	0		
3	.001232		
4	0		
5	6.751429E-03		
6	0		

C1 = 1	C2 = 1.4
Total =	.5084451 in

Ref: GEOTEK Ver. 1.0

ESTIMATED PLASTIC SETTLEMENT OF CLAY LAYERS

Layer No.	H Layer Thickness (ft)	Po Effective Overburden (tsf)	P^1 Added Overburden (tsf)	e Void Ratio	Ce Compression Index
1	10	1.0	2.2	0.9	0.6
2	10	1.7	2.1	1.0	0.7

$$\text{ESTIMATED SETTLEMENT} = \frac{Cc\ H}{1+C} \log \frac{Po+p^1}{Po}$$

Layer No.	Estimated Settlement (ft)
1	1.6
2	1.2
Total	2.8'

FROM "TOMOKA LANDFILL HYDROGEOLOGIC SUMMARY AND GROUNDWATER MONITORING PLAN" MAY 1992

DATE	B-7	B-8	B-9	B-10	B-11
7/87	24.3	18.6	23.8	-	-
8/87	23.9	17.9	23.2	-	-
9/87	22.8	19.5	23.1	-	-
10/87	26.4	19.0	25.7	-	-
11/87	25.9	20.4	25.3	-	-
12/87	25.9	20.8	25.1	-	-
1/88	24.3	18.6	23.8	-	-
2/88	23.9	17.9	23.2	-	-
3/88	22.8	19.5	23.1	-	-
4/88	26.4	19.0	25.7	-	-
5/88	25.9	20.4	25.3	-	-
6/88	25.9	20.8	25.1	-	-
7/88	24.4	17.9	22.8	26.2	-
8/88	23.5	23.0	22.7	27.1	-
9/88	24.4	17.9	22.1	27.2	-
10/88	24.4	18.0	23.7	27.0	-

DATE	B-7	B-8	B-9	B-10	B-11
11/88	24.0	18.0	22.7	27.2	-
12/88	25.5	19.9	24.8	29.1	-
1/89	25.4	18.5	23.2	27.6	-
2/89	25.4	19.8	24.4	27.7	-
3/89	25.4	19.9	24.7	28.1	-
4/89	23.7	20.9	22.6	27.1	-
5/89	24.4	18.9	22.8	27.2	-
6/89	23.4	16.0	21.7	27.1	-
7/89	23.4	15.0	20.7	27.1	-
8/89	25.4	17.9	21.8	28.2	-
9/89	25.4	17.9	21.8	28.2	-
10/89	26.4	19.0	24.7	20.1	-
11/89	26.4	20.9	25.7	29.1	-
12/89	25.4	20.9	24.8	28.2	-
1/90	25.5	19.9	25.7	28.2	-
2/90	26.4	20.0	25.7	28.2	-

DATE	B-7	B-8	B-9	B-10	B-11
3/90	25.5	20.0	25.7	29.2	26.6
4/90	25.5	19.9	25.7	29.1	26.5
5/90	24.4	17.0	23.7	28.1	24.6
6/90	24.4	17.0	22.7	27.2	24.6
7/90	25.1	17.0	23.5	27.6	25.2
8/90	25.1	17.5	23.9	27.6	25.6
9/90	26.4	17.3	23.5	27.7	24.8
10/90	25.0	17.7	23.7	28.0	25.0
11/90	23.7	23.0	22.6	28.1	23.9
12/90	23.5	17.0	22.7	27.2	23.6
1/91	24.4	16.9	21.8	27.2	23.6
2/91	24.4	16.9	21.8	27.2	23.6
3/91	24.4	16.0	22.7	27.2	25.5
4/91	26.4	19.0	24.7	28.2	26.5
5/91	26.4	20.0	25.8	30.1	26.6
6/91	26.4	21.0	25.7	29.1	26.6

DATE	B-7	B-8	B-9	B-10	B-11
7/91	26.5	21.9	26.7	29.1	27.5
8/91	26.4	22.0	25.8	29.1	26.6
9/91	26.4	21.0	25.7	29.2	26.6
10/91	25.5	22.0	25.7	29.2	26.6
11/91	24.5	21.0	24.7	28.1	25.6
12/91	25.4	20.9	24.7	28.1	25.6

The Owner shall hire an independent quality assurance firm to provide an Inspector to be on-site at all times during construction to monitor construction activities and to observe all quality control procedures. The Inspector will check material certifications, observe all testing, and monitor construction compliance with the plans and specifications. The Inspector will conduct field testing procedures and will arrange for independent laboratory testing where required. He will also prepare daily logs of all construction activity, including the time, location, identification, number, and results of all field tests and samples.

The firm to be selected to provide quality assurance inspection shall be a professional firm having quality assurance inspection as a significant part of their regular professional practice. The firm shall have at least two years of experience in construction quality assurance, testing and shall employ licensed professional engineers.

3.0 SPECIFICATIONS

The specifications for the HDPE membrane liner and for the geosynthetic clay liner are attached at the back of this section.

4.0 SUBGRADE PREPARATION QUALITY ASSURANCE

The Inspector shall provide field density tests using ASTM D2922 at a frequency of one per acre to verify the compaction of the subgrade. The Inspector shall visually observe the subgrade during GCL installation to confirm that the surface on which the liner is to be placed is maintained in a firm, clean, and smooth condition, free of standing water, during liner installation.

5.0 GEOSYNTHETIC CLAY LINER QUALITY ASSURANCE

5.1 Off-Site Quality Assurance

The GCL manufacturer shall allow the Inspector to visit the manufacturing facility in order to:

- observe the quality control testing facilities;
- meet and review the manufacturer's quality control and production personnel;
- observe that the quality control procedures being followed are in strict accordance wit those outlined in the manufacturer's Quality Control Manual;

!!
!!

TOMOKA LANDFILL EXPANSION
VOLUSIA COUNTY
10-21-92

!!
!!

BARE GROUND

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4790 VOL/VOL
FIELD CAPACITY	=	0.3714 VOL/VOL
WILTING POINT	=	0.2505 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3714 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000024999999 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	96.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2942 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 3

LATERAL DRAINAGE LAYER

THICKNESS	=	24.00 INCHES
POROSITY	=	0.3509 VOL/VOL
FIELD CAPACITY	=	0.0705 VOL/VOL
WILTING POINT	=	0.0326 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0705 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000155000002 CM/SEC

LAYER 4

LATERAL DRAINAGE LAYER

THICKNESS	=	0.20 INCHES
POROSITY	=	0.8000 VOL/VOL
FIELD CAPACITY	=	0.6240 VOL/VOL
WILTING POINT	=	0.0245 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.6240 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	19.684999465942 CM/SEC
SLOPE	=	2.00 PERCENT
DRAINAGE LENGTH	=	80.0 FEET

LAYER 5

BARRIER SOIL LINER WITH FLEXIBLE MEMBRANE LINER

THICKNESS	=	0.25 INCHES
POROSITY	=	0.4000 VOL/VOL
FIELD CAPACITY	=	0.3560 VOL/VOL
WILTING POINT	=	0.2899 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4000 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000010000 CM/SEC
LINER LEAKAGE FRACTION	=	0.00001000

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	96.29
TOTAL AREA OF COVER	=	1263240. SQ FT
EVAPORATIVE ZONE DEPTH	=	10.00 INCHES
POTENTIAL RUNOFF FRACTION	=	0.200000
UPPER LIMIT VEG. STORAGE	=	4.9540 INCHES
INITIAL VEG. STORAGE	=	2.0668 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	32.3884 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND SOLAR RADIATION FOR DAYTONA FLORIDA

MAXIMUM LEAF AREA INDEX	=	0.00
START OF GROWING SEASON (JULIAN DATE)	=	0
END OF GROWING SEASON (JULIAN DATE)	=	367

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
65.20	65.60	70.10	73.30	77.60	80.40
82.00	82.30	81.40	77.30	71.50	67.00

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 87 THROUGH 91

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.81	1.70	1.16	8.66	6.28
	5.22	5.13	8.73	5.69	5.31	3.90
STD. DEVIATIONS	3.08	1.75	0.80	0.39	5.73	2.54
	3.73	2.43	3.86	2.95	3.82	2.42
RUNOFF						
TOTALS	1.018	0.186	0.230	0.058	2.328	1.080
	0.690	0.631	2.080	0.951	1.473	0.582
STD. DEVIATIONS	1.199	0.356	0.270	0.038	2.509	1.130
	0.785	0.653	1.858	1.027	1.767	0.557
EVAPOTRANSPIRATION						
TOTALS	1.829	1.069	1.606	1.027	4.621	5.012
	4.485	4.392	4.518	3.686	2.573	2.609
STD. DEVIATIONS	0.934	0.784	1.016	0.583	1.885	0.475
	2.129	1.844	0.542	1.021	0.806	1.333
LATERAL DRAINAGE FROM LAYER 4						
TOTALS	0.8275	0.6223	0.5867	0.4902	0.4384	0.4281
	0.4776	0.4619	0.5682	0.7390	0.8092	0.9767
STD. DEVIATIONS	0.6098	0.3153	0.2194	0.1495	0.1137	0.0977
	0.1196	0.0967	0.3523	0.4578	0.2520	0.4964
PERCOLATION FROM LAYER 5						
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

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 87 THROUGH 91

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	56.93	(7.808)	5992599.	100.00
RUNOFF	11.309	(3.259)	1190467.	19.87
EVAPOTRANSPIRATION	37.427	(3.691)	3939982.	65.75
LATERAL DRAINAGE FROM LAYER 4	7.4259	(1.9587)	781724.	13.04
PERCOLATION FROM LAYER 5	0.0000	(0.0000)	0.	0.00
CHANGE IN WATER STORAGE	0.764	(2.638)	80426.	1.34

PEAK DAILY VALUES FOR YEARS 87 THROUGH 91

	(INCHES)	(CU. FT.)
PRECIPITATION	5.27	554772.9
RUNOFF	1.644	173067.0
LATERAL DRAINAGE FROM LAYER 4	0.0727	7649.1
PERCOLATION FROM LAYER 5	0.0000	0.0
HEAD ON LAYER 5	0.1	
SNOW WATER	0.00	0.0

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4608
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.2005

FINAL WATER STORAGE AT END OF YEAR 91

LAYER	(INCHES)	(VOL/VOL)
1	2.41	0.4020
2	32.44	0.3379
3	4.82	0.2010
4	0.13	0.6504
5	0.10	0.4000
SNOW WATER	0.00	

BRILEY, WILD AND ASSOCIATES

PROJECT Tomoka Landfill PROJ.NO. VC92067-6E PAGE 1 OF 4
SUBJECT Pump Head Calculations DATE
DETAIL COMPUTED BY LAP CHECKED BY

BRILEY, WILD & ASSOCIATES, Inc.

Leachate Pump Calculations

Static Head

Centerline Elevation in Discharge Pipe		36.17
Minimum water level in sump		12.0
Static Head		24.2 ft.

Friction Head

400 gpm, 6-inch pipe		
Straight pipe	600 ft.	
4 - 90° el	60.8	
1 - Check	50.5	
1 - Butterfly valve	22.7	
	734.0	
Say 800 ft.		
800 x 1.31 ft/hundred ft =		10.5 ft
800 gpm, 8-inch pipe		
Straight Pipe	350 ft.	
2 - Tees	79.8	
1 - Butterfly Valve	29.9	
1 - 45° el	10.6	
	470.3	
Say 500 ft.		
500 x 1.16 ft/hundred ft =		5.8 ft
Inlet/Outlet losses		0.7
Total Head Loss =		41.2 ft

BRILEY, WILD AND ASSOCIATES

PROJECT Tomoka LandFill PROJ.NO. _____ PAGE 2 OF 4

SUBJECT Pump Head Calculations DATE _____

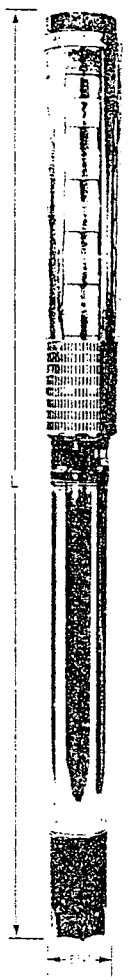
DETAIL _____ COMPUTED BY _____ CHECKED BY _____

BRILEY, WILD & ASSOCIATES, Inc.

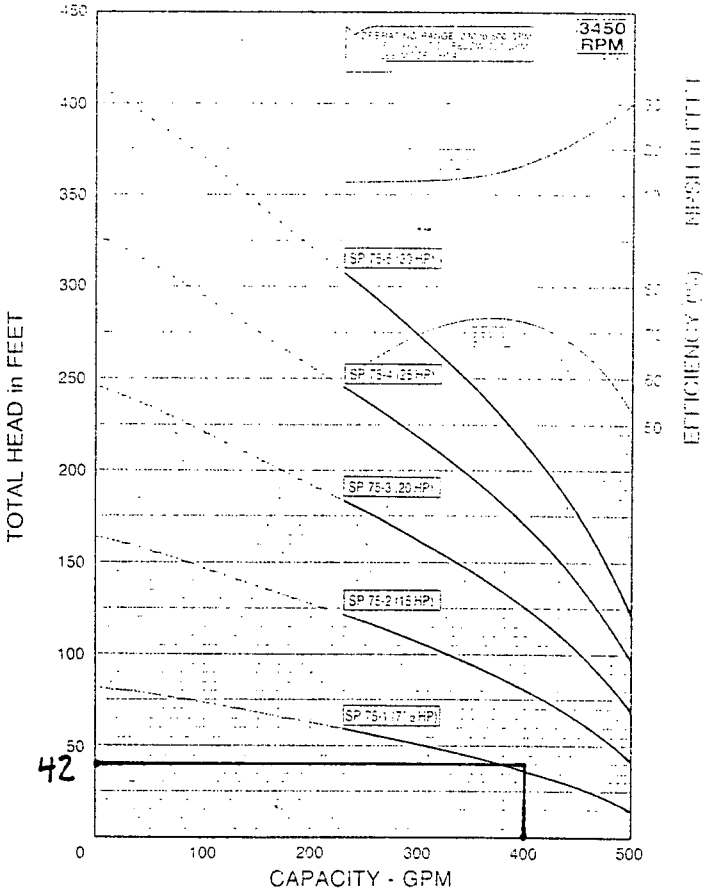
Leachate Pump

MODEL SP 75

NOM. FLOW RATE
375 GPM
FLOW RANGE
230 to 500 GPM
PUMP OUTLET
4" NPT



Performance Curves



DIMENSIONS AND WEIGHTS

MODEL NO.	HP	MIN. WELL SIZE	LENGTH (L)	APPROX. UNIT SHIPPING WT. (LBS.)
SP 75-1	7½	6"	44⅛"	153
SP 75-2	15	6"	53⅛"	181
SP 75-3	20	6"	60"	197
SP 75-4	25	6"	66⅛"	226
SP 75-5	30	6"	73⅛"	245

Specifications are subject to change without notice.

400 gpm @ 42 ft TDH

Leachate Basin Pump Calculations

Static Head

35.0 - 25.0 — 10.0 ft.

Pressure at Nozzle

80 psi ± x 2.307 ft/psi — 184.6 ft.

Friction Head

480 gpm - 6-inch piping

Straight Pipe	40 ft.
Check Valve	50.5
Butterfly	22.7
	113.2 ft

Say 150 ft

240 gpm - 6-inch piping

Straight Pipe	704 ft.
6 - 90° el	91.2
3 - Butterfly Valves	68.1
	863.3 ft

Say 900 ft

480 gpm	150 ft x 2.02 ft/100	3.0
240 gpm	900 ft x .53/100	4.8
Total Head		202.4 ft

BRILEY, WILD AND ASSOCIATES

PROJECT Tomoka Landfill PROJ.NO. _____ PAGE 4 OF 4

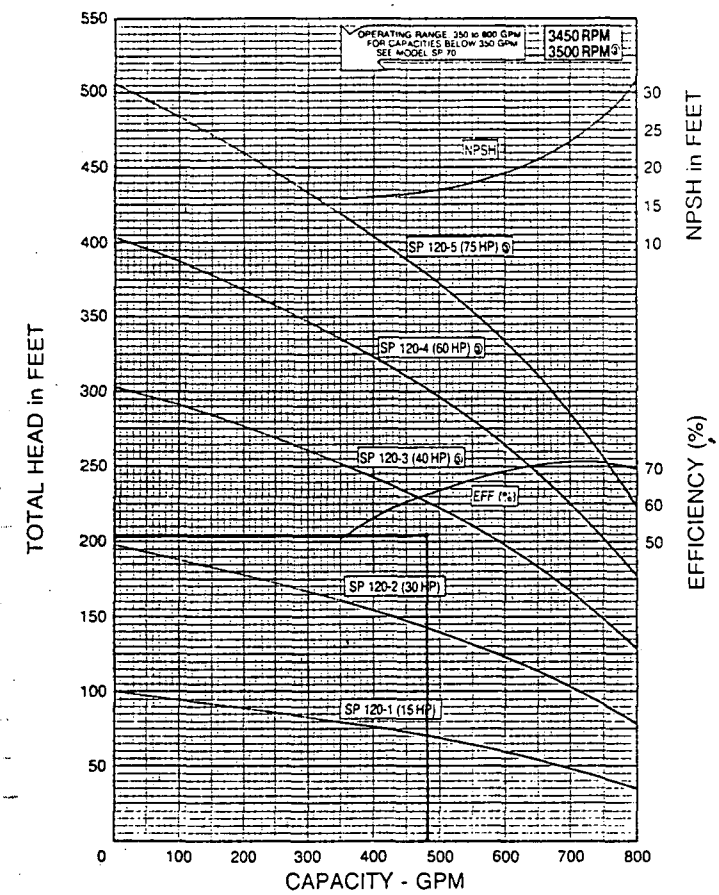
SUBJECT Pump Head Calculations DATE _____

DETAIL _____ COMPUTED BY _____ CHECKED BY _____

BRILEY, WILD & ASSOCIATES, Inc.

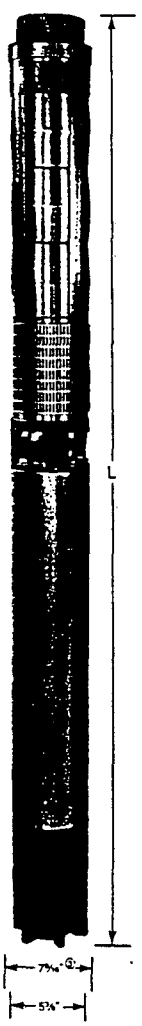
Leachate Basin Pump

Performance Curves



MODEL
SP 120

NOM. FLOW RATE
600 GPM
FLOW RANGE
350 to 800 GPM
PUMP OUTLET
5" NPT



DIMENSIONS AND WEIGHTS

MODEL NO.	HP	MIN. WELL SIZE	LENGTH (L)	APPROX. UNIT SHIPPING WT. (LBS.)
SP 120-1	15	10"	52¼"	207
SP 120-2	30	10"	66⅜"	250
SP 120-3	40 ⊕	10"	75⅝"	482
SP 120-4	60 ⊕	10"	87¾"	567
SP 120-5	75 ⊕	10"	99"	635

⊕ 8 Inch Motor

Specifications are subject to change without notice.

480 gpm @ 202 ft TDH

LAP

Florida Department of Environmental Regulation

Central District • 3319 Maguire Boulevard, Suite 232 • Orlando, Florida 32803-3767

Lawton Chiles, Governor

Carol M. Browner, Secretary

Certified Mail
Return Receipt Requested
P-810 426 749

December 15, 1992

Volusia County Department of Solid Waste Management
123 West Indiana Avenue
DeLand, Florida 32720

OCD-SW-92-0477

ATTN: Mr. James L. Griffin, Director

Volusia County - SW
Tomoka Farms Road Landfill
North Cell, Class I
Permit Application No SC64-218367

Dear Mr. Griffin:

This is to acknowledge receipt of your application for the subject facility. The status of your application is as follows:

[ ] Your application for permit 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.

[x] The additional information received on November 16, 1992 was reviewed, however, the items listed on the attached sheet remain incomplete. Evaluation of your application will continue to be delayed until we receive all requested information.

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, omissions or supply additional information within a reasonable period of time. Please submit three copies of the requested information to the department and reference the above application permit numbers in your correspondence.

If you have any questions, please contact me at 407/894-7555.

Sincerely,

Richard B. Tedder, P.E.
Program Manager
Solid Waste

Enclosure
cc: Bret LeRoux, P.G. - FDER - Waste Cleanup
Lee Powell, P.E. - Briley, Wild and Associates - Ormond Beach, FL
Mike Bateman, P.E. - FDER - Storm Water

(#6) LAP

Volusia County - SW
Tomoka Farms Landfill North Cell, Class I
Permit Application No. SC64-218367

1. This application will remain incomplete until an adequate ground water monitoring plan for the site has been developed.

2. Ground water elevation data from July 1987 to December 1991 submitted for monitoring wells B-7 and B-9 show the bottom of the proposed liner if constructed at a typical bottom elevation of 22.1 NGVD would be above the ground water 7 percent of the time. If the constructed bottom elevation considered is 23.8 NGVD as show on Sheet 7 of 14, the liner would be above ground water 33 percent of the time. Based on your selected design option, the bottom of the liner must be designed to be in the ground water at all times. Please revise your design plans to insure the bottom liner will be constantly in contact with ground water under naturally occurring ground water elevation conditions not under artificially raised or lowered water table conditions.

3. The description how the landfill liner will be constructed below the ground water table remains unclear. Sheets 5 of 14 and 6 of 14 show the design bottom elevation of the perimeter ditch to be 12 NGVD. The response to question 18 indicates the perimeter ditch will be dewatered to an elevation of 10 NGVD. Please clarify. Also, the Department understands installation of geosynthetic clay liners can be very difficult when wet. What procedures will be taken during installation to insure seaming and construction will be adequate?

4. Please provide revised pages of the landfill Operating Plan (to be inserted in the permit application) describing how operators should operate the facility to insure the liner will be protected from maximum potential uplift from ground water at the site. This should reflect any revisions required by Comment #2 above and should include a description of the maximum ground water elevations allowed in the perimeter ditch and how much waste must be in place before dewatering can be discontinued. Supporting calculations should also be provided.

5. The proposed composite liner for the landfill using 60 mil HDPE on top of Claymax or other geosynthetic material is not an approved design. This application will remain incomplete until the Alternate Procedures Approval in accordance with Rule 17-701.078, F.A.C. is approved.

6. A final cover for the landfill consisting of a 6 inch

compacted clay barrier layer with a saturated hydraulic conductivity of $5x10^{-8}$ cm/sec is not acceptable. The final cover barrier layer should be at least 18 inches thick with a maximum permeability of $1x10^{-5}$ cm/sec, or a soil layer with equivalent protection and a minimum thickness of 12 inches or it can be an appropriate geomembrane material. The geomembrane can be a semi-crystalline thermoplastic at least 40 mils thick or a non-crystalline thermoplastic at least 30 mils thick with a maximum water vapor transmission rate of 2.4 grams per meter^2 per day. Please revise the Closure Plan and closure cost estimates to reflect this change in the barrier layer of the final cover.

7. Figure 9, "Typical Terrace Detail" shows the use of a DOT Type B No 231 inlet structure to the downpipe storm water system. What will prevent soil from washing into the inlet structure and eroding the integrity of the system?

8. The water evaporation rate for the leachate basins of 46.6 inches per year is based on estimates only. The Department is concerned that evaporation and recirculation of leachate will be adequate to manage the leachate generated on-site. Please provide written documentation that the City of Daytona Beach is willing to take leachate by tanker trucks if needed as a disposal option for the landfill.

9. Please clarify the operation of the leachate leak detection manholes shown on Figure 11 by providing revised pages of the landfill Operating Plan (to be inserted in the permit application) describing how operators should operate the leachate holding basins. This system must be operated to not allow the leak detection system to become saturated.

10. The initial sentence in response to Comment #37 of the Department letter dated September 21, 1992 reads "The HDPE manhole will be a 4-foot diameter manhole, as manufactured by ADS or Spirolite Leachate to be recirculated to the landfill will be pumped to the manhole". Please clarify what was intended by this sentence.

11. The changes to the landfill drawings shown on Figure 1 through Figure 11a should be included into the application drawings (Sheets 1 through 14, Project No 92067-6). Please provide at least one complete set of sealed engineering drawings including all these changes.

BRILEY, WILD
AND ASSOCIATES

February 17, 1993

VC 92067-6CE

Mr. Richard B. Tedder, P.E.
Solid Waste Program Manager
Florida Department of Environmental Regulation
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Re: Volusia County
Tomoka Farms Road Landfill
Permit Application SC64-218367

Dear Mr. Tedder:

The following is submitted in response to your letter of December 15, 1992:

1. Our hydrogeologic consultant, Dr. David Gomberg, is currently working on preparation of a revised ground water monitoring plan.

2. We have revised the design of the proposed landfill bottom, as indicated on the revised Sheet 5 of 14. With the new design the highest point on the liner is now at elevation 20.7. Based on the water level monitoring data previously submitted, this point would be in the ground water at all times under naturally occurring conditions.

3. The existing perimeter ditch has been dewatered to an elevation of 10 NGVD. This will be the elevation at the start of construction. The proposed perimeter ditch has side slopes that are not as steep as the existing side slopes and is not as deep as the existing ditch. As construction proceeds, the new ditch will gradually replace the old one and the new ditch will be dewatered to 12 NGVD.

4. We have evaluated potential uplift forces for three critical areas of the liner: the sump, the lowest portion of the liner in the leachate collection trench, and the lowest portion of the liner outside the leachate trench. The lowest portion of the liner outside the leachate trench was found to be the critical area, as shown in the attached calculations.

   Enclosed is an addition to be inserted in the operating plan at the end of paragraph h. Gas, Leachate, and Stormwater Control, describing how operators should operate the facility to ensure that the liner will be protected from uplift.

5. A request for approval of the alternate procedures will be submitted under separate cover.

6. The proposed barrier layer consists of six inches of clay with a permeability of 5×10^{-8} cm/sec. As shown in the enclosed calculations the proposed barrier layer will allow only one percent of the amount of percolation that the 18 inches of 1×10^{-5} cm/sec barrier would

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1040 North U.S. Highway One
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Offices in Bradenton, Clearwater,
Daytona Beach, Orlando & Ormond Beach, FL

allow. We, therefore, recommend that the proposed barrier layer be approved for use on the side slopes.

7. Sediment could wash into the inlet structures from two sources: sediment carried directly to the inlet structure by surface runoff flowing down the side slopes and sediment carried by water flowing along the terrace torward the inlet. The heaviest sediment loading will occur after the side slopes are constructed and before a good vegetative cover has been established. To prevent sediment from plugging the inlet boxes during this period sod will be placed for 20 feet in all directions from the inlets and a siltation fence will be constructed on the uphill side of the inlet.

   During the life of the landfill and during the post closure maintenance period it will be necessary to inspect the inlets for sediment build-up. If sediment build-up is excessive it may be necessary to construct additional silt screens or sediment traps to maintain the integrity of the system.

8. The County will submit under separate cover written documentation that the City of Daytona Beach will accept leachate for treatment should off-site disposal be required.

9. Enclosed is a supplement to the Operation Plan describing how the leachate basin and leak detection system should be operated.

10. Please add a period between the words "Spirolite" and "Leachate" to make the sentence into two sentences.

11. We have incorporated the previously submitted figures onto the application drawings. Enclosed are two signed and sealed sets of the revised drawings.

We appreciate your assistance on this project.

Very truly yours,

BRILEY, WILD & ASSOCIATES, INC.
CONSULTING ENGINEERS & PLANNERS

Lee A. Powell, P.E.
Assistant Director of Engineering

LAP/seg
cc: Mr. James Griffin

(to be inserted after page 20 in the Application Report)

The water level in each of the leachate basins and leak detection manholes should be measured and recorded daily. After recording the water levels, the manholes should be pumped dry with a portable pump or baler. To determine if excessive leakage is occurring, it is necessary to measure the flow of water from the leak detection system to the manhole. This flow may be determined by measuring the time it takes for the water level in the manhole to rise one foot. Following are the maximum allowable leakage rates for the various leachate basin water depths:

Leachate Basin Water Depth (feet)	Maximum Acceptable Leakage Rate (GPM)	Time for 1-ft. Rise (min)
1	4.7	20.00
2	6.7	14.03
3	8.2	11.46
4	9.5	9.89
5	10.6	8.87
6	11.6	8.10
7	12.5	7.52
8	13.4	7.01

Any leaks in the liner that are identified should be patched, regardless of the measured leakage rate. When the leakage rate in either basin exceeds the maximum level identified above, it should be taken out of service and the leaks located and repaired.

The leak detection system must not be allowed to become saturated. If there is a steady flow of water from the leak detection system, even if it is below the "acceptable" levels indicated above, it must be pumped from the manhole at a constant rate or at sufficiently frequent intervals to prevent saturation of the leak detection system.

During construction of the landfill, the contractor will keep the site dewatered. The ditch surrounding the landfill will be pumped as needed to keep the water level at 12.0 MSL or lower. When the County accepts the landfill from the contractor, it will become the County's responsibility to keep the ditch sufficiently dewatered to prevent hydraulic uplift from pushing up the liner and displacing the leachate collection system. Until the first lift of refuse is placed over the entire site, the water level in the ditch should be kept below 18.6, the elevation of the top of the sand drainage layer at the lowest point. When the top of the landfill reaches 28.6, the water level in the ditch may be allowed to rise to 26.0.

CLAY CAP EQUIVALENCY CALCULATIONS

The new Florida Landfill Regulations require that the low permeability layer of the landfill cap be a minimum of 18-inches thick and have a maximum hydraulic conductivity of 1×10^{-5} cm/sec. Volusia County proposes to use a clay layer with a hydraulic conductivity of 5×10^{-8} cm/sec. The clay layer would be 6-inches thick on the side slopes and 12-inches thick on the terraces.

To determine the equivalency of the proposed clay layer to the one described in the regulations, it is necessary to calculate the seepage rate through each of the two clay layers.

Steady-state seepage calculations for fluid flow through a clay layer are performed using Darcy's equation: $q = ki$

where: q = steady-state flow per unit area in ft/s; k=hydraulic conductivity in ft/s; and i = hydraulic gradient (dimensionless).

The hydraulic gradient i, is defined by: $i = (h + T)/T$

where h = head of liquid on top of clay layer in ft. and T = thickness of clay layer in ft. Combining the equations gives: $q = k (h + T)/T$

The hydraulic head on a landfill cap is normally very small. For this analysis, one foot of ponding on the terraces due to settlement or uneven grade was considered a reasonable estimate of a hydraulic head unlikely to be exceeded.

For the basic case of a hydraulic head, h, of 1 ft. on a clay layer which has thickness, T, of 1.5 ft. and a hydraulic conductivity, k, of 1×10^{-5} cm/s (3.28×10^{-7} ft./s) (i.e., the reference clay layer), the calculation of steady-state flow per unit area is as follows:

$$q = k (h + T)/T$$
$$q = 3.28 \times 10^{-7} \times (1 + 1.5)/1.5$$
$$= 5.467 \times 10^{-7} \text{ ft/sec}$$
$$= 17.240 \text{ ft/year}$$

Therefore, the steady-state flow per unit area for the basic case is 17.240 ft/year.

Substituting a clay layer with a thickness, T, of 6.0 in. (0.5 ft.) and a hydraulic conductivity of 5×10^{-8} cm/s (1.640×10^{-9} ft/s) in place of the 1.5 ft. of clay in the above calculation gives:

$$q = k (h + T)/T$$
$$q = 1.640 \times 10^{-9} (1 + 0.5)/0.5$$
$$q = 4.921 \times 10^{-9} \text{ ft/sec}$$
$$q = 0.155 \text{ ft/year}$$

Therefore, the steady-state flow per unit area when the proposed clay layer is used is 0.155 ft/year. This is less than one percent of the infiltration that would penetrate the eighteen inch thick clay layer described in the regulations.

If the clay became dry enough to allow desiccation cracks to penetrate the entire six inches, surface water would leak through the crack into the landfill. Because the clay layers are self-healing, the desiccation cracks would fill with clay and any leakage would be of short duration. With normal rainfall and supplemental irrigation necessary to keep the vegetative cover, it is unlikely that six inch deep desiccation cracks would be a major problem.

Differential settling of the landfill could also disrupt the continuity of the clay layer. Minor differential settlement would not prevent the clay layer from re-sealing when the clay was moistened by precipitation. Major differential settlement might require additional clay to restore the continuity of the clay layer. This would also be required with the eighteen inch layer required by the DER.

On the 4H:1V side slopes, surface runoff will also substantially reduce the quantity of water that would be available to percolate through the liner. On the level terraces and on the relatively flat portions of the landfill top, the County proposes to use 12-inches of clay to better ensure the integrity of the clay cap. The clay cap proposed by Volusia County therefore will provide substantially greater protection against infiltration than the eighteen-inch clay layer required by the DER.

Florida Department of Environmental Regulation

Central District • 3319 Maguire Boulevard, Suite 232 • Orlando, Florida 32803-3767

Lawton Chiles, Governor

Virginia B. Wetherell, Secretary

March 18, 1993

CERTIFIED MAIL
RETURN RECEIPT REQUESTED
P-712 572 434

Volusia County Department of Solid Waste Management
123 West Indiana Avenue
DeLand, Florida 32720

OCD-SW-93-0104

Attn: Mr. James L. Griffin, Director

Volusia County - SW
Tomoka Farms Road Landfill
North Cell, Class I
Permit Application No. SC64-218367

Dear Mr. Griffin:

This will acknowledge receipt of your application for the subject facility. The status of your application is as follows:

[ ] Your application for permit 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.

[X] The additional information received on February 18, 1993 was reviewed, however, the items listed on the attached sheet remain incomplete. Evaluation of your application will continue to be delayed until we receive all requested information.

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, omissions or supply additional information within a reasonable period of time. Please submit three copies of the requested information to the Department and reference the above application permit number in your correspondence.

If you have any questions, please contact me at 407/894-7555.

Sincerely,

Richard B. Tedder, P.E.
Program Manager
Solid Waste

RBT/gcw
Enclosure
cc: Bret LeRoux, P.G. - FDER - Waste Cleanup
Lee Powell, P.E.- Briley, Wild & Associates, Inc.

Volusia County - SW
Tomoka Farms Road Landfill - North Cell, Class I
Permit Application No. SC64-218367

Note: The item numbers are the same as in FDER letter dated December 15, 1992.

1) This application will remain incomplete until an adequate Ground Water Monitoring Plan for the site has been developed and submitted to the Department.

3) The Department understands that installation of geosynthetic clay liners can be very difficult when wet. Provide information on what procedures will be taken during installation of the liner to insure seaming and construction will be adequate.

4) The response to Item 4 does not reflect how much waste must be in place before dewatering can be discontinued. The attached calculations referrenced to in response to Item 4 were not received and need to be submitted.

5) The proposed composite liner for the landfill using 60 mil HDPE on top of Claymax or other geosynthetic material is not an approved design. This application will remain incomplete until the Alternate Procedures Approval in accordance with Rule 17-701.310, Florida Administrative Code (F.A.C.) is approved.

6) Regulations which became effective on January 6, 1993, state the Department can allow a 12 inch thick barrier layer in the final cover provided it will minimize infiltration to an equivalent degree as 18 inches of 1 X 10^{-5} cm/sec soils. We are not authorized to allow 6 inches of 5 X 10^{-8} cm/sec per day. Should you wish to continue with this design, an Alternate Procedures Approval in accordance with Rule 17-701.310, F.A.C. will be required. Otherwise, please revise the closure plan and closure cost estimates to be consistent with the final cover design requirements of Rule 17-701.600(5), F.A.C. Also, the calculations showing your proposal would only allow 1 percent of the percolation through 18 inches of 1 X 10^{-5} cm/sec clay were not included with the response.

8) This item will remain incomplete until such time documentation is submitted to indicate that the City of Daytona Beach will accept leachate for treatment should off-site disposal be required.

11) The landfill leachate header detail on sheet 11 of 15 does not show a geosynthetic clay liner underlying the 60 mil HDPE geomembrane. Please revise this detail to be consistent with the Alternate Procedures request to create a composite bottom liner for the landfill using GCL material.

BRILEY, WILD
AND ASSOCIATES

File copy

July 15, 1993

VC 92067-6CE

Mr. Richard B. Tedder, P.E.
Solid Waste Program Manager
Florida Department of Environmental Regulation
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Re: Tomoka Farms Road Landfill
Permit Application No.: SC64-218367

Dear Mr. Tedder:

We have received your letter dated March 18, 1993 on the proposed landfill expansion. This letter is submitted in response to your request for information.

The County has made several changes in the proposed landfill design, based partly on concerns raised during your review. These changes are as follows:

A. The footprint has been extended 100-feet further north and 75-feet further east. The terraces have been reduced from 20-feet wide to 12-feet wide, allowing the top of the landfill to rise from 131 to 155 MSL.

B. The side slopes have been changed from 4H:1V to 3H:1V. The service road across the landfill has been modified to accommodate the steeper side slopes. With terraces after every 20-feet of rise, only 60-feet side slope will be exposed to rainfall between terraces. Because of the low permeability barrier layer in the proposed final cover, the total runoff is not expected to be increased by the steeper slope.

C. The two borrow pits where the proposed landfill is to be constructed have both been dewatered. The base is firm and dry, and there is no need to raise the bottom elevation with clean fill to provide a stable base to construct the liner. We have lowered the proposed bottom elevations to reduce the amount of clean fill that would be required for shaping the subgrade. Except at the sumps or the deeper leachate trenches, the proposed liner system will be constructed at or above the bottom of the existing borrow pit. This change, along with those described above, increase the life of the proposed landfill to 5 years.

Briley, Wild and Associates, Inc.
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1040 North U.S. Highway One
P.O. Box 607
Ormond Beach, FL 32175
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Offices in Bradenton, Clearwater, Daytona Beach, Orlando & Ormond Beach, FL

D. Previous work by Dr. David Gomberg in 1986 found that a clay layer with a permeability of 2.1×10^{-7} cm/sec underlaid the area of the proposed landfill expansion. The borrow pits were constructed into that clay layer. To confirm that the clay layer extends under the entire proposed landfill, four hand auger holes were constructed in the dewatered borrow pits. A clayey layer greater than six inches in depth was found at the base of the borrow pits at all four locations.

Although the natural clay formation meets the requirements for subbase to a double liner, shaping and grading prior to placing the liner would expose lenses and inconsistencies. These would have to be identified and corrected so that the geomembrane liner would be placed directly on clay. We have proposed to place a geocomposite clay liner (GCL) on the prepared subgrade to assure compliance with soil component requirements.

E. A Detection System and second geomembrane liner have been added. We believe that due to the low permeability of the subgrade, the reliability of the composite liner, and the inward hydraulic gradient, that the originally proposed liner system would provide adequate protection of the groundwater. The proposed leak detection system however will provide greater assurance that the groundwater is protected and will help assure that the liner system will comply with possible future more stringent liner requirements. The liner system now being proposed consists of the following components, from top to bottom:

- a 2-foot (0.6-m) thick sand drainage layer,
- a leachate collection system (LCS) geotextile filter (Trevira 1125, Amoco 4508, Polyfelt TS650 or approved equal);
- an LCS geonet drainage layer (National Seal PN-3000, or approved equal);
- a 60-mil (1.5 mm) thick High Density Polyethylene (HDPE) geomembrane (Gundle or National Seal)
- a leak detection system geonet drainage layer (National Seal PN-3000 or approved equal);
- a composite liner composed of a 60-mil (1.5 mm) thick HDPE geomembrane (Gundle or National Seal) placed on top of a bentonite geocomposite (Claymax®, Bentomat®, or approved equal);
- a prepared subgrade not less than 6-inches thick with a permeability not more than 1×10^{-5} cm/sec.

Enclosed are three sets of the revised project drawings reflecting the changes described above. Also enclosed are the design calculations and operation plan for the leak detection system.

The comments in your March 18, 1993 letter are addressed as follows:

1. We have received your May 18, 1993 comments on the groundwater monitoring plan and we are in the process of addressing those concerns.

3. The proposed site is currently dewatered and is very dry. The site will remain dewatered during construction. Paragraph 3.02 Installation, of the GCL specifications say that the number of GCL panels that may be deployed in any one day is limited to the number that can be placed in a dry condition and covered by the HDPE while still dry. No installation or seaming under wet conditions will be allowed. The Construction Quality Assurance Plan requires the owner's inspector to inspect the subgrade each day prior to placing the GCL.

4. As indicated on the enclosed calculations, twenty feet of waste and soil cover must be placed before all dewatering may be discontinued.

5. As indicated above, the liner design has been revised to include a subgrade with a permeability of 1×10^{-5} cm/sec, the composite liner previously proposed, a leak detection layer and a primary 60 mil HDPE liner. This proposed liner system is in compliance with FAC and no Approval of Alternate Procedures is required.

6. We have revised the proposed final cover barrier layer to 12-inches of clay with a permeability of not more than 5×10^{-7} cm/sec. As indicated on the enclosed calculations, the proposed barrier layer will allow a percolation of only six percent of that allowed by the barrier layer described in FAC.

8. The County is still looking at off-site leachate treatment alternatives.

11. This detail has been revised as discussed above.

I appreciate your assistance with this application.

Very truly yours,

BRILEY, WILD & ASSOCIATES, INC.
CONSULTING ENGINEERS & PLANNERS

Lee A. Powell, P.E.
Assistant Director of Engineering

LAP/lhm
cc: Mr. Jim Griffin, Volusia County

Leak Detection System Design and Operation

Introduction

The proposed Leak Detection System (LDS) consists of a geonet drainage layer, sandwiched between two HDPE geomembranes, four-inch diameter perforated HDPE collection laterals, eight-inch diameter perforated HDPE leak detection headers, and three submersible leak detection pump stations.

Estimated Leakage

The 60 mil HDPE liner is designed to have no leaks. Quality control procedures during construction include testing for leaks and repair of all leaks detected at the time of installation. The liner will be protected by the geonet and the two feet of sand drainage layer. The initial layer of solid waste will be carefully screened and placed to avoid damage to the liner. For a number of reasons however leaks do occur in liners.

Leakage calculations are based on the following assumptions:

Hole size: one square centimeter

Hole Frequency: one hole per acre

Head: Design head is one foot
Normal head is 0.2-inches

As shown in the attached calculations, the total leachate flow to the leak detection system under the above conditions would vary between 10 and 80 gallons per minute.

If the holes were distributed evenly over the landfill the north and south LDS pumps would each receive 20 gpm and the middle LDS pump would receive 40 gpm. The LDS must be designed to keep the head on the composite liner less than the thickness of the drainage layer, 0.2-inches, even when excessive leakage is occurring. Each LDS pump station therefore has been designed to handle 125 gpm. The geonet, laterals, and headers are designed to deliver up to 125 gpm of leachate to each of the LDS pump stations. This is not the amount of leakage that we expect will occur or that would be considered acceptable. We anticipate that the actual leakage will be 10 gpm or less during normal operation.

LDS Pump Station

The three LDS pump stations are each designed to drain the LDS laterals and headers. The pump stations are located in four foot diameter concrete manholes lined with HDPE. The pump stations may be visually inspected to observe the water level. Each pump station has a 125 gpm submersible pump that discharges to the adjacent leachate collection pump riser.

LDS Header

The LDS header will be eight-inch diameter SDR 15.5 HDPE pipe installed with a slope of 0.1%. This pipe will convey 125 gpm to the pump station with a flow depth of 4.5 inches. A 10 gpm flow would have a velocity of 0.7 fps. A leak of 10 gpm entering the header at a point furthest from the sump would take 25 minutes to reach the sump.

Lidwell
12/1/93

LDS Lateral

The LDS lateral will be four-inch diameter SDR 15.5 HDPE pipe installed with a slope of 1.0%. This pipe has the capacity deliver a flow of 125 gpm flow full. A flow of 10 gpm would have a velocity of approximately 2 fps. A leak of 10 gpm entering the lateral at a point furthest from the header would take approximately two minutes to reach the header.

LDS Geonet

The geonet will be installed directly underneath the primary liner at a slope of 2%. With a transmissivity of 1×10^{-3} m^2/sec, per unit gradient and a slope of 2% the geonet has a flow per width of 2×10^{-5} m^2/sec, or 0.0966 gpm per foot. The 260-feet of lateral would be fed from both sides for a total flow per lateral of 50 gpm. The time for flow from a leak to reach the lateral from a point furthest from the lateral is calculated with the following formula:

$t = n\,l/(ki)$

where t = travel time in seconds
n = geonet porosity = 1.0
l = length of drainage path - 80-feet = 24.4 m
k = hydraulic conductivity = 20 cm/sec (0.20 m/s)
i = gradient = 0.02

t = (1) (24.4 m)/(.20 m/sec) (0.02)
= 6,100 sec = 102 minutes

Travel Time

The total travel time for a leak of 10 gpm to flow to the LDS pump station from a point furthest from the pump station is as follows:

102 minutes through geonet
2 minutes through lateral
25 minutes through header
129 minutes total travel time

Operation

Each LDS pump station is designed to operate automatically, with pumps set to come on when the wet well water level reaches 11.6, the lowest invert level in the header pipe prior to the sump. The pumps turn off automatically when the water level drops to 7.0. A flow meter at each pump station may be read daily to record the total quantity of leakage being pumped from each pump station. A high level alarm will alert the operator to pump malfunction. The pumps in the three pump station are interchangeable and may be rotated by the operator if one pump is temporarily out of service.

The three headers are connected by the laterals and failure in part of the system would divert flow to the other pump stations.

The laterals and headers may be cleaned by flushing.

CLAY CAP EQUIVALENCY CALCULATIONS

The new Florida Landfill Regulations require that the low permeability layer of the landfill cap be a minimum of 18-inches thick and have a maximum hydraulic conductivity of 1×10^{-5} cm/sec. Volusia County proposes to use a clay layer with a hydraulic conductivity of 5×10^{-7} cm/sec. The clay layer would be 12-inches thick on the side slopes and terraces.

To determine the equivalency of the proposed clay layer to the one described in the regulations, it is necessary to calculate the seepage rate through each of the two clay layers.

Steady-state seepage calculations for fluid flow through a clay layer are performed using Darcy's equation: $q = ki$.

where: q = steady-state flow per unit area in ft/s; k = hydraulic conductivity in ft/s; and i = hydraulic gradient (dimensionless).

The hydraulic gradient i, is defined by: $i = (h + T)/T$

where h = head of liquid on top of clay layer in ft. and T = thickness of clay layer in ft. Combining the equations give: $q = k (h + T)/T$

The hydraulic head on a landfill cap is normally very small. For this analysis, one foot of ponding on the terraces due to settlement or uneven grade was considered a reasonable estimate of a hydraulic head unlikely to be exceeded.

For the basic case of a hydraulic head, h, of 1 ft. on a clay layer which has thickness, T, of 1.5 ft. and a hydraulic conductivity, k, of 1×10^{-5} cm/s (3.28×10^{-7} ft./s) (i.e., the reference clay layer), the calculation of steady-state flow per unit area is as follows:

$$q = k (h + T)/T$$
$$q = 3.28 \times 10^{-7} \times (1 + 1.5)/1.5$$
$$= 5.467 \times 10^{-7} \text{ ft/sec}$$
$$= 17.24 \text{ ft/year}$$

Lee Powell
12.1.93

Therefore, the steady-state flow per unit area for the basic case is 17.24 ft/year.

Substituting a clay layer with a thickness, T, of 12-inches (1.0 ft.) and a hydraulic conductivity of 5×10^{-7} cm/s (1.64×10^{-8} ft/s) in place of the 1.5 ft. of clay in the above calculation gives:

$$q = k\,(h + T)/T$$
$$q = 1.64 \times 10^{-8}\,(1 + 0.5)/0.5$$
$$q = 3.28 \times 10^{-8} \text{ ft/sec}$$
$$q = 1.03 \text{ ft/year}$$

Therefore the steady-state flow per unit area when the proposed clay layer is used is 1.03 ft/year. This is approximately six percent of the infiltration that would penetrate the eighteen-inch thick clay layer described in the regulations.

If the clay became dry enough to allow desiccation cracks to penetrate the entire 12-inches, surface water would leak through the crack into the landfill. Because the clay layers are self-healing, the desiccation cracks would fill with clay and any leakage would be of short duration. With normal rainfall and supplemental irrigation necessary to keep the vegetative cover, it is unlikely that 12-inch deep desiccation cracks would be a major problem.

Differential settling of the landfill could also disrupt the continuity of the clay layer. Minor differential settlement would not prevent the clay layer from re-sealing when the clay was moistened by precipitation. Major differential settlement might require additional clay to restore the continuity of the clay layer. This would also be required with the 18-inch layer required by the DER.

On the 3H:1V side slopes, surface runoff will also substantially reduce the quantity of water that would be available to percolate through the liner. The clay cap proposed by Volusia County therefore will provide substantially greater protection against infiltration that the 18-inch clay layer required by the DER.

BRILEY, WILD AND ASSOCIATES

PROJECT Tomoka Landfill PROJ.NO. UC92067-6CE PAGE 1 OF 3
SUBJECT North Cell DATE May 93
DETAIL Liner Uplift Calculations COMPUTED BY LAP CHECKED BY

Evaluate the uplift potential at the leachate sump, the leachate collection pipe trench, and at the low point of the liner outside the leachate pipe trench

Sump

Evaluate a point directly under the 24" pipe

top of sand	18.0 ft
bottom of sump	8.0 ft
	10.0 ft
less 24" pipe	8.0
less 8" pipe	7.3 ft

Assume sand and drainage rock has an average density of 110 lb/cf

$7.3 \text{ ft} \times 110 \text{ lb/cf} = 803 \text{ lb/sf}$

$$\frac{803 \text{ lb/sf}}{62.4 \text{ lb/cf}} = 12.87$$

The liner would resist uplift caused by 12.87 ft of water

$$\begin{array}{r} 8.0 \\ 12.87 \\ \hline 20.9 \end{array}$$

12/1/93

The groundwater could rise to 20.9 without causing uplift.

Leachate Trench

The lowest part of the trench

top of sand	16.6
bottom of trench	11.64
	4.96 ft

less 12" pipe	1.0
less 8" pipe	.67
	3.92 ft

$3.92 \text{ ft} \times 110 \text{ lb/CF} = 431.2 \text{ lb/SF}$

$$\frac{431.2 \text{ lb/SF}}{62.4 \text{ lb/CF}} = 6.91$$

11.64	The water level could rise to 18.55 without causing uplift
6.91	
18.55	

Liner outside the leachate trench

At the deepest part of the liner

top of sand	16.6
liner	14.6
	2.0 ft

3.0 Ft X 110 lb/CF = 220 lb/SF

$$\frac{220\ lb/SF}{62.4\ lb/CF} = 3.5\ ft$$

The liner would resist an uplift caused by 3.5 ft of water

$$\begin{array}{r} 14.6 \\ 3.5 \\ \hline 18.1 \end{array}$$

The water level could rise to elev 18.1 without uplift.

The critical area for prevention of uplift is the liner outside the leachate trench.

Assuming an in-place density of 1000 lb/cy for refuse with soil cover, the water levels above which uplift would occur are as follows:

Refuse Depth	Top of Fill	Water level at start of uplift
0	16.6	18.1
8	24.6	22.8
12	28.6	25.2
16	32.6	27.6
20	36.6	30.0
24	40.6	32.3

Florida Department of
Environmental Protection

Central District
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Lawton Chiles
Governor

Virginia B. Wetherell
Secretary

Certified Mail
Return Receipt Requested
P-123 350 781

August 30, 1993

Volusia County Department of Solid Waste Management
123 West Indiana Avenue
DeLand, Florida 32720

OCD-SW-93-0347

ATTN: Mr. James L. Griffin, Director

Volusia County - SW
Tomoka Farms Road Landfill
North Cell, Class I
Permit Application No SC64-218367

Dear Mr. Griffin:

This is to acknowledge receipt of your application for the subject facility. The status of your application is as follows:

[ ] Your application for permit 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.

[x] The additional information received on July 13, 1993 and August 4, 1993 was reviewed, however, the items listed on the attached sheet remain incomplete. Evaluation of your application will continue to be delayed until we receive all requested information.

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, omissions or supply additional information within a reasonable period of time. Please submit three copies of the requested information to the department and reference the above application permit numbers in your correspondence.

If you have any questions, please contact me at 407/894-7555.

Sincerely,

Richard B. Tedder, P.E.
Program Manager
Solid Waste

Enclosure
cc: Bret LeRoux, P.G. - FDER - Waste Cleanup
Lee Powell, P.E. - Briley, Wild and Associates - Ormond Beach, FL
David N. Gomberg, Ph.D., P.G.

(3) LAP file

Volusia County - SW
Tomoka Farms Landfill North Cell, Class I
Permit Application No. SC64-218367

1. This application will remain incomplete until such time documentation is submitted to indicate that the City of Daytona Beach will accept leachate for treatment should off-site disposal be required.

2. The portion of your response entitled "Leak Detection System Design and Operation" indicates calculations showing the estimated leachate flow into the leak detection layer are attached. These calculations (indicating a flow rate of 10 to 80 gmp) cannot be located in the submittal. Please provide.

3. Please clarify how the leachate will be removed from the landfill leak detection system. Detail B on Sheet 11 of 15 indicates the flows from the leak detection system will penetrate the liner and drain by gravity to a 4-foot diameter leak detection pump station (Sheet 15 of 15 indicates the pump station is 8-feet in diameter). Based on Sheet 14 of 15, the 3-inch lines from these pump stations appear to discharge into the 24-inch side slope riser for the primary leachate collection system. This system is not clear. Will the leachate from both the primary collection system and the leak detection system flow by common pipe to the leachate basins? Please clarify the piping arrangement and connections.

4. The drawings show flow meters will be installed on both the primary collection system and the leak detection system flows. Is in the intention of the County to measure both these flow rates independently? Data from both systems must be available to assess the performance of the liner system.

5. The proposed well spacing around the "old landfill" exceeds 500 feet between wells. It is recommended that well spacing be adjusted to conform to a 500 foot spacing and that additional wells be proposed to accomplish that spacing. Because this was an unlined facility, each location should at a minimum monitor zones 1 and 2 of the surficial aquifer. Well screens for these wells should be 10 feet in length and straddle the water table to allow for fluctuations in water levels. Deeper wells to monitor zone 4 should have screen lengths no greater than 10 feet. Vertical separation between cluster well screens should be no greater than 15 feet.

6. The proposed well spacing along the north and south sides of the present Class I landfill exceeds 500 feet. Additional wells need to be proposed to accomplish this spacing.

7. Additional wells should be proposed to accomplish a 500 foot spacing along the north and east sides of the proposed Class I cell. Additionally, only zone 4 monitoring is being proposed. Wells monitoring zones 1 and 2 should also be installed along the north and east sides of the proposed Class I cell.

8. Wells B-32 and B-33 are listed in Table 2 as compliance wells. However, the spacing between them exceeds 500 feet. It is recommended that an additional well cluster should be installed to the west of the proposed Leachate Ponds. Zones 1, 2 and 4 should be monitored.

9. It is agreed, at this time, not to install a ground water monitoring well pair between the Detention Pond and the proposed Class I cell. However, water levels must be measured in the Detention Pond quarterly and if

ground water flow is shown to be toward the Detention Pond, a well cluster will need to be installed between the Detention Pond and the proposed Class I cell.

10. The analysis of the grain size distribution of zones to be monitored needs to be done prior to approval of the Ground Water Monitoring Plan (GWMP). Calculations used to determine the proper filter pack should be included in the GWMP.

11. It is understood that there may not be sufficient room to emplace much of a secondary seal above the filter pack in wells screened near the water table. However, if at all possible some very fine sand should be placed above the filter pack prior to grout emplacement to prevent grout filtrate from entering the filter pack. Bentonite should not be used as the seal in these wells. The grout should be mixed as viscous as possible but with no more than 6 gallons of potable water per 94 pound bag of Type I Portland cement.

BRILEY, WILD
AND ASSOCIATES

September 30, 1993

VC 92067-6E

Mr. Richard B. Tedder, P.E.
Solid Waste Program Manager
Florida Department of Environmental Protection
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Re: Volusia County
Tomoka Farms Road Landfill
Permit Application No.: SC64-218367

Dear Mr. Tedder:

The following is submitted in response to your letter of August 30, 1993.

1. The requested documentation will be provided by the County under separate cover.

2. Copies of the requested calculations are enclosed.

3. As shown on Detail B of Sheet 11 of 15, flows in the leak detection system drain by gravity to the leak detection pump station. As shown on Sheet 14 and on Sheet 15 of 15, the leak detection pump stations discharge into the 24-inch side slope risers, which drain into the leachate sumps. The leachate pumps take both the leak detection flows and the leachate collection system drainage from the sumps and discharge through a common force main to the leachate basins.

   I cannot find anywhere on Sheet 15 of 15 where the leak detection pump station diameter is called out as 8-feet, although there are two places where it is called out as 4-feet. Give the flows that are expected, a 4-feet diameter pump station is sufficient.

4. The purpose of installing flow meters on both the primary collection system pump discharge and the leak detection pump discharge is to allow the County to measure these flows independently. The County is very interested in monitoring these flows and we anticipate that the DEP may also require such monitoring.

Briley, Wild and Associates, Inc.
Consulting Engineers and Planners
1040 North U.S. Highway One
P.O. Box 607
Ormond Beach, FL 32175
904/672-5582 • FAX 904/673-8264
Daytona Beach, Orlando & Ormond Beach, FL

5-11. These questions on the groundwater monitoring plan have been referred to Dr. David Gomberg, our hydrogeologist and we will be replying to them under separate cover.

If you have any further questions on the above items please let me know.

Very truly yours,

BRILEY WILD & ASSOCIATES, INC.
CONSULTING ENGINEERS & PLANNERS

Lee A. Powell, P.E.
Assistant Director of Engineering

LAP/lhm
cc: Mr. James Griffin, Volusia County
Dr. David Gomberg

BRILEY, WILD AND ASSOCIATES

PROJECT Tomeka Landfill PROJ.NO. VC92067-6 CE PAGE 1 OF ____
SUBJECT Leachate Leak Detection DATE May 1993
DETAIL ____ COMPUTED BY LAP CHECKED BY ____

Flow in leak detection system

Flow into the leachate leak detection system will come from two sources: leachate leaking through the upper liner and groundwater leaking through the composite liner

1. Leakage of groundwater

The estimated leakage rate through a hole in a membrane liner is calculated with the following formula:

$$q = 0.21\ h^{0.9}\ a^{0.1}\ k_s^{0.74}$$

Where q = flow rate in m^3/sec
h = depth of liquid (m)
a = area of hole (m^2)
k_s = hydraulic conductivity of layer beneath liner (m/sec)

In the proposed landfill, the maximum head on the liner occurs when the groundwater outside the landfill is at elevation 26.0. The head across the liner would be 26.0 - 13.5 or 12.5 feet (3.8 M). The hydraulic conductivity of the clay beneath the membrane is 1×10^{-9} cm/sec or 1×10^{-11} m/sec. Using an estimate hole size of 1 cm^2 and a frequency of 1 hole per acre results in an estimated inward leakage of:

$= (0.21)\ (3.8)^{0.9}\ (.0001)^{0.1}\ (1 \times 10^{-11})^{0.74}$

$= 2 \times 10^{-9}\ M^3/s = 0.046$ gpd/acre

Area of landfill = $1175^{ft} \times 1270^{ft}$ = 34 acres

$Q = (34)(0.046) = 1.56$ gpd

$= 0.0011$ gpm

∴ Flow is negligible

BRILEY, WILD AND ASSOCIATES

PROJECT _____ PROJ.NO. _____ PAGE 2 OF _____

SUBJECT _____ DATE _____

DETAIL _____ COMPUTED BY _____ CHECKED BY _____

2. Leakage through upper liner

$Q = 19.636\ cd^2\ h^{.5}$

Where Q = flow through the orifice in gpm

c = discharge coefficient (0.61 for a sharp puncture)

d = diameter of the hole in inches

h = head at orifice, in feet

Assume

hole size $1\ cm^2 = 0.4443$ in diameter

Average head = 0.2" = 0.0167 ft

Maximum head = 1 ft

Area = 1175 × 1270 = 34 acres

$Q_{normal} = (19.636)(0.61)(0.4443)^2(.0167)^{.5}$

$= 0.3$ gpm /hole

@ 1 hole/acre 10.4 gpm = 14,960 gpd

$Q_{max} = 2.36$ gpm/hole

= 80.4 gpm = 115,765 gpd

Total Flow to leak detection system

= 10.4 to 80.4 gpm

BRILEY, WILD
AND ASSOCIATES

October 11, 1993

VC 92067-6CE

Mr. Richard B. Tedder, P.E.
Solid Waste Section Manager
Florida Department of Environmental Protection
3319 Maguire Boulevard, Suite 232
Orlando, FL 32803

Re: Volusia County
Tomoka Farms Road Landfill
Permit Application SC64-218367

Dear Mr. Tedder:

Enclosed is a copy of an agreement from the Volusia County Utilities to treat and dispose of leachate generated from the proposed expansion of the above landfill.

If you need further information, please let me know.

Yours very truly,

BRILEY, WILD & ASSOCIATES, INC.
CONSULTING ENGINEERS & PLANNERS

Lee A. Powell, P.E.
Assistant Director of Engineering

LAP/dma
Enclosures
cc: Mr. Jim Griffin, Volusia County

Briley, Wild and Associates, Inc.
Consulting Engineers and Planners
1040 North U.S. Highway One
PO Box 607
Ormond Beach, FL 32175
904/672-5660 • FAX 904/673-6264
Offices in Jacksonville, Clearwater
Tallahassee, Boca Raton, Naples & Panama City, FL

Inter-Department
Memorandum

TO: J. L. Griffin, Director
Solid Waste Management

DATE: September 30, 1993

FROM: Larry Hayduk LH
Utility Engineer

FILE: EG-UT-93-3025

SUBJECT: Tomoka Landfill -
Proposed New Disposal Cell

REFERENCE:

This is to advise that Volusia County Utilities can provide for emergency treatment of leachate generated from the proposed new double lined disposal cell at the Tomoka Landfill site. It is understood that approximately 20,000 gallons per day of leachate would be produced by the cell on an average daily basis.

Treatment and disposal of the leachate would be at one of the County's existing wastewater treatment plants.

Volusia County Utilities will need a copy of a complete chemical analysis of the leachate prior to treatment to ensure that our operating parameters will not be violated.

If additional information is required on this matter or clarification needed, please contact this office.

LH:mb
c: Vohnnie L. Pearson, Jr., Director of Engineering
Mr. Al Roe, Utility Operation and Maintenance Superintendent
Mr. Lee A. Powell, P.E., Briley, Wild & Associates, Inc., P.O. Box 607, Ormond Beach, Florida 32175
File

WP51\EG\UT\Hayduk\933025

Florida Department of
Environmental Protection

Central District
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Lawton Chiles
Governor

Virginia B. Wetherell
Secretary

November 1, 1993

CERTIFIED
P-123 350 811

Volusia County Department of Solid Waste Management OCD-SW-93-0501
123 West Indiana Avenue
DeLand, Florida 32720

Attn: Mr. James L. Griffin, Director

Volusia County - SW
Tomoka Farms Road Landfill, North Cell, Class I
Permit Application SC64-218367

Dear Mr. Griffin:

This is to acknowledge receipt of your application for the subject facility. The status of your application is as follows:

( ) Your application for permit received on _____ 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.

(X) The additional information received on October 4 and 14, 1993 was reviewed, however, the items listed on the attached sheet remain incomplete. Evaluation of your application will continue to be delayed until we receive all requested information.

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, omissions or supply additional information within a reasonable period of time. Please submit three copies of the requested information to the Department and reference the above application permit number in your correspondence.

If you have any questions, please contact me at 407/894-7555.

Sincerely,

Richard B. Tedder, P.E.
Program Manager
Solid Waste

RBT/ew
Enclosure
cc: Bret LeRoux, P.G. - FDEP - Waste Cleanup
Lee Powell, P.E. - Briely, Wild and Associates - Ormond Beach, FL
David N. Gomberg, Ph.D., P.G.

DKAP file

Volusia County - SW
Tomoka Farms Road Landfill, North Cell, Class I
Permit Application No. SC64-218367

All of the items 5 to 11 in Florida Department of Environmental Protection letter dated August 30, 1993 remain incomplete.

David N. Gomberg, Ph.D.
Water Resources Consultant

2247 S.E. 27th ST.
CAPE CORAL, FL 33904
(813) 574-6196

November 22, 1993

Memo to: Lee A. Powell, P.E.

Re: Tomoka Landfill Groundwater Monitoring Plan -
Aug. 30, 1993 DEP Requests for Additional Information

1. This memo addresses hydrogeologic items 5 through 11 in the FDEP letter of Aug. 30, 1993 to James L. Griffin, concerning the North Cell at Tomoka Landfill. The same items (numbered 1 through 7) were contained in a second letter to Mr. Griffin, also dated Aug. 30, 1993, and concerning the Renewal Permit Application for Tomoka Landfill. The responses to these items are mostly based on agreements reached during our Oct. 19, 1993 meeting with the DEP, as documented in my memo to you of Nov. 3, 1993. For reference, a copy of the DEP letter and comments is attached to this memo.

2. The new monitoring well network is shown in the attached figure. Existing and proposed wells are shown, as are piezometers to be used for water level monitoring only. All wells are listed in the 3-part table that also accompanies this memo. Part A of the table lists 13 existing monitor wells; part B lists the 40 proposed monitor wells; part C lists 13 piezometers.

3. Regarding monitoring around the <u>old landfill</u> (Comment #1 of the DEP letter):

   a. As "recommended" by DEP and agreed to in our October meeting, the site spacing along the North, South and East sides of the old landfill will be approximately 500 feet, using B5 as a starting point and making minor adjustments to accomodate existing sites B1 and M05. This is shown on the revised site plan.

   b. As shown in the table, there will be a well to monitor layer 1-2 at every site (e.g. sites 1, 2, 3...) and a well to monitor layer 4 at every other site (e.g. sites 1, 3, 5...).

   c. The screens for wells constructed to monitor layer 1-2 will be 7 to 10 feet long. The top of the screen will be no deeper than 5 feet below ground. In areas where our geologic control is not too good, we will use auger or split spoon to locate the top of clayey layer 3, so that we can avoid placing the screen against this aquitard.

   d. We will screen approximately the upper 10 feet of layer 4, even if the vertical separation between the bottom of layer 1-2 and the top of layer 4 slightly exceeds 15 feet (as mentioned in comment #1 of the DEP letter). We will have to take a few test borings along the East and North sides of the old landfill, to determine the shallow geologic profile and the depth at which screens should be placed.

4. Comments 2, 3 and 5 of the DEP letter deal with compliance monitoring on the downgradient sides of the existing and proposed landfill areas. With regard to those comments, and as agreed in our October meeting:

   a. The 500-foot spacing of groundwater monitoring sites will be continued westward from the northwest corner of the old landfill. There will be three sites between the Detention Pond and the existing landfill. The pattern of having wells at each site into layer 1-2 and at alternating sites into layer 4 will also be continued.

   b. From the southwest corner of the Detention Pond, the line of compliance wells will be continued northward, then westward, along the boundary of the expansion area. That is six sites. Per Comment #5 of the DEP letter, no wells will be constructed at the first of those sites, between the Detention Pond and the expansion area. This site will be reserved for possible future monitoring. Because of a depressed water table from dewatering, each of the 5 remaining sites will have a well to monitor layer 4, while two of the 5 sites will have wells screened into layer 1-2.

5. As agreed in our October meeting, the south side of the existing landfill and the west sides of the existing and proposed landfill areas are upgradient. As shown on the site plan, these areas will be monitored for background purposes and special circumstances, as follows:

   a. Background sites will be spaced no farther than 1500 feet apart.

   b. Proceeding westward from B5, the first background site will be B35. This site will have a layer 1-2 and a layer 4 monitor well.

   c. Site B63 has been moved to the south side of the drainage ditch and about 1500 feet west of B35. This site will have a layer 1-2 and a layer 4 monitor well.

   d. Well B10 will be converted to a piezometer, and monitored for water levels only.

   e. Site B34, near FA-1B, will have a layer 1-2 and a layer 4 well.

   f. Existing wells B11 (layer 1-2) and B2 (layer 4) will serve both to monitor the sludge disposal area and as a two-well background site.

   g. Sites B32 and B33 have been repositioned so that they are 500 feet apart. Both sites will have a layer 1-2 monitor well. Site B33 will also have a layer 4 well.

6. Regarding Comment #6 of the DEP letter, it was agreed at the DEP meeting that screened monitor wells would be constructed with the following guidelines:

   a. The screen slot size will be #5 or #8;

   b. the filter pack will be 30/40 quartz sand;

   c. the filter pack supplier will be required to furnish sieve analyses showing that no more than a few percent of the pack will pass through the screen.

7. Regarding Comment #7 of the DEP letter, monitor wells screened into layer 1-2 will have fine sand placed above the filter pack, bentonite will not be used as a well seal, and the grout will be mixed with no more than 6 gallons of potable water per 94-pound bag of Type I Portland cement.

Table 1. Existing and Proposed Monitoring Wells

A. Existing Monitor Wells as of November, 1993[1]

Well	Year Installed	Total Depth (ft.)	Screened or Open Interval (ft. depth)	DEP #
M05-B	1987	32	27-32	64A14964
B1-B	1987	33	28-33	64A14965
B-2	1980	24	19-24	64A12081
B3-B	1987	22	17-22	64A14966
B4	1980	25	20-25	64A71M08
B5	1980	23	18-23	64A12082
B6	1980	30	25-30	64A12090
B7	1987	32	27-32	64A14970
B8	1987	48	43-48	64A14971
B9	1987	33	28-33	64A14972
B11-B	1993	14.5	9.5-14.5	64A15502 ?
FA-1B	1987	92	91-92	64A14968
FA-2C	1991	100	94-100	64A14969 ?

[1] Existing well B10 is to be used as a piezometer in the revised GWMP. It is listed in part C of this table.

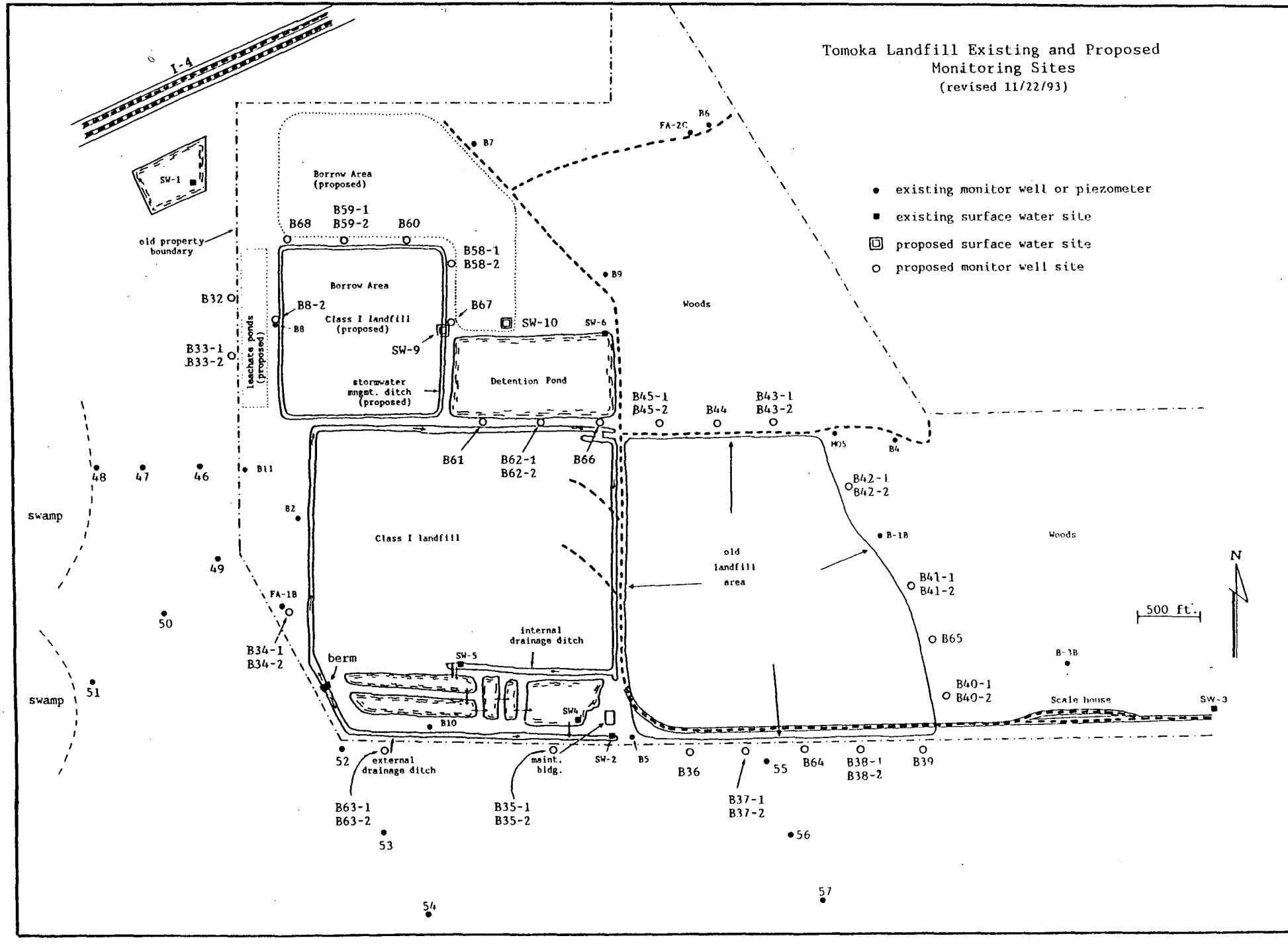
B. Proposed Monitor Wells

Site/Well Number	Approx. Monitored Interval (ft. depth)	Borings Used to Estimate Interval[2]	Layer Monitored	Use
B8-2	20-30	V1, V9	4	intermediate
B-32	20-30	V9, B30	4	background
B33-1	22-32	V1, B22	4	background
B33-2	5-15	-	1-2	background
B34-1	22-32	B-24	4	background
B34-2	5-15	-	1-2	background
B35-1	22-32	B5-19, B25	4	background
B35-2	5-15	-	1-2	background
B36	23-33	B5-19	4	compliance
B37-1	23-33	B5-19	4	compliance
B37-2	5-15	-	1-2	compliance
B38-1	22-32	B5-19, V17	4	compliance
B38-2	5-15	-	1-2	compliance
B39	5-15	-	1-2	compliance
B40-1	22-32	V17	4	compliance
B40-2	5-15	-	1-2	compliance
B41-1	20-30	V17, V19	4	compliance
B41-2	5-15	-	1-2	compliance
B42-1	18-28	V4, V18	4	compliance
B42-2	5-12	-	1-2	compliance
B43-1	18-28	V4	3-4	compliance
B43-2	5-12	-	1-2	compliance
B44	5-12	-	1-2	compliance
B45-1	25-35	V3, V4	4	compliance
B45-2	5-15	-	1-2	compliance
B58-1	18-28	V8A, V8B	4	compliance
B58-2	5-12	-	1-2	compliance
B59-1	22-32	B30	4	compliance
B59-2	5-15	-	1-2	compliance
B-60	20-30	B30, V8B	4	compliance
B61	5-12	-	1-2	compliance
B62-1	25-35	B21, V2	4	compliance
B62-2	5-12	-	1-2	compliance
B63-1	19-29	B25, B24	4	background
B63-2	5-12	-	1-2	background
B64	5-15	-	1-2	compliance
B65	5-15	-	1-2	compliance
B66	5-15	-	1-2	compliance
B67	18-28	B23, V8A	4	compliance
B68	20-30	B30, V9	4	compliance

[2]borings with a "V" prefix are from Brooks' 1980 investigation

C. Existing Wells to be Monitored for Water Levels Only (Piezometers)

Site/Well Number	Year Installed	Total Depth (ft.)	Screened Interval (ft. depth)
B10	1988	25	15-25
46	1992	13.5	8.5-13.5
47	1992	14.4	9.4-14.4
48	1992	13.4	8.4-13.4
49	1992	14.1	9.1-14.1
50	1992	13.7	8.7-13.7
51	1992	13.7	8.7-13.7
52	1992	13.9	8.9-13.9
53	1992	13.4	8.4-13.4
54	1992	13.5	8.5-13.5
55	1992	13.6	8.6-13.6
56	1992	13.6	8.6-13.6
57	1992	13.5	8.5-13.5


Tomoka Landfill Existing and Proposed
Monitoring Sites
(revised 11/22/93)
existing monitor well or piezometer
existing surface water site
proposed surface water site
proposed monitor well site
I-4
SW-1
old property boundary
Borrow Area (proposed)
B59-1
B68
B59-2
B60
B58-1
B58-2
B7
B6
FA-2C
B9
Woods
Borrow Area
B32
B8-2
B8
Class I landfill (proposed)
B67
SW-10
SW-6
SW-9
B33-1
B33-2
leachate ponds (proposed)
stormwater mngmt. ditch (proposed)
Detention Pond
B45-1
B45-2
B44
B43-1
B43-2
MW5
B4
B61
B62-1
B62-2
B66
B42-1
B42-2
48
47
46
B11
swamp
B2
Class I landfill
old landfill area
B-1B
Woods
49
B41-1
B41-2
FA-1B
50
500 ft.
N
internal drainage ditch
B65
B34-1
B34-2
berm
SW-5
B-3B
swamp
51
B40-1
B40-2
Scale house
SW-3
SW4
B10
52
external drainage ditch
maint. bldg.
SW-2
B5
B36
55
B64
B38-1
B38-2
B39
B63-1
B63-2
B35-1
B35-2
B37-1
B37-2
53
56
54
57

Florida Department of
Environmental Protection

Central District
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Lawton Chiles
Governor

Virginia B. Wetherell
Secretary

Certified Mail
Return Receipt Requested
P-123-350-795

August 30, 1993

Volusia County Department of Solid Waste Management
123 West Indiana Avenue
DeLand, Florida 32720

OCD-SW-93-0398

ATTN: Mr. James L. Griffin, Director

Volusia County - SW
Tomoka Farms Road Landfill, Class I
Renewal Permit Application No SO64-198377

Dear Mr. Griffin:

This is to acknowledge receipt of your application for the subject facility. The status of your application is as follows:

[ ] Your application for permit 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.

[x] The additional information received on August 4, 1993 was reviewed, however, the items listed on the attached sheet remain incomplete. Evaluation of your application will continue to be delayed until we receive all requested information.

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, omissions or supply additional information within a reasonable period of time. Please submit three copies of the requested information to the department and reference the above application permit numbers in your correspondence.

If you have any questions, please contact me at 407/894-7555.

Sincerely,

Richard B. Tedder, P.E.
Program Manager
Solid Waste

Enclosure
cc: Bret LeRoux, P.G. - FDER - Waste Cleanup
Lee Powell, P.E. - Briley, Wild and Associates - Ormond Beach, FL
David N. Gomberg, Ph.D., P.G.

Volusia County - SW
Tomoka Farms Landfill, Class I
Renewal Permit Application No. SO64-198377

1. The proposed well spacing around the "old landfill" exceeds 500 feet between wells. It is recommended that well spacing be adjusted to conform to a 500 foot spacing and that additional wells be proposed to accomplish that spacing. Because this was an unlined facility, each location should at a minimum monitor zones 1 and 2 of the surficial aquifer. Well screens for these wells should be 10 feet in length and straddle the water table to allow for fluctuations in water levels. Deeper wells to monitor zone 4 should have screen lengths no greater than 10 feet. Vertical separation between cluster well screens should be no greater than 15 feet.

2. The proposed well spacing along the north and south sides of the present Class I landfill exceeds 500 feet. Additional wells need to be proposed to accomplish this spacing.

3. Additional wells should be proposed to accomplish a 500 foot spacing along the north and east sides of the proposed Class I cell. Additionally, only zone 4 monitoring is being proposed. Wells monitoring zones 1 and 2 should also be installed along the north and east sides of the proposed Class I cell.

4. Wells B-32 and B-33 are listed in Table 2 as compliance wells. However, the spacing between them exceeds 500 feet. It is recommended that an additional well cluster should be installed to the west of the proposed Leachate Ponds. Zones 1, 2 and 4 should be monitored.

5. It is agreed, at this time, not to install a ground water monitoring well pair between the Detention Pond and the proposed Class I cell. However, water levels must be measured in the Detention Pond quarterly and if ground water flow is shown to be toward the Detention Pond, a well cluster will need to be installed between the Detention Pond and the proposed Class I cell.

6. The analysis of the grain size distribution of zones to be monitored needs to be done prior to approval of the Ground Water Monitoring Plan (GWMP). Calculations used to determine the proper filter pack should be included in the GWMP.

7. It is understood that there may not be sufficient room to emplace much of a secondary seal above the filter pack in wells screened near the water table. However, if at all possible some very fine sand should be placed above the filter pack prior to grout emplacement to prevent grout filtrate from entering the filter pack. Bentonite should not be used as the seal in these wells. The grout should be mixed as viscous as possible but with no more than 6 gallons of potable water per 94 pound bag of Type I Portland cement.