44-01

Carmen Johnson

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PERMIT TO CONSTRUCT LANDFILL NO. 6A-WEST CANTON, NORTH CAROLINA

CHAMPION INTERNATIONAL CORPORATION CANTON, NORTH CAROLINA

VOLUME I

NORTH CAROLINA SOLID WASTE MANAGEMENT RULES 15A NCAC 13B

JANUARY 1997

Prepared by

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Cumberland Center, Maine

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EXECUTIVE SUMMARY

Champion International Corporation proposes to construct an extension to the permitted Landfill No. 6. The expansion is identified as Landfill No. 6 Area A West. Area A West abuts a previously constructed landfill area, Area A East. Area A West preliminary base grading was permitted in 1992 as part of the development of Area A East. This document was prepared pursuant to North Carolina Department of Environment, Health and Natural Resources' Solid Waste Management Rules - 15A NCAC 13B.

The proposed design of Landfill No. 6 Area A West includes the following: a geosynthetic liner system for the containment of waste and leachate; a leachate collection system which minimizes leachate head levels upon the liner system; access roadways which provide one-way traffic into and out-of the landfill area; and a clean storm water management system which diverts non-contact surface water from un-used areas of the landfill thus reducing total leachate volume.

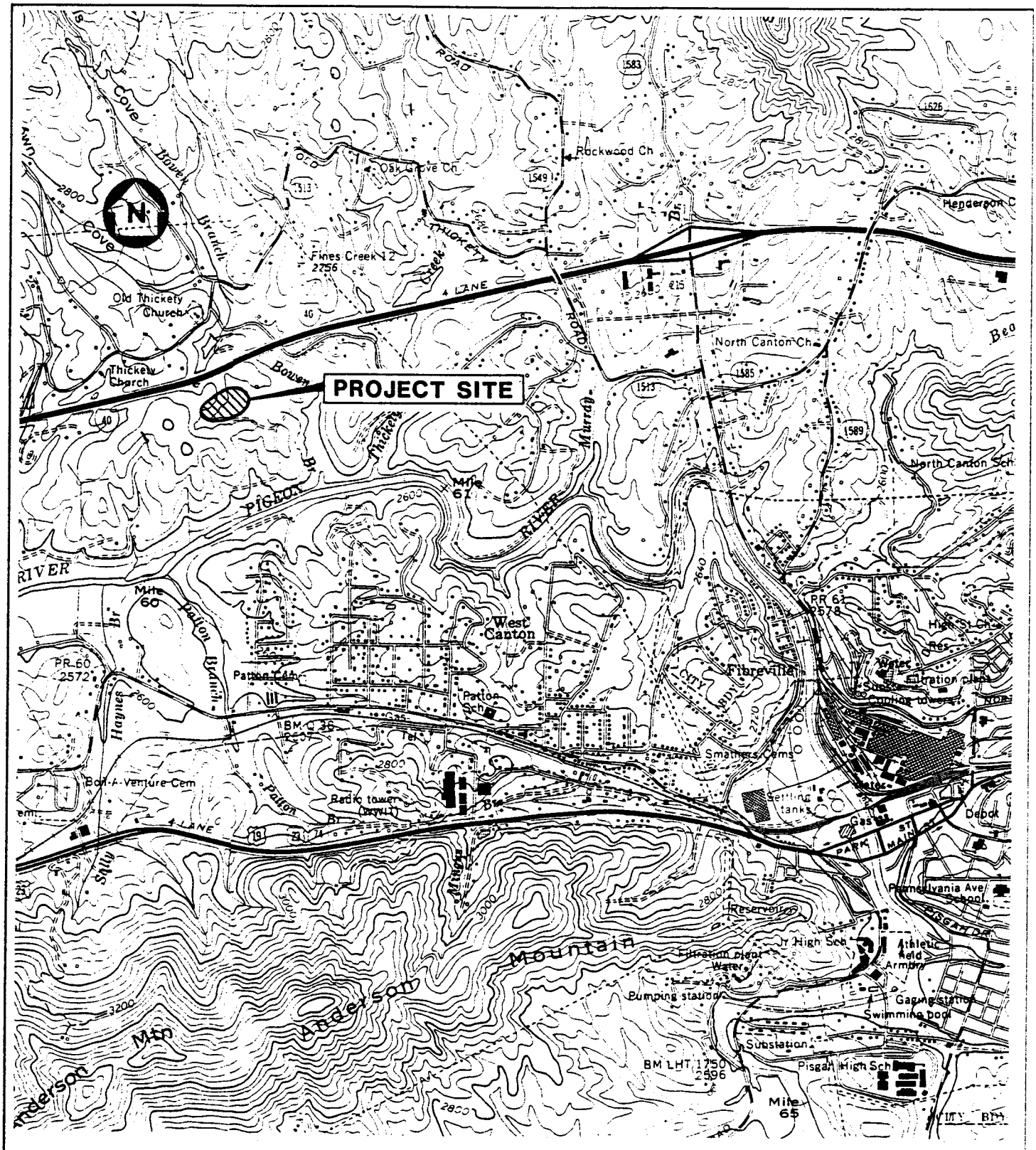
The detailed design of Landfill No. 6 Area A West is provided within Volume II of this permit application, and includes a narrative of historical use of the landfill, design considerations, construction considerations, construction schedule and a construction cost estimate. The design report also includes engineering drawings, exploration logs, engineering calculations, engineering specifications, groundwater modeling information and site specific soil permeability testing, all of which are related to the design and construction of Area A West.

1.0 INTRODUCTION

Champion International Corporation (hereinafter referred to as "Champion") operates a pulp and paper mill in Canton, North Carolina. Currently, approximately 280,000 cubic yards of production residuals are generated each year that require landfilling. The production residuals consist of boiler fly ash, cinders, dewatered wastewater treatment sludge, lime mud, wood waste, and asbestos containing material. At the present time, these wastes are landfilled at a company-owned landfill in Canton, North Carolina, referred to as Landfill No. 6 (see Figure 1-1). Landfill No. 6 was initially permitted for construction and operation in February 1984 Permit (#44-06).

Landfill No. 6 is divided into eight landfilling areas designated as Areas A through H. Areas A through E are designated for disposal of wastewater treatment sludge (sludge), ash, lime mud, wood waste and asbestos containing material (ACM). Areas F through H are designated for disposal of lime mud. Currently, Areas B, C, F, G, and H have been constructed according to the original design specifications and landfilled to capacity. In addition, Areas B, F, and G have been capped according to the original design. Area C is scheduled to be capped in 1996 and 1997. Areas D and E have not been developed as of this writing.

Area A is the current landfilling unit in operation. Area A was permitted for construction in 1992, and for operation in 1995. The original design for Area A construction sub-divided the area into two units, Area A East and Area A West. The construction associated with



BASE MAP ADAPTED FROM 7.5 MIN.
USGS TOPOGRAPHIC QUADRANGLES
CANTON, NC - 1990
CLYDE, NC - 1978

0 2000 4000 FEET

FIGURE 1-1
SITE LOCATION PLAN
CHAMPION INTERNATIONAL CORPORATION
CANTON, NORTH CAROLINA

SEVEE & MAHER ENGINEERS

The permit to construct Area A included the full development (liner system, leachate collection system) of Area A East and the excavation to original design base grades of Area A West.

This document has been prepared to serve as Champion's solid waste construction permit application for the development of Area A West of Landfill No. 6. This application has been prepared pursuant to the North Carolina Solid Waste Management Rules, 15A NCAC 13B, Chapters .0100, .0200, and .0500.

1.1 Application Structure

This application consists of two volumes. Volume I addresses the North Carolina Solid Waste Management Rules. Volume II is the design report for the proposed Area A West landfill, which includes design and development considerations, leachate management, landfill construction, stormwater and erosion control, and an assessment of environmental impact from the facility.

2.0 SOLID WASTE MANAGEMENT RULES

2.1 Statement of Compliance

The application for Area A West has been prepared pursuant to and in compliance with the applicable sections of the Solid Waste Management Rules 15A NCAC 13B Chapters .0100, .0200, and .0500.

2.2 Solid Waste Management Rules

This section will address all pertinent issues of the Rules and respond to the Rule and/or refer the reader to the location of the detailed information provided in Volume II - Design Report. Where applicable the Rule will be re-iterated in normal font, all responses or referrals will be in bold type.

2.2.1 Section .0100 - General Provisions

This application refers to the expansion of Landfill No. 6, a permitted landfill owned and operated by Champion International Corporation. On January 9, 1992 a construction permit was issued by the North Carolina Department of Environment, Health, and Natural Resources, Division of Solid Waste Management (NCDEHNR-SWM) for the construction of the lined expansion, Area A of Canton Mill Landfill No. 6, Cells III and IV (East), and for excavation of Cells I and II (West).

This application pertains to the construction of Cells I and II, hereafter referred to as Landfill No. 6 Area A West, or Area A West. The general provision requirements of this section of the Rules were approved in the original permitting of Landfill No. 6 Area A East and are not re-addressed herein.

2.2.2 Section .0200 - Permits for Solid Waste Management Facilities

.0201 PERMIT REQUIRED

A permit is required, and this submittal shall be viewed as an application request, to construct the proposed landfill unit referred to as Landfill No. 6 Area A West.

.0202 PERMIT APPLICATION

This permit application is contained within two documents:

Volume I- Permit Requirements; and

Volume II - Design Report.

Site and construction plans are included in Appendix A of the Design Report.

A letter from the Haywood County Planning Department, stating the facility meets the requirements of the County zoning ordinance is included in Attachment 1.

The detailed plans and specifications provided within the Design Report bear the imprint of the registration seal of a State of North Carolina professional engineer. Also, the geologic study, prepared and approved within the permit to construct Area A, bears the imprint of the registration of a State of North Carolina professional geologist.

All other pertinent information of the proposed facility is found within the Volume I - Permit Requirements and Volume II - Design Report of this application.

Specific information regarding the proposed construction of Landfill No. 6 Area A West detailed within the Design Report is addressed in the following sections.

.0203 PERMIT APPROVAL OR DENIAL

Not applicable.

.0204 RECORDATION OF LAND DISPOSAL PERMITS

When granted, Champion International Corporation will file the approved, certified copy of the permit in the Haywood County register of deeds. The register of deeds will be

notified to record the certified copy and index it in the grantor index under Champion International Corporation.

When the property is sold, leased, conveyed or transferred in any manner, the deed or other instrument of transfer shall contain in the description section in no smaller type than that used in the body of the deed or instrument a statement that the property has been used as a sanitary landfill and a reference by book and page to the recordation of the permit.

.0205 VARIANCES

Not applicable.

2.2.3 Section .0500 - Disposal Sites

.0501 APPROVED DISPOSAL METHODS

The sanitary landfill disposal method is referred to within this permit application.

.0502 OPEN DUMPS

Not Applicable.

Siting requirements for Landfill No. 6 Area A were approved as part of Permit No. 44-06. The siting of Landfill No. 6 Area A West has not been modified within this application.

The design of Landfill No. 6 Area A West is provided within Volume II - Design Report of this application. The permit requirements regarding the design of the site are briefly discussed below with reference to the specific section within the Design Report. The specific requirements, as found within the Solid Waste Management Rules, are provided in normal font with the response and/or reference to the Design Report immediately following in bolded type.

(2) A site shall meet the following design requirements:

(a) The concentration of explosive gases generated by the site shall not exceed:

(i) twenty-five percent of the limit for the gases in site structures (excluding gas control or recovery system components); and

(ii) the lower explosive limit for the gases at the property boundary;

The proposed development of Landfill No. 6 Area A West will not concentrate explosive gases which exceed twenty-five percent of the limit for the gases in site structures and the lower explosive limit for the gases at the property boundary. The proposed geosynthetic liner, 60-mil HDPE, will retard lateral movement of gases during the operational and post-closure life time of the landfill area. The leachate transport pipeline is sealed from the landfill to the leachate pond and from the leachate pond to the wastewater treatment facility.

(b) A site shall not allow uncontrolled public access so as to expose the public to potential health and safety hazards at the disposal site;

The site is accessed via one entrance, the entrance is gated and locked at all times the facility is not in operation. A sign at the entrance states the site is a landfill owned and operated by Champion for disposal of Champion waste products, and that no unauthorized entrance is allowed.

(c) A site shall meet the following surface water requirements:

(i) A site shall not cause a discharge of pollutants into waters of the state that is in violation of the requirements of the National Pollutant Discharge Elimination

System (NPDES), under Section 402 of the Clean Water Act, as amended, or that is in violation of standards promulgated under G.S. 143-214.1 and G.S. 143-215;

The site shall not cause a discharge of pollutants into waters of the state that are in violation of the NPDES or of standards promulgated under G.S. 143-214.1 and G.S. 143-215. The proposed geosynthetic liner, 60-mil HDPE, will contain virtually one-hundred percent of all leachate generated within Area A West, in addition, the leachate collection system is designed to minimize leachate head levels which contribute significantly to leakage rates of liner systems, refer to Section 2 and 3 of the Design Report.

(ii) A site shall not cause a discharge of dredged material or fill material into waters of the state that is in violation of the requirements under Section 404 of the Clean Water Act, as amended, or that is in violation of any state requirements regulating the discharge of dredged or fill material into waters of the state, including wetlands; and

The site will not discharge dredged material or fill material into waters of the state that is in violation of the requirements under Section 404 of the Clean Water Act, as amended, or that is in violation of any state requirements regulating the discharge of dredged or fill material into water of the state, including wetlands. Landfill No. 6 Area A West does not abut any water

body of the state, including wetlands, and the base grades are designed to provide at least four feet of separation between the seasonal high water table and any waste placement. The proposed construction will abide by the existing Erosion and Sedimentation Control Permit issued during Landfill No. 6 Area A-East construction. Refer to Section 3.3 of the Design Report.

(iii) A site shall not cause non-point source pollution of waters of the state that violates assigned water quality standards.

The site will not cause non-point source pollution of waters of the state that violates assigned water quality standards, as determined by groundwater modeling of the site. Refer to Attachment 2.

(d) A site shall meet the following groundwater requirements:

(i) A site, except for landfill clearing and inert debris landfills subject to Rule .0564(8)(e) of this Section, shall be designed so that the bottom elevation of solid waste will be a minimum of four feet above the seasonal high water table;

The site is designed for the bottom elevation of solid waste to be a minimum of four feet above the seasonal high water table. Regional and site-specific

groundwater elevations are provided on Drawing C-101 in Appendix A of the Design Report.

(ii) Operators of new industrial solid waste landfills, lateral expansions of existing industrial solid waste landfills, and industrial solid waste landfills receiving solid waste on or after January 1, 1998 shall submit to the Division a design which satisfies one of the following criteria:

(A) a design that will ensure that the groundwater standards established under 15A NCAC 2L will not be exceeded in the uppermost aquifer at the compliance boundary established by the Division in accordance with 15A NCAC 2L. The design shall be based upon modeling methods acceptable to the Division, which shall include, at a minimum, the following factors:

(I) the hydrogeologic characteristics of the facility and surrounding lands;

(II) the climatic factors of the area; and

(III) the volume and physical and chemical characteristics of the leachate; or

Landfill No. 6 Area A West includes a base liner system consisting of two components; the upper component is a 60-mil textured HDPE geomembrane, and the lower component is two feet of compacted site soils. The geomembrane liner will be installed in direct and uniform contact with the compacted soil component.

A groundwater model was performed with regard to site climatological data, waste chemical analysis, proposed liner design, and site hydrogeologic information which demonstrates that the proposed design will not cause groundwater standards to be exceeded in the uppermost aquifer at the compliance boundary established by the Division in accordance with 15A NCAC 2L. The groundwater model is presented in Attachment 2.

(B) a design with a leachate collection system, a closure cap system, and a composite liner system consisting of two components; the upper component shall consist of a minimum 30-mil flexible membrane (FML), and the lower components shall consist of at least a two-foot layer of compacted soil with a hydraulic conductivity of no more than 1×10^{-7} cm/sec. FML components consisting of high density polyethylene (HDPE) shall be at least 60-mil thick. The FML component shall be installed in direct and uniform contact with the compacted soil component.

Not applicable.

(iii) The Division reserves the right to require an applicant to submit a liner design if the groundwater protection demonstration in sub-item (ii) of this paragraph is not satisfactory.

No response.

(iv) Industrial solid waste landfills shall comply with groundwater standards established under 15A NCAC 2L at the compliance boundary.

Groundwater and surface water quality are monitored routinely by Champion around Landfill No. 6 for compliance to groundwater standards.

(e) A site shall not engage in open burning of solid waste;

The landfill site does not engage in open burning of solid waste.

(f) A site, except a land clearing and inert debris landfill, shall meet the following buffer requirements:

(i) A 50-foot minimum buffer between all property lines and disposal areas;

(ii) A 500-foot minimum buffer between private dwellings and wells and disposal areas; and

(iii) A 50-foot minimum buffer between streams and rivers and disposal areas; and

The site meets the above buffer requirements. Refer to Permit No. 44-06.

(g) Requirements of the Sedimentation Pollution Control Law (15A NCAC 4) shall be met.

Requirements of the Sedimentation Pollution Control Law (15A NCAC 4) will be met. Furthermore, an Erosion and Sedimentation Control Plan permit was approved for the original excavation of this site. This proposed construction will abide by the original Erosion and Sedimentation Control Plan permit, and the Design Report is prepared for review by the NCDEHNR for comment regarding sedimentation and erosion control. A copy of the original Erosion and Sedimentation Control Permit is attached as Attachment 3.

.0504 APPLICATION REQUIREMENTS FOR SANITARY LANDFILLS

1. The following information shall be required for reviewing a site application for a proposed sanitary landfill.

The information requested within this sub-section has been provided during initial construction permitting of the site. Refer to Permit No. 44-06.

2. The following information shall be required for reviewing a construction plan application for a proposed sanitary landfill:

a) A map showing existing features to include:

i) existing topography of the site on a scale of at least 1 inch equals 200 feet with five foot contours;

Drawings C-101 and C-102 are included in Appendix A of the Design Report. The horizontal scale of C-101 is 1 inch equals 200 feet and includes 10 foot contours. Drawing C-102 has a scale of 1 inch equals 60 feet and includes 2 foot contours.

ii) benchmarks;

Drawing C-102 is included in Appendix A of the Design Report, and includes the location of three existing benchmarks.

iii) springs;

The immediate vicinity of Landfill No. 6 Area A West does not abut any known springs.

iv) streams;

Bowen Branch is located east of Landfill No. 6 Area A East. Refer to Drawing C-101 (Appendix A of the Design Report).

v) potential groundwater monitoring sites;

The location of current monitoring points is found on Drawing C-101 in Appendix A of the Design Report.

vi) pertinent geological features;

Geological features of the site have been reported in the original permitting of the facility (Law Engineering and Testing Company, 1982), in the construction permitting of Area A (Sirrine Environmental Consultants, 1989), and in a groundwater and surface water assessment (Roy F. Weston, 1995, 1996). The reports, if required, will be forwarded upon request.

vii) soil boring locations.

As part of the field investigation performed by Sevee & Maher Engineers, Inc., twelve soil/rock borings were drilled and ten test pits were excavated. Locations of the soil/rock borings and test pits are presented in Drawing C-103 in Appendix A of the Design Report.

Soil/rock boring logs, bedrock core logs, and test pit logs are in Appendix B of the Design Report.

Also, previous boring locations in the vicinity of 6A-West performed by Law Engineering and Testing Company and Sirrine Environmental Consultants are provided on Drawing C-103.

b) A grading plan that provides:

i) proposed excavated contours;

Proposed base grading contours are depicted on Drawing C-103 in Appendix A of the Design Report. The plan is shown at a horizontal scale of 1 inch equals 60 feet and a contour interval of 2 feet.

ii) soil boring locations;

As part of the field investigation performed by Sevee & Maher Engineers, Inc., twelve soil/rock borings were drilled and ten test pits were excavated. Locations of the soil/rock borings and test pits are presented in Drawing C-103 in Appendix A of the Design Report.

Soil/rock boring logs, bedrock core logs, and test pit logs are in Appendix B of the Design Report.

Also, previous boring locations in the vicinity of 6A-West performed by Law Engineering and Testing Company and Sirrine Environmental Consultants are provided on Drawing C-103.

iii) locations and elevations of dikes or trenches;

Locations and elevations of dikes and trenches are included on Drawings C-101, C-102, C-103, C-104 and C-105 in Appendix A of the Design Report. Minor earthwork is proposed for enhancement of existing containment dikes. Existing containment dikes were designed and constructed as part of the initial excavation work of Landfill No. 6 Area A West. The proposed alternative leachate collection transport pipeline is located through the northern containment dike, refer to Drawing C-105. The installation of the pipeline will not require trenching; horizontal boring and installation of the pipeline is proposed instead. Elevations of the pipeline are included on Drawing C-105.

iv) designated buffer zones;

Designated buffer zones were established during initial permitting of the facility and are not proposed to be affected due to this project.

v) diversion and controlled removal of surface water from the work areas; and

Diversion and controlled removal of surface water from the work areas is accomplished via the existing storm water piping system extended into Landfill No. 6 Area A West from Landfill No. 6 Area A East. The storm water piping system proposed for use in Landfill No. 6 Area A West is included in Drawing C-105 in Appendix A of the Design Report.

vi) proposed utilities and structures;

The development of Landfill No. 6 Area A West does not require new permanent structures or utilities. Temporary structures will include general contractor and engineer site offices to be located prior to construction activities.

c) A construction plan that provides:

i) engineering design for liners, leachate collection systems;

Engineering design for liners and leachate collection systems is provided on Drawings C-104 and C-105, in Appendix A of the Design Report. Drawings C-104 and C-105 include the base grading system prior to geomembrane installation and the location of proposed leachate collection piping system. Details of the base geomembrane system and the leachate collection system are included on Drawings C-300, C-301 and C-302, in Appendix A of the Design Report. Cross sections of the base geomembrane system and the leachate collection piping system are included on Drawings C-200 and C-201, in Appendix A of the Design Report.

ii) proposed final contours showing removal of surface water runoff; and

Proposed final contours showing removal of surface water runoff are included on Drawing C-106 in Appendix A of the Design Report. Drawing C-106 includes the proposed final contours, preliminary design of a perimeter leachate collection piping system, and the perimeter surface water ditching system. The perimeter surface water

ditching system is an extension of the Landfill No. 6 Area A East system described in the Operations Manual for Landfill No. 6 Area A East.

iii) locations of slope drains or other drop structures.

Locations of slope drains or other drop structures are presented on Drawing C-103 included in Appendix A of the Design Report. Drawing C-103 includes the location of two existing catch basins and slope drain pipes along the top of the northern containment dike. The slope drains discharge at the base of the north containment dike. No additional slope drains or drop structures are proposed.

d) An erosion control plan that identifies the following:

i) locations of temporary erosion control measures (sediment basins, stone filters, terraces, silt fences, etc.);

Locations of temporary erosion control measures for excavating the landfill area to base grades are in the original permit to construct. The proposed excavating to base grades for this project will abide by the original Erosion and Sedimentation Control Plan. Additional

erosion and sedimentation control measures are in this application for review and approval by the NCDEHNR.

After construction of Landfill No. 6 Area A West, and prior to landfilling, several structures are designed to transport clean water runoff (clean storm water) from the landfill. The location of these temporary erosion control measures are included on Drawing C-105 in Appendix A of the Design Report.

ii) locations of permanent erosion control measures (rip-rap, energy dissipaters, ditch stabilization, pipe drain, etc.); and

Construction for this proposed project will include permanent erosion control measures. Seeding will permanently control erosion on all disturbed surfaces not scheduled for landfill liner installation. Final capping (closure) of the landfill will require the installation of riprap drainage paths, seeding and upgrading of existing stormwater culverts. The final capping design will be in the Operations Manual as part of the Operations Permit Request.

iii) seeding specifications and schedules.

Seeding specifications and schedules are included on Drawing C-100 included in Appendix A of the Design Report and in the specifications included in Appendix D of the Design Report. Seeding specifications and schedules are also included in the Operations Manual, to be submitted to the Division as part of the Operations Permit application request.

e) Detailed diagrams showing typical sections of:

i) dikes,

The original design of Landfill No. 6 Areas A East and West included detailed diagrams showing typical sections and design calculations for the containment dikes.

Detailed diagrams showing typical sections of the landfill, including dikes, are in Drawings C-200, C-300, C-301 and C-302 in Appendix A of the Design Report.

ii) trenches,

The proposed project does not include the installation or use of trenches.

iii) diversions,

The proposed internal containment berm (Cell I/II Berm) will divert Cell I storm water during Cell II operation. The internal containment berm is detailed on Drawings C-105 and C-301 in Appendix A of the Design Report.

iv) sediment basins, and

The eastern base area of Landfill No. 6 Area A West acts as a sediment basin and includes an outlet structure for the controlled removal of collected storm water. This existing structure will be maintained according to the original design until the area is excavated to base grades and lined with geomembrane, at which time, the proposed storm water outlet structures will be installed. Due to the nature of the design, no sediment basins are required for the post-lined area.

v) other pertinent details.

The comprehensive design of Landfill No. 6 Area A West includes details other than those described above. Other pertinent details are located on Engineering Drawings in Appendix A of the Design Report. Some of the details include the following: landfill access roadway detail; landfill perimeter road detail; Cell II/Cell III roadway detail; anchor trench detail; future geomembrane tie-in detail; final closure detail; and intermediate closure detail.

f) A minimum of two cross sections per operational area showing:

i) original elevations,

Refer to Drawing C-200 in Appendix A of the Design Report.

ii) proposed excavated depths,

Refer to Drawing C-200 in Appendix A of the Design Report.

iii) proposed final elevations,

Refer to Drawing C-200 in Appendix A of the Design Report.

iv) groundwater elevation, and

Refer to Drawing C-200 in Appendix A of the Design Report.

v) soil borings.

Refer to Drawing C-200 in Appendix A of the Design Report.

g) Site development showing phases or progression of operation.

An operations manual, not in this design, will be submitted as part of the Operations Permit application for Landfill No. 6 Area A West. The operations manual will include site development showing phases or progression of operation. Champion has proven successful operation of this type of landfill as demonstrated in Landfill No. 6 Area A East.

h) A written report that contains the following:

i) A copy of the deed or other legal description of the landfill site that would be sufficient as a description in an instrument of conveyance and property owner's name;

A copy of the deed is found in Attachment 4.

ii) Name of individual responsible for operation and maintenance of the site;

Mr. D.M. Cody, Champion's Superintendent - Waste Treatment Plant, is responsible for operation and maintenance of the site.

iii) Projected use of land after completion of the sanitary landfill;

There are no planned uses for the site after closure. Champion will provide post-closure maintenance such as mowing and contour maintenance.

iv) Anticipated lifetime of the project;

The construction of Landfill No. 6 Area A West is anticipated to take 16 months, refer to Section 4.0 of the Design Report. According to current landfilling disposal rates obtained from Champion, the lifespan of the landfill is estimated at approximately 6 years.

v) Description of systematic usage of area, operation, orderly development and completion of the sanitary landfill;

An operations manual, not in this design, will be submitted prior to the operations of Landfill No. 6 Area A West. The operations manual will include the systematic usage of the area, operation, orderly development and completion of the landfill. The Operations Manual will be similar to the Division approved Operations Manual for Landfill No. 6 Area A East.

vi) Earthwork calculations;

Earthwork calculations are included in Section 2.3 of the Design Report.

vii) Seeding specifications and schedules;

Seeding specifications and schedules are addressed in Section 3.3 of the Design Report and in Specification Section 02270 located in Appendix D of the Design Report.

viii) Calculations for temporary and permanent erosion control measures;

Calculations for temporary and permanent erosion control measures are in Appendix C of the Design Report.

ix) Any narrative necessary to describe compliance with the Sedimentation Pollution Control Act of 1973 (15A NCAC 4);

Section 3.3 of the Design Report includes a narrative which describes compliance with the Sedimentation Pollution Control Act of 1973.

x) A discussion of compliance with design requirements in Rule .0503(2) of this Section; and

Section 2.0 of the Design Report includes a narrative which describes compliance with design requirements in Rule .0503 (2).

xi) Any other information pertinent to the proposed construction plan.

The comprehensive design of Landfill No. 6 Area A West includes details other than those described above. Other pertinent details are described within the Design Report. Some of the information includes the following: site history; site location; basis for design; and additional engineering calculations not described or mentioned above.

LANDFILL NO. 6A-WEST
CANTON, NORTH CAROLINA

CHAMPION INTERNATIONAL CORPORATION
CANTON, NORTH CAROLINA

VOLUME II - DESIGN REPORT

JANUARY 1997

Prepared by

Sevee & Maher Engineers, Inc.
Cumberland Center, Maine

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1.0 INTRODUCTION

1.1 Site History

Champion International Corporation (Champion) owns and operates a solid waste landfill known as Landfill No. 6 under Permit #44-06[1] of the North Carolina Department of Environment, Health & Natural Resources, Division of Solid Waste. The 240-acre site is used for the disposal of boiler fly ash cinders, dewatered wastewater treatment sludge, lime mud, woodwaste, and asbestos containing material (ACM).

Landfill No. 6 is divided into eight major landfilling areas designated as Areas A through H. The original design of the facility was based upon plans and specifications[2] prepared by Law Engineering and Testing Company (Law) of Charlotte, North Carolina. Areas A through E are designated for sludge, ash, lime mud, and wood waste disposal. Areas F, G, and H are designated for lime mud and ACM disposal. Currently, Areas B, C, F, G, and H have been constructed according to the original design specifications and landfilled to capacity. In addition, Areas B, F, and G have been capped according to the original design. Area C is scheduled for capping in 1996/1997.

In 1989, Champion contracted the services of Sirrine Environmental Consultants (Sirrine) of Greenville, South Carolina to prepare the design and specification report[3,4,5,6] for the construction of Area A. Area A was permitted as an approximately 29.1-acre area, and

was subdivided into two areas, East and West, for construction. Area A-East, approximately 14.1 acres, was constructed during 1992 and 1993.

In 1994, Champion contracted the services of Sevee & Maher Engineers, Inc. (SME) to review the landfill design and prepare an Operation Manual for Area A-East[7]. SME recommended design changes to Area A-East which included a higher pipe strength for the leachate collection pipes, and construction of an access road and cell dike between Cells III and IV. The work performed in 1994 and 1995[8], and in July of 1995 Champion commenced landfilling within Area A-East.

In 1996, Champion retained the services of SME to prepare engineering drawings and specifications for Area A-West. This document is prepared to supplement Champion's request to construct Landfill No. 6 Area A-West. SME has reviewed the previous reports prepared by Law and Sirrine and has prepared this document to detail the proposed site development and construction specifications for Area A-West.

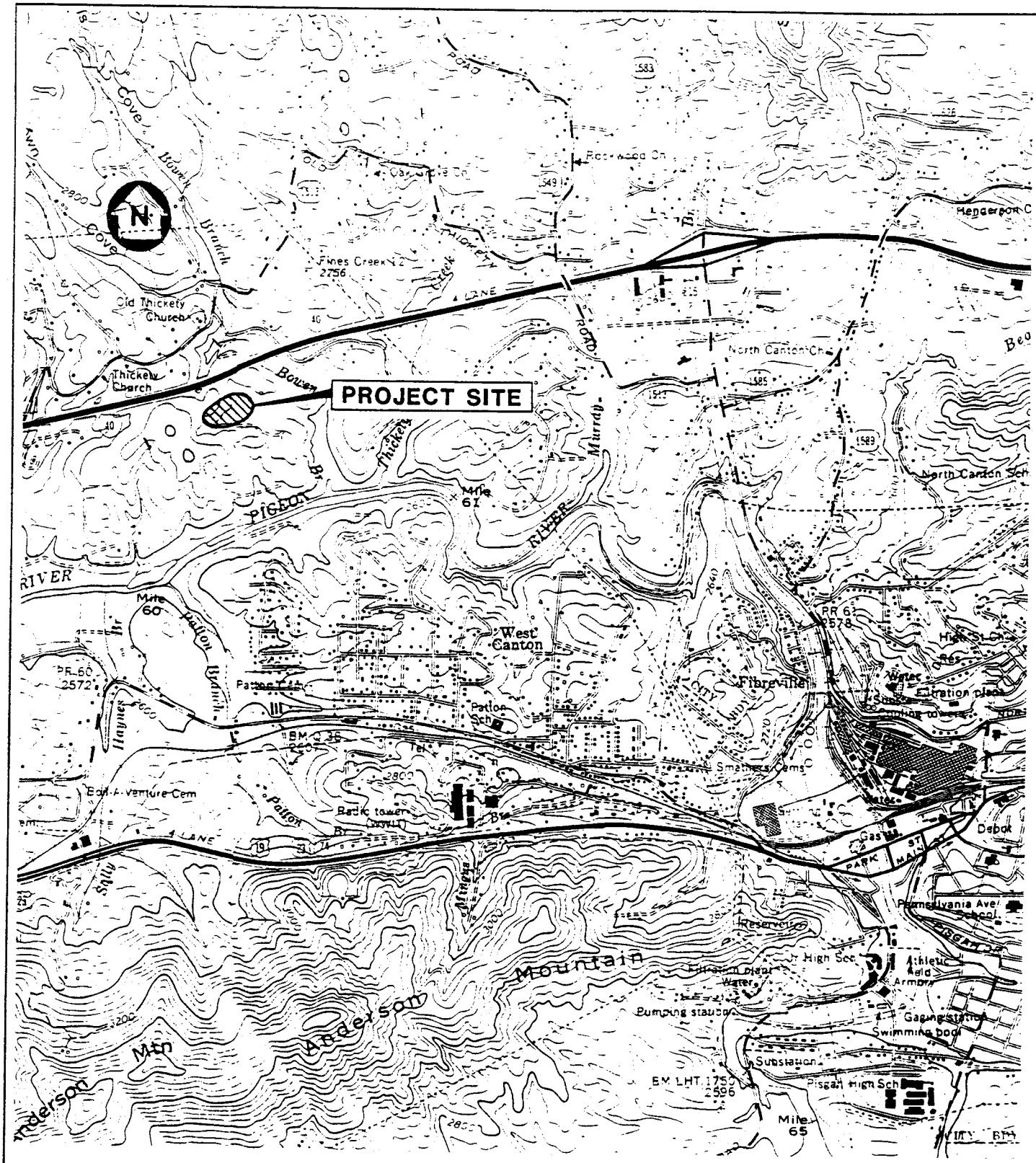
1.2 Site Location

Champion's Landfill No. 6 is located approximately two (2) miles northwest of the City of Canton in Haywood County, North Carolina. The 240-acre site is situated north of the Pigeon River and south of Interstate I-40, between State Routes 1550 and 1513. A site location plan is provided as Figure 1-1.

1.3 Basis of Design

The objective of this design is to present a site development plan which will protect the environment, compliment the existing operation plan and maximize landfilling volume for the plan area of the landfill.

Protection of groundwater quality is provided by the use of a synthetic membrane. The synthetic membrane proposed for use is a 60-mil textured High Density Polyethylene (HDPE).



BASE MAP ADAPTED FROM 7.5 MIN.
USGS TOPOGRAPHIC QUADRANGLES
CANTON, NC - 1990
CLYDE, NC - 1978

0 2000 4000 FEET

FIGURE 1-1
SITE LOCATION PLAN
CHAMPION INTERNATIONAL CORPORATION
CANTON, NORTH CAROLINA

SEVEE & MAHER ENGINEERS

As designed and constructed, Area A-East includes one access road and one chimney drain to promote internal drainage of the waste. The design of Area A-West proposes to include two access roads for more efficient traffic movement and two chimney drains to promote rapid drainage from the landfilled waste.

Landfill volume for waste is maximized through the base grading plan which includes 2H:1V sideslope grades and a minimum 5-percent "saw-tooth" base grade.

1.4 Design Support

The proposed design is supported by calculations presented herein for the following: stability of the geomembrane anchor trench; piping system design strength; maximum leachate head on the liner head; geotextile cushion design to protect the geomembrane from the leachate collection stone; and erosion control measures and temporary storage of collected clean water runoff.

The design of Area A-West is based on engineering evaluations consistent with those normally employed in geotechnical engineering for landfills.

2.0 LANDFILL DESIGN

2.1 Design Considerations

The proposed landfill facility is designed as a secure landfill for the acceptance of pulp and paper production residuals from the Canton Mill. In general, the facility will be an area-type landfill where waste will be spread and compacted to create an above-grade mound. The design of this landfill is based on the volume and characteristics of the waste and the physical characteristics of the site, with the primary objective being to provide an ultimate disposal mechanism which will not cause degradation of the environment.

2.2 Base Liner System

Area A-West will utilize a liner system consisting of a 60-mil HDPE textured geomembrane over 2 feet of compacted site soils, refer to drawing C-300 in Appendix A. In addition, a geosynthetic clay liner will be installed over the southern half of the base at Area A-West. The HDPE liner system reduces leachate leakage rates by providing a barrier with a very low hydraulic conductivity, i.e. $1x10^{-13}$ cm/sec, between the waste and the native soils.

A textured geomembrane was selected for an increased interface friction angle between the geomembrane and the soil subgrade and the overlying non-woven geotextile. The

textured geomembrane will provide stable liner sideslopes and allow for safer installation and oversight of the geomembrane installation on the 2H:1V sideslopes. Installation of the geomembrane will follow a quality assurance/quality control plan as presented in Appendix D.

2.3 Base Grading

Base grading of Area A-West will require filling (fill) and excavation (cut) of soil and weathered bedrock to meet the proposed base grades, refer to drawings C-102, C-103, C-104, C-200, and C-302 in Appendix A. Maximum excavation depth is approximately 15 feet and maximum filling depth is approximately 5 feet. The estimated volume of material filling and excavation is listed in Table 2-1 below.

TABLE 2-1

ESTIMATED CUT/FILL VOLUMES

Material Cut/Fill	Volume (cu yd)
Stripping	13,000
Soil Fill	44,000
Soil Cut	30,000
Weathered Bedrock Cut	40,000

The bedrock removal may be accomplished by ripping or other approved methods, depending on the competency of the bedrock. As part of the landfill design, SME conducted a site investigation to evaluate the depth to bedrock and competency of the bedrock. The site investigation included a total of 12 borings and 10 test pits. Six of the borings were drilled by Geotek Environmental of Knoxville, Tennessee during March 1996. An additional six borings were drilled by Geotek during June 1997. The borings were designated B-204 through B-209, and B97-01 through B97-06. The test pits were dug by Plemmons Contracting of Canton, North Carolina. The test pits are designated TP-1 through TP-10. Logs are presented in Appendix B.

The borings generally indicate a weathered layer of varying depth over competent rock. There also were exposed rock outcrops or pinacles within Area A-West which were not ripable with the small excavator used to dig the test pits. Areas of the base grade with exposed bedrock will require additional excavation of 4 feet below the proposed base grades and the placement of 4 feet of compacted site soils prior to geomembrane installation. The removal of bedrock for landfill development is proposed to maximize landfill volume and simplify landfill operations.

The proposed base grades were designed to provide at least 4 feet of separation between seasonal high water elevation and waste.

2.4 Leachate Collection and Transport System

Leachate collection above the geomembrane is provided through the placement of 15 inches of granular drainage material, refer to Drawing C-300 in Appendix A. Leachate entering the drainage layer will drain into perforated collection pipes. The collection pipes consist of two 12-inch diameter HDPE pipes which travel west to east, refer to Drawing C-301 in Appendix A. Leachate collected is transported to the existing leachate storage ponds via an extension of the 12-inch pipeline, which services Landfill 6A-East. In addition to the existing pipeline, a proposed 12-inch pipeline, located through the northern containment dike, will provide Champion an alternative transport pipeline in the event the existing line becomes unserviceable, refer to Drawing C-105.

The leachate collection pipes at the base of the landfill will be extended to the rim elevation of the landfill. The purpose of the pipe extensions is to provide access to the headers for cleaning and maintenance and to provide collection of leachate for above-rim landfilling. The location of the leachate collection piping system is presented in Drawings C-103 and C-106 in Appendix A.

Drainage of the waste leachate is a critical aspect of the landfill operations with regard to stability and ease of operation. To allow rapid drainage of the waste leachate as landfilling progresses, strip drains will be installed over the leachate collection headers in the northeast, southeast, and west end of Area A-West.

2.5 Erosion Control

The site soils consist of micaceous silty-sands and/or sandy-silts which are susceptible to erosion. The construction of Area A-West will require a staged schedule or the use of a protective material (jute-mat, temporary geotextile, etc.) to minimize exposure of site soils prior to geomembrane installation. In 1991 and 1992, a State-approved erosion control plan was implemented during the construction activities for Area A. The primary erosion control feature necessary for completing Area A-West is a sedimentation pond which is currently in-place and functioning. The sedimentation pond is located at the low end of Area A-West with a perforated riser pipe to provide stormwater retention time for soil particles to settle out. Champion has routinely removed sediment from the pond in order for the sediment pond to function properly and maintain the design capacity of the pond. Additional erosion control during construction will follow Best Management Practices[9].

Above rim (landfill perimeter road elevation) erosion control is provided through proper grading of the perimeter access road. The road is graded to drain away from the landfill and will drain to existing catch basins or culverts located in adjacent landfill areas Area A, Area B, or Area C. In addition, an existing silt fence is surrounding the base of the northern containment dike will be inspected and maintained to assure proper function.

2.6 Access Roadways

Access for Area A-West will utilize two roadways constructed along the north and south sideslopes. The access roads will be approximately 18 feet wide and slope at approximately 13 to 15 percent.

Enhancement of the perimeter roadway will provide adequate road surface for the anticipated construction traffic during landfill development. The location of the roadways is presented on Drawing C-103, along with detailed cross-section on Drawing C-302 in Appendix A.

2.7 Cell Division Berm

Area A-West is divided into two landfilling units identified as Cell I (Western Half) and Cell II (Eastern Half). A berm will divide the two cells to aid in minimizing leachate generation and to connect the north and south access roads. During landfilling in Cell II water collected in Cell I can be discharged as clean water via a proposed storm water piping system described below in Section 2.8. The cell division berm will be constructed upon the geomembrane liner system and will consist of suitable site soils (silty sand or sandy silt). The top of the berm will consist of a geotextile overlain with 12 inches of ABC road gravel. The berm sideslopes will also be covered with a geotextile and overlain

with granular drainage material, #78M. A cross-section of the cell division berm is shown on Drawing C-300 in Appendix A.

2.8 Stormwater Piping System

The existing stormwater piping system from Area A-East will be extended into Cell I and Cell II. To reduce leachate generation, the piping system will be installed with inlet structures to collect clean water from within each cell prior to landfilling operations thus reducing leachate volumes. Upon commencing landfill operations within each cell, the owner will cap the stormwater inlet structure and open the leachate collection piping system. The stormwater piping system is located in plan view on Drawing C-103 and in cross-section on Drawing C-300 and C-301 in Appendix A.

3.0 DESIGN CONSIDERATIONS

3.1 Stability

3.1.1 Geomembrane Anchor Trench. The geomembrane liner will be anchored along the inside edge of the perimeter access road. The anchor trench is designed to provide enough pull-out resistance to hold the geomembrane in place under normal operating conditions. The anchor trench is also designed to allow the geomembrane to pull out of the trench under extreme loading conditions before the limits of the geomembrane are exceeded.

Based on this criteria, the anchor trench will be 2 feet in depth and will have a run-out of 3 feet. The design calculations and a list of design parameters are provided within Appendix C.

3.1.2 Access Road. The access roads on the north and south sideslopes of Area A-West are underlain with the HDPE textured liner. The access road design was reviewed for liner stability utilizing traffic loads and movement. The calculations show the roadway design is adequate for heavy loads and are presented in Appendix C.

3.1.3 Landfill Containment Berm and Waste Stability. Previous reports by Law[2] and Sirrine[3,4,5] have demonstrated the stability of the 6A-West containment berms with waste

landfilled to the top of the cell. No additional investigation or stability analysis is provided within this report.

3.2 Leachate Collection System

3.2.1 Maximum Leachate Head on Liner. An important design constraint of the leachate collection system is the depth at which the leachate will mound on top of the liner system. The depth of the leachate over the liner or head on the liner is directly related to the leakage rate through the liner system. Therefore, the goal in designing the leachate collection system is to minimize the head on the liner and likewise the leakage rate. A typical design standard for the landfill leachate collection system is to maintain head levels on the liner to less than 12 inches.

The maximum head on the base liner system is calculated by using Giroud's method[10]. The equation to solve the head on the liner utilizes the slope of the base liner system, the leachate collection stone's hydraulic conductivity, the leachate impingement rate, the thickness of the leachate collection stone, and the drainage length between pipes. The head on the liner for the collection system design is 0.14 feet, which is less than the typical maximum allowable head of 1 foot. The leachate collection/liner head calculations are shown in Appendix C.

3.2.2 Geotextile Cushion. The geotextile located between the geomembrane liner and the leachate collection stone is required to provide adequate cushion to protect the geomembrane from puncture. The method used to determine the cushion requirements of the geotextile, utilized the geotextile weight, the maximum stone diameter, and the confining stresses to calculate a cushion pressure capacity (Boschuk[11]). The proposed geotextile will provide adequate cushion for protection of the liner. Design calculations presented in Appendix C provide a factor of safety of 16.6, which exceeds the recommended minimum of 2.0. The proposed 16 oz/sy cushion geotextile is considered industry standard.

3.2.3 Leachate Collection and Storm Drain Pipe Strength. The leachate collection piping must be able to withstand the anticipated loads produced by the depth of waste placed over the pipes. The pipe material selected for the landfill is high density polyethylene pipe which is manufactured in a variety of thicknesses, or Standard Diameter Ratios (SDR). The design strength to resist buckling and critical pressure (crushing) was calculated using pipe thickness, perforations, and confining stresses under a positive projecting condition, i.e. no trench. The proposed pipe and thickness, SDR 7.0 for the perforated leachate collection piping and SDR 7.3 for the storm drain piping, meets the minimum factor of safety of 2.3 recommended by the manufacturer. Calculations are provided in Appendix C.

3.2.4 Leachate Transport Pipe Strength. The existing leachate transport pipeline through the 6A-East and 6A-West dike is SDR 11.0 and SDR 9.0 through Cell 6A-East. The proposed emergency transport pipeline is required to be a SDR 9.0 due to installation stresses through the eastern dike.

3.3 Stormwater and Erosion Control

3.3.1 Perimeter Access Roadway Runoff. The access roadway surrounding Area A-West will be graded to drain away from the landfill, refer to drawings C-103 and C-302 in Appendix A. Existing catch basins and outfall pipes are located along the north side of the landfill. Calculations of peak surface water flow generated from a 25-year/24-hour duration storm, were made using the Soil Conservation Service Technical Release Manual TR-55 methodology. The calculations indicate that the capacity of the existing stormwater control system will not be exceeded, refer to Appendix C.

Along the west and southern portions of the perimeter access roadway, the runoff is directed over the outside slope of the road. The anticipated runoff from the west and south roadways is not expected to erode the grassed areas of the future Area D, and the proposed capped Area C-Upper.

3.3.2 Sedimentation Control During Base Grading. A sedimentation control structure is located at the low gradient area of Area 6A-West. This structure was designed and

installed during the preliminary base grading performed in 1992. The structure will require maintenance during base grading proposed in the report. Otherwise, the structure is functioning as designed.

3.3.3 Stormwater Retention Prior to Landfilling. As previously described, Area A-West will be divided into two (2) cells, Cell I (West) and Cell II (East). The schedule for construction of Area A-West is expected to occur a few years before landfilling operations are required to commence in the area. Therefore, Cell I and Cell II will generate clean stormwater runoff which can be discharged to Bowen Branch which flows adjacent to the landfill. The stormwater pipe in Cells I and II will include inlet structures to collect the runoff. Cell I capacity to retain runoff is determined by the height of the Cell I/Cell II berm. Design calculations indicate the available capacity for stormwater retention is greater than the required volume of the 25-year/24-hour duration storm (refer to Appendix C).

3.3.4 Erosion Control During Base Grading. Base grading of the landfill area consists of excavating soil and bedrock. The on-site soils are micaceous and are susceptible to erosion. To minimize erosion, the general contractor will be required to perform the work in conformance with the Best Management Practices Manual[9] prepared by the State of North Carolina, and to take any additional measures required to protect the base soil prior to installation of the geomembrane. Additional measures will include staged construction, i.e. grade a 2-acre area, compact, install the geomembrane, and move to the next 2-acre

area; or installation of a temporary erosion control material such as a geotextile or jute mat.

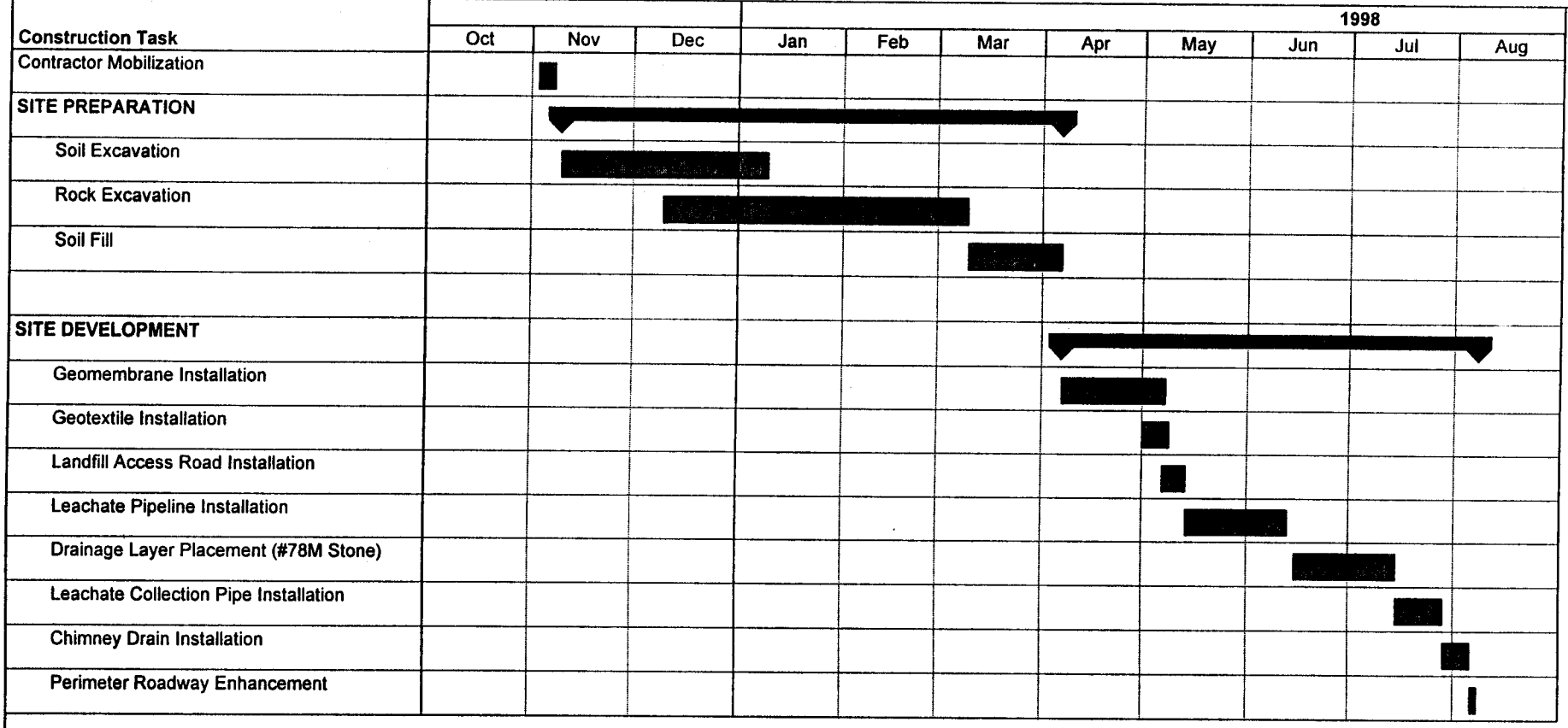
4.0 LANDFILL CONSTRUCTION

Champion plans to initiate construction of Area A-West in the fall of 1997 and anticipates that the facility will be operational by the fall of 1999. A proposed construction schedule is presented on Figure 4-1. The landfill will be constructed by a general contractor who will be responsible for supplying the materials, labor, and equipment necessary to complete the landfill. Services of a general contractor will be procured through a competitive bid process. Bid packages for the solicitation of construction services will require the contractor to identify and demonstrate familiarity and experience with the various aspects of landfill construction. These will include:

- Earthmoving;
- Pipe installation; and
- HDPE liner installation.

The specific levels of experience required for the various components of the landfill are included in the technical specifications prepared for the project. These technical specifications are attached in Appendix D.

FIGURE 4-1
CHAMPION INTERNATIONAL CORPORATION
LANDFILL 6A-WEST



\\DATABASE\D-DRIVE\CPC\6AWEST.MPP

4.1 Quality Assurance/Quality Control

To control the quality of the soil materials used in the landfill construction, a quality assurance/quality control (QA/QC) program will be implemented. The program will include source testing to demonstrate compliance with material specifications and construction testing to demonstrate that the materials have been properly installed. In addition to source testing of soil materials, the contractor will be responsible for submitting to the engineer for review the manufacturer's specifications and warranties for the following items:

- Leachate collection pipes and fittings;
- Liner geomembrane material; and
- Geotextile.

The specific items which must be submitted for each of these items is discussed in the specifications included in Appendix D.

4.1.1 Source Testing. The soil materials used at the landfill construction will be tested at their source prior to being delivered on-site, to demonstrate compliance with the materials

specifications. The soil materials that will require source testing include: granular drainage material and graded drainage stone for leachate collection, and material for the access road. Samples will be collected at each borrow source in accordance with the methods specified by ASTM D 420 and C 702, and tested by the contractor prior to the Owner's acceptance of the materials. The contractor will be required to have the test performed by a State of North Carolina qualified testing laboratory.

4.1.2 Construction Testing. As the soil materials are used in the landfill construction, in-place testing will be performed by Champion to monitor material placement and conformance with the criteria specified in the construction specifications. In-place material testing will be performed by a qualified materials testing laboratory and will be observed by the owner's representative.

4.1.3 Liner QA/QC. The quality assurance and quality control of the facility's synthetic liner will be as described in the construction specifications contained in Appendix D of this report.

4.2 Weekly Inspection Reports

Weekly inspection reports will be prepared by the owner's representative during the landfill construction period. The report will include material test results, summary of

contractor submittals, actions taken, summary of progress made to date, and anticipated work items.

4.3 Photographic Documentation

To provide photographic documentation of the landfill construction, photographs will be taken periodically. Copies of the photographs will be provided in the construction certification report.

4.4 Record Drawings

Upon completion of the landfill construction, record drawings will be prepared for the facility. The drawings will be sealed by a State of North Carolina Professional Engineer and will be submitted to the NCDEHNR.

4.5 Final Construction Certification and Report

A final construction report will be submitted by Champion to the NCDEHNR following the construction completion at Area A-West. The report will include written certification signed and stamped by the engineer supervising project inspection that the site has been constructed in accordance with the approved plans and specifications.

5.0 CONCLUSIONS

The Landfill No. 6 Area A-West proposed design is a state-of-the-art design which provides Champion International Corporation with an improved operational area (over that of Area A-East) which maximizes the waste volume for the project area. Area A-West is estimated to require approximately 16 months to complete construction.

Based on the proposed landfill base grades and final grades, Area A-West will have an approximate volume of 1.6 -million cubic yards, and according to current waste disposal rates[13], a service life of approximately 6 years.

Proposed specifications are attached to this report in Appendix D for use in procuring bids and detailing construction activities.

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APPENDIX B

EXPLORATION LOGS

PROJECT CHAMPION INT'L – LANDFILL 6A WEST	JOB NO. 96010	BORING NO. B–204
DATE COMPLETED 3/5/96	DATE WELLS INSTALLED	DRILLING METHOD HSA/WB
GROUND SURFACE ELEVATION (FT) 2730.3	DRILLING CONTRACTOR GEOTECH	LOGGED BY CJB
BOREHOLE DIAMETER (IN) 4 IN	ROCK CORE DIAMETER (IN) 2 IN	SHEET 1 OF 1

DEPTH (FT)	SAMPLE NO.	MATERIAL DESCRIPTION	INSTRUMENT LOG	DEPTH (FT)
10		BROWN SANDY SILT OR SILTY SAND		10
12.5		VERY WEATHERED ROCK, NO RECOVERY		
15.5		MED. WEATHERED ROCK BECOMING MORE COMPETENT W/DEPTH		
20				20
29.0		B.O.B.		
30				30
40				40

NOTES

PROJECT CHAMPION INT'L – LANDFILL 6A WEST	JOB NO. 96010	BORING NO. B-205
DATE COMPLETED 3/5/96	DATE WELLS INSTALLED	DRILLING METHOD HSA/WB
GROUND SURFACE ELEVATION (FT) 2729.9	DRILLING CONTRACTOR GEOTECH	LOGGED BY CJB
BOREHOLE DIAMETER (IN) 4 IN	ROCK CORE DIAMETER (IN) 2 IN	SHEET 1 OF 1

DEPTH (FT)	SAMPLE NO.	MATERIAL DESCRIPTION	INSTRUMENT LOG
0		BROWN SILTY SAND OR SANDY SILT	
5.0		VERY WEATHERED ROCK	
9.0		MED. WEATHERED ROCK TO SL. WEATHERED ROCK	
23.9		SL. WEATHERED ROCK	
33.9		B.O.B.	

NOTES

PROJECT CHAMPION INT'L – LANDFILL 6A WEST	JOB NO. 96010	BORING NO. B-206
DATE COMPLETED 3/6/96	DATE WELLS INSTALLED	DRILLING METHOD HSA/WB
GROUND SURFACE ELEVATION (FT) 2744.4	DRILLING CONTRACTOR GEOTECH	LOGGED BY CJB
BOREHOLE DIAMETER (IN) 4 IN	ROCK CORE DIAMETER (IN) 2 IN	SHEET 1 OF 1

DEPTH (FT)	SAMPLE NO.	MATERIAL DESCRIPTION	INSTRUMENT LOG	DEPTH (FT)
10		BROWN SILTY SAND OR SANDY SILT		10
20				20
21.5		VERY WEATHERED ROCK		
23.0		SL. WEATHERED ROCK		
30				30
33.0		B.O.B.		
40				40

NOTES

PROJECT CHAMPION INT'L – LANDFILL 6A WEST	JOB NO. 96010	BORING NO. B–207
DATE COMPLETED 3/6/96	DATE WELLS INSTALLED	DRILLING METHOD HSA/WB
GROUND SURFACE ELEVATION (FT) 2746.5	DRILLING CONTRACTOR GEOTECH	LOGGED BY CJB
BOREHOLE DIAMETER (IN) 4 IN	ROCK CORE DIAMETER (IN) 2 IN	SHEET 1 OF 1

DEPTH (FT)	SAMPLE NO.	MATERIAL DESCRIPTION	INSTRUMENT LOG	DEPTH (FT)
10		BROWN SILTY SAND OR SANDY SILT		10
20				20
30	30.5			30
		SL. WEATHERED ROCK		
40	40.5	B.O.B.		40

NOTES

PROJECT CHAMPION INT'L – LANDFILL 6A WEST	JOB NO. 96010	BORING NO. B-208
DATE COMPLETED 3/7/96	DATE WELLS INSTALLED	DRILLING METHOD HSA/WB
GROUND SURFACE ELEVATION (FT) 2690.9	DRILLING CONTRACTOR GEOTECH	LOGGED BY CJB
BOREHOLE DIAMETER (IN) 4 IN	ROCK CORE DIAMETER (IN) 2 IN	SHEET 1 OF 1

DEPTH (FT)	SAMPLE NO.	MATERIAL DESCRIPTION	INSTRUMENT LOG	DEPTH (FT)
10		BROWN SILTY SAND OR SANDY SILT		10
20				20
29.0				
30				30
40		VERY WEATHERED ROCK TO MED. WEATHERED ROCK		40
50				50
59.0				
60		B.O.B.		60

NOTES

PROJECT CHAMPION INT'L – LANDFILL 6A WEST	JOB NO. 96010	BORING NO. B-209	
DATE COMPLETED 3/11/96	DATE WELLS INSTALLED	DRILLING METHOD HSA/WB	
GROUND SURFACE ELEVATION (FT) 2697.5	DRILLING CONTRACTOR GEOTECH	LOGGED BY CJB	
BOREHOLE DIAMETER (IN) 4 IN	ROCK CORE DIAMETER (IN) 2 IN	SHEET 1 OF 1	

DEPTH (FT)	SAMPLE NO.	MATERIAL DESCRIPTION	INSTRUMENT LOG	DEPTH (FT)
10		BROWN SANDY SILT OR SILTY SAND		10
20				20
28.0				
30		VERY WEATHERED ROCK TO SL. WEATHERED ROCK		30
40.0				
40		B.O.B.		40

NOTES

8/96

SEVEE & MAHER ENGINEERS

BEDROCK CORE LOG

PROJECT CHAMPION INT'L – LANDFILL 6A WEST BORING NO. B-204 PAGE 1 OF 2

JOB NO. 96010 DRILLER GEOTECH

CORE DIAMETER (IN.) 1.8 IN ELEVATION (FT) INTERVAL _____ DEPTH (FT) INTERVAL 15.5'-24'

AZIMUTH _____ INCLINATION NV LOGGED BY J. SEVEE (NAME) 5/1/96 (DATE)

MEASURED BREAKS OR PARTINGS ACROSS CORE
CHIPS, CAVITY, LOST CORE
MEASURED HIGH-ANGLE JOINT (JT=JOINT)
D CORE BROKEN BY DRILLER
M CORE PARTED ALONG MICA CONCENTRATION

WX: WEATHERED-WEATHERING
SL-SLIGHT
MOD-MODERATE
SEV-SEVERE
DIP: DIP OF LAYERING, TEXTURE, FOLIATION, BEDDING, ETC.

DEPTH	BREAKS IN CORE	CONDITION OF CORE, WX, ETC.	DIP	RECOVERY (%)	RQD (%)	GRAPHIC LOG	ROCK TYPE, GRAIN SIZE, COLOR, TEXTURE, ETC.
0		SL WX ON JOINTS Fe STAINING ON JOINTS CAN POTENTIALLY RIP		8.5 / 8.5	4.5 / 8.5		BROWN TO GRAY BECOMING GRAY W/DEPTH COARSE GRAINED TEXTURE
2							
4	D? D? D?		15°				QUARTZ, MICA, BIOTITE, (FELDS?) GRAY TO BROWN TO WHITE Fe ON JOINT
6		COMPETENT ROCK					
8							

BEDROCK CORE LOG

PROJECT CHAMPION INT'L – LANDFILL 6A WEST BORING NO. B-204 PAGE 2 OF 2

JOB NO. 96010 DRILLER GEOTECH

CORE DIAMETER (IN.) 1.8 IN ELEVATION (FT) INTERVAL _____ DEPTH (FT) INTERVAL 24'-29'

AZIMUTH _____ INCLINATION NV LOGGED BY J. SEVEE (NAME) 5/1/96 (DATE)

BREAKS IN CORE

MEASURED BREAKS OR PARTINGS ACROSS CORE

CHIPS, CAVITY, LOST CORE

MEASURED HIGH-ANGLE JOINT (JT=JOINT)

D CORE BROKEN BY DRILLER

M CORE PARTED ALONG MICA CONCENTRATION

WX: WEATHERED-WEATHERING

SL-SLIGHT
MOD-MODERATE
SEV-SEVERE

DIP: DIP OF LAYERING, TEXTURE, FOLIATION, BEDDING, ETC.

DEPTH	CONDITION OF CORE, WX, ETC.	DIP	RECOVERY (%)	RQD (%)	GRAPHIC LOG	ROCK TYPE, GRAIN SIZE, COLOR, TEXTURE, ETC.
0	UN WX – COMPETENT CRYSTALLINE ROCK NO SIGNS OF WX		59.5/60	50.5/60		GRAY TO BLACK QUARTZ, MICA, BIOTITE (WHITE FELDS?) NEAR VERTICAL SCHISTOCITY IN SOME SECTIONS
1	D					
2	D					
	D					
	D					
	D					
3	D					COARSE GRAINED TEXTURE
	D					
4						
	D					
5	D					

BEDROCK CORE LOG

PROJECT CHAMPION INT'L – LANDFILL 6A WEST BORING NO. B-205 PAGE 1 OF 2

JOB NO. 96010 DRILLER GEOTECH

CORE DIAMETER (IN.) 1.8 IN ELEVATION (FT) INTERVAL _____ DEPTH (FT) INTERVAL 9'-23'9"

AZIMUTH _____ INCLINATION NV LOGGED BY J. SEVEE (NAME) 5/1/96 (DATE)

BREAKS IN CORE

- MEASURED BREAKS OR PARTINGS ACROSS CORE
- CHIPS, CAVITY, LOST CORE
- MEASURED HIGH-ANGLE JOINT (JT=JOINT)
- D — CORE BROKEN BY DRILLER
- M — CORE PARTED ALONG MICA CONCENTRATION

WX: WEATHERED-WEATHERING
SL-SLIGHT
MOD-MODERATE
SEV-SEVERE

DIP: DIP OF LAYERING, TEXTURE, FOLIATION, BEDDING, ETC.

DEPTH	CONDITION OF CORE, WX, ETC.	DIP	RECOVERY (%)	RQD (%)	GRAPHIC LOG	ROCK TYPE, GRAIN SIZE, COLOR, TEXTURE, ETC.
0	BROKEN PIECES		10.0 / 14'9"	NA		GRAY, BIOTITE W/QUARTZ WHITE POWDERLY SUBSTANCE PRECIP ON FRACTURED FACES
2	MODERATE WX TO UN WX					MICA ZONES FRACTURED
4						Fe STAINING ON MOST JOINT FACES
6						QUARTZ ZONES
8						FINER GRAINED TEXTURE
10						
12	LOCATION OF PIECES RELATIVE TO CORE UNKNOWN					

BEDROCK CORE LOG

PROJECT CHAMPION INT'L – LANDFILL 6A WEST BORING NO. B-205 PAGE 2 OF 2

JOB NO. 96010 DRILLER GEOTECH

CORE DIAMETER (IN.) 1.8 IN ELEVATION (FT) INTERVAL _____ DEPTH (FT) INTERVAL 23'9"–33'9"

AZIMUTH _____ INCLINATION NV LOGGED BY J. SEVEE (NAME) 5/1/96 (DATE)

BREAKS IN CORE

MEASURED BREAKS OR PARTINGS ACROSS CORE

CHIPS, CAVITY, LOST CORE

MEASURED HIGH-ANGLE JOINT (JT=JOINT)

D CORE BROKEN BY DRILLER

M CORE PARTED ALONG MICA CONCENTRATION

WX: WEATHERED–WEATHERING

SL–SLIGHT
MOD–MODERATE
SEV–SEVERE

DIP: DIP OF LAYERING, TEXTURE, FOLIATION, BEDDING, ETC.

DEPTH	CONDITION OF CORE, WX, ETC.	DIP	RECOVERY (%)	RQD (%)	GRAPHIC LOG	ROCK TYPE, GRAIN SIZE, COLOR, TEXTURE, ETC.
0	BROKEN PIECES		9.5'/10'			GRAY TO BROWN QUARTZ, MICA, BIOTITE
2						Fe STAINING IN SOME JOINTS
	BECOMING UN WX W/DEPTH					NEAR VERTICAL SCHISTOCITY
4						
6						
8						FINER GRAINED TEXTURE
10						

BEDROCK CORE LOG

PROJECT CHAMPION INT'L – LANDFILL 6A WEST BORING NO. B-206 PAGE 1 OF 1

JOB NO. 96010 DRILLER GEOTECH

CORE DIAMETER (IN.) 1.8 IN ELEVATION (FT) INTERVAL _____ DEPTH (FT) INTERVAL 21.5'-33.7'

AZIMUTH _____ INCLINATION NV LOGGED BY J. SEVEE (NAME) 5/1/96 (DATE)

BREAKS IN CORE

MEASURED BREAKS OR PARTINGS ACROSS CORE

CHIPS, CAVITY, LOST CORE

MEASURED HIGH-ANGLE JOINT (JT=JOINT)

D CORE BROKEN BY DRILLER

M CORE PARTED ALONG MICA CONCENTRATION

WX: WEATHERED-WEATHERING

SL-SLIGHT
MOD-MODERATE
SEV-SEVERE

DIP: DIP OF LAYERING, TEXTURE, FOLIATION, BEDDING, ETC.

DEPTH	CONDITION OF CORE, WX, ETC.	DIP	RECOVERY (%)	RQD (%)	GRAPHIC LOG	ROCK TYPE, GRAIN SIZE, COLOR, TEXTURE, ETC.
0	D D UN WX		117/120	79/117		Fe STAINING ON JOINTS COMPETENT GRAY TO BROWN QUARTZ, MICA, BIOTITE (FELDS?) COARSE GRAINED TEXTURE
2						
4	D D					
6	D D					
8	D D					
10						

BEDROCK CORE LOG

PROJECT CHAMPION INT'L – LANDFILL 6A WEST BORING NO. B-207 PAGE 1 OF 1

JOB NO. 96010 DRILLER GEOTECH

CORE DIAMETER (IN.) 1.8 IN ELEVATION (FT) INTERVAL _____ DEPTH (FT) INTERVAL 30.5'-40.5'

AZIMUTH _____ INCLINATION NV LOGGED BY J. SEVEE (NAME) 5/1/96 (DATE)

MEASURED BREAKS OR PARTINGS ACROSS CORE
CHIPS, CAVITY, LOST CORE
MEASURED HIGH-ANGLE JOINT (JT=JOINT)
D CORE BROKEN BY DRILLER
M CORE PARTED ALONG MICA CONCENTRATION

WX: WEATHERED-WEATHERING
SL-SLIGHT
MOD-MODERATE
SEV-SEVERE
DIP: DIP OF LAYERING, TEXTURE, FOLIATION, BEDDING, ETC.

DEPTH	← BREAKS IN CORE	CONDITION OF CORE, WX, ETC.	DIP	RECOVERY (%)	ROD (%)	GRAPHIC LOG	ROCK TYPE, GRAIN SIZE, COLOR, TEXTURE, ETC.
0	D	UN WX		9.5/10	9.1/9.5		Fe STAINING ON FRACTURED FACES N.V. SCHISTOCITY GRAY TO BROWN QUARTZ, MICA, BIOTITE (FELDS?) COARSE GRAINED TEXTURE
2	D						
4	D						
	D						
6	D						
8	D						
10							

SEVEE & MAHER ENGINEERS

BEDROCK CORE LOG

PROJECT CHAMPION INT'L – LANDFILL 6A WEST BORING NO. B-208 PAGE 1 OF 2

JOB NO. 96010 DRILLER GEOTECH

CORE DIAMETER (IN.) 1.8 IN ELEVATION (FT) INTERVAL _____ DEPTH (FT) INTERVAL 29'-39'

AZIMUTH _____ INCLINATION NV LOGGED BY J. SEVEE (NAME) 5/1/96 (DATE)

BREAKS IN CORE

MEASURED BREAKS OR PARTINGS ACROSS CORE

CHIPS, CAVITY, LOST CORE

MEASURED HIGH-ANGLE JOINT (JT=JOINT)

D CORE BROKEN BY DRILLER

M CORE PARTED ALONG MICA CONCENTRATION

WX: WEATHERED-WEATHERING
SL-SLIGHT
MOD-MODERATE
SEV-SEVERE

DIP: DIP OF LAYERING, TEXTURE, FOLIATION, BEDDING, ETC.

DEPTH	CONDITION OF CORE, WX, ETC.	DIP	RECOVERY (%)	ROD (%)	GRAPHIC LOG	ROCK TYPE, GRAIN SIZE, COLOR, TEXTURE, ETC.
0	Fe ON JOINT		4/4	30/48		GRAY TO BROWN BECOMING BROWN QUARTZ, BIOTITE, MICA (FELDS?)
	D?					
	D? SL WX					N.V. SCHISTOCITY
	D?					
2	D?					
	D?					
	D?					
	D?					
	D?					
4	VERY WX		4/6	0		SCHISTOCITY AT ANGLE
						SAME ROCK
6						
	SL WX					COARSE GRAINED TEXTURE
8						
10						

BEDROCK CORE LOG

PROJECT CHAMPION INT'L – LANDFILL 6A WEST BORING NO. B-208 PAGE 2 OF 2

JOB NO. 96010 DRILLER GEOTECH

CORE DIAMETER (IN.) 1.8 IN ELEVATION (FT) INTERVAL _____ DEPTH (FT) INTERVAL 39'-59'

AZIMUTH _____ INCLINATION NV LOGGED BY J. SEVEE (NAME) 5/1/96 (DATE)

BREAKS IN CORE

MEASURED BREAKS OR PARTINGS ACROSS CORE

CHIPS, CAVITY, LOST CORE

MEASURED HIGH-ANGLE JOINT (JT=JOINT)

D CORE BROKEN BY DRILLER

M CORE PARTED ALONG MICA CONCENTRATION

WX: WEATHERED-WEATHERING

SL-SLIGHT
MOD-MODERATE
SEV-SEVERE

DIP: DIP OF LAYERING, TEXTURE, FOLIATION, BEDDING, ETC.

DEPTH	CONDITION OF CORE, WX, ETC.	DIP	RECOVERY (%)	RQD (%)	GRAPHIC LOG	ROCK TYPE, GRAIN SIZE, COLOR, TEXTURE, ETC.
0	VERY WX NOT COMPETENT	40° SCHIST	5/10	1.1/10		BROWN BECOMING GRAY W/DEPTH MICA, QUARTZ (FELDS?) COARSE GRAINED TEXTURE
5						
	SL WX					
10		40° SCHIST	5/10	0		GRAY TO BROWN
15						
	SL WX					BROWN COARSE GRAINED TEXTURE
20						
10						

BEDROCK CORE LOG

PROJECT CHAMPION INT'L – LANDFILL 6A WEST BORING NO. B-209 PAGE 1 OF 1

JOB NO. 96010 DRILLER GEOTECH

CORE DIAMETER (IN.) 1.8 IN ELEVATION (FT) INTERVAL _____ DEPTH (FT) INTERVAL 28.5'-40'

AZIMUTH _____ INCLINATION NV LOGGED BY J. SEVEE (NAME) 5/1/96 (DATE)

BREAKS IN CORE

MEASURED BREAKS OR PARTINGS ACROSS CORE

CHIPS, CAVITY, LOST CORE

MEASURED HIGH-ANGLE JOINT (JT=JOINT)

D CORE BROKEN BY DRILLER

M CORE PARTED ALONG MICA CONCENTRATION

WX: WEATHERED-WEATHERING

SL-SLIGHT
MOD-MODERATE
SEV-SEVERE

DIP: DIP OF LAYERING, TEXTURE, FOLIATION, BEDDING, ETC.

DEPTH	CONDITION OF CORE, WX, ETC.	DIP	RECOVERY (%)	RQD (%)	GRAPHIC LOG	ROCK TYPE, GRAIN SIZE, COLOR, TEXTURE, ETC.
0	MOD WX BROKEN PIECES		10 11.5			QUARTZ SEAMS AT SAME ANGLE AS FRACTURES SCHISTOCITY AT ANGLE SAME AS FRACTURES AND QUARTZ SEAMS
2	LESS WX COMPETENT					
4	FRACTURES DIP 45° Fe STAINING ON FRACTURE FACES					BROWN TO GRAY QUARTZ, BIOTITE (VERY LITTLE MICA) (FELDS?)
6	WX ZONE					FINE GRAINED TEXTURE
8						
10	LOCATIONS OF PIECES IN CORE UNKNOWN					

TEST PIT LOG

PROJECT: CHAMPION INTERNATIONAL – LANDFILL 6A–WEST				LOCATION: CANTON, NC		TEST PIT NO.: TP–1	
						JOB NO.: 96010	LOGGED BY: CJB
CONTRACTOR: PLEMMONS CONT.	EXCAVATION METHOD: JD 490D EXCAV.	SURFACE SIZE (FT):	COMPLETION DEPTH (FT): 2.0 FEET	DATE: 3/13/96	GROUND EL. (FT): +/– 2749.0	GROUNDWATER DEPTH (FT): NONE	

DEPTH (FT)	SAMPLE NO.	GRAPHIC LOG	MATERIAL DESCRIPTION AND CLASSIFICATION	WATER DATA	REMARKS, LAB TEST RESULTS, PHOTOGRAPHS
1			BROWN SILTY SAND/SANDY SILT		
2		2.0	REFUSAL		
3					
4					
5					
6					
7					
8					
9					
10					

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TEST PIT LOG

PROJECT: CHAMPION INTERNATIONAL – LANDFILL 6A–WEST				LOCATION: CANTON, NC		TEST PIT NO.: TP–2	
						JOB NO.: 96010	LOGGED BY: CJB
CONTRACTOR: PLEMMONS CONT.	EXCAVATION METHOD: JD 490D EXCAV.	SURFACE SIZE (FT):	COMPLETION DEPTH (FT): 1.5 FEET	DATE: 3/13/96	GROUND EL. (FT): +/– 2747.0	GROUNDWATER DEPTH (FT): NONE	

DEPTH (FT)	SAMPLE NO.	GRAPHIC LOG	MATERIAL DESCRIPTION AND CLASSIFICATION	WATER DATA	REMARKS, LAB TEST RESULTS, PHOTOGRAPHS
1			BROWN SILTY SAND OR SANDY SILT		
2		1.5	REFUSAL		
3					
4					
5					
6					
7					
8					
9					
10					

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TEST PIT LOG

PROJECT: CHAMPION INTERNATIONAL – LANDFILL 6A–WEST				LOCATION: CANTON, NC		TEST PIT NO.: TP–3	
						JOB NO.: 96010	LOGGED BY: CJB
CONTRACTOR: PLEMMONS CONT.	EXCAVATION METHOD: JD 490D EXCAV.	SURFACE SIZE (FT):	COMPLETION DEPTH (FT): 4.0 FEET	DATE: 3/13/96	GROUND EL. (FT): +/– 2742.0	GROUNDWATER DEPTH (FT): NONE	

DEPTH (FT)	SAMPLE NO.	GRAPHIC LOG	MATERIAL DESCRIPTION AND CLASSIFICATION	WATER DATA	REMARKS, LAB TEST RESULTS, PHOTOGRAPHS
1			BROWN SANDY SILT OR SILTY SAND		
2		1.0			
3			WEATHERED ROCK		
4					
5		4.0	REFUSAL		
6					
7					
8					
9					
10					

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TEST PIT LOG

PROJECT: CHAMPION INTERNATIONAL – LANDFILL 6A–WEST				LOCATION: CANTON, NC		TEST PIT NO.: TP–4	
						JOB NO.: 96010	LOGGED BY: CJB
CONTRACTOR: PLEMMONS CONT.	EXCAVATION METHOD: JD 490D EXCAV.	SURFACE SIZE (FT):	COMPLETION DEPTH (FT): 0.5 FEET	DATE: 3/13/96	GROUND EL. (FT): +/– 2731.0	GROUNDWATER DEPTH (FT): NONE	

DEPTH (FT)	SAMPLE NO.	GRAPHIC LOG	MATERIAL DESCRIPTION AND CLASSIFICATION	WATER DATA	REMARKS, LAB TEST RESULTS, PHOTOGRAPHS
0		0.5	REFUSAL BROWN SILTY SAND OR SANDY SILT		
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

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TEST PIT LOG

PROJECT: CHAMPION INTERNATIONAL – LANDFILL 6A–WEST				LOCATION: CANTON, NC		JOB NO.: 96010	LOGGED BY: CJB
CONTRACTOR: PLEMMONS CONT.	EXCAVATION METHOD: JD 490D EXCAV.	SURFACE SIZE (FT):	COMPLETION DEPTH (FT): 6.0 FEET	DATE: 3/13/96	GROUND EL. (FT): +/– 2708.0	GROUNDWATER DEPTH (FT): NONE	

TEST PIT NO.: TP–5

DEPTH (FT)	SAMPLE NO.	GRAPHIC LOG	MATERIAL DESCRIPTION AND CLASSIFICATION	WATER DATA	REMARKS, LAB TEST RESULTS, PHOTOGRAPHS
1–5			WEATHERED ROCK WHITE CEMENTED SAND (SANDSTONE?) AND BLACK CEMENTED SILT W/MICA LAYERED		
6		6.0	REFUSAL		
7–10					

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TEST PIT LOG

PROJECT: CHAMPION INTERNATIONAL – LANDFILL 6A–WEST				LOCATION: CANTON, NC		TEST PIT NO.: TP–6	
						JOB NO.: 96010	LOGGED BY: CJB
CONTRACTOR: PLEMMONS CONT.	EXCAVATION METHOD: JD 490D EXCAV.	SURFACE SIZE (FT):	COMPLETION DEPTH (FT): 8.0 FEET	DATE: 3/13/96	GROUND EL. (FT): +/– 2698.0	GROUNDWATER DEPTH (FT): NONE	

DEPTH (FT)	SAMPLE NO.	GRAPHIC LOG	MATERIAL DESCRIPTION AND CLASSIFICATION	WATER DATA	REMARKS, LAB TEST RESULTS, PHOTOGRAPHS
1 2 3 4 5 6 7 8 9 10			WEATHERED ROCK WHITE CEMENTED SAND AND BLACK CEMENTED SILT W/MICA LAYERED		REFUSAL AT 3.0 FT IN BACK OF PIT, NO REFUSAL IN FRONT OF PIT
		8.0			

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TEST PIT LOG

PROJECT: CHAMPION INTERNATIONAL – LANDFILL 6A–WEST				LOCATION: CANTON, NC		TEST PIT NO.: TP–7	
						JOB NO.: 96010	LOGGED BY: CJB
CONTRACTOR: PLEMMONS CONT.	EXCAVATION METHOD: JD 490D EXCAV.	SURFACE SIZE (FT):	COMPLETION DEPTH (FT): 6.0 FEET	DATE: 3/13/96	GROUND EL. (FT): +/– 2690.0	GROUNDWATER DEPTH (FT): NONE	

DEPTH (FT)	SAMPLE NO.	GRAPHIC LOG	MATERIAL DESCRIPTION AND CLASSIFICATION	WATER DATA	REMARKS, LAB TEST RESULTS, PHOTOGRAPHS
1–5			WEATHERED ROCK WHITE CEMENTED SAND AND BLACK CEMENTED SILT W/MICA LAYERED, HARD		
6		6.0			
7–10					

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TEST PIT LOG

PROJECT: CHAMPION INTERNATIONAL – LANDFILL 6A–WEST				LOCATION: CANTON, NC		TEST PIT NO.: TP–8	
						JOB NO.: 96010	LOGGED BY: CJB
CONTRACTOR: PLEMMONS CONT.	EXCAVATION METHOD: JD 490D EXCAV.	SURFACE SIZE (FT):	COMPLETION DEPTH (FT): 8.0 FEET	DATE: 3/13/96	GROUND EL. (FT): +/– 2696.0	GROUNDWATER DEPTH (FT): NONE	

DEPTH (FT)	SAMPLE NO.	GRAPHIC LOG	MATERIAL DESCRIPTION AND CLASSIFICATION	WATER DATA	REMARKS, LAB TEST RESULTS, PHOTOGRAPHS
1–4			BROWN SILTY SAND OR SANDY SILT		
4.0			WEATHERED ROCK WHITE CEMENTED SAND AND BLACK CEMENTED SILT W/MICA LAYERED, HARD W/CLAY LENSES		
7.0			GETTING HARDER		
8.0			REFUSAL		

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TEST PIT LOG

PROJECT: CHAMPION INTERNATIONAL – LANDFILL 6A–WEST				LOCATION: CANTON, NC		TEST PIT NO.: TP–9	
						JOB NO.: 96010	LOGGED BY: CJB
CONTRACTOR: PLEMMONS CONT.	EXCAVATION METHOD: JD 490D EXCAV.	SURFACE SIZE (FT):	COMPLETION DEPTH (FT): 6.5 FEET	DATE: 3/13/96	GROUND EL. (FT): +/– 2707.0		GROUNDWATER DEPTH (FT): NONE

DEPTH (FT)	SAMPLE NO.	GRAPHIC LOG	MATERIAL DESCRIPTION AND CLASSIFICATION	WATER DATA	REMARKS, LAB TEST RESULTS, PHOTOGRAPHS
1			BROWN SILTY SAND OR SANDY SILT		
2					
3					
4					
5					
6		6.0	WEATHERED ROCK (HARD)		
7		6.5	REFUSAL		
8					
9					
10					

8/26/96

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TEST PIT LOG

PROJECT: CHAMPION INTERNATIONAL – LANDFILL 6A–WEST				LOCATION: CANTON, NC		TEST PIT NO.: TP–10	
						JOB NO.: 96010	LOGGED BY: CJB
CONTRACTOR: PLEMMONS CONT.	EXCAVATION METHOD: JD 490D EXCAV.	SURFACE SIZE (FT):	COMPLETION DEPTH (FT): 1.5 FEET	DATE: 3/13/96	GROUND EL. (FT): +/– 2715.0	GROUNDWATER DEPTH (FT): NONE	

DEPTH (FT)	SAMPLE NO.	GRAPHIC LOG	MATERIAL DESCRIPTION AND CLASSIFICATION	WATER DATA	REMARKS, LAB TEST RESULTS, PHOTOGRAPHS
1		1.5	BROWN SILTY SAND OR SANDY SILT		
2			REFUSAL		
3					
4					
5					
6					
7					
8					
9					
10					

8/26/96

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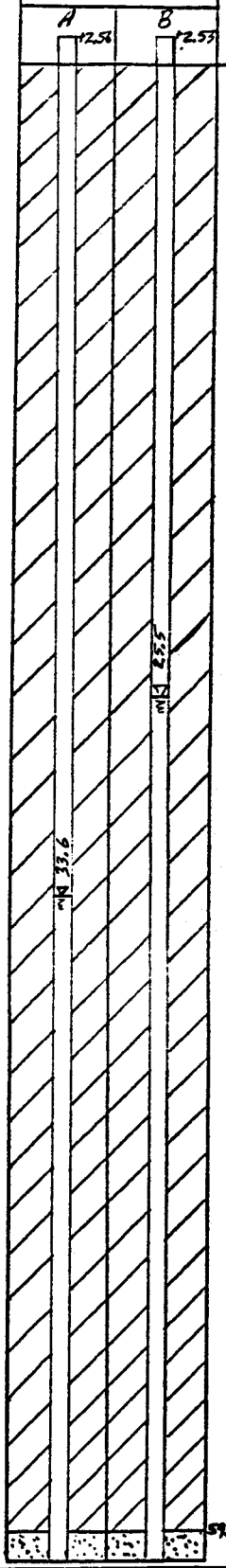
CHAMPION, NC ; LANDFILL - S. AREA A-WEST | JOB NO. 1805 | BORING NO. B-17-01

DATE COMPLETED 5 JUN 97	DATE WELLS INSTALLED 11 JUN 97	DRILLING METHOD DRIVE + WASH
GROUND SURFACE ELEVATION (FT) 2679.55	DRILLING CONTRACTOR GEOTEK	LOGGED BY KNUUTI
BOREHOLE DIAMETER (IN) 4" (HX)	ROCK CORE DIAMETER (IN.) 2.25" (HX)	SHEET 1 OF 2

DEPTH (FT)	SAMPLE NO.	MATERIAL DESCRIPTION	RQD (%)	K (cm/sec)
0		BROWN SILTY SAND		
8.1		TOP OF ROCK - 8.1'		
10		BEDROCK (SEE BEDROCK CORE LOGS)		
18.7	R-1		4	
26.2	R-2		26	
29.9	R-3		36	
38.1	R-4		96	
45.7	R-5		18	
50.0	R-6		98	1.6×10^{-5} cm/sec
58.7	R-7		99	

INSTRUMENT LOG



NOTES

STICK-UP ON A- 2.56 ft

B- 2.53 ft

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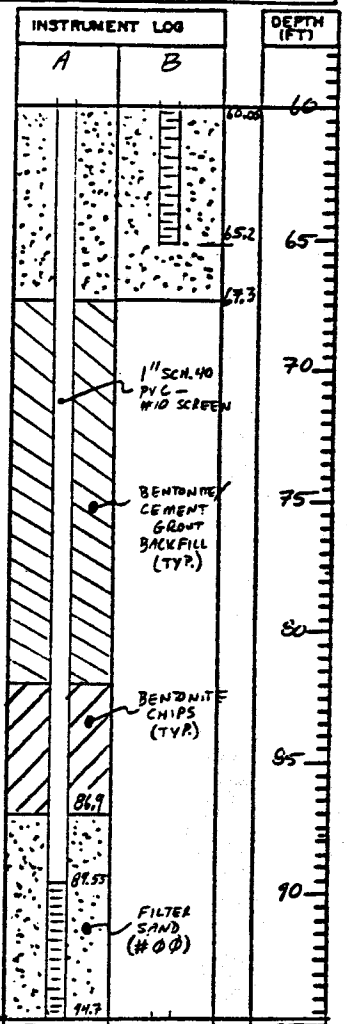
PROJECT CHARLOTTE N.C. LANDFILL EL AREA A-WEST	JOB NO. 96C10	BORING NO. 97-01	
DATE COMPLETED 5 JUN 97	DATE WELLS INSTALLED 11 JUN 97	DRILLING METHOD DRIVE + WASH	
GROUND SURFACE ELEVATION (FT) 2679.55	DRILLING CONTRACTOR GEOTEK	LOGGED BY KNUUTI	
BOREHOLE DIAMETER (IN) 4" (4x)	ROCK CORE DIAMETER (IN.) 2.25" (N.x)	SHEET 2 OF 2	

DEPTH (FT)	SAMPLE NO.	MATERIAL DESCRIPTION	RQD (%)	K (cm/sec)
60				
65				
68.5	R-8		71	3.3x10-5 cm/sec
70				
75				
77.7	R-9		98	1.8x10-5 cm/sec
80				
85				
87.7	R-10		92	1.8x10-5 cm/sec
90				
94.7	R-11	BOTTOM OF EXPLORATION AT 94.7'	100	
95				
100				
105				
110				
115				



NOTES

BEDROCK CORE LOG

PROJECT CHAMPION, N.C. / LANDFILL #6, AREA A-WEST BORING NO. B-97-01 PAGE 1 OF 3

JOB NO. 96010. DRILLER GEOTEK

CORE DIAMETER (IN.) HX - 2.25" ELEVATION (FT) INTERVAL DEPTH (FT) INTERVAL

AZIMUTH INCLINATION LOGGED BY KNUUTI (NAME) 5 JUN 97 (DATE)

BREAKS IN CORE: MEASURED BREAKS OR PARTINGS ACROSS CORE; CHIPS, CAVITY, LOST CORE; MEASURED HIGH-ANGLE JOINT. (JT = JOINT); D CORE BROKEN BY DRILLER; M CORE PARTED ALONG MICA CONCENTRATION

WX: WEATHERED - WEATHERING; SL - SLIGHT; MOD - MODERATE; SEV - SEVERE

DIP: DIP OF LAYERING, TEXTURE, FOLIATION, BEDDING, ETC.

DEPTH	CONDITION OF CORE, WX, ETC.	DIP	RECOVERY (%)	RQD (%)	GRAPHIC LOG	ROCK TYPE, GRAIN SIZE, COLOR, TEXTURE, ETC.
0	BROWN SILTY SAND					
8.1'						
10		50°	3.3/9.2 36%	0.4/9.2 4%	R-1	HIGHLY WEATHERED SCHIST OF GRANITIC ORIGIN. FELDSPAR DEPOSITS CRUMBLE IN HAND.
18.7'						
20	VERY WEATHERED	50°	4.3/7.5 57%	1.96/7.5 26%	R-2	METAMORPHOSED (MEDIUM) GRANITE [SCHIST] CONTAINING QUART, FELDSPAR, BIOTITE, (SOME MUSCOVITE), AND TRACES OF GARNET. . . . 3/4" QUARTZ VEIN [GRANITE SCHIST]
26.2	VERY WEATHERED MD-SV WX FE STAINING SILT SEAMS	50°	3.0/3.7 81%	1.33/3.7 36%	R-3	GRANITE SCHIST, FRACTURED ALONG FOLIATION PLANE MORE HIGHLY METAMORPHOSED THAN R-2 (VERY WEATHERED)
29.9 30	D WX D D D D	≈ 50°	8.2/8.2 100%	7.9/8.2 96%	R-4	COMPETENT GRANITE SCHIST WITH PYRITE THROUGHOUT (FLAKES → VEINS) 32.1-32.4 → FELDSPAR/QUARTZ BAND
35						

5/90

SEVEE & MAHER ENGINEERS

BEDROCK CORE LOG

PROJECT CHAMPION, N.C. - LANDFILL #6, AREA A-WEST BORING NO. B-97-01 PAGE 2 OF 3

JOB. NO. 96010 DRILLER GEOTEK

CORE DIAMETER (IN.) HX - 2.25" ELEVATION (FT) INTERVAL _____ DEPTH (FT) INTERVAL _____

AZIMUTH _____ INCLINATION _____ LOGGED BY KNUUTI (NAME) 5 JUN 97 (DATE)

BREAKS IN CORE: MEASURED BREAKS OR PARTINGS ACROSS CORE; CHIPS, CAVITY, LOST CORE; MEASURED HIGH-ANGLE JOINT (JT = JOINT); D = CORE BROKEN BY DRILLER; M = CORE PARTED ALONG MICA CONCENTRATION

WX: WEATHERED - WEATHERING; SL - SLIGHT; MOD - MODERATE; SEV - SEVERE

DIP: DIP OF LAYERING, TEXTURE, FOLIATION, BEDDING, ETC.

DEPTH	CONDITION OF CORE, WX, ETC.	DIP	RECOVERY (%)	RQD (%)	GRAPHIC LOG	ROCK TYPE, GRAIN SIZE, COLOR, TEXTURE, ETC.
35				35		
	SV WX B				R4	
38.1						
40	ZERO YIELD (?) FRACTURES ARE IRON STAINED AND IRON STAINED	45°	2.8/7.6 37%	40 1.35/7.6 18%		MORE HIGHLY METAMORPHOSED GRANITE SCHIST. PYRITE NOT AS DOMINANT AS IN R-4, BUT STILL PRESENT. SOME MINERAL BANDING EVIDENT, SOME GARNET PRESENT 40
	B 1"-2" PIECES; CHIPS — SV WX, Fe STAINING				R-5	
45				45		45
45.7						
	SL WX D	60°	4.2/4.3 98%	4.2/4.3 98%	R-6	GRAY, COARSE GRAINED SCHIST W/ PERIODIC QUARTZ VEINS. FELDSPAR BANDS (SL WX)
50.0 55	V SL WX D			50		55
	V SL WX D V SL WX D D	65°	8.7/8.7 100%	8.6/8.7 99%		GRAY SCHIST WITH STEEP "DIP" AND LONG, THICK (≤1") BANDS OF QUARTZ. ALSO INCLUDES SECTIONS OF OLIVINE
55	D V SL WX			55	R-7	55
58.7	D D D					
60	D D D D D D	90°	9.8/9.8 100%	60 7.0/9.8 71%		SCHISTY GNEISS, BANDING IS VERTICAL AND OBVIOUS (GRAY/BLACK - WHITE), SIGNIFICANT PYRITE THROUGHOUT. FRACTURED ZONE FROM ≈ 63.45 - 66.20 WITH BOTTOM AREA MORE HEAVILY FRACTURED 60
	SL WX M (VERTICAL)					
65	VERTICAL FRACTURES ALONG MICA PLANES, MIXED WITH HORIZONTAL FRACTURES THROUGHOUT			65	R-8	65
	D D					
68.5						
70	BREAK NEAR BLUE-GRN CRYSTAL DEPOSIT H>7.0 D			70		70

BEDROCK CORE LOG

PROJECT CHAMPION, N.C. / LANDFILL #6, AREA A-WEST BORING NO. B-97-01 PAGE 3 OF 3

JOB. NO. 96010 DRILLER GEOTEK

CORE DIAMETER (IN.) HX - 2.25" ELEVATION (FT) INTERVAL DEPTH (FT) INTERVAL

AZIMUTH INCLINATION LOGGED BY KNUUTI (NAME) 5 JUN 97 (DATE)

MEASURED BREAKS OR PARTINGS ACROSS CORE	D CORE BROKEN BY DRILLER
CHIPS, CAVITY, LOST CORE	
MEASURED HIGH-ANGLE JOINT (JT = JOINT)	M CORE PARTED ALONG MICA CONCENTRATION

WX: WEATHERED - WEATHERING
SL - SLIGHT
MOD - MODERATE
SEV - SEVERE

DIP: DIP OF LAYERING, TEXTURE, FOLIATION, BEDDING, ETC.

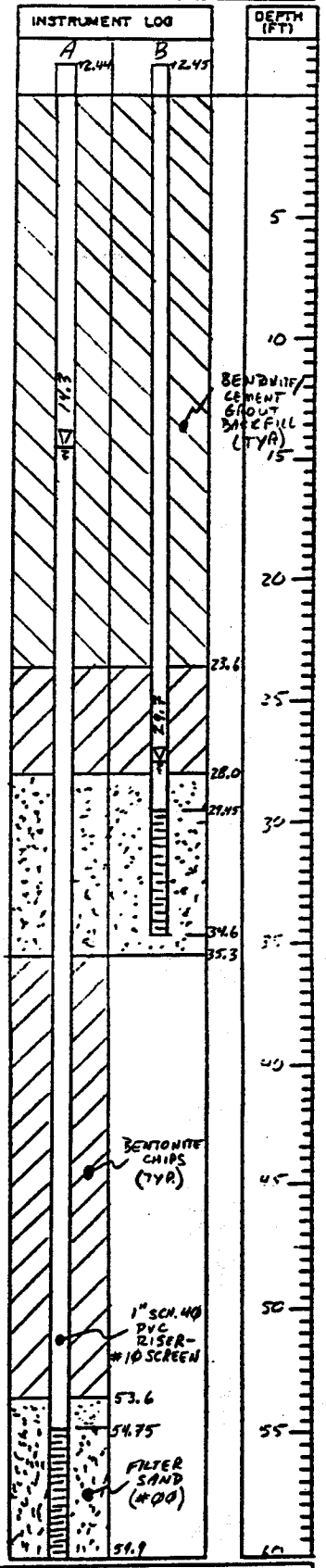
DEPTH	BREAKS IN CORE / CONDITION OF CORE, WX, ETC.	DIP	RECOVERY (%)	RQD (%)	GRAPHIC LOG	ROCK TYPE, GRAIN SIZE, COLOR, TEXTURE, ETC.
70	DRILLER BREAKS NEAR QUARTZ ZONES	60°	9.2 / 9.2 = 100%	9.0 / 9.2 = 98%	R-9	GNEISS w/ 60° DIP OF MINERAL PLANES INTERSPERSED WITH AREAS OF LIGHT COLORED BLUE-GREEN CRYSTAL DEPOSITS (QUARTZ?)
75	V. SL. WX D (V. SL. WX) BREAK/FRACTURE AT MICA CONCENTRATION					
77.7	V. SL. WX. D V. SL. WX. D D D D D D D D V SL WX J SL WX	60°	9.2 / 10.0 = 92%	9.2 / 10.0 = 92%	R-10	GNEISS - BANDING IS PRIMARILY BIOTITE AND QUARTZ/FELDSPAR w/ QUARTZ BEING DOMINANT. BANDING IS OBVIOUS. PYRITE THROUGHOUT
87.7	M, N-SL WX D D D D	55°	7.0 / 7.0 = 100%	7.0 / 7.0 = 100%	R-11	SCHIST / GNEISS WITH TRACES OF OLIVINE AND GARNET. PYRITE THROUGHOUT. CONTAINS TWO LARGE CRYSTAL (QUARTZ) BANDS FROM 90.0 - 90.4 AND 90.8 - 91.0
94.7	BOTTOM OF EXPLORATION AT 94.7'					
100						
105						

PROJECT [illegible] NC LANDFILL #6, [illegible] PROJECT	JOB NO. 76010	BORING NO. P-97-02	
DATE COMPLETED 12 JUN 97	DATE WELLS INSTALLED 16 JUN97	DRILLING METHOD DRIVE AND WASH	
GROUND SURFACE ELEVATION (FT) 2677.30	DRILLING CONTRACTOR GEOTEK	LOGGED BY KNUUTI	
BOREHOLE DIAMETER (IN) 4" (nx)	ROCK CORE DIAMETER (IN.) 2.25 (HX)	SHEET 1 OF 1	

DEPTH (FT)	SAMPLE NO.	MATERIAL DESCRIPTION	RQD	K (cm/sec)
0		OVERBURDEN		
0.3		VERY SOFT, EXTREMELY WEATHERED ROCK (ROLLER CONE - NO CORE)		
9.7				
10		BEDROCK (SEE BEDROCK CORE LOGS)		
15				
18.5	R1		34	
20				
25				
27.5	R2		100	
30				
35	R3		99	
37.5				
40				
45	R4		100	
47.5				
50				
55	R5		100	
57.4				
57.9	R6	BOTTOM OF EXPLORATION AT 57.9'	96	

1.1 x 10-5 cm/sec

6.4 x 10-5 cm/sec



NOTES

STICK-UP ON A- 2.44 ft

B- 2.45 ft

SEVEE & MAHER ENGINEERS

BEDROCK CORE LOG

PROJECT CHAMPION N.C. - LANDFILL #6, AREA A-WEST

BORING NO. B-97-02 PAGE 1 OF 2

JOB NO. 96010. DRILLER GEOTEK

CORE DIAMETER (IN.) HX -2.25" ELEVATION (FT) INTERVAL _____ DEPTH (FT) INTERVAL _____

AZIMUTH _____ INCLINATION _____ LOGGED BY KNUUTI (NAME) 12 JUN 97 (DATE)

BREAKS IN CORE: MEASURED BREAKS OR PARTINGS ACROSS CORE; CHIPS, CAVITY, LOST CORE; MEASURED HIGH-ANGLE JOINT. (JT = JOINT); D = CORE BROKEN BY DRILLER; M = CORE PARTED ALONG MICA CONCENTRATION

WX: WEATHERED - WEATHERING; SL - SLIGHT; MOD - MODERATE; SEV - SEVERE

DIP: DIP OF LAYERING, TEXTURE, FOLIATION, BEDDING, ETC.

DEPTH	BREAKS IN CORE / CONDITION OF CORE, WX, ETC.	DIP	RECOVERY (%)	RQD (%)	GRAPHIC LOG	ROCK TYPE, GRAIN SIZE, COLOR, TEXTURE, ETC.
0	OVERBURDEN					
0.3	VERY SOFT, EXTREMELY WEATHERED ROCK (ROLLER CONE - NO CORE)					VERY SOFT, HIGHLY WEATHERED ROCK
5				5		5
9.7						
10	NO CORE RECOVERED	60°	3.0 / 8.8 = 34%	2.2 / 8.8 = 25%	R-1	WEATHERED ROCK, EXTREMELY SOFT AND STAINED (CAN BE CRUMBLED IN HANDS). COMPETENT ROCK IS SIMILAR TO THAT AT GREATER DEPTH IN B-97-01 (GRAY SCHIST WITH A MIXTURE OF QUART AND BIOTITE AND SOME GARNET)
10				10		10
15	CHIPS SV WX SV WX D D			15		15
18.5						
20	D	60°-65°	9.0 / 9.0 = 100%	8.9 / 9.0 = 99%	R-2	GRANITE SCHIST/GNEISS EXHIBITS BANDING OF QUARTZ/BIOTITE. V. LITTLE FELDSPAR (INTERMIXED W/QUARTZ). SOME GARNET PRESENT.
20				20		20
25	SV WX {FRACTURE YIELDED A 0.1' DISK W/ SV WX, Fe STAINING, FRACTURE HORIZONTAL, NOT ALONG DIP. FRACTURE IS MUD CAKED, MAY PASS A LOT OF WATER} D			25		25
27.5						
30	NO FRACTURES OR WEATHERING, ALL BREAKS WERE W/A HAMMER TO FIT CORE INTO BOX	60°-90°	9.9 / 10.0 = 99%	9.9 / 10.0 = 99%	R-3	SAME AS R2
30				30		30
35						

BEDROCK CORE LOG

PROJECT CHAMPION, N.C. / LANDFILL #6, AREA A-WEST BORING NO. B-97-02 PAGE 2 OF 2

JOB. NO. 9610 DRILLER GEOTEK

CORE DIAMETER (IN.) HX - 2.25" ELEVATION (FT) INTERVAL DEPTH (FT) INTERVAL

AZIMUTH INCLINATION LOGGED BY KNUUTI (NAME) 12 JUN 97 (DATE)

MEASURED BREAKS OR PARTINGS ACROSS CORE
CHIPS, CAVITY, LOST CORE
MEASURED HIGH-ANGLE JOINT (JT = JOINT)
D CORE BROKEN BY DRILLER
M CORE PARTED ALONG MICA CONCENTRATION

WX: WEATHERED-WEATHERING
SL - SLIGHT
MOD - MODERATE
SEV - SEVERE

DIP: DIP OF LAYERING, TEXTURE, FOLIATION, BEDDING, ETC.

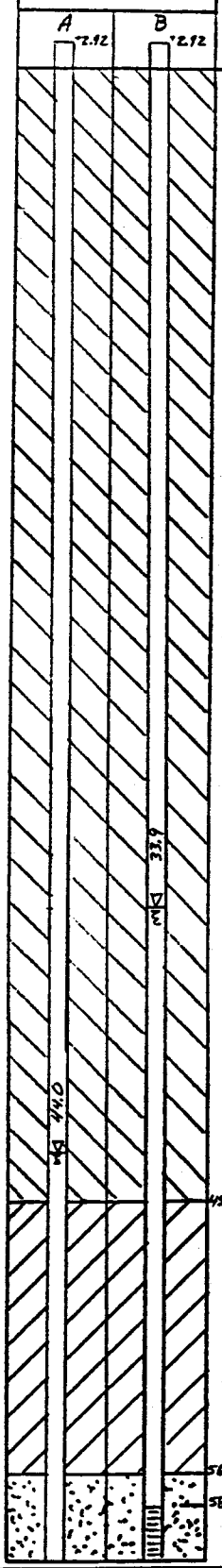
DEPTH	BREAKS IN CORE	CONDITION OF CORE, WX, ETC.	DIP	RECOVERY (%)	RQD (%)	GRAPHIC LOG	ROCK TYPE, GRAIN SIZE, COLOR, TEXTURE, ETC.
35		NO FRACTURES OR WEATHERING				R-3	
37.5							SEE R-2
40		NO FRACTURES OR WEATHERING SEE R-3	75°-90°	10.0/10.0 100%	10.0/10.0 100%	R-4	MEDIUM GRADE METAMORPHOSED GRANITE, APPROACHING GNEISS. QUARTZ AND BIOTITE BANDING, PERIODIC THICK (0.5") BANDS OF QUARTZ/FELDSPAR
45							
47.5	D m, N. WX N. WX D m SL WX m N. WX m SL WX D D A D		70°-90°	9.9/9.9 100%	9.9/9.9 100%	R-5	MODERATE TO LIGHT BANDING, (MORE AT TOP THAN AT BOTTOM) INDICATING A SCHIST/GNEISS. SIMILAR TO R-2/R-4. BIOTITE MORE DOMINANT IN LOWER PORTION OF CORE
55							
57.4	B D		/	2.4/2.5 96%	2.4/2.5 96%	R-6	SEE R-5 (LOWER PORTION)
59.9 EOB		BOTTOM OF EXPLORATION AT 59.9'					
65							
70							

5/90

SEVEE & MAHER ENGINEERS

PROJECT [illegible]	JOB NO. 96010	BORING NO. P-97-03	
DATE COMPLETED 19 JUN 97	DATE WELLS INSTALLED 19 JUN 97	DRILLING METHOD DRIVE + WASH	
GROUND SURFACE ELEVATION (FT) 2737.86	DRILLING CONTRACTOR GEOTEK	LOGGED BY KNUUTI	
BOREHOLE DIAMETER (IN) 4" (HX)	ROCK CORE DIAMETER (IN) 2.25 (HX)	SHEET 1 OF 2	

DEPTH (FT)	SAMPLE NO.	MATERIAL DESCRIPTION	RQD	K (cm/sec)
0				
		SILTY, GRAVELLY SAND INTERMIXED W/ ROCK THAT CRUMBLES IN HAND		
5				
8.3				
10		BEDROCK (SEE BEDROCK CORE LOGS)		
15 / 15.8	R1		28	
18.8	R2		100	
20				
25				
28.7	R3		91	
30				
35				
37.0	R4		100	
40				
45				
47.0	R5		98	
50				
55				
56.9	R6		100	3.7 x 10⁻⁵ cm/sec
60				



NOTES

STICK-UP ON A- 2.92 ft

B- 2.92 ft

PROJECT CHAMPION N.C. - LANDFILL EXPANSION	JOB NO. 9EC10	BORING NO. P-97-03	
DATE COMPLETED JUN 97	DATE WELLS INSTALLED 19 JUN 97	DRILLING METHOD DRIVE + WASH	
GROUND SURFACE ELEVATION (FT) 2737.86	DRILLING CONTRACTOR GEOTEK	LOGGED BY KNUUTI	
BOREHOLE DIAMETER (IN) 4" (HX)	ROCK CORE DIAMETER (IN) 2.25" (HX)	SHEET 2 OF 2	

DEPTH (FT)	SAMPLE NO.	MATERIAL DESCRIPTION						INSTRUMENT LOG A	INSTRUMENT LOG B	DEPTH (FT)
60										60
65										65
66.9	R7		98							
70										70
75										75
76.9	R8		100							
80										80
85										85
87.1	R9		100							
90										90
95										95
96.9	R10		100							
99.9	R11		100							
100		BOTTOM OF EXPLORATION AT 99.9								100
105										105
110										110
115										115

3.7 x 10-3 cm/sec

1.1 x 10-5 cm/sec

1.9 x 10-5 cm/sec

5.7 x 10-6 cm/sec

3.35

64.6

1" SCH. 40 PVC RISER W/ #10 SCREEN

BENTONITE CHIPS (TYP.)

92.8

94.75

FILTER SAND (#00)

99.9

BOE

NOTES

BEDROCK CORE LOG

PROJECT CHAMPION, N.C. - LANDFILL #6, AREA A-WEST — BORING NO. B-97-03 — PAGE 1 OF 3

JOB NO. 96010. — DRILLER GEOTEK

CORE DIAMETER (IN.) HX -2.25" — ELEVATION (FT) INTERVAL — DEPTH (FT) INTERVAL

AZIMUTH — INCLINATION — LOGGED BY KNUUTI (NAME) — 19 JUN 97 (DATE)

BREAKS IN CORE: MEASURED BREAKS OR PARTINGS ACROSS CORE; CHIPS, CAVITY, LOST CORE; MEASURED HIGH-ANGLE JOINT (JT = JOINT); D = CORE BROKEN BY DRILLER; M = CORE PARTED ALONG MICA CONCENTRATION

WX: WEATHERED - WEATHERING; SL - SLIGHT; MOD - MODERATE; SEV - SEVERE

DIP: DIP OF LAYERING, TEXTURE, FOLIATION, BEDDING, ETC.

DEPTH	CONDITION OF CORE, WX, ETC.	DIP	RECOVERY (%)	RQD (%)	GRAPHIC LOG	ROCK TYPE, GRAIN SIZE, COLOR, TEXTURE, ETC.
0	SILTY, GRAVELLY, SAND INTERMIXED W/ ROCK THAT CRUMBLES IN HAND					
8.3	QUARTZ "ROCKS"/PIECES WEATHERED + SL ROUNDED; SV WX	80°-90°	5.2/7.5 = 69%	2.1/7.5 = 28%	R-1	UPPER PORTION IS MOSTLY PIECES - QUARTZ ZONE. QUARTZ PIECES APPEAR TO BE SLIGHTLY ROUNDED (MORE LIKE SURFACE PIECES THAN BROKEN ROCK). BEDROCK SURFACE COULD BEGIN ≈ 12.7 ft
15.8	NO FRACTURES SL WX & SL Fe STAINING IN PARTIAL FRACTURES	/	3.0/3.0 = 100%	3.0/3.0 = 100%	R-2	ROCK SIMILAR TO THAT FROM B-97-01/02 W/LESS METAMORPHISM (i.e. GRANITE). MORE FELDSPAR PRESENT THAN B-97-01/02
18.8	MOD WX; SV WX W/Fe STAINING; D	45°	9.15/9.9 = 92%	9.05/9.9 = 91%	R-3	METAMORPHOSED GRANITE COMPOSED OF BIOTITE (≈40%), QUARTZ (≈ 40%), + FELDSPAR (≈ 20%). MINERAL ALIGNMENT/ BANDING PRESENT @ 45° "DIP." FRACTURED AREA HAS SEVERE Fe STAINING W/SOME MUD SEAMS. FRACTURES ARE PRIMARILY THROUGH LARGER QUARTZ AREAS.
28.7	PYRITE SEAM, MD WX; MD WX, NO Fe STAINING	/	8.3/8.3 = 100%	8.3/8.3 = 100%	R-4	GRANITE (QUARTZ-BIOTITE DOMINANT) W/QUARTZ MORE DOMINANT BELOW 32.2'
35						

5/90

SEVEE & MAHER ENGINEERS

BEDROCK CORE LOG

PROJECT CHAMPION, N.C. - LANDFILL #6, AREA A-WEST — BORING NO. B-97-03 — PAGE 2 OF 3

JOB. NO. 96010 — DRILLER GEOTEK

CORE DIAMETER (IN.) HX - 2.25" — ELEVATION (FT) INTERVAL — DEPTH (FT) INTERVAL

AZIMUTH — INCLINATION — LOGGED BY KNUUTI (NAME) — 19 JUN 97 (DATE)

BREAKS IN CORE: MEASURED BREAKS OR PARTINGS ACROSS CORE; CHIPS, CAVITY, LOST CORE; MEASURED HIGH-ANGLE JOINT (JT = JOINT); D = CORE BROKEN BY DRILLER; M = CORE PARTED ALONG MICA CONCENTRATION

WX: WEATHERED-WEATHERING; SL - SLIGHT; MOD - MODERATE; SEV - SEVERE

DIP: DIP OF LAYERING, TEXTURE, FOLIATION, BEDDING, ETC.

DEPTH	CONDITION OF CORE, WX, ETC.	DIP	RECOVERY (%)	RQD (%)	GRAPHIC LOG	ROCK TYPE, GRAIN SIZE, COLOR, TEXTURE, ETC.
35				35		
	SV WX w/SV Fe STAINING MD WX - BREAK @ PYRITE SEAM				R-4	FROM 36.2-37.0 CORE IS VIRTUALLY ALL QUARTZ
37.0						
40	SL WX	45°	10.0/10.0 100%	9.8/10.0 98%		FROM 37.0-41.3 ALMOST ALL QUARTZ. AFTER 41.3 (-47.0) A FINE GRAINED GRANITE W/NO (?) FELDSPAR (MOSTLY QUARTZ + BIOTITE) AND PERIODIC LARGE (1") QUARTZ VEINS CONTAINS SOME PYRITE
	MD WX MD/SV WX SL-MD WX D				R-5	
45				45		
47.0						
50	m + PYRITE w/ SL WX SL WX m + PYRITE } SL WX D D D	/	9.9/9.9 100%	9.9/9.9 100%	R-6	SIMILAR TO R-4 / R-5 47.0-47.7 - FINE GRAINED GRANITE 47.7-49.7 - SCHIST/GNEISS W/HIGH GARNET CONTENT 49.7-50.5 - FINE GRAINED GRANITE 50.5-51.4 - CRYSTALLINE W/HIGH GARNET CONTENT 51.4-53.0 - MIXED FINE + COARSE GRAINED GRANITE 53.0-56.9 - SCHIST/GNEISS W/HIGH GARNET CONTENT
55	MD WX ALONG PYRITE SEAM			55		
56.9						
60	SL WX, Fx ALONG QTZ/PYRITE SEAM m MD WX Q SL WX Q SL WX	/	10.0/10.0 100%	9.8/10.0 98%	R-7	SIMILAR TO R-6 MIXTURE OF FINE AND COARSE GRAINED GRANITE THAT HAS UNDERGONE SOME METAMORPHISM. (SCHIST) QUARTZ AND BIOTITE DOMINATE GARNET AND PYRITE THROUGHOUT
65				65		
66.9	D					
	SL WX D D D				R-8	SAME AS R-7
70				70		

BEDROCK CORE LOG

PROJECT CHAMPION, N.C. • LANDFILL #6, AREA A-WEST BORING NO. B-97-03 PAGE 3 OF 3

JOB. NO. 96010 DRILLER GEOTEK

CORE DIAMETER (IN.) HX - 2.25" ELEVATION (FT) INTERVAL _____ DEPTH (FT) INTERVAL _____

AZIMUTH _____ INCLINATION _____ LOGGED BY KNUUTI (NAME) 19 JUN 97 (DATE)

BREAKS IN CORE

MEASURED BREAKS OR PARTINGS ACROSS CORE
CHIPS, CAVITY, LOST CORE
MEASURED HIGH-ANGLE JOINT (JT = JOINT)
D CORE BROKEN BY DRILLER
M CORE PARTED ALONG MICA CONCENTRATION

WX: WEATHERED-WEATHERING
SL - SLIGHT
MOD - MODERATE
SEV - SEVERE

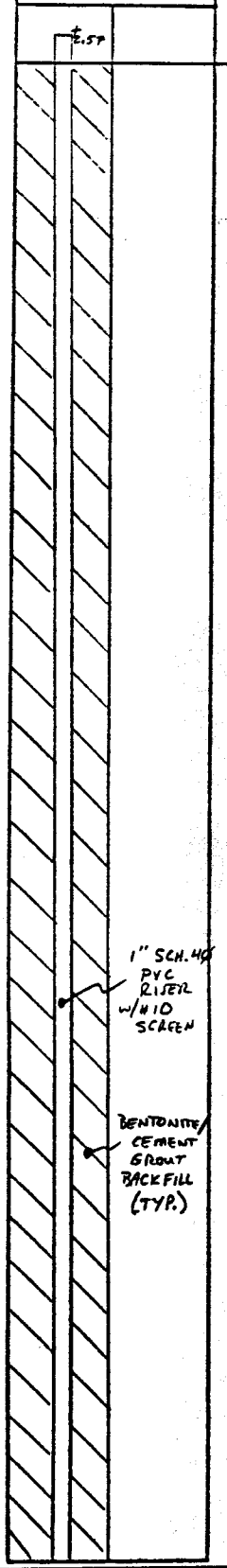
DIP: DIP OF LAYERING, TEXTURE, FOLIATION, BEDDING, ETC.

DEPTH	CONDITION OF CORE, WX, ETC.	DIP	RECOVERY (%)	RQD (%)	GRAPHIC LOG	ROCK TYPE, GRAIN SIZE, COLOR, TEXTURE, ETC.
70	D D D @ PYRITE SEAM D D D	/	10.0/10.0 100%	10.0/10.0 100%	R-8	SAME AS R-7 75.73 - 76.2 - MORE OLIVINE PRESENT (W/QUARTZ)
75	D D D D M (D?) N-SL WX @ OLIVINE CONC. N. WX.			75		75
76.9						
80	D D SL WX V. SL WX V. SL WX	/	10.2/10.2 100%	10.2/10.2 100%	R-9	SCHISTY-GNEISS OF GRANITIC ORIGIN. UNIFORM THROUGHOUT W/PYRITE AND SOME GARNETS.
85				85		85
87.1	D?					
90	V. SL. WX M NO-SL. WX (D?)	/	9.5/9.5 100%	9.5/9.5 100%	R-10	IDENTICAL TO R9 FROM 87.1 - 93.85. 93.85 - 96.6 → FINER GRAINED W/LESS QUARTZ (AS IN R-6/R-7)
95	D			95		95
96.9	NO FRACTURES	/	3.3/3.3 100%	3.3/3.3 100%	R-11	IDENTICAL TO R-9
99.9 100	BOTTOM OF EXPLORATION AT 99.9'			100		100
105				105		105

PROJECT [illegible] LANDFILL #5, [illegible] AUGUST	JOB NO. 96010	BORING NO. P-97-04	
DATE COMPLETED 24 JUN 97	DATE WELLS INSTALLED 30 JUN 97	DRILLING METHOD DRIVE + WASH	
GROUND SURFACE ELEVATION (FT) 2731.46	DRILLING CONTRACTOR GEOTEK	LOGGED BY KNUUTI	
BOREHOLE DIAMETER (IN) 4" (HX)	ROCK CORE DIAMETER (IN.) 2.25 (HX)	SHEET 1 OF 2	

DEPTH (FT)	SAMPLE NO.	MATERIAL DESCRIPTION	RQD
0			
5		OVERBURDEN	
9.2			
10		BEDROCK (SEE BEDROCK CORE LOGS)	
13.8	R1		72
15			
19.3	R2		87
20			
25			
29.3	R3		100
30			
35			
39.3	R4		97
40			
45			
49.0	R5		99
50			
55			
59.0	R6		100
60			

INSTRUMENT LOG



NOTES STICK-UP IS 2.57 FT

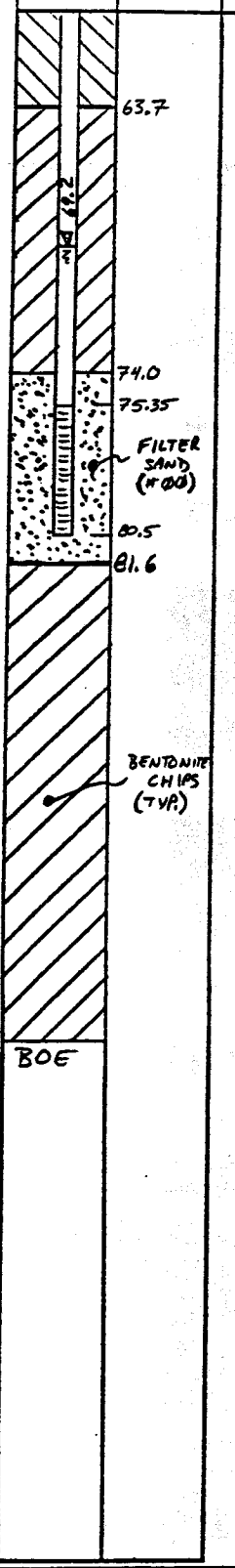
SEVEE & MAHER ENGINEERS

PROJECT Chaffin N.C. - Phase II - FL Area A-West	JOB NO. 96C10	BORING NO. P-97-04	
DATE COMPLETED 24 JUN 97	DATE WELLS INSTALLED 30 JUN '97	DRILLING METHOD DRIVE + WASH	
GROUND SURFACE ELEVATION (FT) 2731.46	DRILLING CONTRACTOR GEOTEK	LOGGED BY KNUDTI	
BOREHOLE DIAMETER (IN) 4" (nr)	ROCK CORE DIAMETER (IN.) 2.25" (nr)	SHEET 2 OF 2	

DEPTH (FT)	SAMPLE NO.	MATERIAL DESCRIPTION	RQD	K (cm/sec)
60				
65				
69.0	R7		100	
70				
75				
79.0	R8		97	
80				
85.0 85	R9		97	
90				
94.5 95	R10		100	
100.0 100	R11		87	
105				
110				
115				

Bottom of Exploration at 100.0

INSTRUMENT LOG



NOTES

SEVEE & MAHER ENGINEERS

BEDROCK CORE LOG

PROJECT CHAMPION, N.C. - LANDFILL #6, AREA A-WEST — BORING NO. B-97-04 PAGE 1 OF 3

JOB NO. 96010. DRILLER GEOTEK

CORE DIAMETER (IN.) HX -2.25" ELEVATION (FT) INTERVAL _____ DEPTH (FT) INTERVAL _____

AZIMUTH _____ INCLINATION _____ LOGGED BY KNUUTI (NAME) 24 JUN 97 (DATE)

BREAKS IN CORE: MEASURED BREAKS OR PARTINGS ACROSS CORE; CHIPS, CAVITY, LOST CORE; MEASURED HIGH-ANGLE JOINT. (JT = JOINT); D = CORE BROKEN BY DRILLER; M = CORE PARTED ALONG MICA CONCENTRATION

WX: WEATHERED - WEATHERING; SL - SLIGHT; MOD - MODERATE; SEV - SEVERE

DIP: DIP OF LAYERING, TEXTURE, FOLIATION, BEDDING, ETC.

DEPTH	BREAKS IN CORE / CONDITION OF CORE, WX, ETC.	DIP	RECOVERY (%)	RQD (%)	GRAPHIC LOG	ROCK TYPE, GRAIN SIZE, COLOR, TEXTURE, ETC.
0						
0.9						
5				5		
9.2						
10	R1 2 CHIPS SV WX; SV WX; SV WX; SV WX; SV WX; SV WX; SV WX; SV WX	N/A	4.1/4.6	33/4.6 = 72%	R1	SEVERELY WEATHERED TO 11.8 FT IS FOLLOWED BY FINE GRAINED GRANITE / QUARTZ, BIOTITE, FELDSPAR; PERIODIC SECTIONS OF QUARTZ (0.2'±)
13.8						
15	R2 SL WX; SV WX (11.7-15.05); SL/MD WX; MD WX	30°-45°	5.1/5.5	4.6/5.5 = 87%	R2	GREY - FINE GRAINED GRANITE, UNIFORM THROUGHOUT
19.3						
20	R3 SL WX; SL WX; MD-SV WX; MD-SV WX	45°-70°	10.0/10.0	100%	R3	SIMILAR TO R2 BUT WITH MORE QUARTZ PRESENT FROM 21.0 - 23.0; 27.4 - 29.3 → MEDIUM GRADE METAMORPHISM INDICATED (GRANITE SCHIST)
25	N-SL WX (D?); SL-MD WX					
29.3						
30	R4 SL WX	70°-90°	10.0/10.0	9.7/10.0	R4	GRANITE SCHIST W/ GARNET AND PYRITE PRESENT; MODERATE BANDING SO APPROACHING HIGH METAMORPHISM (GNEISS)
35						

5/90

SEVEE & MAHER ENGINEERS

BEDROCK CORE LOG

PROJECT CHAMPION, N.C. - LANDFILL #6, AREA A-WEST BORING NO. B-97-04 PAGE 2 OF 3

JOB. NO. 96010 DRILLER GEOTEK

CORE DIAMETER (IN.) HX - 2.25" ELEVATION (FT) INTERVAL DEPTH (FT) INTERVAL

AZIMUTH INCLINATION LOGGED BY KNUUTI (NAME) 24 JUN 97 (DATE)

MEASURED BREAKS OR PARTINGS ACROSS CORE
CHIPS, CAVITY, LOST CORE
MEASURED HIGH-ANGLE JOINT (JT = JOINT)
D CORE BROKEN BY DRILLER
M CORE PARTED ALONG MICA CONCENTRATION

WX: WEATHERED - WEATHERING
SL - SLIGHT
MOD - MODERATE
SEV - SEVERE

DIP: DIP OF LAYERING, TEXTURE, FOLIATION, BEDDING, ETC.

DEPTH	BREAKS IN CORE / CONDITION OF CORE, WX, ETC.	DIP	RECOVERY (%)	RQD (%)	GRAPHIC LOG	ROCK TYPE, GRAIN SIZE, COLOR, TEXTURE, ETC.
35	R4 SL WX; SV WX, SV Fe Staining, chunks	70°-90°	10.0/10.0	9.7/10.0 = 97%		R4 SEE PREVIOUS PAGE
39.3	D					
40	R5 SL-M. WX; SL WX; MD WX; SL WX; SL WX	45°-80°	9.7/9.7	9.6/9.7 = 99%		R5 FINE + MEDIUM GRAINED (GRANITE) SCHISTY - GNEISS W/ GARNET + PYRITE PRESENT (SEE R4)
45	D; SL WX; D					
49.0	SL WX (F)					
50	R6 D; D; D (G); D	30°-60°	10.0/10.0	100%		R6 (SEE R5)
55	D; SL WX; D					
59.0	D					
60	R7 D; SL WX; SL WX; D; D; D; D; D	≈45°	10.0/10.0	100%		R7 (SEE R5)
65						
69.0						
70	MD WX (ALONG JEAM) R8					R8

BEDROCK CORE LOG

PROJECT CHAMPION, N.C. • LANDFILL #6, AREA A-WEST

BORING NO. B-97-04 PAGE 3 OF 3

JOB. NO. 96010 DRILLER GEOTEK

CORE DIAMETER (IN.) HX - 2.25" ELEVATION (FT) INTERVAL _____ DEPTH (FT) INTERVAL _____

AZIMUTH _____ INCLINATION _____ LOGGED BY KNUUTI (NAME) 24 JUN 97 (DATE)

BREAKS IN CORE

MEASURED BREAKS OR PARTINGS ACROSS CORE
CHIPS, CAVITY, LOST CORE
MEASURED HIGH-ANGLE JOINT (JT = JOINT)
D CORE BROKEN BY DRILLER
M CORE PARTED ALONG MICA CONCENTRATION

WX: WEATHERED - WEATHERING
SL - SLIGHT
MOD - MODERATE
SEV - SEVERE

DIP: DIP OF LAYERING, TEXTURE, FOLIATION, BEDDING, ETC.

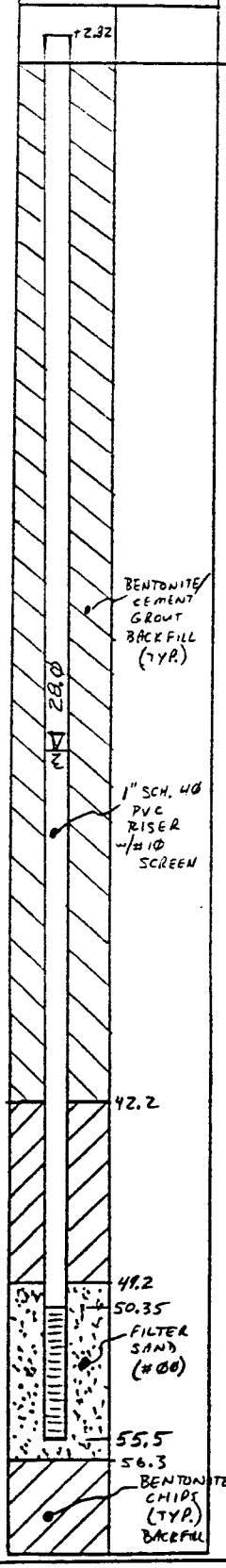
DEPTH	CONDITION OF CORE, WX, ETC.	DIP	RECOVERY (%)	RQD (%)	GRAPHIC LOG	ROCK TYPE, GRAIN SIZE, COLOR, TEXTURE, ETC.
70	R6 MD WX; SL WX; SL-MD WX; SL WX; SL WX	60°-90°	10.0/10.0	9.7/10.0; 97%		R8 MOD - HIGHLY METAMORPHOSED GRANITE W/ SEVERAL OTHER MINERALS (AMPHIBOLE, GARNET, OLIVINE, PYRITE) PRESENT THROUGHOUT A - GRANITE SCHIST
79.0						
80	R9 SL WX; SL WX; SL WX; SL WX (D?)	70°-90°	6.0/6.0	5.8/6.0; 97%		R9 SEE R8
85.0						
90	R10 N.-SL WX (D?); SL WX (m); SL WX (m); SL WX	30°-60°	9.5/9.5	9.5/9.5; 100%		R10 SEE R5
94.5						
95	R11 SL WX; N.-SL WX (D?); SL WX; LEFT IN HOLE	45°-55°	5.0/5.5	4.8/5.5; 87%		R11 SEE R5
100.0	BOTTOM OF EXPLORATION AT 100.0					
105						

SEVEE & MAHER ENGINEERS

PROJECT [illegible] LANDFILL [illegible]	JOB NO. 96010	BORING NO. P-97-05
DATE COMPLETED 26 JUN 97	DATE WELLS INSTALLED 30 JUN 97	DRILLING METHOD DRIVE & WASH
GROUND SURFACE ELEVATION (FT) 2698.24	DRILLING CONTRACTOR GEOTEK	LOGGED BY KNUUTI
BOREHOLE DIAMETER (IN) 4" (HX)	ROCK CORE DIAMETER (IN) 2.25 (HX)	SHEET 1 OF 2

DEPTH (FT)	SAMPLE NO.	MATERIAL DESCRIPTION	RQD
0			
2.0		SPOON SAMPLE	
5			
		OVERBURDEN	
10			
15			
18.2			
20			
23.5	R1		18
25			
29.7	R2		55
30			
35.7	R3		45
39.6	R4		77
40			
45			
49.6	R5		96
50			
55			
57.4	R6		97
60			

INSTRUMENT LOG



DEPTH (FT)

NOTES STICK-UP IS 2.82 FT

PROJECT CHAMPION N.C. - LANDFILL #2 ALLA-WEST	JOB NO. 96010	BORING NO. P-97-05	
DATE COMPLETED 26 JUN 97	DATE WELLS INSTALLED 30 JUN 97	DRILLING METHOD DRIVE + WASH	
GROUND SURFACE ELEVATION (FT) 2698.24'	DRILLING CONTRACTOR GEOTEK	LOGGED BY KNUUTI	
BOREHOLE DIAMETER (IN) 4" (4x)	ROCK CORE DIAMETER (IN.) 2.25" (4x)	SHEET 2 OF 2	

DEPTH (FT)	SAMPLE NO.	MATERIAL DESCRIPTION	RQD	INSTRUMENT LOG
60				
65 / 66.0	R7		97	
70				
75	R8		98	
78.5	R9		100	
80				
85	R10		100	
85.6				
90	R11	BOTTOM OF EXPLORATION AT 90.0	100	BOE
95				
100				
105				
110				
115				

BACKFILLED WITH BENTONITE CHIPS (TYP.)

NOTES

BEDROCK CORE LOG

PROJECT Champion N.C. - Landfill #6, Area A-West BORING NO. B-97-05 PAGE 1 OF 3

JOB NO. 96010. DRILLER Geotek

CORE DIAMETER (IN.) HX - 2.25" ELEVATION (FT) INTERVAL _____ DEPTH (FT) INTERVAL _____

AZIMUTH _____ INCLINATION _____ LOGGED BY Knuuti (NAME) 26 Jun 97 (DATE)

BREAKS IN CORE: MEASURED BREAKS OR PARTINGS ACROSS CORE; CHIPS, CAVITY, LOST CORE; MEASURED HIGH-ANGLE JOINT. (JT = JOINT); D CORE BROKEN BY DRILLER; M CORE PARTED ALONG MICA CONCENTRATION

WX: WEATHERED-WEATHERING
SL - SLIGHT
MOD - MODERATE
SEV - SEVERE

DIP: DIP OF LAYERING, TEXTURE, FOLIATION, BEDDING, ETC.

DEPTH	CONDITION OF CORE, WX, ETC.	DIP	RECOVERY (%)	RQD (%)	GRAPHIC LOG	ROCK TYPE, GRAIN SIZE, COLOR, TEXTURE, ETC.
0						
18.2	R1 SV WX CHUNKS Fe STAINING		5.2/7.1	1.3/7.1 18%	R1	FINE GRAINED (META) METAMORPHOSED GRANITE W/HIGH QUARTZ/FELDSPAR CONTENT EX. WEATHERED & HEAVILY IRON STAINED
25.3	SV WX SV WX					
29.7	SV WX Fe STAINING R2 SV WX CHUNKS GOOD COMPETENT ROCK SV WX CHUNKS Fe STAINING SV WX CHUNKS		4.3/4.4	2.4/4.4 55%	R2	SEE R1
35	SV WX R3 SV WX, CHUNKS W/PIECES MISSING MOD WX SV WX MOD WX SV WX MOD WX SV WX W/Fe Staining	30°	5.0/6.0	2.7/6.0 45%	R3	MIXED FINE + COARSE GRAINED GRANITE THAT HAS EXPERIENCED MEDIUM GRADE METAMORPHISM. PYRITE, OLIVINE, + GARNET PRESENT THROUGHOUT. →

BEDROCK CORE LOG

PROJECT CHAMPION, N.C. - LANDFILL #6, AREA A-WEST — BORING NO. B-97-05 — PAGE 2 OF 3

JOB. NO. 96010 — DRILLER GEOTEK

CORE DIAMETER (IN.) HX - 2.25" — ELEVATION (FT) INTERVAL — DEPTH (FT) INTERVAL

AZIMUTH — INCLINATION — LOGGED BY KNUUTI (NAME) — 26 JUN 97 (DATE)

BREAKS IN CORE: | MEASURED BREAKS OR PARTINGS ACROSS CORE; CHIPS, CAVITY, LOST CORE; MEASURED HIGH-ANGLE JOINT (JT = JOINT); D CORE BROKEN BY DRILLER; M CORE PARTED ALONG MICA CONCENTRATION

WX: WEATHERED - WEATHERING
SL - SLIGHT
MOD - MODERATE
SEV - SEVERE

DIP: DIP OF LAYERING, TEXTURE, FOLIATION, BEDDING, ETC.

DEPTH	CONDITION OF CORE, WX, ETC.	DIP	RECOVERY (%)	RQD (%)	GRAPHIC LOG	ROCK TYPE, GRAIN SIZE, COLOR, TEXTURE, ETC.
35	CHUNKS - SL WX	30°				(CONTINUED FROM P. 1)
35.7	R4 SL WX; SL-MD WX W/ LITTLE Fe STAINING; SV-MD WX	30°-60°	3.9/3.9	3.0/3.9 77%	R4	(SEE R3) GARNETS ARE MORE PREVALENT WHERE METAMORPHISM HAS RESULTED IN PARTIAL MINERAL ALIGNMENT (BANDING) (CHARACTERISTIC OF SCHIST-GNEISS TRANSITION)
39.6						
40	R5 MD-SV WX; SV WX	30°-60°	10.0/10.0	9.6/10.0 96%	R5	SEE R3
45						
49.6						
50	R6 MD WX	30°-60°	7.8/7.8	7.6/7.8 97%	R6	SEE R3
55						
57.4						
60	R7 MD WX; MD WX; SL WX	30°-60°	8.6/8.6	8.3/8.6 97%	R7	SEE R3
65						
66.0	R8 SL WX	30°-60°	9.0/9.0	8.8/9.0 98%	R8	SEE R3
70						

BEDROCK CORE LOG

PROJECT CHAMPION, N.C. - LANDFILL #6, AREA A-WEST — BORING NO. B-97-05 — PAGE 3 OF 3

JOB. NO. 96010 — DRILLER GEOTEK

CORE DIAMETER (IN.) HX - 2.25" — ELEVATION (FT) INTERVAL — DEPTH (FT) INTERVAL

AZIMUTH — INCLINATION — LOGGED BY KNUUTI (NAME) — 26 JUN 97 (DATE)

BREAKS IN CORE: MEASURED BREAKS OR PARTINGS ACROSS CORE; CHIPS, CAVITY, LOST CORE; MEASURED HIGH-ANGLE JOINT (JT = JOINT); D = CORE BROKEN BY DRILLER; M = CORE PARTED ALONG MICA CONCENTRATION

WX: WEATHERED - WEATHERING; SL - SLIGHT; MOD - MODERATE; SEV - SEVERE

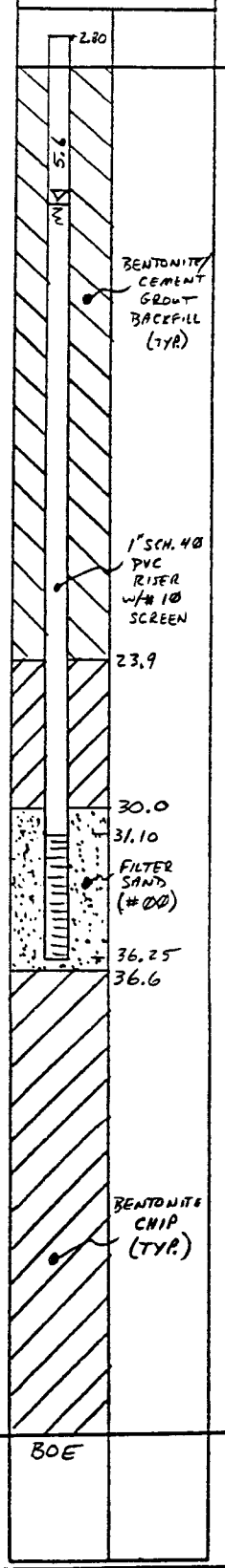
DIP: DIP OF LAYERING, TEXTURE, FOLIATION, BEDDING, ETC.

DEPTH	CONDITION OF CORE, WX, ETC.	DIP	RECOVERY (%)	RQD (%)	GRAPHIC LOG	ROCK TYPE, GRAIN SIZE, COLOR, TEXTURE, ETC.
70	R8 D MD WX; (P) SL WX; BD; DB; D	30°-60°	9.0 / 9.0	8.8 / 9.0 = 98%	R8	SEE R3
75.0	R9 D; D MD WX; MD WX; MD WX	30°-60°	3.5 / 3.5	100%	R9	SEE R3
78.5	R10 D; D; D; D; DB; DB	30°-60°	7.1 / 7.1	100%	R10	SEE R3
85.6	R11 D; D; BB	30°-60°	4.4 / 4.4	100%	R11	SEE R3
90.0	BOTTOM OF EXPLORATION AT 90.0					

PROJECT CHAMPION NC LANDFILL #6, AREA A INFO	JOB NO. 96010	BORING NO. P-97-06	
DATE COMPLETED 27 JUN 97	DATE WELLS INSTALLED 30 JUN 97	DRILLING METHOD DRIVE + WASH	
GROUND SURFACE ELEVATION (FT) 2664.89	DRILLING CONTRACTOR GEOTEK	LOGGED BY KNUUTI	
BOREHOLE DIAMETER (IN) 4" (HX)	ROCK CORE DIAMETER (IN) 2.25 (HX)	SHEET 1 OF 1	

DEPTH (FT)	SAMPLE NO.	MATERIAL DESCRIPTION	RQD
0			
		OVERBURDEN	
5		SEVERELY WEATHERED BEDROCK - NO CORE COLLECTED (ROLLER CONE)	
10			
13.3			
15			
19.4	R1		79
20			
25			
27.7	R2		96
30			
34.3	R3		100
35			
37.0	R4		100
40			
44.3	R5		96
45			
50			
54.3	R6		100
55	R7		100
55.0		BOTTOM OF EXPLORATION AT 55.0	
60			

INSTRUMENT LOG



DEPTH (FT)

NOTES STICK-UP IS 2.80 ft.

SEVEE & MAHER ENGINEERS

BEDROCK CORE LOG

PROJECT CHAMPION, N.C. - LANDFILL #6, AREA A-WEST BORING NO. B-97-06 PAGE 1 OF 2

JOB NO. 96010. DRILLER GEOTEK

CORE DIAMETER (IN.) HX - 2.25" ELEVATION (FT) INTERVAL _____ DEPTH (FT) INTERVAL _____

AZIMUTH _____ INCLINATION _____ LOGGED BY KNUUTI (NAME) 27 JUN 97 (DATE)

MEASURED BREAKS OR PARTINGS ACROSS CORE
CHIPS, CAVITY, LOST CORE
MEASURED HIGH-ANGLE JOINT. (JT = JOINT)
D CORE BROKEN BY DRILLER
M CORE PARTED ALONG MICA CONCENTRATION

WX: WEATHERED - WEATHERING
SL - SLIGHT
MOD - MODERATE
SEV - SEVERE

DIP: DIP OF LAYERING, TEXTURE, FOLIATION, BEDDING, ETC.

DEPTH	BREAKS IN CORE / CONDITION OF CORE, WX, ETC.	DIP	RECOVERY (%)	RQD (%)	GRAPHIC LOG	ROCK TYPE, GRAIN SIZE, COLOR, TEXTURE, ETC.
0						BROWN SILTY-GRAVELLY-SAND (HIGH MICA CONTENT)
2.0	SPOON REFUSAL					
5	N/A ROLLER CONE					EXTREMELY WEATHERED BEDROCK, PARTIALLY ERODED TO BROWN GRAVELLY-SILTY-SAND
10						
12.7	N/A ROLLER CONE					
13.3	SV WX, SV Fe Staining R1					WEATHERED BEDROCK
15	D	45°-	5.9	4.8		R1 INTRUSIVE IGNEOUS ROCK COMPOSED PRIMARILY OF QUARTZ + MICA (BIOTITE) WITH SOME FELDSPAR. LOW TO INTERMEDIATE METAMORPHISM (SCHIST) INTERSPERSED W/PYRITE [GRANITE SCHIST]
	MD WX, SV Fe STAINING	60°	6.1	6.1		
	MD WX, "			79%		
	MD-SV WX					
	D					
19.4	D					
20	D R2					R2 SAME AS R1, BUT WITH MORE DISTINCT ZONES OF FINE + COARSE GRAINED ROCK. MORE DISTINCT MINERAL ALIGNMENT INDICATES INTERMEDIATE METAMORPHISM SOME OLIVINE PRESENT @ 24.75
	D SL WX	25°-		8.0		
	D SL-NO WX (D?)	90°	8.3	8.3		
	B		8.3	96%	MOSTLY QUARTZ (FINE GRAINED) W/SOME OLIVINE	
25	m/Q - N. WX mVQ - SL WX					
	X m/PYRITE - N-SL WX					
27.7	m - N-SL WX D					
	R3	25°-				R3 SCHISTY-GNEISS (GRANITIC ORIGIN) MEDIUM-HIGH METAMORPHISM AS INDICATED BY BIOTITE/QUARTZ-FELDSPAR BANDING.
30	D M N. WX (D?)	70°	6.6	30		
	H		6.6	100%		
	D					
34.3	D					
35						

5/90

SEVEE & MAHER ENGINEERS

BEDROCK CORE LOG

PROJECT CHAMPION, N.C. - LANDFILL #6, AREA A-WEST — BORING NO. B-97-06 — PAGE 2 OF 2

JOB. NO. 96010 — DRILLER GEOTEK

CORE DIAMETER (IN.) HX - 2.25" — ELEVATION (FT) INTERVAL — DEPTH (FT) INTERVAL

AZIMUTH — INCLINATION — LOGGED BY KNUUTI (NAME) — 27 JUN 97 (DATE)

BREAKS IN CORE: MEASURED BREAKS OR PARTINGS ACROSS CORE; CHIPS, CAVITY, LOST CORE; MEASURED HIGH-ANGLE JOINT (JT = JOINT); D CORE BROKEN BY DRILLER; M CORE PARTED ALONG MICA CONCENTRATION

WX: WEATHERED - WEATHERING — SL - SLIGHT, MOD - MODERATE, SEV - SEVERE

DIP: DIP OF LAYERING, TEXTURE, FOLIATION, BEDDING, ETC.

DEPTH	BREAKS IN CORE / CONDITION OF CORE, WX, ETC.	DIP	RECOVERY (%)	RQD (%)	GRAPHIC LOG	ROCK TYPE, GRAIN SIZE, COLOR, TEXTURE, ETC.
35	R4	45°-90°	2.7/2.7	100%	R4	
37.0	SL-N. WX; R5			7.0/7.3	R5	- MOSTLY FINE GRAINED GRANITE W/ SOME MODERATE METAMORPHISM (SCHISTY) - PYRITE THROUGHOUT - OLIVINE PRESENT IN QUARTZ TO A MINOR DEGREE - LOWER 1/6 (43.0 - 44.3) IS SCHIST
40			7.3/7.3	96%		
44.3	R6				R6	44.3 - 48.4 → COARSE GRAINED SCHIST 48.4 - 54.8 → FINE GRAINED SCHISTY GRANITE; SIMILAR TO R3
45				100%		
50			10.4/10.0			
54.3						
55.0	R7		0.3/0.7 =	100%	R7	(SAME AS R6)
	BOTTOM OF EXPLORATION AT 55.0'					
60						
65						
70						

APPENDIX C

ENGINEERING CALCULATIONS

APPENDIX C-1

ANCHOR TRENCH DESIGN
AND
GEOMEMBRANE STRESS CALCULATIONS

CHAMPION INTERNATIONAL CORPORATION
CANTON, NORTH CAROLINA

ANCHOR TRENCH CALCULATION
REF. REQUIREMENTS FOR HAZARDOUS WASTE LANDFILL DESIGN, CONSTRUCTION AND CLOSURE, EPA CERI-88-33
DATE: 7/2/96

DESIGN PARAMETERS

$\beta := 26.6 \cdot deg$ **Maximum Slope Angle**

$\phi := 29 \cdot deg$ **Soil Internal Friction Angle**

$\delta := 26 \cdot deg$ **Minimum Interface Friction Angle**

$L := 3 \cdot ft$ **Anchor Runout Length**

$d_{at} := 2 \cdot ft$ **Anchor Trench Depth**

$d_{cs} := 1 \cdot ft$ **Cover Soil Depth**

$\gamma_{cs} := 100 \cdot \frac{lb}{ft^3}$ **Cover Soil Density**

$DR := 1.5$ **Design Ratio**

CALCULATED PULLOUT CAPACITIES

$q := d_{cs} \cdot \gamma_{cs}$

$K_o = 1 - \sin(\phi)$

$K_a = \frac{1 - \sin(\phi)}{1 + \sin(\phi)}$

$K_p = \frac{1 + \sin(\phi)}{1 - \sin(\phi)}$

$$T_{kp} = \frac{(q \cdot L \cdot \tan(\delta)) - \left(K_p + K_a\right) \cdot \tan(\delta) \cdot \left[\left(.5 \cdot \gamma_{cs} \cdot d_{at}^{\,2}\right) + \left(q \cdot d_{at}\right)\right]}{DR \cdot \cos(\beta) - (\sin(\beta) \cdot \tan(\delta))}$$

Passive Stress

$T_{kp} = 691.4 \cdot \frac{lb}{ft}$

$$T_{ko} = \frac{(q \cdot L \cdot \tan(\delta)) - \left[\left(K_o + K_a\right) \cdot \tan(\delta) \cdot \left[\left(.5 \cdot \gamma_{cs} \cdot d_{at}^{\,2}\right) + \left(q \cdot d_{at}\right)\right]\right]}{DR \cdot \cos(\beta) - (\sin(\beta) \cdot \tan(\delta))}$$

At-rest Stress

$T_{ko} = 280.1 \cdot \frac{lb}{ft}$

Sevee & Maher Engineers, Inc.

CHAMPION INTERNATIONAL CORPORATION
CANTON, NORTH CAROLINA

GEOMEMBRANE STRESS CALCULATION
REF. REQUIREMENTS FOR HAZARDOUS WASTE LANDFILL DESIGN, CONSTRUCTION AND CLOSURE, EPA CERI-88-33
DATE: 7/2/96

DESIGN PARAMETERS

$\beta := 26.6 \cdot deg$	Maximum Slope Angle
$G := 0.941$	Geomembrane Specific Gravity
$\delta := 26 \cdot deg$	Minimum Interface Friction Angle
$D := 80 \cdot ft$	Vertical Height of Landfill
$\gamma_w := 62.4 \cdot \frac{lb}{ft^3}$	Density of Water
$t := 0.060 \cdot in$	Geomembrane Thickness

CALCULATED GEOMEMBRANE TENSILE FORCE, T

$W := (G \cdot \gamma_w \cdot t) \cdot (D \cdot \sin(\beta))$ $\quad W = 10.517 \cdot \frac{lb}{ft}$

$F := W \cdot \cos(\beta) \cdot \tan(\delta)$ $\quad F = 4.586 \cdot \frac{lb}{ft}$

$T := W \cdot \sin(\beta) - F$ $\quad T = 0.123 \cdot \frac{lb}{ft}$

GEOMEMBRANE DESIGN STRESS

Geomembrane - 60-mil, HDPE, Textured

Specification - Min. 132 lbs/in Yield Strength
Min. 13 percent Yield Elongation

Allowable Stress, FS=5,	316.8 lb/ft Yield Strength
FS=2,	6.5 percent Yield Elongation

Sevee & Maher Engineers, Inc.

CHAMPION INTERNATIONAL CORPORATION
CANTON, NORTH CAROLINA

LEACHATE COLLECTION STONE STRESS CALCULATION
REF. REQUIREMENTS FOR HAZARDOUS WASTE LANDFILL DESIGN, CONSTRUCTION AND CLOSURE, EPA CERI-88-33
DATE: 7/2/96

DESIGN PARAMETERS

$\beta := 26.6 \cdot deg$	**Maximum Slope Angle**
$\gamma_s := 110 \cdot \frac{lb}{ft^3}$	**Soil Density**
$\delta := 26 \cdot deg$	**Minimum Interface Friction Angle**
$D := 10 \cdot ft$	**Vertical Height of Stone Layer**
$t_s := 1 \cdot ft$	**Thickness of the Stone Layer**

CALCULATED GEOMEMBRANE TENSILE FORCE, T

$W := (\gamma_s \cdot t_s) \cdot (D \cdot \sin(\beta))$ $\quad W = 492.5 \cdot \frac{lb}{ft}$

$F := W \cdot \cos(\beta) \cdot \tan(\delta)$ $\quad F = 214.8 \cdot \frac{lb}{ft}$

$T := W \cdot \sin(\beta) - F$ $\quad T = 5.7 \cdot \frac{lb}{ft}$

GEOMEMBRANE DESIGN STRESS

Geomembrane - 60-mil, HDPE, Textured

Specification - Min. 132 lbs/in Yield Strength
Min. 13 percent Yield Elongation

Allowable Stress, FS=5,	**316.8 lb/ft Yield Strength**
FS=2,	**6.5 percent Yield Elongation**

Sevee & Maher Engineers, Inc.

A membrane must have sufficient modulus in addition to penetration and tear resistance. This ensures that excessive stretching of the FML will not occur and that local sheet deformations due to settlement will be resisted by a larger sheet area. West German standards require that the membrane support 89.9 pounds (40N) per 1.97 inches (50mm) width at less than 5% deformation, i.e. approximate modulus of 900 lb/in. Additionally, the West German standards require that the ultimate multi-axis strain determined from a burst test should be at least 10% at failure. Currently such multi-axis data is available (EPA,1983) only in the form of Mullen-burst test which is not suitable for membranes. A possible alternative is the large scale hydrostatic test reviewed in Appendix D.

FML ANCHORAGE

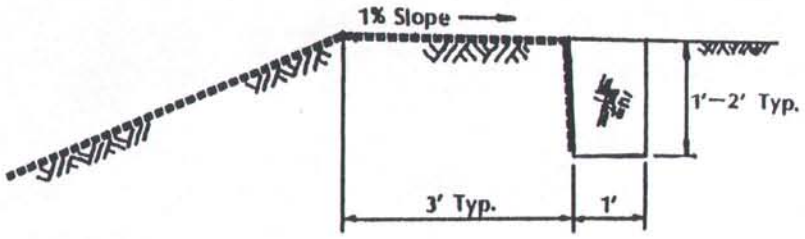
The geotextiles and geomembranes lining the sides of waste facilities must be anchored at the top of these slopes to prevent movement of the systems into the cell. An anchor must provide sufficient restraint to prevent this movement but should not be so rigid or strong that the FML will tear before the anchor yields. The anchor should therefore be designed to provide a reaction force that is greater than that required to stabilize the synthetics and less than the ultimate strength of the attached components. Generally, the FML is anchored at the top of the berm using a (a) friction method, (b) trench and backfill method or (c) anchoring to a concrete structure, Figure 3.9. The trench and backfill technique is most often recommended by manufacturers, probably due to its simplicity and economy. Excavation of the anchor trench is accomplished by a trenching machine or by using a bulldozer blade tilted at an angle.

FML panels should be anchored following the field seaming operation. After the seaming crew has completed the seams for a particular panel, the panel should be anchored by backfilling the trench with soil or by anchoring the FML to the concrete structure. It is important that the panel not be anchored until it has been completely seamed to allow positioning as needed for optimum seaming. Anchoring the FML after seaming avoids stress tears on or along the seam from thermal contraction and expansion.

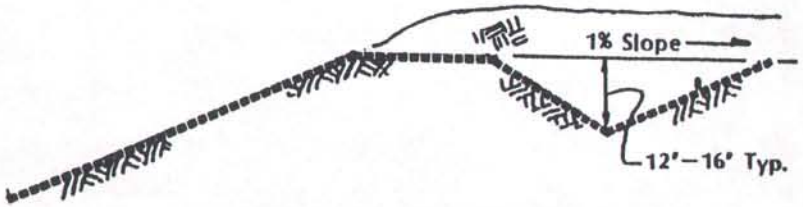
Anchor trench geometries include vertical walled trenchs, shallow "V" trenches, and horizontal embedment. Each trench geometry requires a different set of analysis assumptions. The vertical-walled trench requires the least amount of space but creates construction problems due to the vertical trench faces and greater difficulty in properly recompacting soil within the trench. Horizontal embedment requires the most land surface but makes the fewest analysis assumptions. Based on the accuracy of analysis assumptions, the three geometries can be ranked best to worst as horizontal, shallow "V", and vertical trench.

It should be noted that most anchor trenches are currently constructed to meet general recommendations provided by the FML installer. These recommendations are based on past experience and are purely empirical. No definitive field testing on actual anchorage capacities was found in the preparation of this study. In view of this lack of correlation between design capacities and actual field capacities, the designer is cautioned to compare design geometries with that recommended by the FML installer. When significant differences in proposed geometries exist, a limited field

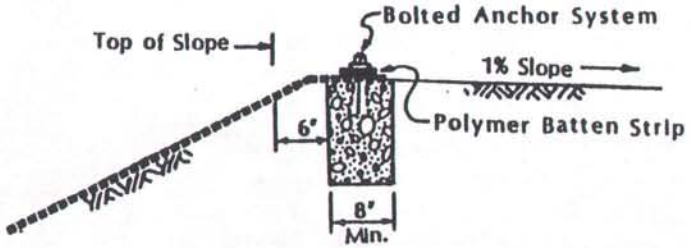
HORIZONTAL ANCHOR



TRENCH ANCHOR



SHALLOW "V" ANCHOR



CAST CONCRETE ANCHOR

Figure 3.9 FML ANCHORAGE DETAILS

pullout test should be performed to establish the actual ultimate force capacity of the anchor trench.

Both the shallow "V" and the horizontal embedment anchors rely exclusively on the frictional bond developed between the sheeting and the adjacent soil. Figure 3.10 shows the forces assumed and variables used in the analysis of these anchors. The pullout capacity, T, of horizontal and "V" anchors are given by

$$T_{horiz} = \frac{q\ L\ \tan\delta}{\cos\beta\ -\ \sin\beta\ \tan\delta} \qquad \text{Eq(3.19)}$$

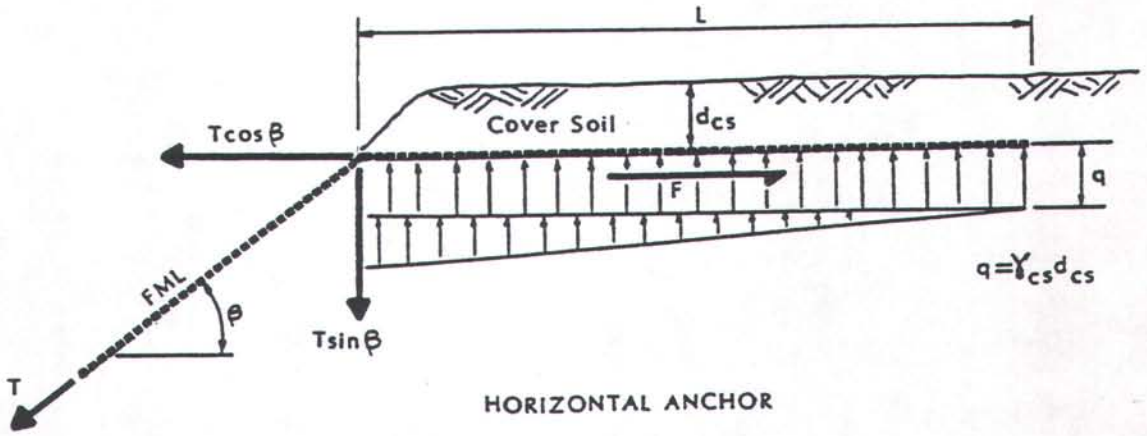
$$T_{"V"} = \frac{[q(L-L_v+L_v/\cos i)\ +\ (d_v L_v\ \gamma_{cs}/2\cos i)]\ \tan\delta}{\cos\beta\ -\ \sin\beta\ \tan\delta} \qquad \text{Eq(3.20)}$$

For deep waste cells, the runout length, L, required to develop sufficient frictional resistance may become excessive. Both frictional anchor concepts do, however, result in a significant simplification of analysis assumptions and a corresponding increase in confidence of the resulting calculated anchor capacity. Direct shear tests should be performed to establish the soil-geosynthetic friction angle, δ , used in these calculations.

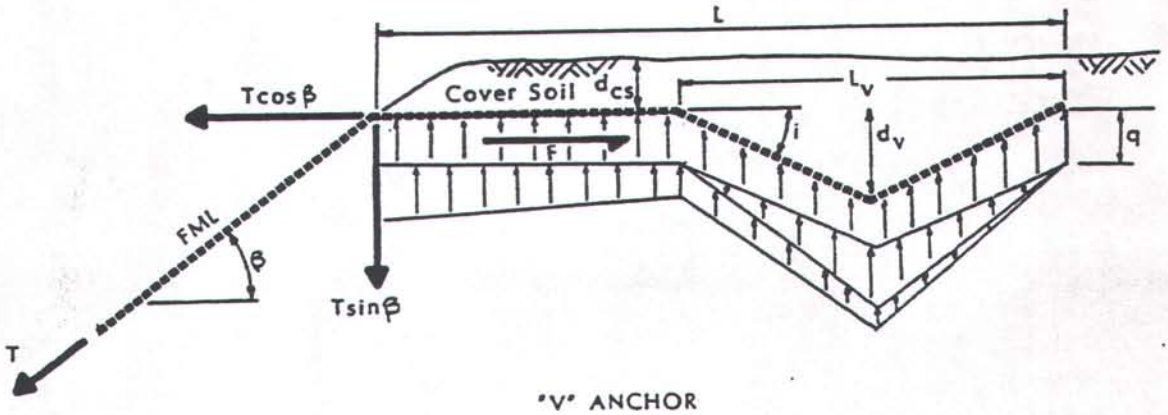
The analysis assumptions used in the vertical wall anchor trench are shown on Figure 3.10 for a trench anchor. The earth pressure assumptions made in the analysis were first proposed by Koerner(1986) and do not attempt to replicate the distribution of the actual field pressures but to estimate the total horizontal force component provided by the soil. The method sums forces in the horizontal plane to predict the anchor capacity. The most glaring assumption needed in this analysis is whether the embedded sheet will be stiff enough to produce a passive resistance force wedge. While appropriate for concrete anchors ,this assumption is poor for FML. The 90 degree entrant angle of the FML sheet into the trench produces a very difficult design condition. The tension forces in the horizontal sheet must be resisted by horizontal earth pressures from the soil adjacent to the sheet. Actual horizontal earth pressures during this process are largest at the surface and decrease to zero at some depth beneath the surface. Vertical force components resulting from the earth pressures at the ground surface and excess sheet tension may require pullout restraint obtained from further embedment of the sheeting below the point at which the horizontal earth pressure is zero. Unfortunately, no available analysis procedure correctly models the anchoring of an FML in a trench. It is reasonable to assume, however, that the earth pressure acting against the FML on the inside of the trench will be bounded by the passive and at-rest earth pressure assumptions. The anchorage capacity of the trench system can therefore be bounded using the following expression

$$T_{trench} = \frac{q\ L\ \tan\delta\ +\ (K'+K_a)\tan\ \ [0.5\ \gamma_{cs} d_{at}^2\ +\ q d_{at}]}{\cos\beta\ -\sin\beta\ \tan\delta} \qquad \text{Eq(3.21)}$$

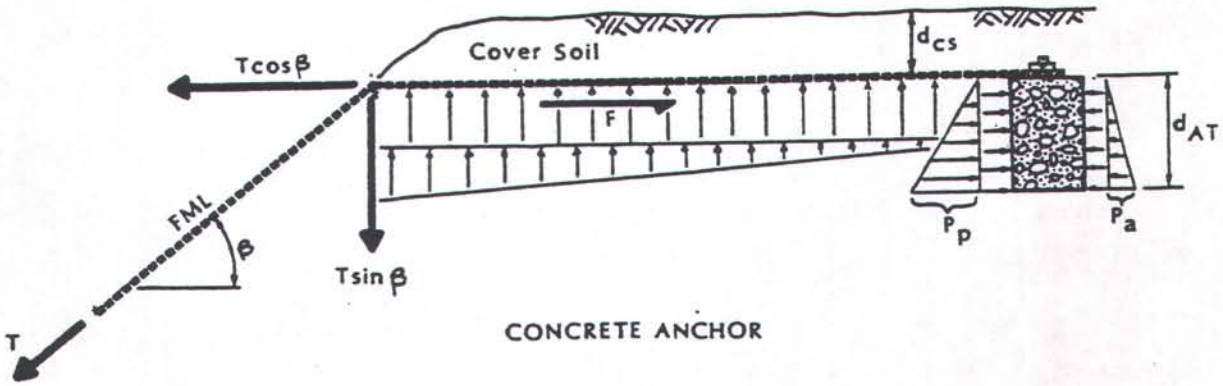
where K' is bounded by K_p and $K_{at\text{-}rest}$. For design it is recommended that



HORIZONTAL ANCHOR



"V" ANCHOR



CONCRETE ANCHOR

Figure 3.10 Forces and Variables - Anchor Analysis

the FML be sized so that it will not fail in tension if the full K_p pressure develops and T_{trench} calculated using $K_{at\text{-}rest}$ should exceed the pullout capacity to prevent failure in other modes.

The Design Ratio for the anchor should be low enough that the anchor will slip and prevent the FML or geotextile from tearing. An overly conservative design of the anchor may indeed lead to a needless tearing failure of the FML. Since the function served by the anchor is short lived, the designer can be justified in using a Design Ratio less than 2.0. An anchor design is shown on Example 3.17 using a vertical trench, horizontal, and a shallow "V" anchor trench.

The FML can also be anchored to concrete structures along the top of the berm by securing the geosynthetic with batten strips attached to anchor bolts embedded in the concrete. This technique is also applicable for bonding the FML to metal structures, such as pipes. A common approach entails placing the anchor bolts on 15 to 30 centimeter centers. The liner is placed over the bolts, an adhesive is generally applied to the FML, and the batten strip is secured and bolted in place. The analysis assumptions used in the vertical wall anchor trench are the same as shown on Figure 3.10 for a trench anchor. The anchor capacity is calculated using Eq(3.20) assuming K' is equal to K_p. Compatibility of the adhesive/sealant with the type of synthetic and liquid impounded must be verified to ensure the seal is maintained. Details of anchoring techniques are discussed by EPA (1984) and Kays (1977).

SURFACE IMPOUNDMENT CONSIDERATIONS

FML Protection

The liner system, including soil and flexible membrane components, plays a significant role in containing the wastes within the SI by preventing the migration and escape of hazardous waste and its constituents. To enhance the longevity of the liner, a protective covering will usually be required over the uppermost component to prevent damage from mechanical or environmental factors. The liner system will often have an FML as the uppermost component, which is sensitive to many of the following conditions (EPA, 1983):

1. Ultraviolet degradation of some polymers;
2. Infrared radiation;
3. Mechanical damage during placement of waste;
4. Wind;
5. Wave action;
6. Oxygen and ozone;
7. Freeze/thaw;
8. Hail/rain;
9. Animals; and
10. Vandalism.

A compacted soil liner is not as susceptible to these forces. However, a soil covering will provide additional protection from weathering effects which may change the properties or cause erosion of the liner. Weather effects include freeze/thaw, wave action or wind.

between the limiting stresses p_a and p_p which are established by the indicated stress-circle construction. These limiting stress values will be referred to as *active* and *passive* stresses, respectively.

Relationships between the vertical stress and the active and passive stress values may be established as follows from the geometry of the stress diagram:

Active stress:

$$\frac{p_v - p_a}{2} = \left(p_a + \frac{p_v - p_a}{2}\right) \sin \phi$$

$$p_v - p_a = (p_a + p_v) \sin \phi$$

$$p_a \sin \phi + p_a = p_v - p_v \sin \phi$$

$$p_a = p_v \frac{1 - \sin \phi}{1 + \sin \phi} \tag{7–14}$$

For uniform soil conditions,

$$p_a = \gamma h \frac{1 - \sin \phi}{1 + \sin \phi} \tag{7–15}$$

By a similar procedure the following expression for the passive stress value may be developed.

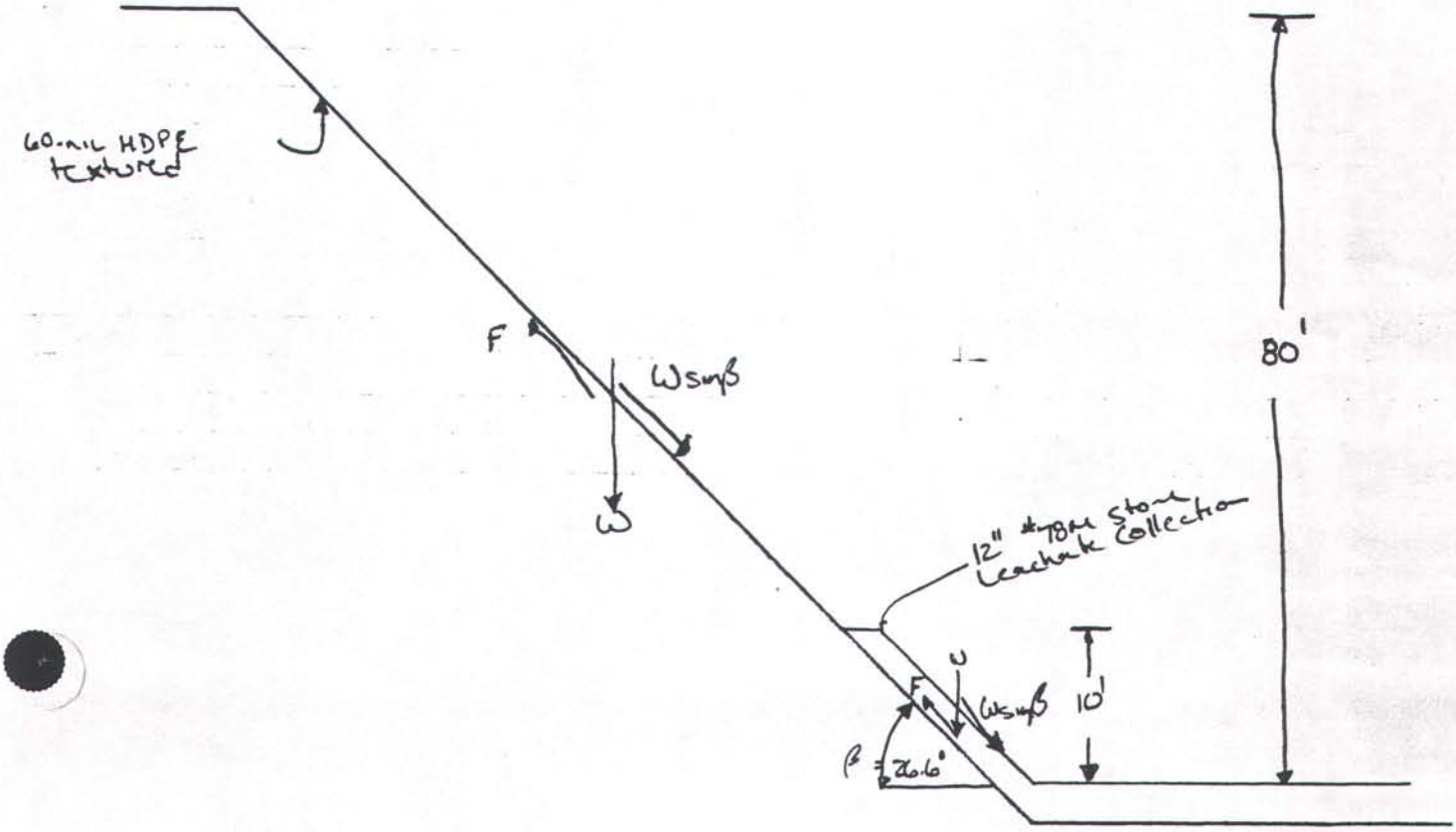
Passive stress:

$$p_p = \gamma h \frac{1 + \sin \phi}{1 - \sin \phi} \tag{7–16}$$

Stress-Strain Relations. Variation of lateral stress between the active and passive values given above can be brought about only through lateral strains or movements within the soil mass. Specifically, if the soil to the left of point a in Fig. 7–18(a) is moved an infinitesimal distance away from the point while the vertical stress remains constant, the lateral pressure at a will gradually decrease to the value p_a. It is evident that for these conditions, p_a is the minor and p_v the major principal stress. If the soil to the left of point a is forced to move in the opposite direction, the lateral stress will gradually increase until the value p_p is reached. For these conditions, p_v is the minor and p_p the major principal stress.

Lateral pressure values which are intermediate between p_a and p_p are entirely possible. In fact, in a natural soil formation it is perhaps more likely that an intermediate rather than a limiting stress condition exists. The lateral pressure under these conditions is termed *pressure at rest.*

Opportunity for Strain Due to Wall Movement. If the soil to the left of the vertical plane in Fig. 7–18(a) could be removed and replaced



Geomembrane Stress

Specification Yield Strength 132 lb/in = 1584 lb/ft

Max Stress from Liner Weight

T = 0.123 lb/ft FS = 00 ✓

Max Stress from LC Stone

T = 5.7 lb/ft FS = 277 ✓

Anchor Trench, At Rest must be > 5.7 + 0.1 = 5.8 lbs

T_{Ko} = 280 lb/ft FS = 48 ✓

Anchor Trench, Passive must be > At Rest < Yield Strength

T_p = 691 lb/ft FS = 2.5 ✓ > 2.3 ✓

APPENDIX C-2

INTERIOR LANDFILL ACCESS ROAD
SLIDING CALCULATION

CHAMPION INTERNATIONAL CORPORATION
CANTON, NORTH CAROLINA

ACCESS ROAD SLIDING CALCULATION
REF. **REQUIREMENTS FOR HAZARDOUS WASTE LANDFILL DESIGN, CONSTRUCTION AND CLOSURE, EPA CERI-88-33**
DATE: 12/5/96

DESIGN PARAMETERS

$W_{pan} := 55 \cdot ton$ — **Weight of the vehicle**

$\delta_{gmsoil} := 26 \cdot deg$ $\quad c_{gmsoil} := 1100 \cdot \frac{lb}{ft^2}$ — **Interface friction angles, cohesion (Textured 60-mil HDPE/Till Soil)**

$\delta_{gmgt} := 31 \cdot deg$ $\quad c_{gmgt} := 200 \cdot \frac{lb}{ft^2}$

$\delta_{gtstone} := 30 \cdot deg$ $\quad c_{gtstone} := 0 \cdot \frac{lb}{ft^2}$

gm - geomembrane
gt - geotextile
soil - subgrade
stone - drainage stone

$Width_{road} := 18 \cdot ft$ $\quad thick_{road} := 3 \cdot ft$ — **Roadway dimensions and slope**

$Length_{road} := 200 \cdot ft$ $\quad \beta := 8.5 \cdot deg$

$\gamma_{sub} := 110 \cdot \frac{lb}{ft^3}$ $\quad \gamma_{road} := 120 \cdot \frac{lb}{ft^3}$ — **Subgrade properties**

$\phi_{sub} := 29 \cdot deg$ $\quad c_{sub} := 700 \cdot \frac{lb}{ft^2}$

DRIVING FORCES

$W_{road} := Length_{road} \cdot Width_{road} \cdot thick_{road} \cdot \gamma_{road}$ $\quad W_{road} = 1.296 \cdot 10^6 \cdot lb$

$W_{vehicle} := W_{pan}$ $\quad W_{vehicle} = 1.1 \cdot 10^5 \cdot lb$

$F_{brake} := .3 \cdot W_{vehicle}$ $\quad F_{brake} = 3.3 \cdot 10^4 \cdot lb$

RESISTING FORCES

$F_{resist} := \left(W_{road} + W_{vehicle}\right) \cdot \cos(\beta) \cdot \tan\left(\delta_{gmsoil}\right)$ $\quad F_{resist} = 6.782 \cdot 10^5 \cdot lb$

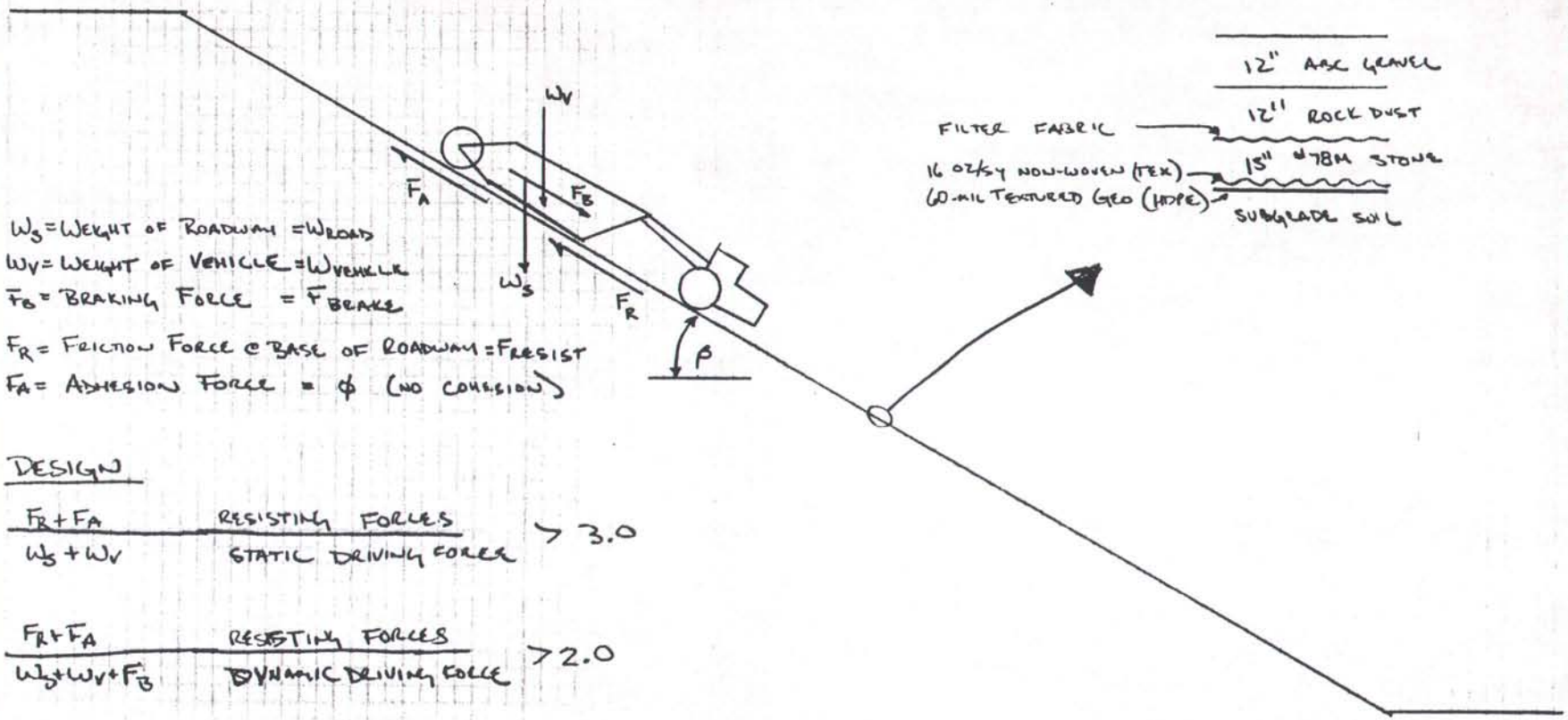
DESIGN RATIOS

$$DR_{static} := \frac{F_{resist}}{\left(W_{road} + W_{vehicle}\right) \cdot \sin(\beta)} \qquad DR_{static} = 3.263$$

$$DR_{dynam} := \frac{F_{resist}}{\left(W_{road} + W_{vehicle}\right) \cdot \sin(\beta) + F_{brake}} \qquad DR_{dynam} = 2.816$$

JOB NO.	DATE
COMP. BY	CHK. BY

PROJECT



W_S = WEIGHT OF ROADWAY = W_{ROAD}

W_V = WEIGHT OF VEHICLE = $W_{VEHICLE}$

$\bar{F}_B$ = BRAKING FORCE = $\bar{F}_{BRAKE}$

F_R = FRICTION FORCE @ BASE OF ROADWAY = F_{RESIST}

F_A = ADHESION FORCE = ϕ (NO COHESION)

DESIGN

$$\frac{F_R + F_A}{W_S + W_V} = \frac{\text{RESISTING FORCES}}{\text{STATIC DRIVING FORCE}} > 3.0$$

$$\frac{F_R + F_A}{W_S + W_V + F_B} = \frac{\text{RESISTING FORCES}}{\text{DYNAMIC DRIVING FORCE}} > 2.0$$

SEVEE & MAHER ENGINEERS

08-6/86

APPENDIX C-3

HEAD ON LINER CALCULATION

CHAMPION INTERNATIONAL CORPORATION
CANTON, NORTH CAROLINA

MAXIMUM HEAD ON LINER CALCULATION
REF. GIROUD, ET AL., 1993
DATE: 7/3/96

DESIGN PARAMETERS

$K := 1 \cdot \frac{cm}{sec}$ — **Leachate Collection Stone Permeability**

$L := 100 \cdot ft$ — **Length from Peak of "Saw-Tooth" to LC Header**

$t := 15 \cdot in$ — **Leachate Collection Stone Thickness**

$e := 0.10167 \cdot \frac{in}{hr}$ — **Impingement Rate, 25-yr/24-hr Storm (6.1 inches) Assume 40 percent will infiltrate as leachate**

$\beta := 0.05$ — **Base Slope of the Landfill**

$$T_{max} = L \cdot \frac{\sqrt{\left(4 \cdot \frac{e}{K}\right) + \tan(\beta)^2} - \tan(\beta)}{2 \cdot \cos(\beta)}$$

$T_{max} = 0.14 \cdot ft$ — **Maximum Head on the Liner, recommended maximum 1 ft.**

APPENDIX C-4

GEOTEXTILE CUSHION CALCULATION

CHAMPION INTERNATIONAL CORPORATION
CANTON, NORTH CAROLINA

GEOTEXTILE CUSHION CALCULATION
REF. DESIGNING WITH GEOSYNTHETIC CUSHIONS, BOSCHUK
CIVIL ENGINEERING NEWS, OCTOBER 1994
DATE: 7/2/96

DESIGN PARAMETERS

$M := 16 \frac{oz}{sy}$ $M := 542.5 \frac{g}{m^2}$ **Geotextile Weight**

$H := 1.0$ in $H := .0254$ m **Stone maximum diameter**

$MF_s := 1.0$ **Modification Factor for Stone Shape**

$MF_{pd} := .2$ **Modification Factor for Stone Packing**

$MF_a := 0.17$ **Modification Factor for Overburden Pressure**

$FS_{cr} := 1.5$ **Modification Factor for Creep Puncture**

$$P_{allow} := (50) \cdot 0.00045 \cdot \frac{M}{H^2} \cdot \left(\frac{1}{MF_s \cdot MF_{pd} \cdot MF_a \cdot FS_{cr}} \right)$$

$P_{allow} = 8.4 \cdot 10^3$ kPa **Allowable Pressure**

$\gamma_{waste} := 80 \frac{lb}{ft^3}$ **Density of Waste, 80 percent**

$\gamma_{soil} := 125 \frac{lb}{ft^3}$ **Density of Gravel, 20 percent**

$d := 120$ ft **Depth of Landfill**

$P_{reqd} := (80 \cdot .75 + 120 \cdot .25) \cdot d$

$P_{reqd} = 1.08 \cdot 10^4 \frac{lb}{ft^2}$ $P_{reqd} := 505.6$ kPa **Required Pressure**

$FS := \frac{P_{allow}}{P_{reqd}}$ $FS = 16.6$ **Factor of Safety, recommended minimum 2.0**

APPENDIX C-5

HDPE PIPE STRENGTH CALCULATION

CHAMPION INTERNATIONAL CORPORATION
CANTON, NORTH CAROLINA

PIPE STRENGTH CALCULATION FOR 6A WEST LC PIPING
REF. SCLAIRPIPE MANUAL
DATE: 1/20/97

DESIGN PARAMETERS

$OD := \frac{12.75}{12}\cdot ft$ $DR := 7.0$ **Pipe Diameter, Thickness to Diamter Ratio**

$P := .375\cdot in$ $OC := 6\cdot in$ $ROWS := 2$ **Pipe Perforations**

$$W_{adj} := \frac{12\cdot in}{\left[(12\cdot in) - \left[P\cdot\left(\frac{12}{OC}\right)\cdot ROWS\right]\cdot in\right]}$$ $W_{adj} = 1.14$ **Pipe Perforation Factor**

$H_{max} := 120\cdot ft$ $\gamma_{waste} := 80\cdot\frac{lb}{ft^3}$ $\gamma_{gravel} := 125\cdot\frac{lb}{ft^3}$ **Waste Height, Densities**

LOAD ON PIPE (psi)

$$W := OD\cdot 1\cdot ft\cdot\frac{H_{max}\cdot\left(\gamma_{waste}\cdot 0.75 + \gamma_{gravel}\cdot 0.25\right)}{144\cdot in^2}$$ $W = 80.8\cdot\frac{lb}{in^2}$

$W_{act} := W\cdot W_{adj}$ $W_{act} = 92.3\cdot\frac{lb}{in^2}$

CRITICAL PRESSURE FOR PIPE

for pipe < 8" for pipe > 8"

$$P_{cr} := if\left(OD < \frac{8}{12}\cdot ft, DR^{-3.00585}\cdot 75231.4\cdot\frac{lb}{in^2}, DR^{-3.06399}\cdot 92144.1\cdot\frac{lb}{in^2}\right)$$

$P_{cr} = 237.2\cdot\frac{lb}{in^2}$

FACTOR OF SAFETY (Recommended minimum 2.3)

$FS := \frac{P_{cr}}{W_{act}}$ $FS = 2.6$

Sevee & Maher Engineers, Inc.

CHAMPION INTERNATIONAL CORPORATION
CANTON, NORTH CAROLINA

PIPE STRENGTH CALC. FOR LC PIPE THROUGH 6A EAST/6AWEST DIKE
REF. SCLAIRPIPE MANUAL
DATE: 1/20/97

DESIGN PARAMETERS

$OD := \frac{12.75}{12}\cdot ft$ $DR := 11.0$ **Pipe Diameter, Thickness to Diameter Ratio**

$H_{max} := 120\cdot ft$ $\gamma_{dike} := 110\cdot\frac{lb}{ft^3}$ **Waste Height, Densities**

LOAD ON PIPE

$C_d := 3.5$

$w := \gamma_{dike}$ $w = 110\cdot\frac{lb}{ft^3}$

$B_d := 3\cdot ft$

$W_c := C_d\cdot w\cdot B_d\cdot OD$ $W_c = 102.266\cdot\frac{lb}{in}$

DEFLECTION CALCULATION

$DI := 1.5$ $K := 0.10$

$E_1 := 300\cdot\frac{lb}{in^2}$ $E := 30000\cdot\frac{lb}{in^2}$

$$\Delta x := \frac{DI\cdot K\cdot W_c}{\left(\frac{2\cdot E}{3\cdot DR^3}\right) + 0.061\cdot E_1}$$ $\Delta x = 0.038\cdot ft$

$$\%def := \left(\frac{\Delta x}{OD}\right)\cdot 100$$ $\%def = 3.61$ Ok , <5%

Sevee & Maher Engineers, Inc.

CHAMPION INTERNATIONAL CORPORATION
CANTON, NORTH CAROLINA

PIPE STRENGTH CALCULATION FOR 6A WEST SD PIPING
REF. SCLAIRPIPE MANUAL
DATE: 1/20/97

DESIGN PARAMETERS

$OD := \frac{12.75}{12} \cdot ft$ $DR := 7.3$ **Pipe Diameter, Thickness to Diamter Ratio**

$P := .375 \cdot in$ $OC := 6 \cdot in$ $ROWS := 2$ **Pipe Perforations**

$H_{max} := 120 \cdot ft$ $\gamma_{waste} := 80 \cdot \frac{lb}{ft^3}$ $\gamma_{gravel} := 125 \cdot \frac{lb}{ft^3}$ **Waste Height, Densities**

LOAD ON PIPE (psi)

$$W := OD \cdot 1 \cdot ft \cdot \frac{H_{max} \cdot \left(\gamma_{waste} \cdot 0.75 + \gamma_{gravel} \cdot 0.25\right)}{144 \cdot in^2} \qquad W = 80.8 \cdot \frac{lb}{in^2}$$

CRITICAL PRESSURE FOR PIPE

for pipe < 8" for pipe > 8"

$$P_{cr} := if\left(OD < \frac{8}{12} \cdot ft, DR^{-3.00585} \cdot 75231.4 \cdot \frac{lb}{in^2}, DR^{-3.06399} \cdot 92144.1 \cdot \frac{lb}{in^2}\right)$$

$P_{cr} = 208.6 \cdot \frac{lb}{in^2}$

FACTOR OF SAFETY (Recommended minimum 2.3)

$FS := \frac{P_{cr}}{W}$ $FS = 2.6$

Sevee & Maher Engineers, Inc.

APPENDIX C-6

CELL I STORMWATER DETENTION CAPACITY CALCULATION

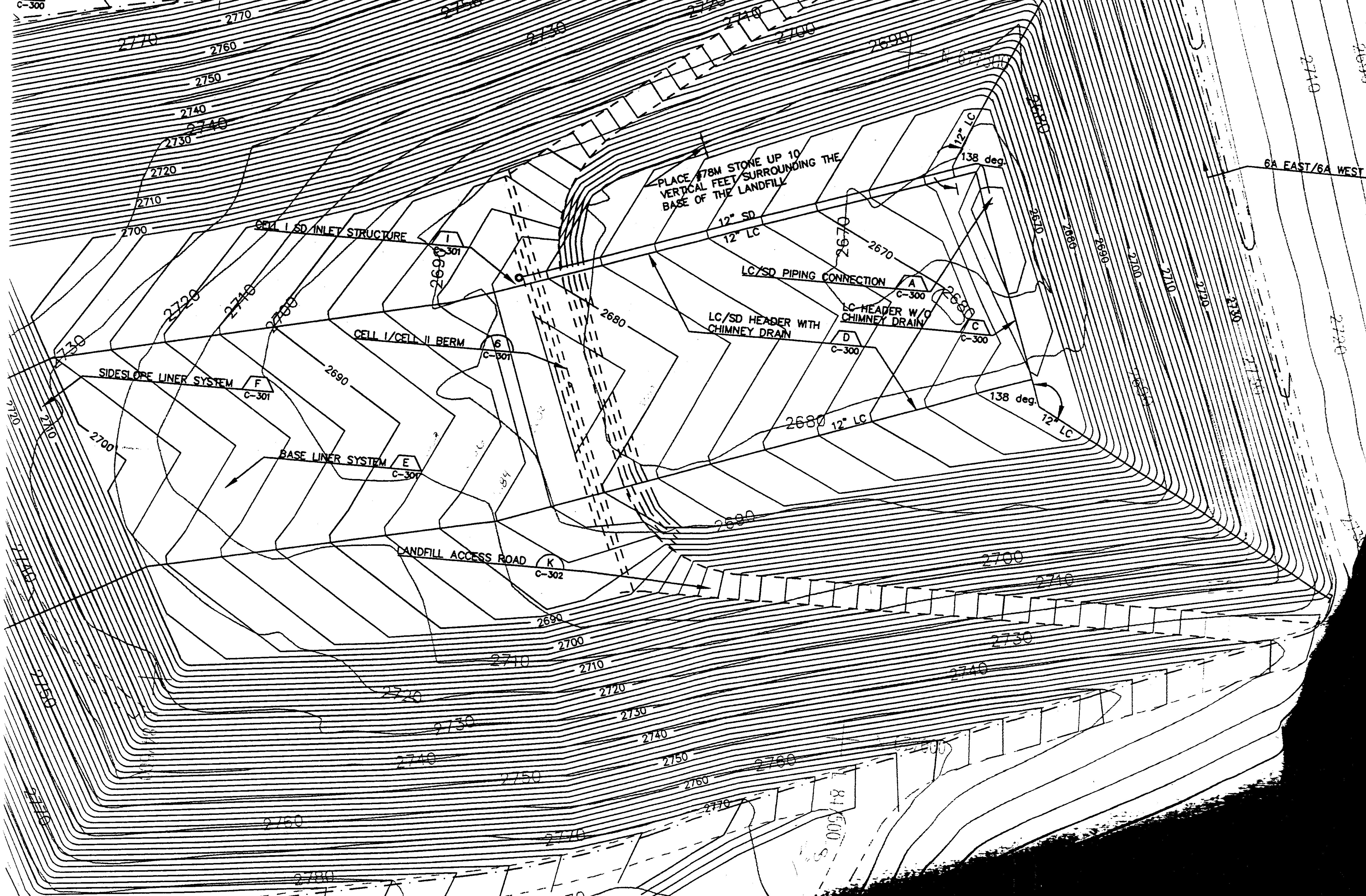
PROJECT	COMP. BY	JOB NO.
CANYON - NC	RBC	96010
	CHK. BY	DATE
	CSB	7-8-96

ELEV.	AREA (SF)	VOLUME (CF)
2682	4743	4743
2684	13057	17800
2686	24440	37497
2688	38948	63380

STORAGE AVAILABLE 123,428 CF

STORAGE REQUIRED 84,272 cf

$$FS = \frac{123,428}{84,272} = 1.5 \quad \checkmark$$


6A EAST/6A WEST B
PLACE #78M STONE UP 10 VERTICAL FEET SURROUNDING THE BASE OF THE LANDFILL
LC/SD PIPING CONNECTION
LC HEADER W/O CHIMNEY DRAIN
LC/SD HEADER WITH CHIMNEY DRAIN
12" SD
12" LC
138 deg.
CELL I/CELL II BERM
CELL I SD INLET STRUCTURE
BASE LINER SYSTEM
SIDESLOPE LINER SYSTEM
LANDFILL ACCESS ROAD
A C-300
C C-300
D C-300
E C-301
F C-301
I C-301
6 C-301
K C-302
2670
2680
2690
2700
2710
2720
2730
2740
2750
2760
2770
2780

Time (hr)	Flow (cfs)	Volume (cf)	12" HDPE (cfs)	Peak Storage (cf)	
11	1	1080	2.9	0	
11.3	1	2160	2.9	0	
11.6	2	4320	2.9	0	
11.9	13	18360	2.9	10908	
12	26	27720	2.9	19224	
12.1	40	42120	2.9	32580	
12.2	25	51120	2.9	40536	
12.3	9	54360	2.9	42732	
12.4	6	56520	2.9	43848	
12.5	5	58320	2.9	44604	
12.6	4	59760	2.9	45000	
12.7	3	60840	2.9	45036	
12.8	3	61920	2.9	45072	
13	3	64080	2.9	45144	* Peak Storage
13.2	2	65520	2.9	44496	
13.4	2	66960	2.9	43848	
13.6	2	68400	2.9	43200	
13.8	2	69840	2.9	42552	
14	2	71280	2.9	41904	
14.3	1	72360	2.9	39852	
14.6	1	73440	2.9	37800	
15	1	74880	2.9	35064	
15.5	1	76680	2.9	31644	
16	1	78480	2.9	28224	
16.5	1	80280	2.9	24804	
17	1	82080	2.9	21384	
17.5	1	83880	2.9	17964	
18	1	85680	2.9	14544	
19	1	89280	2.9	7704	
20	1	92880	2.9	864	
22	0	92880	2.9	0	

TR-55 CURVE NUMBER COMPUTATION

VERSION 1.11

Project : CHAMPION INTERNATIONAL
User: CJB
Date: 06-11-96

County : HAYWOOD
State: NC
Checked: MC
Date: 7-8-96

Subtitle: 6A WEST INTERMEDIATE DIKE DESIGN

Subarea : A

COVER DESCRIPTION	Hydrologic Soil Group A	B	C	D
		Acres (CN)		
FULLY DEVELOPED URBAN AREAS (Veg Estab.)				
Impervious Areas				
Paved parking lots, roofs, driveways	-	-	4.41(98)	-
Total Area (by Hydrologic Soil Group)			4.41	
			====	

SUBAREA: A TOTAL DRAINAGE AREA: 4.41 Acres WEIGHTED CURVE NUMBER:98

TR-55 Tc and Tt THRU SUBAREA COMPUTATION VERSION 1.11

Project : CHAMPION INTERNATIONAL User: CJB Date: 06-11-96
County : HAYWOOD State: NC Checked: RAC Date: 7.3.96
Subtitle: 6A WEST INTERMEDIATE DIKE DESIGN

Subarea #1 - A

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	3.5	275	.3	A					0.015
Shallow Concent'd		110	.05	U					0.008
Open Channel		270	.05		.013	44	2.35		0.009
							Time of Concentration =		0.03*
									=====

--- Sheet Flow Surface Codes ---

A Smooth Surface
B Fallow (No Res.)
C Cultivated < 20 % Res.
D Cultivated > 20 % Res.
E Grass-Range, Short
F Grass, Dense
G Grass, Burmuda
H Woods, Light
I Woods, Dense

--- Shallow Concentrated --- Surface Codes ---

P Paved
U Unpaved

* - Generated for use by TABULAR method

TR-55 TABULAR DISCHARGE METHOD VERSION 1

Project : CHAMPION INTERNATIONAL User: CJB Date: 06-11
County : HAYWOOD State: NC Checked: RBC Date: 7-5
Subtitle: 6A WEST INTERMEDIATE DIKE DESIGN

Total watershed area: 0.007 sq mi Rainfall type: II Frequency: 25 year

---------- Subareas ----------

	A
Area(sq mi)	0.01
Rainfall(in)	6.0
Curve number	98*
Runoff(in)	5.76
Tc (hrs)	0.03*
(Used)	0.10
TimeToOutlet	0.00
Ia/P	0.01
(Used)	0.10

Time (hr)	Total Flow	Subarea Contribution to Total Flow (cfs) A
11.0	1	1
11.3	1	1
11.6	2	2
11.9	13	13
12.0	26	26
12.1	40P	40P
12.2	25	25
12.3	9	9
12.4	6	6
12.5	5	5
12.6	4	4
12.7	3	3
12.8	3	3
13.0	3	3
13.2	2	2
13.4	2	2
13.6	2	2
13.8	2	2
14.0	2	2
14.3	1	1
14.6	1	1
15.0	1	1
15.5	1	1
16.0	1	1
16.5	1	1
17.0	1	1
17.5	1	1
18.0	1	1
19.0	1	1
20.0	1	1
22.0	0	0
26.0	0	0

P - Peak Flow * - value(s) provided from TR-55 system routines

LANDOWNER _____ ADDRESS _____

PROJECT _____ BY _____ DATE ___/___/___

********** IMPUTS FOR CURCULAR CULVERT ANALYSIS **********

MANNINGS COEFFICIENT PVC=.009 R/C=.013 CMP<=.025		N= .011
CULVERT DIAMETER	(FT)	D= .75
HEADWATER ABOVE UPSTREAM ENTRANCE INVERT	(FT)	DE= 4
TAILWATER ABOVE OUTLET INVERT => 0	(FT)	DO= 0
LENGTH OF CULVERT PIPE	(FT)	LP= 1000
DROP ALONG CULVERT LENGTH (INVERT TO INVERT)	(FT)	PD= 20
ENTRANCE LOSS COEFFICIENT		KE= .8

********** CULVERT OUTLET CONTROL (PRESSURE FLOW) EXISTS **********

CULVERT CAPACITY	**********	(CFS)	Q= 2.91
PIPE VELOCITY		(FPS)	V= 6.6
NEUTRAL SLOPE		(FT/FT)	SN= .0222
ACTUAL SLOPE ON CULVERT PIPE		(FT/FT)	SO= .02

DO YOU WANT TO CHANGE A VARIABLE Y/N ?

NORTH ROAD CATCH BASIN CAPACITY
AND
PEAK FLOW CALCULATION

TR-55 CURVE NUMBER COMPUTATION VERSION 1.11

Project : CHAMPION INTERNATIONAL CORP. User: CJB Date: 05-23-96
County : HAYWOOD State: NC Checked: RBC Date: 7-8-96
Subtitle: LANDFILL 6A WEST ROADWAY CATCH BASIN DESIGN
Subarea : A

COVER DESCRIPTION	Hydrologic Soil Group A	B	C	D
		Acres (CN)		
FULLY DEVELOPED URBAN AREAS (Veg Estab.)				
Streets and roads				
Gravel (w/ right-of-way)	-	-	.358(89)	-
Total Area (by Hydrologic Soil Group)			.358	
			====	

SUBAREA: A TOTAL DRAINAGE AREA: .358 Acres WEIGHTED CURVE NUMBER:89

TR-55 Tc and Tt THRU SUBAREA COMPUTATION VERSION 1.11

Project : CHAMPION INTERNATIONAL CORP. User: CJB Date: 05-23-96
County : HAYWOOD State: NC Checked: RBL Date: 7 3 96
Subtitle: LANDFILL 6A WEST ROADWAY CATCH BASIN DESIGN

---------- Subarea #1 - A ----------

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	3.5	24	.031	A					0.005
Shallow Concent'd		650	.04	U					0.056
								Time of Concentration =	0.06*
									=====

--- Sheet Flow Surface Codes ---

A Smooth Surface
B Fallow (No Res.)
C Cultivated < 20 % Res.
D Cultivated > 20 % Res.
E Grass-Range, Short
F Grass, Dense
G Grass, Burmuda
H Woods, Light
I Woods, Dense

--- Shallow Concentrated --- Surface Codes ---

P Paved
U Unpaved

* - Generated for use by TABULAR method

TR-55 TABULAR DISCHARGE METHOD VERSION 1.11

Project : CHAMPION INTERNATIONAL CORP. User: CJB Date: 05-23-96
County : HAYWOOD State: NC Checked: RB Date: 7-8-96
Subtitle: LANDFILL 6A WEST ROADWAY CATCH BASIN DESIGN

Total watershed area: 0.001 sq mi Rainfall type: II Frequency: 25 years

Subareas

	A
Area(sq mi)	0.00
Rainfall(in)	6.0
Curve number	89*
Runoff(in)	4.74
Tc (hrs)	0.06*
(Used)	0.10
TimeToOutlet	0.00
Ia/P	0.04
(Used)	0.10

Time (hr)	Total Flow	Subarea Contribution to Total Flow (cfs) A
11.0	0	0
11.3	0	0
11.6	0	0
11.9	1	1
12.0	2	2
12.1	3P	3P
12.2	2	2
12.3	1	1
12.4	0	0
12.5	0	0
12.6	0	0
12.7	0	0
12.8	0	0
13.0	0	0
13.2	0	0
13.4	0	0
13.6	0	0
13.8	0	0
14.0	0	0
14.3	0	0
14.6	0	0
15.0	0	0
15.5	0	0
16.0	0	0
16.5	0	0
17.0	0	0
17.5	0	0
18.0	0	0
19.0	0	0
20.0	0	0
22.0	0	0
26.0	0	0

P - Peak Flow * - value(s) provided from TR-55 system routines

PROJECT _____ BY _____ DATE ___/___/___

********** IMPUTS FOR CURCULAR CULVERT ANALYSIS **********

MANNINGS COEFFICIENT PVC=.009 R/C=.013 CMP<=.025		N=	.025
CULVERT DIAMETER	(FT)	D=	1.5
HEADWATER ABOVE UPSTREAM ENTRANCE INVERT	(FT)	DE=	4
TAILWATER ABOVE OUTLET INVERT => 0	(FT)	DO=	0
LENGTH OF CULVERT PIPE	(FT)	LP=	200
DROP ALONG CULVERT LENGTH (INVERT TO INVERT)	(FT)	PD=	80
ENTRANCE LOSS COEFFICIENT		KE=	.8

********** CULVERT INLET CONTROL (ORIFICE FLOW) EXISTS **********

CULVERT CAPACITY **********	(CFS)	Q=	13.45
ORIFICE VELOCITY	(FPS)	V=	7.61
ENTRANCE ORIFICE COEFFICIENT		C=	.6
NEUTRAL SLOPE	(FT/FT)	SN=	.3928
ACTUAL SLOPE OF CULVERT PIPE	(FT/FT)	SO=	.4

DO YOU WANT TO CHANGE A VARIABLE Y/N ?

PROJECT _____ BY _____ DATE ___/___/___

********** IMPUTS FOR CURCULAR CULVERT ANALYSIS **********

MANNINGS COEFFICIENT PVC=.009 R/C=.013 CMP<=.025		N=	.025
CULVERT DIAMETER	(FT)	D=	1.5
HEADWATER ABOVE UPSTREAM ENTRANCE INVERT	(FT)	DE=	4
TAILWATER ABOVE OUTLET INVERT => 0	(FT)	DO=	0
LENGTH OF CULVERT PIPE	(FT)	LP=	200
DROP ALONG CULVERT LENGTH (INVERT TO INVERT)	(FT)	PD=	80
ENTRANCE LOSS COEFFICIENT		KE=	.8

********** CULVERT INLET CONTROL (ORIFICE FLOW) EXISTS **********

CULVERT CAPACITY **********	(CFS)	Q=	13.45
ORIFICE VELOCITY	(FPS)	V=	7.61
ENTRANCE ORIFICE COEFFICIENT		C=	.6
NEUTRAL SLOPE	(FT/FT)	SN=	.3928
ACTUAL SLOPE OF CULVERT PIPE	(FT/FT)	SO=	.4

DO YOU WANT TO CHANGE A VARIABLE Y/N ?

APPENDIX D

ENGINEERING SPECIFICATIONS

ATTACHMENT 1

HAYWOOD COUNTY PLANNING DEPARTMENT LETTER

Haywood County Planning Department
Courthouse Annex III
2200 Asheville Road
Waynesville, NC 28786
(704) 452-6632
Fax: (704) 452-6767

October 24, 1996

Mr. Derric Brown
Environmental Supervisor
Champion International
P.O. Box C-10
Canton, N.C. 28716

Dear Derric,

This letter is to inform you that in my capacity as administrator of the Flood Damage Prevention Ordinance, I have examined the Federal Emergency Management Agency flood maps for Haywood County for the following PIN numbers:

8647-67-4357, 8647-67-5397, 8647-77-1373, 8647-98-3394, 8647-98-5018, 8647-98-8104, 8647-98-5412, 8657-07-1654, 8657-08-0275, 8647-23-6435, 8647-56-1843, 8647-56-8865, 8647-57-6361, and 8647-67-1132

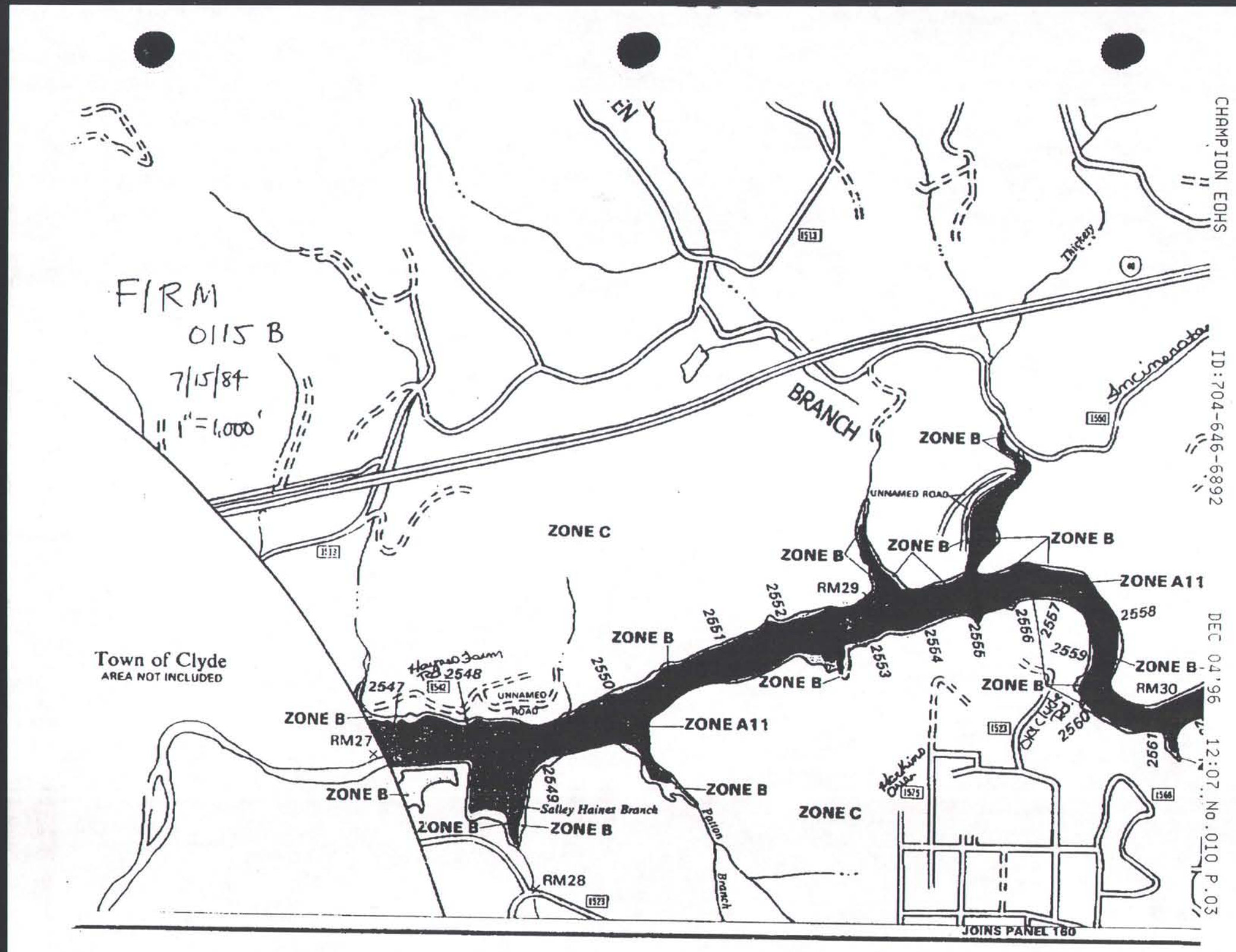
All of these PIN numbers are located outside of the flood area, in Zone C as shown on FEMA FIRM 370120 0115B which is dated July 15, 1984.

A portion of PIN 8647-86-4896, which is adjacent to the Pigeon River, is in the 100 year flood area as indicated on the FIRM (Flood Insurance Rate Map).

The area of Haywood County which is outside the jurisdiction of the municipalities is not zoned, which includes the above PIN numbers. If you have any questions or need additional information, please let me know.

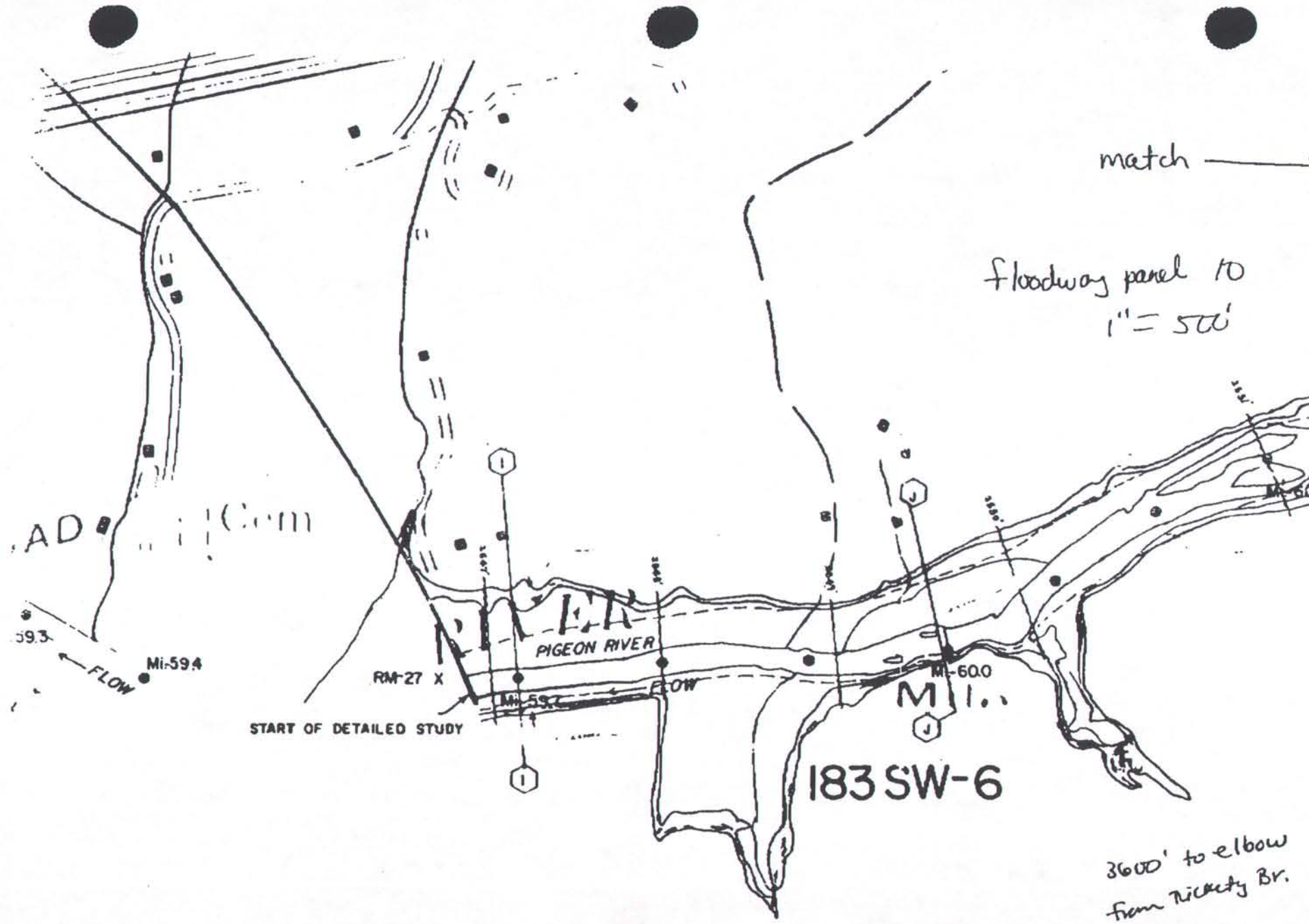
Sincerely,

Ginny Faust, AICP
Planning Director


FIRM
0115 B
7/15/84
1" = 1,000'
CHAMPION EOHS
ID:704-646-6892
DEC 04'96 12:07 No.010 P.03
BRANCH
ZONE B
UNNAMED ROAD
ZONE C
ZONE B
ZONE B
ZONE B
ZONE A11
RM29
2552
2551
2558
2557
2556
2555
2554
2553
2559
ZONE B
RM30
ZONE B
ZONE B
ZONE A11
2550
2548
2547
UNNAMED ROAD
Town of Clyde
AREA NOT INCLUDED
ZONE B
RM27
ZONE B
2549
Salley Haines Branch
ZONE B
ZONE B
ZONE B
ZONE C
RM28
Patton Branch
2560
2561
JOINS PANEL 180

match →

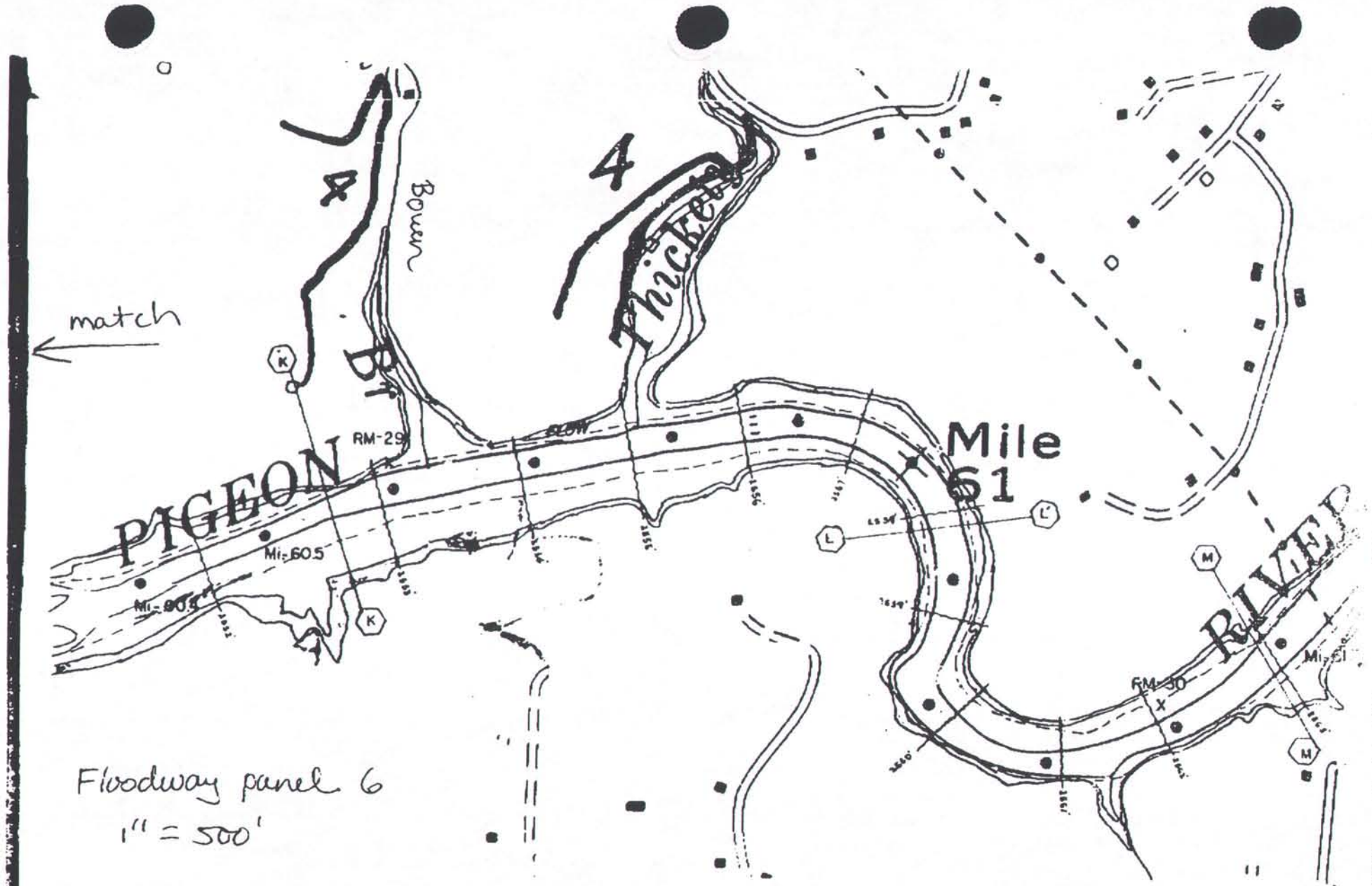
floodway panel 10
1" = 500'



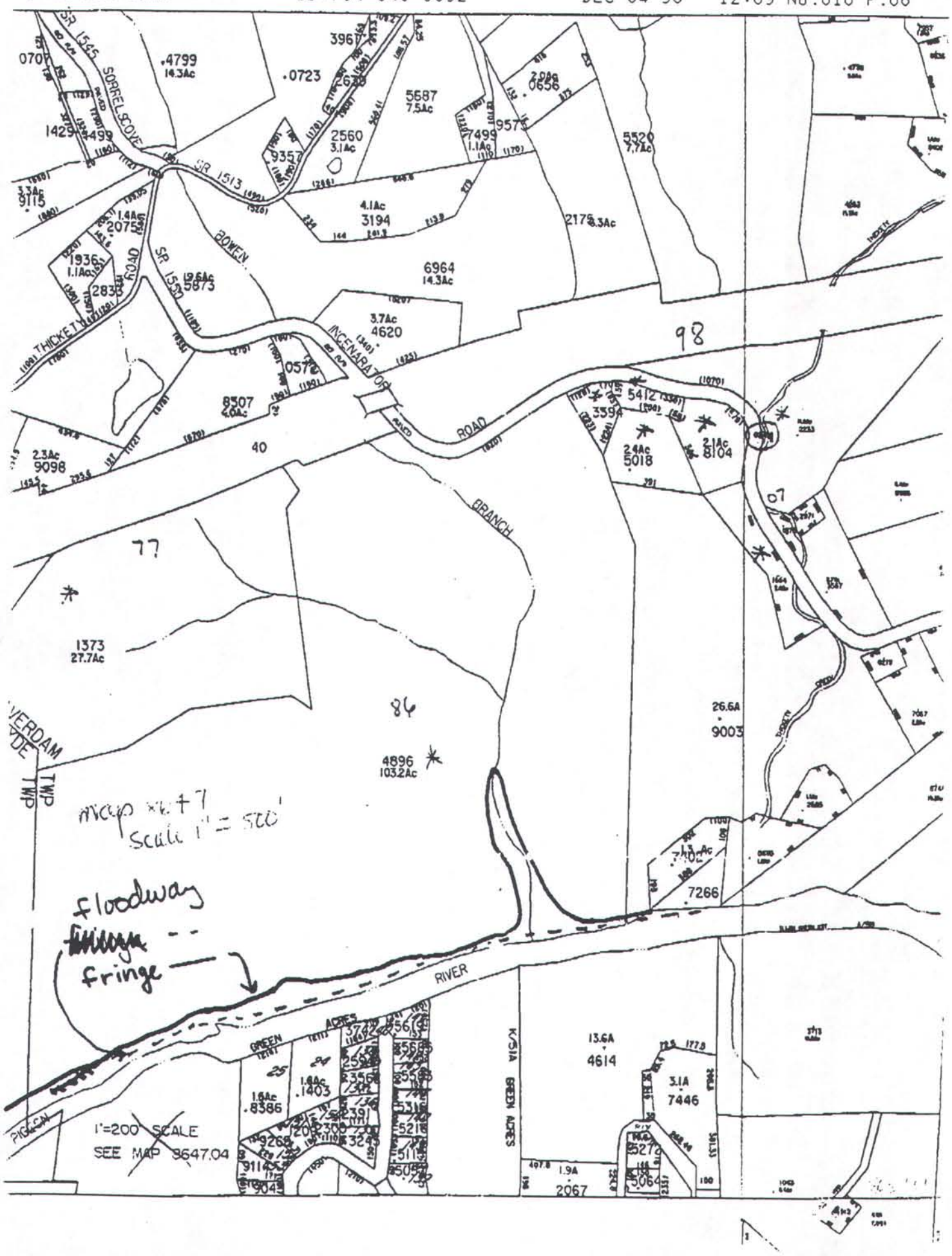
3600' to elbow
from Hickety Br.

NOTES
A THIS M...
AND F...
ELEVAT...
REFER...
RATE
B REFER...
DESCR...
C THIS M...
REFER...
ADDITI...
D WHERE...
TOGETI...

ZONE C...
ZONE...
ZON...
BASE FLOOD...
100 YEA...



Floodway panel 6
1" = 500'


SR 1545
SORRELSCOVE
SR 1513
BOWEN
ROAD
SR 1550
THICKET
INGENARAJOR
ROAD
BRANCH
RIVER
map #47
Scale 1" = 500'
floodway
fringe
1" = 200' SCALE
SEE MAP 9647.04
GREEN ACRES
KOSIA GREEN ACRES
4799
14.3Ac
.0723
5687
7.5Ac
2560
3.1Ac
4.1Ac
3194
6964
14.3Ac
3.7Ac
4620
8307
4.0Ac
2.3Ac
9098
1373
27.7Ac
4896
103.2Ac
26.6A
9003
5412
3394
2.4Ac
5018
2.1Ac
8104
7.3Ac
7266
13.6A
4614
3.1A
7446
1.9A
2067
1.6Ac
.8386
1.6Ac
.1403
2175
3.3Ac
5520
7.7Ac
98
77
86
40

ATTACHMENT 2

LANDFILL LINER ANALYSIS

ANALYSIS OF LANDFILL LINER SYSTEM
FOR
CHAMPION INTERNATIONAL CORPORATION

LANDFILL NO. 6
AREA A WEST
CANTON, NORTH CAROLINA

ADDENDUM

APRIL 24, 1998

Prepared by

Sevee & Maher Engineers, Inc.
Cumberland Center, Maine

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LIST OF APPENDICES

LIST OF TABLES

ANALYSIS OF LANDFILL LINER SYSTEM
LANDFILL NO. 6
AREA A WEST
CANTON, NORTH CAROLINA

EXECUTIVE SUMMARY

Champion International Corporation (Champion) owns and operates Landfill No. 6 (Permit #44-06) located approximately two miles northwest of the City of Canton in Haywood County, North Carolina. Champion proposes to complete construction of Area A West located within the permitted Landfill No. 6. Under adopted industrial waste rules. 15A NCAC 13B Section 0503(2)(d)(ii)(A), the State of North Carolina Department of Environment and Natural Resources, Division of Solid Waste requires an assessment of the proposed liner system for Area A West. The assessment is required to estimate potential groundwater quality impact at the downgradient point of compliance.

The potential impact of the proposed landfill on the groundwater was evaluated by modeling the landfill design and site characteristics. The modeling study included the use of the HELP computer model, version 3.5, and a mass balance dilution analysis. The HELP model is an U.S.EPA sponsored model used for evaluating the performance of landfill designs. The HELP model input included: waste characteristics; leachate collection design; landfill liner components; construction quality control; and site climatological data. The HELP model results indicated that the leakage rate from the landfill would be on the order of 4.7 cubic feet/acre/year. The hydrogeologic assessment

indicates the groundwater beneath Area A West flows towards the east and into Bowen Branch.

Leachate water samples were obtained from the current active landfill cell, Area A East, and analyzed by a State certified laboratory. The laboratory data for the leachate showed eleven constituents with concentrations above North Carolina's groundwater standards: arsenic, cadmium, chloride, coliform, color, dissolved solids (total), iron, manganese, nickel, silver, and sulfate.

The leakage rate from the HELP model was used along with the leachate water quality data in a mass balance dilution analysis. Given the use of conservative assumptions throughout the evaluation, the results of the mass balance dilution analysis estimated the concentration of constituents to be up to several orders of magnitude below their respective groundwater standards at the model boundary, Bowen Branch. Based on the assessment, the landfill liner and leachate collection system proposed for Area A West, will not cause any 2L listed compounds to exceed groundwater standards beyond the landfill property.

1.0 INTRODUCTION

Champion International Corporation (Champion) has submitted an application[1] to the North Carolina Department of Environment and Natural Resources (NCDENR) for a permit to construct Area A West at Landfill No. 6 in Canton, North Carolina. The application included an assessment of the proposed liner system to estimate potential groundwater quality impact at the downgradient point of compliance. The liner analysis was performed for compounds listed by U.S.EPA for Subtitle D landfills. This report is an addendum to the permit to construct application and includes an analysis of the liner system with all the compounds listed in 15A NCAC 2L Section .0202(g). The report addendum includes the analytical data used in the analysis and results of the analysis, using the Hydrologic Evaluation of Landfill Performance (HELP) Model Version 3.05, dated March 30, 1996. The report addendum does not repeat the complete hydrogeologic conditions or liner design details described in the original permit application.

[1] January 1997, Sevee & Maher Engineers, Inc. Permit To Construct, Landfill No. 6A-West, Canton, North Carolina, Champion International Corporation, Canton, North Carolina.

2.0 LEACHATE QUALITY

Champion's Landfill No. 6 is permitted for the disposal of boiler fly ash, cinders, dewatered wastewater treatment sludge, lime mud, woodwaste, and asbestos containing material (ACM). The primary source of waste accepted is wastewater treatment sludge that accounts for approximately 60 percent of the waste disposed of at Landfill No. 6.

Results of water quality analyses of the Landfill No. 6 Area A East leachate, provided by Pace Analytical, Inc., and Champion's laboratories in West Nyack, New York and Canton, North Carolina, were reviewed to determine initial leachate concentrations of each compound listed in the Standards from 15A NCAC 2L Section .0202(g). Specifically, analytical results from April 25, 1997, May 21, 1997, October 15, 1996, June 24, 1996, July 7, 1997, and November 19, 1997 were referenced. The laboratory results are listed on Table 2-1 and the laboratory analyses are found in Appendix A. From the list of 88 compounds on Table 2-1, 81 were analyzed and reported by the laboratory. The seven compounds not tested include foaming agents, three synthetic organic compounds, gross alpha, and radium. The parameters not tested are not suspected to be present in the leachate based on Champion's knowledge of the process waste streams. Gross alpha particle activity and radium compounds are typically hydrophobic and not partitioned to the landfill leachate and are not suspected to be present in Champion's process waste stream. It should also be noted that several of the laboratory reporting limits were higher than the respective groundwater standard, which is not uncommon for these types of samples and analytes. This was due to the

characteristics of the sample. e.g. excessive foaming, which required dilution prior to analyzing the sample.

TABLE 2-1

LEACHATE LABORATORY RESULTS

Chemical	Standard[1] (mg/l)	Laboratory Result (mg/l)
Acetone	0.7	*ND (1.0)*
Acrylamide (propenamide)	0.00001	*ND (1.0)*
Arsenic	0.05	**1.71**
Barium	2.0	0.112
Benzene	0.001	*ND (0.05)*
Boron	0.32	ND (0.2)
Bromoform (tribromomethane)	0.00019	*ND (0.05)*
Butylbenzyl phthalate	0.10	ND (0.010)
Cadmium	0.005	**0.04**
Carbofuran	0.036	Not Tested
Carbon tetrachloride	0.0003	*ND (0.05)*
Chlordane	$2.7x10^{-5}$	*ND (0.004)*
Chloride	250.0	**490**
Chlorobenzene	0.05	ND (0.05)
Chloroform (trichloromethane)	0.00019	*ND (0.05)*
2-Chlorophenol	0.0001	*ND (0.010)*
Chromium	0.05	ND (0.05)
Cis-1,2-dichloroethene	0.07	ND (0.05)
Coliform organisms (total)	1 per 100 milliliters	**6,225**
Color	15 color units	**1,607**
Copper	1.0	ND (0.01)
Cyanide	0.154	0.004
2,4-D (2,4-dichlorophenoxy acetic acid)	0.07	ND (0.012)
1,2-Dibromo-3-chloropropane	$2.5x10^{-5}$	*ND (0.05)*
Dichlorodifluoromethane (Freon-12; Halon)	1.4	ND (0.050)
1,1-Dichloroethane	0.7	ND (0.05)
1,2-Dichloroethane (ethylene dichloride)	0.00038	*ND (0.05)*
1,1-Dichloroethylene (vinylidene chloride)	0.007	*ND (0.05)*
1,2-Dichloropropane	0.00056	*ND (0.05)*
Di-n-butyl (or dibutyl) phthalate (DBP)	0.7	ND (0.010)
Diethylphthalate (DEP)	5.0	ND (0.010)
Di(2-ethylhexyl) phthalate (DEHP)	0.003	*ND (0.010)*
Di-n-octyl phthalate	0.14	ND (0.010)
P-dioxane (1,4-diethylene dioxide)	0.007	Not tested
Dioxin	$2.2x10^{-10}$	ND (1 ppq)
Dissolved solids (total)	500	**1,100**
Diundecyl phthalate (Santicizer 711)	0.14	Not tested
Endrin	0.002	ND (0.0012)
Epichlorohydrin (1-chloro-2,3-epoxypropane)	0.00354	*ND (0.025)*
Ethylbenzene	0.029	*ND (0.05)*
Ethylene dibromide (EDB; 1,2-dibromoethane)	$4.0x10^{-7}$	*ND (0.00001)*
Ethylene glycol	7.0	*ND (10)*
Fluorene	0.28	ND (0.010)
Fluoride	2.0	1.6

Chemical	Standard[1] (mg/l)	Laboratory Result (mg/l)
Foaming agents	0.5	Not Tested
Gross alpha (adjusted) particle activity (excluding radium-226 and uranium)	15 pCi/l	Not Tested
Heptachlor	$8.0x10^{-6}$	*ND (0.001)*
Heptachlor epoxide	$4.0x10^{-6}$	*ND (0.016)*
Heptane	2.1	ND (0.025)
Hexachlorobenzene (perchlorobenzene)	0.00002	*ND (0.010)*
N-hexane	0.42	ND (0.025)
Iron	0.3	**0.47**
Lead	0.015	0.009
Lindane	$2.0x10^{-4}$	*ND (0.001)*
Manganese	0.05	**7.1**
Mercury	0.0011	ND (0.0005)
Metadichlorobenzene (1,3-dichlorobenzene)	0.62	ND (0.010)
Methoxychlor	0.035	ND (0.010)
Methylene chloride (dichloromethane)	0.005	*ND (0.100)*
Methyl ethyl ketone (MEK; 2-butanone)	0.17	*ND (1.0)*
Methyl tert-butyl ether (MTBE)	0.2	ND (0.025)
Naphthalene	0.021	ND (0.010)
Nickel	0.1	**0.12**
Nitrate	10.0	ND (0.2)
Nitrite	1.0	0.05
Orthodichlorobenzene (1,2-dichlorobenzene)	0.62	ND (0.05)
Oxamyl	0.175	Not tested
Paradichlorobenzene	0.075	ND (0.05)
Pentachlorophenol	0.0003	*ND (0.050)*
pH	6.5 - 8.5	7.7
Phenanthrene	0.21	ND (0.010)
Phenol	0.30	0.026
Radium-226 and radium-228 (combined)	5 pCi/l	Not Tested
Selenium	0.05	ND (0.005)
Silver	0.018	**0.1**
Styrene (ethenylbenzene)	0.1	ND (0.05)
Sulfate	250.0	**660**
Tetrachloroethylene (perchloroethylene; PCE)	0.0007	*ND (0.05)*
Toluene (methylbenzene)	1.0	0.054
Toxaphene	$3.1x10^{-5}$	*ND (0.0024)*
2,4,5-TP (Silvex)	0.05	ND (0.002)
Trans-1,2-dichloroethene	0.07	ND (0.05)
1,1,1-Trichloroethane (methyl chloroform)	0.2	ND (0.05)
Trichloroethylene (TCE)	0.0028	*ND (0.05)*
Trichlorofluoromethane	2.1	ND (0.05)
Vinyl chloride (chloroethylene)	$1.5x10^{-5}$	*ND (0.100)*
Xylenes (o-, m-, and p-)	0.53	ND (0.05)
Zinc	2.1	0.04

Notes

1. Standards from 15A NCAC 2L Section .0202(g), dated October 25, 1994.

ND Not detected above reporting limit shown in parenthesis.

660 results in bold exceed standard.

ND (0.001) results in italic are reported below detection, however the detection limit exceeds the standard.

From the data reviewed, the compound values that exceeded laboratory detection levels in the leachate were arsenic, barium, cadmium, chloride, coliform organisms, color, cyanide, dissolved solids (total), fluoride, iron, lead, manganese, nickel, nitrite, phenol, silver, sulfate, toluene, and zinc. Of these, arsenic, cadmium, chloride, coliform, color, dissolved solids (total), iron, manganese, nickel, silver, and sulfate were the only compounds detected above their groundwater standards listed on Table 2-1 (laboratory results in **Bold**). The compounds used in the HELP model liner analysis included compounds detected above the groundwater standards. In addition, the analysis included compounds where the laboratory results were reported below detection limits, and where the laboratory reporting limits were above the groundwater standards. The compounds meeting the previous condition are shown in *italic* on Table 2-1.

LANDFILL LINER AND GCL EVALUATION

Following review with the North Carolina Department of Environment and Natural Resources (NCDENR) of the January 1997 Permit to Construct[1] request, a change is proposed to the landfill liner system for Landfill No. 6 Area A-West. The change includes the addition of a geosynthetic clay liner (GCL) in a portion of the landfill base. A description and results of the evaluation for the proposed change follows.

The landfill liner system as currently proposed in Area A- West consists of a compacted soil layer, overlain by a 60-mil HDPE geomembrane followed by a leachate collection layer. The change proposed to the liner system is the addition of a GCL inserted between the soil layer and HDPE geomembrane. The GCL would encompass the southern base portion of Area A-West and extend 10 feet vertically up the south sideslope, see Figure 1. The areal extent of the GCL is approximately 2.6 acres.

The liner analysis with a GCL was made using the Hydrologic Evaluation of Landfill Performance (HELP) Model Version 3.05, dated March 30, 1996. The HELP model input file used for the original liner evaluation was modified by inserting a GCL layer between the soil layer and HDPE geomembrane. The GCL was represented using a hydraulic conductivity of 3×10^{-9} cm/sec, which is the default value for a GCL in the HELP model. In addition, the pinhole density in the HELP model input file was

[1] January 1997, Sevee & Maher Engineers, Inc. Permit To Construct, Landfill No. Area A-West, Canton, North Carolina, Champion International Corporation, Canton, North Carolina; and as amended April 1998.

increased from 1 hole per acre to 8 holes per acre. The estimated leakage rate with the GCL is 0.02 cubic feet/acre/year, based on HELP modeling results, see Appendix A. Using an areal extent of 2.6 acres, the leakage rate is less than 0.5 gallons per year into the soil layer. Furthermore, the HELP model results show that no measurable quantity of water percolates through the soil layer. Since the HELP model indicates no measurable quantity of leakage entering the groundwater, we were unable to conduct a 2L groundwater standards analysis.

CONCLUSIONS

Champion submitted a permit application in February 1997 to construct Area A-West with a liner system consisting of a 2-foot thick soil layer meeting a hydraulic conductivity of less than or equal to $5x10^{-5}$ cm/sec, overlain by a 60-mil HDPE geomembrane, and leachate collection system. The hydrogeologic assessment for Landfill No. 6 Area A-West indicates the groundwater beneath Area A-West will flow towards the east and into Bowen Branch. Due to the potential for some groundwater movement in the bedrock to the southeast and southwest along the southern boundary of Area A-West, a liner analysis was conducted incorporating a GCL into a portion of the proposed liner system.

The HELP model inputs, which included hydrogeologic characteristics of the site, and climatic factors, show the landfill liner system with a GCL for the southern portion of Landfill No. 6 Area A-West will meet the criteria of 15A NCAC 13B

Section .0503(2)(d)(ii)(A). Based on this analysis, the original landfill liner system proposed in combination with a GCL on the southern portion for Area A-West, will not cause groundwater concentrations of leachate compounds to exceed groundwater standards beyond the landfill property.

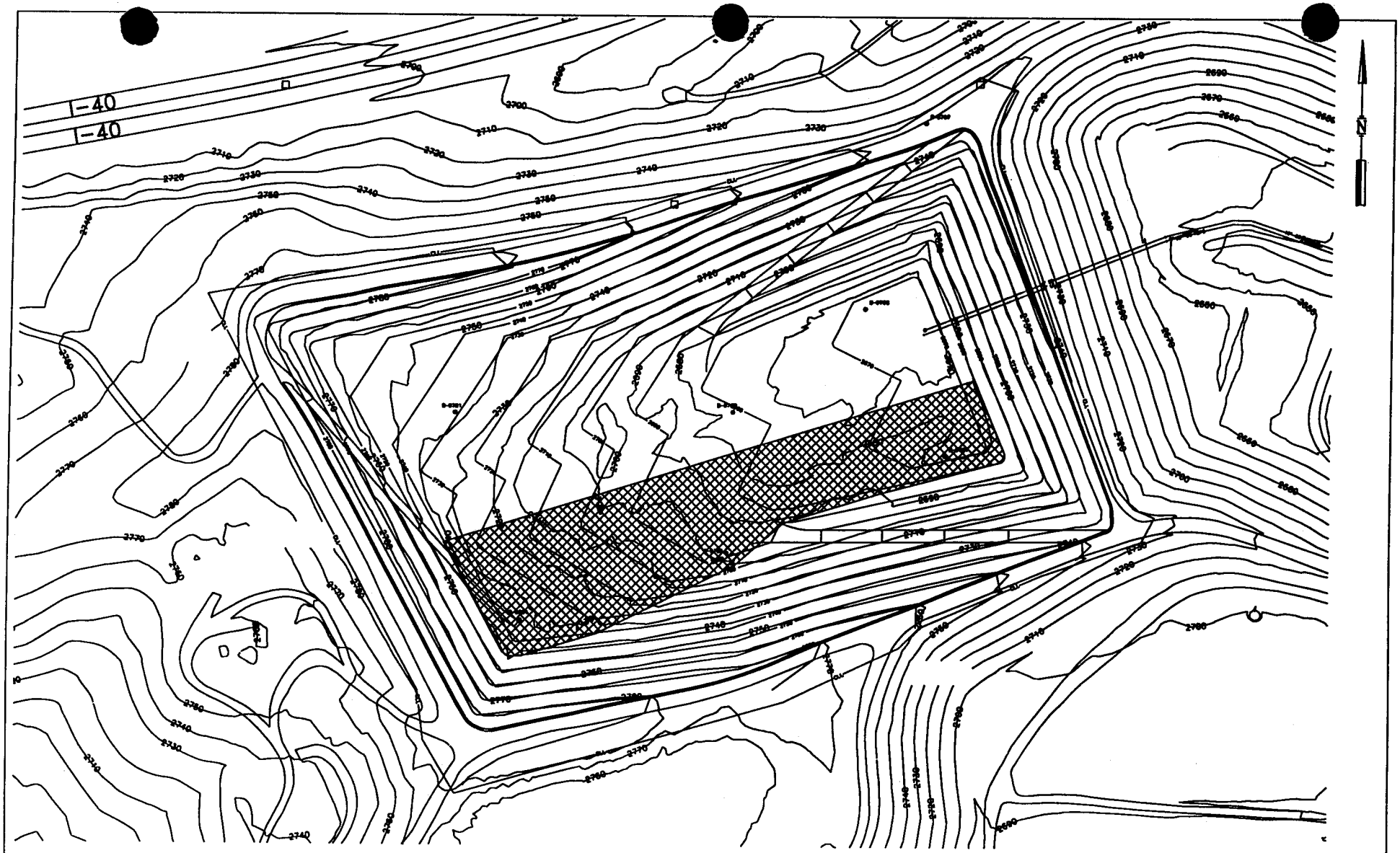

FIGURE 1
GCL LINER AREA
LANDFILL #6
CHAMPION INTERNATIONAL CORP.
CANTON, NORTH CAROLINA

SME

Sevee & Maher Engineers, Inc.

DWG: MAY96 LA. CFG. GCL-LINER REV. 10/1/98

APPENDIX A

LEACHATE ANALYTICAL RESULTS

Pace Analytical Services, Inc.
54 Ravenscroft Drive
Asheville, NC 28801
Tel: 704-254-7176
Fax: 704-252-4618

Pace Analytical

October 29, 1996

Mr. Jim Giauque
Champion International
P. O. Box C-10
Canton, NC 28716

RE: PACE Project No. A61016.502
Client Reference: L/F #6AE Leachate

Dear Mr. Giauque:

Enclosed is the report of laboratory analyses for samples received October 15, 1996.

Footnotes are given at the end of the report.

If you have any questions concerning this report, please feel free to contact us.

Sincerely,

Walter L Miller

Walter L. Miller
Project Manager

Enclosures

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
54 Ravenscroft Drive
Asheville, NC 28801
Tel: 704-254-7176
Fax: 704-252-4618

Pace Analytical

Champion International
P. O. Box C-10
Canton, NC 28716

October 29, 1996
PACE Project Number: A61016

Attn: Mr. Jim Giauque

Client Reference: L/F #6AE Leachate

Parameter	Units	PRL	93 0287387 10/15/96 10/15/96 L/F #6AE Leachate (1)
PACE Sample Number:			
Date Collected:			
Date Received:			
Client Sample ID:			
INORGANIC ANALYSIS			
INDIVIDUAL PARAMETERS			
Arsenic	mg/L	0.200	1.71
Barium	mg/L	0.10	0.112
Cadmium	mg/L	0.01	0.040
Chromium, Hexavalent	mg/L	0.05	ND
Fluoride, Total Recoverable (Electrode)	mg/L	1.0	1.5
Lead	mg/L	0.005	0.009
Mercury	mg/L	0.0005	ND
Nitrogen, Nitrate in Wastewater	mg/L	0.2	ND
Selenium	mg/L	0.005	ND
Silver	mg/L	0.001	ND

These data have been reviewed and are approved for release.

Barbara M. Miller
Supervisor, Inorganic Chemistry

REPORT OF LABORATORY ANALYSIS

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Pace Analytical

FOOTNOTES
for page 1

October 29, 1996
PACE Project Number: A61016

Client Reference: L/F #6AE Leachate

ND	Not detected at or above the PRL.
PRL	PACE Reporting Limit
(1)	Vials for VOA Analysis have air bubbles.

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
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Pace Analytical

Champion International
P. O. Box C-10
Canton, NC 28716

October 28, 1996
PACE Project Number: A61016

Attn: Mr. Jim Giauque

Client Reference: Champion

Parameter	Units	PRL	PACE Sample Number: 93 0287387 Date Collected: 10/15/96 Date Received: 10/17/96 L/F #6AE Leahcate	METHOD	DATE ANALYZ
ORGANIC ANALYSIS					
PESTICIDES AND PCBS			SD	8080	
alpha-BHC	ug/L	1.0	ND		10/25/9
beta-BHC	ug/L	1.0	ND		10/25/9
gamma-BHC (Lindane)	ug/L	1.0	ND		10/25/9
delta-BHC	ug/L	2.0	ND		10/25/9
Heptachlor	ug/L	1.0	ND		10/25/9
Aldrin	ug/L	1.0	ND		10/25/9
Heptachlor epoxide	ug/L	16	ND		10/25/9
Endosulfan I	ug/L	2.0	ND		10/25/9
Dieldrin	ug/L	0.4	ND		10/25/9
Endrin	ug/L	1.2	ND		10/25/9
4,4-DDD	ug/L	2.0	ND		10/25/9
Endosulfan II	ug/L	2.0	ND		10/25/9
4,4-DDT	ug/L	2.0	ND		10/25/9
4,4-DDE	ug/L	2.0	ND		10/25/9
Endrin aldehyde	ug/L	4.0	ND		10/25/9
Endosulfan sulfate	ug/L	14	ND		10/25/9
Methoxychlor	ug/L	10	ND		10/25/9
Toxaphene	ug/L	48	ND		10/25/9
Chlordane (tech)	ug/L	4.0	ND		10/25/9
Aroclor-1016	ug/L	20	ND		10/25/9
Aroclor-1221	ug/L	20	ND		10/25/9
Aroclor-1232	ug/L	20	ND		10/25/9
Aroclor-1242	ug/L	20	ND		10/25/9
Aroclor-1248	ug/L	20	ND		10/25/9
Aroclor-1254	ug/L	20	ND		10/25/9
Aroclor-1260	ug/L	20	ND		10/25/9
Date Extracted, Pesticides & PCBs	Date		102296		10/22/9

REPORT OF LABORATORY ANALYSIS

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Fax: 704-252-4618

October 28, 1996
PACE Project Number: A61016

Client Reference: Champion

Parameter	Units	PRL	93 0287387 10/15/96 10/17/96 L/F #6AE Leahcate	METHOD	DATE ANALYZ
PACE Sample Number:					
Date Collected:					
Date Received:					
Client Sample ID:					
ORGANIC ANALYSIS					
HERBICIDES, SELECTED CHLORINATED				8150	
2,4-D	ug/L	12	ND		10/24/9
2,4,5-T	ug/L	2.0	ND		10/24/9
Silvex	ug/L	2.0	ND		10/24/9
Date Extracted	Date		102296		10/22/9
APPENDIX I, LANDFILL VOLATILES			SF	8260	
Methyl Chloride	ug/L	100	ND		10/18/9
Chloroethene (Vinyl chloride)	ug/L	100	ND		10/18/9
Bromomethane	ug/L	100	ND		10/18/9
Chloroethane	ug/L	100	ND		10/18/9
Trichlorofluoromethane	ug/L	50	ND		10/18/9
1,1-Dichloroethene	ug/L	50	ND		10/18/9
Acetone	ug/L	1000	ND		10/18/9
Methyl iodide	ug/L	50	ND		10/18/9
Carbon disulfide	ug/L	50	ND		10/18/9
Dichloromethane	ug/L	50	ND		10/18/9
Acrylonitrile	ug/L	1000	ND		10/18/9
trans-1,2-Dichloroethene	ug/L	50	ND		10/18/9
1,1-Dichloroethane	ug/L	50	ND		10/18/9
Vinyl acetate	ug/L	500	ND		10/18/9
Methyl ethyl ketone	ug/L	1000	ND		10/18/9
cis-1,2-Dichloroethene	ug/L	50	ND		10/18/9
Bromochloromethane	ug/L	50	ND		10/18/9
Chloroform	ug/L	50	ND		10/18/9
1,1,1-Trichloroethane	ug/L	50	ND		10/18/9
Carbon tetrachloride	ug/L	50	ND		10/18/9
Benzene	ug/L	50	ND		10/18/9
1,2-Dichloroethane	ug/L	50	ND		10/18/9
Dibromomethane	ug/L	50	ND		10/18/9
Trichloroethene	ug/L	50	ND		10/18/9
1,2-Dichloropropane	ug/L	50	ND		10/18/9
Bromodichloromethane	ug/L	50	ND		10/18/9

REPORT OF LABORATORY ANALYSIS

Pace Analytical

Pace Analytical Services, Inc.
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Asheville, NC 28801
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Fax: 704-252-4618

October 28, 1996
PACE Project Number: A61016

Client Reference: Champion

Parameter	Units	PRL	93 0287387 10/15/96 10/17/96 L/F #6AE Leahcate	METHOD	DATE ANALYZ
PACE Sample Number:					
Date Collected:					
Date Received:					
Client Sample ID:					
ORGANIC ANALYSIS					
APPENDIX I, LANDFILL VOLATILES			SF	8260	
4-Methyl-2-pentanone (MIBK)	ug/L	500	ND		10/18/9
cis-1,3-Dichloropropene	ug/L	50	ND		10/18/9
Toluene	ug/L	50	54		10/18/9
trans-1,3-Dichloro-1-propene	ug/L	50	ND		10/18/9
1,1,2-Trichloroethane	ug/L	50	ND		10/18/9
Tetrachloroethylene	ug/L	50	ND		10/18/9
2-Hexanone	ug/L	500	ND		10/18/9
Dibromochloromethane	ug/L	50	ND		10/18/9
1,1,1,2-Tetrachloroethane	ug/L	50	ND		10/18/9
1,2-Dibromoethane	ug/L	50	ND		10/18/9
Chlorobenzene	ug/L	50	ND		10/18/9
Ethylbenzene	ug/L	50	ND		10/18/9
Xylenes, (total)	ug/L	50	ND		10/18/9
Styrene	ug/L	50	ND		10/18/9
Bromoform	ug/L	50	ND		10/18/9
trans-1,4-Dichloro-2-butene	ug/L	50	ND		10/18/9
1,1,2,2-Tetrachloroethane	ug/L	50	ND		10/18/9
1,2,3-Trichloropropane	ug/L	50	ND		10/18/9
1,4-Dichlorobenzene	ug/L	50	ND		10/18/96
1,2-Dichlorobenzene	ug/L	50	ND		10/18/9
1,2-Dibromo-3-chloropropane	ug/L	50	ND		10/18/9
Surrogate - Dibromofluoromethane	%		101		10/18/96
Surrogate - Toluene-d8	%		99		10/18/96
Surrogate - 4-Bromofluorobenzene	%		95		10/18/96

REPORT OF LABORATORY ANALYSIS

Pace Analytical

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Mr. Jim Giauque
Page 4

October 28, 1996
PACE Project Number: A61016

Client Reference: Champion

Parameter	Units	PRL	93 0287727 10/15/96 10/17/96 Travel Blank	METHOD	DATE ANALYZ
PACE Sample Number:					
Date Collected:					
Date Received:					
Client Sample ID:					
ORGANIC ANALYSIS					
APPENDIX I, LANDFILL VOLATILES				8260	
Methyl Chloride	ug/L	10	ND		10/18/9
Chloroethene (Vinyl chloride)	ug/L	10	ND		10/18/9
Bromomethane	ug/L	10	ND		10/18/9
Chloroethane	ug/L	10	ND		10/18/9
Trichlorofluoromethane	ug/L	5.0	ND		10/18/9
1,1-Dichloroethene	ug/L	5.0	ND		10/18/9
Acetone	ug/L	100	ND		10/18/9
Methyl iodide	ug/L	5.0	ND		10/18/9
Carbon disulfide	ug/L	5.0	ND		10/18/9
Dichloromethane	ug/L	5.0	ND		10/18/9
Acrylonitrile	ug/L	100	ND		10/18/9
trans-1,2-Dichloroethene	ug/L	5.0	ND		10/18/9
1,1-Dichloroethane	ug/L	5.0	ND		10/18/9
Vinyl acetate	ug/L	50	ND		10/18/9
Methyl ethyl ketone	ug/L	100	ND		10/18/9
cis-1,2-Dichloroethene	ug/L	5.0	ND		10/18/9
Bromochloromethane	ug/L	5.0	ND		10/18/9
Chloroform	ug/L	5.0	ND		10/18/9
1,1,1-Trichloroethane	ug/L	5.0	ND		10/18/9
Carbon tetrachloride	ug/L	5.0	ND		10/18/9
Benzene	ug/L	5.0	ND		10/18/9
1,2-Dichloroethane	ug/L	5.0	ND		10/18/96
Dibromomethane	ug/L	5.0	ND		10/18/96
Trichloroethene	ug/L	5.0	ND		10/18/96
1,2-Dichloropropane	ug/L	5.0	ND		10/18/96
Bromodichloromethane	ug/L	5.0	ND		10/18/96
4-Methyl-2-pentanone (MIBK)	ug/L	50	ND		10/18/96
cis-1,3-Dichloropropene	ug/L	5.0	ND		10/18/96
Toluene	ug/L	5.0	ND		10/18/96
trans-1,3-Dichloro-1-propene	ug/L	5.0	ND		10/18/96
1,1,2-Trichloroethane	ug/L	5.0	ND		10/18/96

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
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Pace Analytical

Mr. Jim Giauque
Page 5

October 28, 1996
PACE Project Number: A61016

Client Reference: Champion

Parameter	Units	PRL	93 0287727 Travel Blank	METHOD	DATE ANALYZE
PACE Sample Number:			93 0287727		
Date Collected:			10/15/96		
Date Received:			10/17/96		
Client Sample ID:			Travel Blank		
ORGANIC ANALYSIS					
APPENDIX I, LANDFILL VOLATILES				8260	
Tetrachloroethylene	ug/L	5.0	ND		10/18/96
2-Hexanone	ug/L	50	ND		10/18/96
Dibromochloromethane	ug/L	5.0	ND		10/18/96
1,1,1,2-Tetrachloroethane	ug/L	5.0	ND		10/18/96
1,2-Dibromoethane	ug/L	5.0	ND		10/18/96
Chlorobenzene	ug/L	5.0	ND		10/18/96
Ethylbenzene	ug/L	5.0	ND		10/18/96
Xylenes, (total)	ug/L	5.0	ND		10/18/96
Styrene	ug/L	5.0	ND		10/18/96
Bromoform	ug/L	5.0	ND		10/18/96
trans-1,4-Dichloro-2-butene	ug/L	5.0	ND		10/18/96
1,1,2,2-Tetrachloroethane	ug/L	5.0	ND		10/18/96
1,2,3-Trichloropropane	ug/L	5.0	ND		10/18/96
1,4-Dichlorobenzene	ug/L	5.0	ND		10/18/96
1,2-Dichlorobenzene	ug/L	5.0	ND		10/18/96
1,2-Dibromo-3-chloropropane	ug/L	5.0	ND		10/18/96
Surrogate - Dibromofluoromethane	%		102		10/18/96
Surrogate - Toluene-d8	%		97		10/18/96
Surrogate - 4-Bromofluorobenzene	%		95		10/18/96

These data have been reviewed and are approved for release.

Walter L. Miller

Walter L. Miller
General Manager

REPORT OF LABORATORY ANALYSIS

Pace Analytical

Pace Analytical Services, Inc.
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FOOTNOTES
for pages 1 through 5

October 28, 1996
PACE Project Number: A61016

Client Reference: Champion

ND	Not detected at or above the PRL.
PRL	PACE Reporting Limit
SD	Sample dilution required for analysis.
SF	Elevated detection limit due to excessive sample foaming.

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
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Pace Analytical

QUALITY CONTROL DATA

October 28, 1996
PACE Project Number: A61016

Client Reference: Champion

APPENDIX I, LANDFILL VOLATILES
Batch: 92 51610
Samples: 93 0287387, 93 0287727

METHOD BLANK:

Parameter	Units	PRL	Method Blank
Methyl Chloride	ug/L	10	ND
Chloroethene (Vinyl chloride)	ug/L	10	ND
Bromomethane	ug/L	10	ND
Chloroethane	ug/L	10	ND
Trichlorofluoromethane	ug/L	5.0	ND
1,1-Dichloroethene	ug/L	5.0	ND
Acetone	ug/L	100	ND
Methyl iodide	ug/L	5.0	ND
Carbon disulfide	ug/L	5.0	ND
Dichloromethane	ug/L	5.0	ND
Acrylonitrile	ug/L	100	ND
trans-1,2-Dichloroethene	ug/L	5.0	ND
1,1-Dichloroethane	ug/L	5.0	ND
Vinyl acetate	ug/L	50	ND
Methyl ethyl ketone	ug/L	100	ND
cis-1,2-Dichloroethene	ug/L	5.0	ND
Bromochloromethane	ug/L	5.0	ND
Chloroform	ug/L	5.0	ND
1,1,1-Trichloroethane	ug/L	5.0	ND
Carbon tetrachloride	ug/L	5.0	ND
Benzene	ug/L	5.0	ND
1,2-Dichloroethane	ug/L	5.0	ND
Dibromomethane	ug/L	5.0	ND
Trichloroethene	ug/L	5.0	ND
1,2-Dichloropropane	ug/L	5.0	ND
Bromodichloromethane	ug/L	5.0	ND
4-Methyl-2-pentanone (MIBK)	ug/L	50	ND
cis-1,3-Dichloropropene	ug/L	5.0	ND
Toluene	ug/L	5.0	ND
trans-1,3-Dichloro-1-propene	ug/L	5.0	ND
1,1,2-Trichloroethane	ug/L	5.0	ND
Tetrachloroethylene	ug/L	5.0	ND

REPORT OF LABORATORY ANALYSIS

Pace Analytical

Pace Analytical Services, Inc.
54 Ravenscroft Drive
Asheville, NC 28801
Tel: 704-254-7176
Fax: 704-252-4618

QUALITY CONTROL DATA

October 28, 1996
PACE Project Number: A61016

Client Reference: Champion

APPENDIX I, LANDFILL VOLATILES
Batch: 92 51610
Samples: 93 0287387, 93 0287727

METHOD BLANK:

Parameter	Units	PRL	Method Blank
2-Hexanone	ug/L	50	ND
Dibromochloromethane	ug/L	5.0	ND
1,1,1,2-Tetrachloroethane	ug/L	5.0	ND
1,2-Dibromoethane	ug/L	5.0	ND
Chlorobenzene	ug/L	5.0	ND
Ethylbenzene	ug/L	5.0	ND
Xylenes, (total)	ug/L	5.0	ND
Styrene	ug/L	5.0	ND
Bromoform	ug/L	5.0	ND
trans-1,4-Dichloro-2-butene	ug/L	5.0	ND
1,1,2,2-Tetrachloroethane	ug/L	5.0	ND
1,2,3-Trichloropropane	ug/L	5.0	ND
1,4-Dichlorobenzene	ug/L	5.0	ND
1,2-Dichlorobenzene	ug/L	5.0	ND
1,2-Dibromo-3-chloropropane	ug/L	5.0	ND
Surrogate - Dibromofluoromethane	%		101
Surrogate - Toluene-d8	%		97
Surrogate - 4-Bromofluorobenzene	%		96

SPIKE AND SPIKE DUPLICATE:

Parameter	Units	PRL	930287670	Spike	Spike Recv	Spike Dupl Recv	F
Methyl Chloride	ug/L	10	ND	50	88%	82%	
Chloroethene (Vinyl chloride)	ug/L	10	ND	50	96%	88%	
Bromomethane	ug/L	10	ND	50	88%	94%	
Chloroethane	ug/L	10	14	50	96%	78%	2
Trichlorofluoromethane	ug/L	5.0	ND	50	96%	86%	1
1,1-Dichloroethene	ug/L	5.0	ND	50	94%	96%	
Acetone	ug/L	100	ND	100	190%	245%	2
Methyl iodide	ug/L	5.0	ND	100	80%	64%	2
Carbon disulfide	ug/L	5.0	ND	100	78%	75%	
Dichloromethane	ug/L	5.0	ND	50	102%	92%	1

REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA

October 28, 1996
PACE Project Number: A61016

Client Reference: Champion

APPENDIX I, LANDFILL VOLATILES
Batch: 92 51610
Samples: 93 0287387, 93 0287727

SPIKE AND SPIKE DUPLICATE:

Parameter	Units	PRL	930287670	Spike	Spike Recv	Spike Dupl Recv
Acrylonitrile	ug/L	100	ND	500	91%	122%
trans-1,2-Dichloroethene	ug/L	5.0	ND	50	96%	92%
1,1-Dichloroethane	ug/L	5.0	18	50	104%	96%
Vinyl acetate	ug/L	50	ND	100	109%	209%
Methyl ethyl ketone	ug/L	100	ND	100	58%	195%
cis-1,2-Dichloroethene	ug/L	5.0	ND	50	102%	104%
Bromochloromethane	ug/L	5.0	ND	50	104%	106%
Chloroform	ug/L	5.0	ND	50	100%	96%
1,1,1-Trichloroethane	ug/L	5.0	ND	50	102%	100%
Carbon tetrachloride	ug/L	5.0	ND	50	98%	102%
Benzene	ug/L	5.0	ND	50	108%	108%
1,2-Dichloroethane	ug/L	5.0	ND	50	116%	110%
Dibromomethane	ug/L	5.0	ND	50	98%	96%
Trichloroethene	ug/L	5.0	ND	50	96%	96%
1,2-Dichloropropane	ug/L	5.0	ND	50	106%	104%
Bromodichloromethane	ug/L	5.0	ND	50	94%	90%
4-Methyl-2-pentanone (MIBK)	ug/L	50	ND	100	126%	124%
cis-1,3-Dichloropropene	ug/L	5.0	ND	50	92%	92%
Toluene	ug/L	5.0	ND	50	98%	108%
trans-1,3-Dichloro-1-propene	ug/L	5.0	ND	50	94%	98%
1,1,2-Trichloroethane	ug/L	5.0	ND	50	104%	104%
Tetrachloroethylene	ug/L	5.0	ND	50	94%	90%
2-Hexanone	ug/L	50	ND	100	134%	122%
Dibromochloromethane	ug/L	5.0	ND	50	104%	90%
1,1,1,2-Tetrachloroethane	ug/L	5.0	ND	50	102%	94%
1,2-Dibromoethane	ug/L	5.0	ND	50	102%	94%
Chlorobenzene	ug/L	5.0	ND	50	110%	110%
Ethylbenzene	ug/L	5.0	ND	50	108%	104%
Xylenes, (total)	ug/L	5.0	ND	150	105%	104%
Styrene	ug/L	5.0	ND	50	102%	104%
Bromoform	ug/L	5.0	ND	50	108%	90%

REPORT OF LABORATORY ANALYSIS

Pace Analytical

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Mr. Jim Giauque
Page 10

QUALITY CONTROL DATA

October 28, 1996
PACE Project Number: A61016

Client Reference: Champion

APPENDIX I, LANDFILL VOLATILES
Batch: 92 51610
Samples: 93 0287387, 93 0287727

SPIKE AND SPIKE DUPLICATE:

Parameter	Units	PRL	930287670	Spike	Spike Recv	Spike Dupl Recv
trans-1,4-Dichloro-2-butene	ug/L	5.0	ND	50	104%	102%
1,1,2,2-Tetrachloroethane	ug/L	5.0	ND	50	108%	104%
1,2,3-Trichloropropane	ug/L	5.0	ND	50	114%	104%
1,4-Dichlorobenzene	ug/L	5.0	ND	50	98%	98%
1,2-Dichlorobenzene	ug/L	5.0	ND	50	98%	94%
1,2-Dibromo-3-chloropropane	ug/L	5.0	ND	50	104%	98%

LABORATORY CONTROL SAMPLE:

Parameter	Units	PRL	Reference Value	Recv
Methyl Chloride	ug/L	10	20	100%
Chloroethene (Vinyl chloride)	ug/L	10	20	100%
Bromomethane	ug/L	10	20	120%
Chloroethane	ug/L	10	20	95%
Trichlorofluoromethane	ug/L	5.0	20	95%
1,1-Dichloroethene	ug/L	5.0	20	100%
Acetone	ug/L	100	40	185%
Methyl iodide	ug/L	5.0	40	65%
Carbon disulfide	ug/L	5.0	40	80%
Dichloromethane	ug/L	5.0	20	110%
Acrylonitrile	ug/L	100	200	139%
trans-1,2-Dichloroethene	ug/L	5.0	20	100%
1,1-Dichloroethane	ug/L	5.0	20	105%
Vinyl acetate	ug/L	50	40	213%
Methyl ethyl ketone	ug/L	100	40	148%
cis-1,2-Dichloroethene	ug/L	5.0	20	100%
Bromochloromethane	ug/L	5.0	20	105%
Chloroform	ug/L	5.0	20	100%
1,1,1-Trichloroethane	ug/L	5.0	20	95%
Carbon tetrachloride	ug/L	5.0	20	95%
Benzene	ug/L	5.0	20	105%
1,2-Dichloroethane	ug/L	5.0	20	105%

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QUALITY CONTROL DATA

October 28, 1996
PACE Project Number: A61016

Client Reference: Champion

APPENDIX I, LANDFILL VOLATILES
Batch: 92 51610
Samples: 93 0287387, 93 0287727

LABORATORY CONTROL SAMPLE:

Parameter	Units	PRL	Reference Value	Recv
Dibromomethane	ug/L	5.0	20	105%
Trichloroethene	ug/L	5.0	20	100%
1,2-Dichloropropane	ug/L	5.0	20	105%
Bromodichloromethane	ug/L	5.0	20	95%
4-Methyl-2-pentanone (MIBK)	ug/L	50	40	123%
cis-1,3-Dichloropropene	ug/L	5.0	20	95%
Toluene	ug/L	5.0	20	110%
trans-1,3-Dichloro-1-propene	ug/L	5.0	20	105%
1,1,2-Trichloroethane	ug/L	5.0	20	105%
Tetrachloroethylene	ug/L	5.0	20	100%
2-Hexanone	ug/L	50	40	113%
Dibromochloromethane	ug/L	5.0	20	90%
1,1,1,2-Tetrachloroethane	ug/L	5.0	20	95%
1,2-Dibromoethane	ug/L	5.0	20	95%
Chlorobenzene	ug/L	5.0	20	105%
Ethylbenzene	ug/L	5.0	20	105%
Xylenes, (total)	ug/L	5.0	60	103%
Styrene	ug/L	5.0	20	100%
Bromoform	ug/L	5.0	20	90%
trans-1,4-Dichloro-2-butene	ug/L	5.0	20	90%
1,1,2,2-Tetrachloroethane	ug/L	5.0	20	100%
1,2,3-Trichloropropane	ug/L	5.0	20	100%
1,4-Dichlorobenzene	ug/L	5.0	20	105%
1,2-Dichlorobenzene	ug/L	5.0	20	105%
1,2-Dibromo-3-chloropropane	ug/L	5.0	20	105%

REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA

October 28, 1996
PACE Project Number: A61016

Client Reference: Champion

HERBICIDES, SELECTED CHLORINATED
Batch: 92 51797
Samples: 93 0287387

METHOD BLANK:

Parameter	Units	PRL	Method Blank
2,4-D	ug/L	12	ND
2,4,5-T	ug/L	2.0	ND
Silvex	ug/L	2.0	ND

LABORATORY CONTROL SAMPLE AND CONTROL SAMPLE DUPLICATE:

Parameter	Units	PRL	Reference Value	Recv	Dupl Recv	RF
2,4-D	ug/L	12	5.0	86%	84%	
2,4,5-T	ug/L	2.0	5.0	70%	70%	
					R1	
Silvex	ug/L	2.0	5.0	76%	76%	
				R1		

REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA

October 28, 1996
PACE Project Number: A6101

Client Reference: Champion

PESTICIDES AND PCBS
Batch: 92 51833
Samples: 93 0287387

METHOD BLANK:

Parameter	Units	PRL	Method Blank
alpha-BHC	ug/L	0.05	ND
beta-BHC	ug/L	0.05	ND
gamma-BHC (Lindane)	ug/L	0.05	ND
delta-BHC	ug/L	0.1	ND
Heptachlor	ug/L	0.05	ND
Aldrin	ug/L	0.05	ND
Heptachlor epoxide	ug/L	0.8	ND
Endosulfan I	ug/L	0.1	ND
Dieldrin	ug/L	0.02	ND
Endrin	ug/L	0.06	ND
4,4-DDD	ug/L	0.1	ND
Endosulfan II	ug/L	0.1	ND
4,4-DDT	ug/L	0.1	ND
4,4-DDE	ug/L	0.1	ND
Endrin aldehyde	ug/L	0.2	ND
Endosulfan sulfate	ug/L	0.7	ND
Methoxychlor	ug/L	0.5	ND
Toxaphene	ug/L	2.4	ND
Chlordane (tech)	ug/L	0.2	ND
Aroclor-1016	ug/L	1.0	ND
Aroclor-1221	ug/L	1.0	ND
Aroclor-1232	ug/L	1.0	ND
Aroclor-1242	ug/L	1.0	ND
Aroclor-1248	ug/L	1.0	ND
Aroclor-1254	ug/L	1.0	ND
Aroclor-1260	ug/L	1.0	ND

REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA

October 28, 1996
PACE Project Number: A6101E

Client Reference: Champion

PESTICIDES AND PCBS
Batch: 92 51833
Samples: 93 0287387

LABORATORY CONTROL SAMPLE:

Parameter	Units	PRL	Reference Value	Recv
alpha-BHC	ug/L	0.05	0.16	63%
beta-BHC	ug/L	0.05	0.16	56%
gamma-BHC (Lindane)	ug/L	0.05	0.16	50%
delta-BHC	ug/L	0.1	0.16	63%
Heptachlor	ug/L	0.05	0.16	63%
Aldrin	ug/L	0.05	0.16	63%
Heptachlor epoxide	ug/L	0.8	0.16	69%
Endosulfan I	ug/L	0.1	0.16	69%
Dieldrin	ug/L	0.02	0.16	75%
Endrin	ug/L	0.06	0.16	75%
4,4-DDD	ug/L	0.1	0.16	81%
Endosulfan II	ug/L	0.1	0.16	75%
4,4-DDT	ug/L	0.1	0.16	81%
4,4-DDE	ug/L	0.1	0.16	75%
Endrin aldehyde	ug/L	0.2	0.16	63%
Endosulfan sulfate	ug/L	0.7	0.16	88%
Methoxychlor	ug/L	0.5	0.40	93%

REPORT OF LABORATORY ANALYSIS

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Pace Analytical

FOOTNOTES
for pages 7 through 14

October 28, 1996
PACE Project Number: A61016

Client Reference: Champion

ND	Not detected at or above the PRL.
PRL	PACE Reporting Limit
R1	Recovery falls outside the quality control limit, however, this compound is not detected in the associated sample(s).
RPD	Relative Percent Difference

REPORT OF LABORATORY ANALYSIS

Pace Analytical

344112

CHAIN-OF-CUSTODY RECORD
Analytical Request

Client: Champion Int. Corp.
Address: 13th C-10
Canton, NC
Phone: 704-646-2028

Report To: J.A. Giangue
Bill To: J.A Giangue
P.O. # / Billing Reference: P.O.# C90233
Project Name / No.: L/F #6 AE Leachate

Pace Client No. 702105
Pace Project Manager
Pace Project No. A61016.502
*Requested Due Date:

Sampled By (PRINT): James A. Giangue
Sampler Signature
Date Sampled: 10/15/96

ITEM NO.	SAMPLE DESCRIPTION	TIME	MATRIX	PACE NO.	NO. OF CONTAINERS	PRESERVATIVES: UNPRESERVED	H_2SO_4	HNO_3	VOA	HCl	ANALYSES REQUEST: Metals	8080/8150	NO_3/F^-	8260	REMARKS
1	Metals	1410	Water	28736.1	1	X					X				
2	8080/8150	1437			3	X						X			
3	NO_3/F^-	1439			1	X							X		
4	8260	1444			2				X					X	
5				28732.1											
6	Travel Blank														VFW Lot ACH052096
7															
8															

COOLER NOS.	BAILERS	SHIPMENT METHOD: OUT DATE	RETURNED DATE

Additional Comments
Vials have air bubbles.
GM

ITEM NUMBER	RELINQUISHED BY / AFFILIATION	ACCEPTED BY / AFFILIATION	DATE	TIME
1			10/15/96	1705

SEE REVERSE SIDE FOR INSTRUCTIONS

Pace Analytical

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June 20, 1997

Mr. Jim Giauque
Champion International
P.O. Box C-10
Canton, NC 28716

RE: PACE Project No. A70522.517
Client Reference: L/F Leachate-Dieldrin

Dear Mr. Giauque:

Enclosed is the report of laboratory analyses for samples received May 22, 1997.

Footnotes are given at the end of the report.

If you have any questions concerning this report, please feel free to contact us.

Sincerely,

Walter L. Miller
Project Manager

Enclosures

REPORT OF LABORATORY ANALYSIS

Pace Analytical

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Fax: 704-252-4618

Champion International
P.O. Box C-10
Canton, NC 28716

June 20, 1997
PACE Project Number: A70522517

Attn: Mr. Jim Glauque

Client Reference: L/F Leachate-Dieldrin

PACE Sample Number:			93 0395600
Date Collected:			05/21/97
Date Received:			05/22/97
Client Sample ID:			L/F 6A
Parameter	Units	PRL	Leachate
ORGANIC ANALYSIS			
PESTICIDES AND PCBS, SW846			
Dieldrin	ug/L	0.02	ND

These data have been reviewed and are approved for release.

Walter L. Miller
General Manager

REPORT OF LABORATORY ANALYSIS

Pace Analytical

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Mr. Jim Giauque
Page 2

FOOTNOTES
for page 1

June 20, 1997
PACE Project Number: A70522517

Client Reference: L/F Leachate-Dieldrin

ND Not detected at or above the PRL.
PRL PACE Reporting Limit

REPORT OF LABORATORY ANALYSIS

ATTACHMENT B

HELP MODEL
B-1 LEAKAGE THROUGH LINER
B-2 GROUNDWATER RECHARGE

B-1 LEAKAGE THROUGH LINER

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*******************************************************************************
**                                                                           **
**                                                                           **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                **
**                   HELP MODEL VERSION 3.05a  (5 JUNE 1996)                 **
**                   DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                     USAE WATERWAYS EXPERIMENT STATION                     **
**                FOR USEPA RISK REDUCTION ENGINEERING LABORATORY            **
**                                                                           **
**                                                                           **
*******************************************************************************
*******************************************************************************
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PRECIPITATION DATA FILE: g:\cpc\nc\6a-west\help\CANTON.D4
TEMPERATURE DATA FILE: g:\cpc\nc\6a-west\help\canton.D7
SOLAR RADIATION DATA FILE: g:\cpc\nc\6a-west\help\canton.D13
EVAPOTRANSPIRATION DATA: g:\cpc\nc\6a-west\help\canton.D11
SOIL AND DESIGN DATA FILE: g:\cpc\nc\6a-west\help\6aw-bent.D10
OUTPUT DATA FILE: g:\cpc\nc\6a-west\help\6aw-bent.OUT

TIME: 16:58 DATE: 9/28/1998

****

TITLE: CHAMPION - LANDFILL 6A WEST - LEAKAGE w/bentomat (8 holes)

****

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

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	960.00	INCHES
POROSITY	=	0.4000	VOL/VOL
FIELD CAPACITY	=	0.3600	VOL/VOL
WILTING POINT	=	0.2800	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3655	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.139999997000E-05	CM/SEC

LAYER 2

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 21

THICKNESS	=	15.00	INCHES
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0320	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000012000	CM/SEC
SLOPE	=	5.00	PERCENT
DRAINAGE LENGTH	=	100.0	FEET

LAYER 3

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	8.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	1.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 4

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 17

THICKNESS	=	0.10	INCHES
POROSITY	=	0.7500	VOL/VOL
FIELD CAPACITY	=	0.7470	VOL/VOL
WILTING POINT	=	0.4000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.7500	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000003000E-08	CM/SEC

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	48.00	INCHES
POROSITY	=	0.4710	VOL/VOL
FIELD CAPACITY	=	0.3420	VOL/VOL
WILTING POINT	=	0.2100	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3419	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.499999987000E-04	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

SCS RUNOFF CURVE NUMBER	=	90.00	
FRACTION OF AREA ALLOWING RUNOFF	=	0.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	8.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.166	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	3.200	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.240	INCHES
INITIAL SNOW WATER	=	2.623	INCHES
INITIAL WATER IN LAYER MATERIALS	=	367.814	INCHES
TOTAL INITIAL WATER	=	370.437	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
ASHEVILLE NORTH CAROLINA

STATION LATITUDE	=	35.26	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	96	
END OF GROWING SEASON (JULIAN DATE)	=	298	
EVAPORATIVE ZONE DEPTH	=	8.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	7.60	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	71.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	75.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	84.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	77.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ASHEVILLE NORTH CAROLINA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.28	3.52	4.27	3.34	3.52	3.28
4.48	4.23	3.00	2.65	2.69	3.05

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ASHEVILLE NORTH CAROLINA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
36.80	39.10	46.40	55.70	63.30	69.80
73.20	72.60	66.90	56.00	46.40	39.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ASHEVILLE NORTH CAROLINA
AND STATION LATITUDE = 35.26 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 15

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.08	3.43	3.81	3.13	4.04	3.51
	4.03	3.94	2.52	2.24	2.86	3.14
STD. DEVIATIONS	1.33	1.85	2.32	1.66	1.36	1.47
	1.52	1.79	1.45	1.26	2.00	1.73
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

EVAPOTRANSPIRATION

TOTALS	0.780	1.028	1.656	2.174	2.836	3.071
	2.916	2.482	1.640	1.100	1.212	0.565
STD. DEVIATIONS	0.394	0.555	1.306	2.108	2.821	3.049
	2.920	2.473	1.760	1.179	0.781	0.339

LATERAL DRAINAGE COLLECTED FROM LAYER 2

TOTALS	0.7055	0.5880	0.5947	0.5894	0.6573	0.6537
	0.6776	0.7622	0.8539	0.8645	0.8638	0.7612
STD. DEVIATIONS	0.4938	0.4722	0.5143	0.4997	0.5553	0.5167
	0.5205	0.4709	0.3605	0.3536	0.3420	0.4889

PERCOLATION/LEAKAGE THROUGH LAYER 4

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

PERCOLATION/LEAKAGE THROUGH LAYER 5

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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	0.0268	0.0246	0.0226	0.0232	0.0250	0.0257
	0.0258	0.0290	0.0336	0.0329	0.0339	0.0289
STD. DEVIATIONS	0.0188	0.0198	0.0196	0.0196	0.0211	0.0203
	0.0198	0.0179	0.0142	0.0134	0.0134	0.0186

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 15

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.73 (4.479)	144205.4	100.00
RUNOFF	0.000 (0.0000)	0.00	0.000
EVAPOTRANSPIRATION	21.459 (17.8486)	77896.57	54.018
LATERAL DRAINAGE COLLECTED FROM LAYER 2	8.57188 (4.93152)	31115.926	21.57751
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00001 (0.00000)	0.022	0.00002
AVERAGE HEAD ON TOP OF LAYER 3	0.028 (0.016)		
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00000 (0.00000)	0.000	0.00000
CHANGE IN WATER STORAGE	9.520 (17.6218)	34557.62	23.964

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 15

	(INCHES)	(CU. FT.)
PRECIPITATION	2.99	10853.700
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 2	0.04762	172.86516
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000000	0.00010
AVERAGE HEAD ON TOP OF LAYER 3	0.056	
MAXIMUM HEAD ON TOP OF LAYER 3	0.111	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	0.9 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000000	0.00000
SNOW WATER	122.47	444571.0310

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3958
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.2800

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

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

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FINAL WATER STORAGE AT END OF YEAR 15

LAYER	(INCHES)	(VOL/VOL)
1	373.3469	0.3889
2	0.4878	0.0325
3	0.0000	0.0000
4	0.0750	0.7500
5	16.4130	0.3419
SNOW WATER	122.914	

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**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                   **
**                   HELP MODEL VERSION 3.05a  (5 JUNE 1996)                     **
**                   DEVELOPED BY ENVIRONMENTAL LABORATORY                      **
**                     USAE WATERWAYS EXPERIMENT STATION                        **
**                FOR USEPA RISK REDUCTION ENGINEERING LABORATORY               **
**                                                                              **
**                                                                              **
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PRECIPITATION DATA FILE:     h:\CHP\nc\6a-west\HELP\CANTON2.D4
TEMPERATURE DATA FILE:       h:\CHP\nc\6a-west\HELP\CANTON2.D7
SOLAR RADIATION DATA FILE:   h:\CHP\nc\6a-west\HELP\CANTON2.D13
EVAPOTRANSPIRATION DATA:     h:\CHP\nc\6a-west\HELP\CANTON2.D11
SOIL AND DESIGN DATA FILE:   h:\CHP\nc\6a-west\HELP\covered.D10
OUTPUT DATA FILE:            h:\CHP\nc\6a-west\HELP\covered.OUT

TIME:  11:11     DATE:   3/ 5/1998

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  TITLE:  CHAMPION - LANDFILL 6A WEST - LEAKAGE THROUGH LINER

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


                                  LAYER  1
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                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER  12
          THICKNESS                     =      6.00   INCHES
          POROSITY                      =      0.4710 VOL/VOL
          FIELD CAPACITY                =      0.3420 VOL/VOL
          WILTING POINT                 =      0.2100 VOL/VOL
          INITIAL SOIL WATER CONTENT    =      0.3308 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =  0.419999997000E-04 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.20
                 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                  LAYER  2
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                  TYPE 2 - LATERAL DRAINAGE LAYER
                    MATERIAL TEXTURE NUMBER  21
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THICKNESS	=	12.00	INCHES
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0482	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000012000	CM/SEC
SLOPE	=	5.00	PERCENT
DRAINAGE LENGTH	=	250.0	FEET

LAYER 3

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.04	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	0.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	0.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	4 - POOR	

LAYER 4

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

THICKNESS	=	36.00	INCHES
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06	CM/SEC

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	960.00	INCHES
POROSITY	=	0.4000	VOL/VOL
FIELD CAPACITY	=	0.3600	VOL/VOL
WILTING POINT	=	0.2800	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3600	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.139999997000E-05	CM/SEC

LAYER 6

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 21

THICKNESS	=	15.00	INCHES

POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0320	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000012000	CM/SEC
SLOPE	=	5.00	PERCENT
DRAINAGE LENGTH	=	100.0	FEET

LAYER 7

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

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

LAYER 8

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	48.00	INCHES
POROSITY	=	0.4710	VOL/VOL
FIELD CAPACITY	=	0.3420	VOL/VOL
WILTING POINT	=	0.2100	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4710	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.499999987000E-04	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #12 WITH A GOOD STAND OF GRASS, A SURFACE SLOPE OF 5.% AND A SLOPE LENGTH OF 250. FEET.

SCS RUNOFF CURVE NUMBER	=	83.70	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	18.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.203	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	7.590	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.416	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	386.623	INCHES
TOTAL INITIAL WATER	=	386.623	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
ASHEVILLE NORTH CAROLINA

STATION LATITUDE	=	35.26 DEGREES
MAXIMUM LEAF AREA INDEX	=	3.00
START OF GROWING SEASON (JULIAN DATE)	=	96
END OF GROWING SEASON (JULIAN DATE)	=	298
EVAPORATIVE ZONE DEPTH	=	18.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	7.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	71.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	75.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	84.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	77.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ASHEVILLE NORTH CAROLINA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.28	3.52	4.27	3.34	3.52	3.28
4.48	4.23	3.00	2.65	2.69	3.05

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ASHEVILLE NORTH CAROLINA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
36.80	39.10	46.40	55.70	63.30	69.80
73.20	72.60	66.90	56.00	46.40	39.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ASHEVILLE NORTH CAROLINA
AND STATION LATITUDE = 35.26 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 15

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.08	3.43	3.81	3.13	4.04	3.51
	4.03	3.94	2.52	2.24	2.86	3.14

STD. DEVIATIONS	1.33	1.85	2.32	1.66	1.36	1.47
	1.52	1.79	1.45	1.26	2.00	1.73

RUNOFF

TOTALS	0.227	0.294	0.074	0.015	0.062	0.028
	0.022	0.073	0.041	0.017	0.122	0.042
STD. DEVIATIONS	0.358	0.764	0.107	0.028	0.104	0.071
	0.033	0.192	0.098	0.034	0.218	0.062

EVAPOTRANSPIRATION

TOTALS	1.150	1.508	2.381	2.517	3.198	3.296
	3.365	2.864	2.058	1.388	1.078	0.798
STD. DEVIATIONS	0.262	0.343	0.524	1.005	1.045	0.940
	1.123	0.750	0.771	0.612	0.329	0.185

LATERAL DRAINAGE COLLECTED FROM LAYER 2

TOTALS	2.0862	1.7546	1.5550	0.9975	0.7827	0.3370
	0.4928	0.8346	0.4348	0.6773	1.4361	1.7421
STD. DEVIATIONS	1.2978	1.4915	1.7504	0.9259	0.7995	0.4278
	0.6859	0.9262	0.6289	0.9425	1.5437	1.1100

PERCOLATION/LEAKAGE THROUGH LAYER 4

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

LATERAL DRAINAGE COLLECTED FROM LAYER 6

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

PERCOLATION/LEAKAGE THROUGH LAYER 8

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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	0.1983	0.1838	0.1479	0.0981	0.0745	0.0332
	0.0469	0.0794	0.0427	0.0644	0.1411	0.1656
STD. DEVIATIONS	0.1234	0.1573	0.1664	0.0910	0.0760	0.0421
	0.0652	0.0881	0.0618	0.0896	0.1517	0.1055

DAILY AVERAGE HEAD ON TOP OF LAYER 7

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 15

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.73 (4.479)	144205.4	100.00
RUNOFF	1.015 (1.0295)	3684.59	2.555
EVAPOTRANSPIRATION	25.600 (2.7254)	92928.22	64.442
LATERAL DRAINAGE COLLECTED FROM LAYER 2	13.13061 (3.63342)	47664.113	33.05294
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00001 (0.00000)	0.025	0.00002
AVERAGE HEAD ON TOP OF LAYER 3	0.106 (0.030)		
LATERAL DRAINAGE COLLECTED FROM LAYER 6	0.00001 (0.00000)	0.021	0.00001
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00000 (0.00000)	0.004	0.00000
AVERAGE HEAD ON TOP OF LAYER 7	0.000 (0.000)		
CHANGE IN WATER STORAGE	-0.020 (1.4797)	-71.55	-0.050

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 15

	(INCHES)	(CU. FT.)
PRECIPITATION	2.99	10853.700
RUNOFF	1.157	4201.1709
DRAINAGE COLLECTED FROM LAYER 2	1.11788	4057.90308
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000001	0.00203
AVERAGE HEAD ON TOP OF LAYER 3	3.295	
MAXIMUM HEAD ON TOP OF LAYER 3	5.923	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	24.7 FEET	
DRAINAGE COLLECTED FROM LAYER 6	0.00000	0.00157
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000000	0.00003
AVERAGE HEAD ON TOP OF LAYER 7	0.000	
MAXIMUM HEAD ON TOP OF LAYER 7	0.005	
LOCATION OF MAXIMUM HEAD IN LAYER 6 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	5.37	19489.3320

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.2560
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0787

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

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

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FINAL WATER STORAGE AT END OF YEAR 15

LAYER	(INCHES)	(VOL/VOL)
1	2.0750	0.3458
2	0.8325	0.0694
3	0.0000	0.0000
4	15.3720	0.4270
5	345.6000	0.3600
6	0.4800	0.0320
7	0.0000	0.0000
8	22.6080	0.4710
SNOW WATER	0.000	

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B-2 LEAKAGE THROUGH CAP (6A-East)

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**                                                                  **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE        **
**                   HELP MODEL VERSION 3.05a  (5 JUNE 1996)        **
**                   DEVELOPED BY ENVIRONMENTAL LABORATORY          **
**                     USAE WATERWAYS EXPERIMENT STATION            **
**                FOR USEPA RISK REDUCTION ENGINEERING LABORATORY    **
**                                                                  **
**                                                                  **
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PRECIPITATION DATA FILE: g:\cpc\nc\6a-west\help\CANTON2.D4
TEMPERATURE DATA FILE: g:\cpc\nc\6a-west\help\CANTON2.D7
SOLAR RADIATION DATA FILE: g:\cpc\nc\6a-west\help\CANTON2.D13
EVAPOTRANSPIRATION DATA: g:\cpc\nc\6a-west\help\CANTON2.D11
SOIL AND DESIGN DATA FILE: g:\cpc\nc\6a-west\help\covered.D10
OUTPUT DATA FILE: g:\cpc\nc\6a-west\help\covered.OUT

TIME: 14: 6 DATE: 2/23/1999

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TITLE: CHAMPION - LANDFILL 6A EAST - LEAKAGE THROUGH CAP

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

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 12

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4710	VOL/VOL
FIELD CAPACITY	=	0.3420	VOL/VOL
WILTING POINT	=	0.2100	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3702	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.499999987000E-04	CM/SEC

NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 4.20 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

THICKNESS	=	24.00	INCHES
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.499999987000E-04	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 21

THICKNESS	=	12.00	INCHES
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0547	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000012000	CM/SEC
SLOPE	=	5.00	PERCENT
DRAINAGE LENGTH	=	250.0	FEET

LAYER 4

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4000	VOL/VOL
FIELD CAPACITY	=	0.3600	VOL/VOL
WILTING POINT	=	0.2800	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.139999997000E-05	CM/SEC

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	960.00	INCHES

POROSITY	=	0.4000 VOL/VOL
FIELD CAPACITY	=	0.3600 VOL/VOL
WILTING POINT	=	0.2800 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3624 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.139999997000E-05 CM/SEC

LAYER 6

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 21

THICKNESS	=	15.00 INCHES
POROSITY	=	0.3970 VOL/VOL
FIELD CAPACITY	=	0.0320 VOL/VOL
WILTING POINT	=	0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0320 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000012000 CM/SEC
SLOPE	=	5.00 PERCENT
DRAINAGE LENGTH	=	100.0 FEET

LAYER 7

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

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

LAYER 8

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	48.00 INCHES
POROSITY	=	0.4710 VOL/VOL
FIELD CAPACITY	=	0.3420 VOL/VOL
WILTING POINT	=	0.2100 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4710 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.499999987000E-04 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #12 WITH A GOOD STAND OF GRASS, A SURFACE SLOPE OF 5.% AND A SLOPE LENGTH OF 250. FEET.

SCS RUNOFF CURVE NUMBER	=	85.00	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	4.443	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	5.652	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.520	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	391.157	INCHES
TOTAL INITIAL WATER	=	391.157	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM ASHEVILLE NORTH CAROLINA

STATION LATITUDE	=	35.26 DEGREES
MAXIMUM LEAF AREA INDEX	=	3.00
START OF GROWING SEASON (JULIAN DATE)	=	96
END OF GROWING SEASON (JULIAN DATE)	=	298
EVAPORATIVE ZONE DEPTH	=	12.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	7.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	71.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	75.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	84.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	77.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR ASHEVILLE NORTH CAROLINA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.28	3.52	4.27	3.34	3.52	3.28
4.48	4.23	3.00	2.65	2.69	3.05

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ASHEVILLE NORTH CAROLINA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
36.80	39.10	46.40	55.70	63.30	69.80
73.20	72.60	66.90	56.00	46.40	39.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ASHEVILLE NORTH CAROLINA
AND STATION LATITUDE = 35.26 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 15

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.08	3.43	3.81	3.13	4.04	3.51
	4.03	3.94	2.52	2.24	2.86	3.14
STD. DEVIATIONS	1.33	1.85	2.32	1.66	1.36	1.47
	1.52	1.79	1.45	1.26	2.00	1.73
RUNOFF						
TOTALS	0.270	0.355	0.113	0.028	0.089	0.038
	0.039	0.105	0.049	0.032	0.169	0.071
STD. DEVIATIONS	0.384	0.852	0.153	0.042	0.139	0.093
	0.054	0.253	0.108	0.061	0.286	0.099
EVAPOTRANSPIRATION						
TOTALS	1.136	1.503	2.536	2.868	3.608	3.510
	3.566	2.994	2.263	1.525	1.057	0.788
STD. DEVIATIONS	0.248	0.345	0.390	1.021	1.084	1.059
	1.224	0.739	0.868	0.725	0.308	0.169
PERCOLATION/LEAKAGE THROUGH LAYER 2						
TOTALS	1.9094	1.7467	1.5212	0.7448	0.4442	0.1129
	0.2655	0.5553	0.2574	0.4374	1.3177	1.7228

STD. DEVIATIONS	1.1452	1.4680	1.7401	0.8384	0.6878	0.1759
	0.4527	0.9598	0.4918	0.7735	1.4903	1.1076

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	1.4451	1.2864	1.1280	0.5294	0.3224	0.0622
	0.1877	0.4027	0.2090	0.3220	0.9801	1.2119
STD. DEVIATIONS	0.9503	1.2285	1.4440	0.6214	0.5470	0.1060
	0.3496	0.7379	0.4191	0.6396	1.1981	0.8348

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.5512	0.4513	0.3838	0.2419	0.1216	0.0509
	0.0684	0.1289	0.0812	0.1147	0.3309	0.4353
STD. DEVIATIONS	0.2415	0.2836	0.3172	0.2761	0.1486	0.0764
	0.0956	0.2107	0.1081	0.1515	0.2998	0.2942

LATERAL DRAINAGE COLLECTED FROM LAYER 6

TOTALS	0.1324	0.0858	0.0861	0.1170	0.1781	0.2145
	0.2595	0.2619	0.2355	0.2390	0.2429	0.1998
STD. DEVIATIONS	0.0925	0.0450	0.0718	0.0937	0.1259	0.1402
	0.1365	0.1083	0.0761	0.0901	0.0876	0.1076

PERCOLATION/LEAKAGE THROUGH LAYER 8

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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	0.0864	0.0947	0.0665	0.0401	0.0213	0.0064
	0.0094	0.0296	0.0060	0.0258	0.0625	0.0726
STD. DEVIATIONS	0.0654	0.0750	0.0719	0.0451	0.0337	0.0107
	0.0190	0.0495	0.0114	0.0514	0.0759	0.0558

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.1377	0.1351	0.1074	0.0521	0.0307	0.0061
	0.0179	0.0383	0.0206	0.0307	0.0965	0.1155
STD. DEVIATIONS	0.0903	0.1296	0.1373	0.0611	0.0520	0.0104
	0.0333	0.0702	0.0412	0.0608	0.1178	0.0794

DAILY AVERAGE HEAD ON TOP OF LAYER 7

AVERAGES	0.0050	0.0036	0.0033	0.0046	0.0068	0.0084
	0.0099	0.0100	0.0093	0.0091	0.0095	0.0076
STD. DEVIATIONS	0.0035	0.0019	0.0027	0.0037	0.0048	0.0055
	0.0052	0.0041	0.0030	0.0034	0.0034	0.0041

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 15

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.73 (4.479)	144205.4	100.00
RUNOFF	1.357 (1.1615)	4927.69	3.417
EVAPOTRANSPIRATION	27.354 (2.9096)	99296.37	68.858
PERCOLATION/LEAKAGE THROUGH LAYER 2	11.03539 (3.61451)	40058.453	27.77875
AVERAGE HEAD ON TOP OF LAYER 2	0.043 (0.015)		
LATERAL DRAINAGE COLLECTED FROM LAYER 3	8.08698 (2.90405)	29355.730	20.35689
PERCOLATION/LEAKAGE THROUGH LAYER 4	2.96008 (0.83737)	10745.104	7.45125
AVERAGE HEAD ON TOP OF LAYER 4	0.066 (0.024)		
LATERAL DRAINAGE COLLECTED FROM LAYER 6	2.25252 (0.81143)	8176.633	5.67013
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00039 (0.00013)	1.410	0.00098
AVERAGE HEAD ON TOP OF LAYER 7	0.007 (0.003)		
CHANGE IN WATER STORAGE	0.674 (1.7772)	2447.55	1.697

****

PEAK DAILY VALUES FOR YEARS 1 THROUGH 15

	(INCHES)	(CU. FT.)
PRECIPITATION	2.99	10853.700
RUNOFF	1.200	4355.0679
PERCOLATION/LEAKAGE THROUGH LAYER 2	1.617410	5871.19775
AVERAGE HEAD ON TOP OF LAYER 2	3.008	
DRAINAGE COLLECTED FROM LAYER 3	0.91107	3307.20215
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.058277	211.54575
AVERAGE HEAD ON TOP OF LAYER 4	2.685	
MAXIMUM HEAD ON TOP OF LAYER 4	4.894	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	21.6 FEET	
DRAINAGE COLLECTED FROM LAYER 6	0.02279	82.72500
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000004	0.01286
AVERAGE HEAD ON TOP OF LAYER 7	0.027	
MAXIMUM HEAD ON TOP OF LAYER 7	0.053	
LOCATION OF MAXIMUM HEAD IN LAYER 6 (DISTANCE FROM DRAIN)	0.2 FEET	
SNOW WATER	5.37	19489.3320
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4223	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.2100	

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

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

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FINAL WATER STORAGE AT END OF YEAR 15

LAYER	(INCHES)	(VOL/VOL)
1	4.1239	0.3437
2	10.2480	0.4270
3	0.4812	0.0401
4	4.8000	0.4000
5	358.5281	0.3735
6	0.4822	0.0321
7	0.0000	0.0000
8	22.6080	0.4710
SNOW WATER	0.000	

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MONTHLY PRECIPITATION STATS FOR CANTON, N.C. (d:\cpc\nc\stats2.txt)
DATE: 01/13/97

SOURCE: RAINFALL DATA FROM NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION.
MONTHLY AVERAGES BASED ON 63 YEARS OF RECORD (1931-1993).
MISSING MONTHLY DATA WAS NOT INCLUDED IN MONTHLY AVERAGES.

JAN	NUMBER OF YEARS OF DATA	=	61
	MONTHLY AVERAGE (inches)	=	3.3
FEB	NUMBER OF YEARS OF DATA	=	62
	MONTHLY AVERAGE (inches)	=	3.5
MAR	NUMBER OF YEARS OF DATA	=	63
	MONTHLY AVERAGE (inches)	=	4.3
APR	NUMBER OF YEARS OF DATA	=	63
	MONTHLY AVERAGE (inches)	=	3.3
MAY	NUMBER OF YEARS OF DATA	=	61
	MONTHLY AVERAGE (inches)	=	3.5
JUN	NUMBER OF YEARS OF DATA	=	62
	MONTHLY AVERAGE (inches)	=	3.3
JUL	NUMBER OF YEARS OF DATA	=	62
	MONTHLY AVERAGE (inches)	=	4.5
AUG	NUMBER OF YEARS OF DATA	=	61
	MONTHLY AVERAGE (inches)	=	4.2
SEP	NUMBER OF YEARS OF DATA	=	62
	MONTHLY AVERAGE (inches)	=	3.0
OCT	NUMBER OF YEARS OF DATA	=	62
	MONTHLY AVERAGE (inches)	=	2.6
NOV	NUMBER OF YEARS OF DATA	=	62
	MONTHLY AVERAGE (inches)	=	2.7
DEC	NUMBER OF YEARS OF DATA	=	62
	MONTHLY AVERAGE (inches)	=	3.0

TABLE 1. DEFAULT LOW DENSITY SOIL CHARACTERISTICS

Soil Texture Class			Total Porosity vol/vol	Field Capacity vol/vol	Wilting Point vol/vol	Saturated Hydraulic Conductivity cm/sec
HELP	USDA	USCS				
1	CoS	SP	0.417	0.045	0.018	1.0×10^{-2}
2	S	SW	0.437	0.062	0.024	5.8×10^{-3}
3	FS	SW	0.457	0.083	0.033	3.1×10^{-3}
4	LS	SM	0.437	0.105	0.047	1.7×10^{-3}
5	LFS	SM	0.457	0.131	0.058	1.0×10^{-3}
6	SL	SM	0.453	0.190	0.085	7.2×10^{-4}
7	FSL	SM	0.473	0.222	0.104	5.2×10^{-4}
8	L	ML	0.463	0.232	0.116	3.7×10^{-4}
9	SiL	ML	0.501	0.284	0.135	1.9×10^{-4}
10	SCL	SC	0.398	0.244	0.136	1.2×10^{-4}
11	CL	CL	0.464	0.310	0.187	6.4×10^{-5}
12	SiCL	CL	0.471	0.342	0.210	4.2×10^{-5}
13	SC	SC	0.430	0.321	0.221	3.3×10^{-5}
14	SiC	CH	0.479	0.371	0.251	2.5×10^{-5}
15	C	CH	0.475	0.378	0.251	2.5×10^{-5}
21	G	GP	0.397	0.032	0.013	3.0×10^{-1}

a = constant representing the effects of various fluid constants and gravity, 21 cm^3/sec

ϕ = total porosity, vol/vol

θ_r = residual volumetric water content, vol/vol

ψ_b = bubbling pressure, cm

λ = pore-size distribution index, dimensionless

A more detailed explanation of Equation 11 can be found in Appendix A of the HELP program Version 3 User's Guide and the cited references.

TABLE 2. MODERATE AND HIGH DENSITY DEFAULT SOILS

Soil Texture Class			Total Porosity vol/vol	Field Capacity vol/vol	Wilting Point vol/vol	Saturated Hydraulic Conductivity cm/sec
HELP	USDA	USCS				
22	L (Moderate)	ML	0.419	0.307	0.180	1.9×10^{-5}
23	SiL (Moderate)	ML	0.461	0.360	0.203	9.0×10^{-6}
24	SCL (Moderate)	SC	0.365	0.305	0.202	2.7×10^{-6}
25	CL (Moderate)	CL	0.437	0.373	0.266	3.6×10^{-6}
26	SiCL (Moderate)	CL	0.445	0.393	0.277	1.9×10^{-6}
27	SC (Moderate)	SC	0.400	0.366	0.288	7.8×10^{-7}
28	SiC (Moderate)	CH	0.452	0.411	0.311	1.2×10^{-6}
29	C (Moderate)	CH	0.451	0.419	0.332	6.8×10^{-7}
16	Liner Soil (High)		0.427	0.418	0.367	1.0×10^{-7}
17	Bentonite (High)		0.750	0.747	0.400	3.0×10^{-9}

Waste Product! Porosity, Field Capacity & Wilting Point

3.5.2 Default Waste Characteristics

Table 4 provides a summary of default moisture retention values for various waste layers. Municipal waste properties provided in Tchobanoglous et al. (1977) and Equations 6 and 7 were used to determine the total porosity, field capacity, and wilting point of a well compacted municipal waste. The field capacity and wilting point were calculated using Tchobanoglous et al.'s high and low water content values, respectively. Oweis et al. (1990) provided information on the in-situ saturated hydraulic conductivity of municipal waste. Zeiss and Major (1993) described the moisture flow through

The saturated hydraulic conductivities of the ash and slag wastes were taken directly from the references. The saturated hydraulic conductivities of the coal burning electric plant ashes at maximum dry density were determined in-situ and the maximum dry density municipal solid waste incinerator ash and fine copper slag values were determined by laboratory methods. The saturated hydraulic conductivities of various other waste materials are provided in Table 5. Similar to default soils, the HELP program uses Equation 8 to adjust the saturated hydraulic conductivities of the default wastes in the top half of the evaporative zone to account for root penetration.

A more detailed explanation of the calculation procedure used for the ash and slag wastes can be found in Appendix A of the HELP program Version 3 User's Guide. Like the soil properties, the default waste properties were determined using empirical equations developed from soil data. Therefore, these values should not be used in place of a detailed laboratory and field testing program.

TABLE 5. SATURATED HYDRAULIC CONDUCTIVITY OF WASTES

Waste Material	Saturated Hydraulic Conductivity cm/sec*	Reference
Stabilized Incinerator Fly Ash	8.8×10^{-5}	Poran and Ahtchi-Ali (1989)
High-Density Pulverized Fly Ash	2.5×10^{-5}	Swain (1979)
Solidified Waste	4.0×10^{-2}	Rushbrook et al. (1989)
Electroplating Sludge	1.6×10^{-5}	Bartos and Palermo (1977)
Nickel/Cadmium Battery Sludge	3.5×10^{-6}	"
Inorganic Pigment Sludge	5.0×10^{-6}	"
Brine Sludge - Chlorine Production	8.2×10^{-5}	"
Calcium Fluoride Sludge	3.2×10^{-5}	"
[illegible] Ash-Papermill Sludge	1.4×10^{-3}	Perry and Schultz (1977)

* - Determined by laboratory methods.

3.5.3 Default Geosynthetic Material Characteristics

Table 6 provides a summary of default properties for various geosynthetic materials. The values were extracted from Geotechnical Fabrics Report--1992 Specifiers Guide (Industrial Fabrics Association International, 1991) and Giroud and Bonaparte (1985).

3.6 SOIL MOISTURE INITIALIZATION

The soil moisture of the layers may be initialized by the user or the program. If initialized by the program, the soil moisture is initialized near steady-state using a three step procedure. The first step sets the soil moisture of all liners to porosity or saturation and the moisture of all other layers to field capacity.

In the second step the program computes a soil moisture for each layer below the top liner system. These soil moistures are computed to yield an unsaturated hydraulic conductivity equal to 85% of the lowest effective saturated hydraulic conductivity of all

TABLE 6. DEFAULT GEOSYNTHETIC MATERIAL CHARACTERISTICS

Geosynthetic Material Description		Saturated Hydraulic Conductivity cm/sec
HELP	Geosynthetic Material	
20	Drainage Net (0.5 cm)	$1.0 \times 10^{+1}$
34	Drainage Net (0.6 cm)	$3.3 \times 10^{+1}$
35	High Density Polyethylene (HDPE) Membrane	2.0×10^{-13}
36	Low Density Polyethylene (LDPE) Membrane	4.0×10^{-13}
37	Polyvinyl Chloride (PVC) Membrane	2.0×10^{-11}
38	Butyl Rubber Membrane	1.0×10^{-12}
39	Chlorinated Polyethylene (CPE) Membrane	4.0×10^{-12}
40	Hypalon or Chlorosulfonated Polyethylene (CSPE) Membrane	3.0×10^{-12}
41	Ethylene-Propylene Diene Monomer (EPDM) Membrane	2.0×10^{-12}
42	Neoprene Membrane	3.0×10^{-12}

B-2 GROUNDWATER RECHARGE

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**
** HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE **
** HELP MODEL VERSION 3.05a (5 JUNE 1996) **
** DEVELOPED BY ENVIRONMENTAL LABORATORY **
** USAE WATERWAYS EXPERIMENT STATION **
** FOR USEPA RISK REDUCTION ENGINEERING LABORATORY **
**
**
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****

PRECIPITATION DATA FILE: D:\CHP\NC\HELP\CANTON2.D4
TEMPERATURE DATA FILE: D:\CHP\NC\HELP\CANTON2.D7
SOLAR RADIATION DATA FILE: D:\CHP\NC\HELP\CANTON2.D13
EVAPOTRANSPIRATION DATA: D:\CHP\NC\HELP\CANTON2.D11
SOIL AND DESIGN DATA FILE: D:\CHP\NC\HELP\6AW-GWR.D10
OUTPUT DATA FILE: D:\CHP\NC\HELP\6AW-GWR.OUT

TIME: 9:57 DATE: 10/ 3/1997

****

TITLE: CHAMPION - LANDFILL 6A WEST - RECHARGE TO GW

****

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

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 12

THICKNESS	=	240.00	INCHES
POROSITY	=	0.4710	VOL/VOL
FIELD CAPACITY	=	0.3420	VOL/VOL
WILTING POINT	=	0.2100	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3619	VOL/VOL

EFFECTIVE SAT. HYD. COND. = 0.419999997000E-04 CM/SEC
NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 4.20
FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE #12 WITH A
FAIR STAND OF GRASS, A SURFACE SLOPE OF 50.%
AND A SLOPE LENGTH OF 300. FEET.

SCS RUNOFF CURVE NUMBER	=	88.70	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	18.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	6.742	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	8.478	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	3.780	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	86.850	INCHES
TOTAL INITIAL WATER	=	86.850	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
ASHEVILLE NORTH CAROLINA

STATION LATITUDE	=	35.26	DEGREES
MAXIMUM LEAF AREA INDEX	=	3.00	
START OF GROWING SEASON (JULIAN DATE)	=	96	
END OF GROWING SEASON (JULIAN DATE)	=	298	
EVAPORATIVE ZONE DEPTH	=	18.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	7.60	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	71.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	75.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	84.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	77.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ASHEVILLE NORTH CAROLINA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.28	3.52	4.27	3.34	3.52	3.28
4.48	4.23	3.00	2.65	2.69	3.05

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ASHEVILLE NORTH CAROLINA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
36.80	39.10	46.40	55.70	63.30	69.80
73.20	72.60	66.90	56.00	46.40	39.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ASHEVILLE NORTH CAROLINA
AND STATION LATITUDE = 35.26 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 15

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.08	3.43	3.81	3.13	4.04	3.51
	4.03	3.94	2.52	2.24	2.86	3.14
STD. DEVIATIONS	1.33	1.85	2.32	1.66	1.36	1.47
	1.52	1.79	1.45	1.26	2.00	1.73
RUNOFF						
TOTALS	0.387	0.453	0.270	0.095	0.216	0.085
	0.122	0.217	0.108	0.062	0.304	0.173
STD. DEVIATIONS	0.413	0.818	0.348	0.088	0.284	0.154
	0.141	0.368	0.192	0.090	0.457	0.189

EVAPOTRANSPIRATION

TOTALS	1.085	1.467	2.545	3.040	4.233	3.613
	3.657	2.939	2.528	1.614	0.958	0.725
STD. DEVIATIONS	0.254	0.352	0.285	0.806	0.954	1.041
	1.256	0.767	0.909	0.753	0.258	0.165

PERCOLATION/LEAKAGE THROUGH LAYER 1

TOTALS	0.2621	0.4363	0.8399	1.2481	1.3451	1.2090
	0.9847	0.7822	0.5818	0.5449	0.4859	0.3139
STD. DEVIATIONS	0.1396	0.3813	0.5749	0.8213	0.5869	0.4660
	0.2818	0.2183	0.1916	0.2401	0.1999	0.1794

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 15

	INCHES		CU. FEET	PERCENT
PRECIPITATION	39.73	(4.479)	144205.4	100.00
RUNOFF	2.492	(1.2987)	9045.12	6.272
EVAPOTRANSPIRATION	28.404	(3.0914)	103105.91	71.499
PERCOLATION/LEAKAGE THROUGH LAYER 1	9.03387	(2.83991)	32792.961	22.74046
CHANGE IN WATER STORAGE	-0.203	(2.7721)	-738.61	-0.512

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 15

	(INCHES)	(CU. FT.)
PRECIPITATION	2.99	10853.700
RUNOFF	1.195	4338.7646
PERCOLATION/LEAKAGE THROUGH LAYER 1	0.184828	670.92499
SNOW WATER	5.37	19489.3320

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4000
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.2100

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FINAL WATER STORAGE AT END OF YEAR 15

LAYER	(INCHES)	(VOL/VOL)
1	83.7976	0.3492
SNOW WATER	0.000	

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APPENDIX C

MASS BALANCE ANALYSIS CALCULATION

Champion International Corporation
Area 6A West
Mass Balance Calculation for 2L Standard

GIVEN:

Watershed Area (Acres)	38	
Landfill Area- Open (Acres)	15	
Landfill Area- Closed (Acres)	14	
Precipitation Recharge (in/yr)	9	HELP Model (Groundwater Recharge)
Landfill Leakage Rate-open (cf/ac/yr)	4.67	HELP Model (Leakage through liner - 6A-West)
Landfill Leakage Rate-closed (cf/ac/yr)	1.4	HELP Model (Leakage through cap - 6A-East)

Groundwater Recharge throughout watershed less landfill area (cf/yr) 294030

Leakage from landfill (cf/yr) 90

Determine concentration at Bowen Branch:

Concentration(Bowen Branch)=((Concentration(Lab)*Leakage Rate)/(GW Recharge + Leakage Rate))

Chemical	Standard (mg/l)	Laboratory Result (mg/l)		Estimated Concentration at Bowen Branch (mg/l)	Standard Met
Acetone	0.7	ND	1	1.5E-04	ok
Acrylamide (propenamide)	0.00001	ND	1	1.5E-04	Exceeded
Arsenic	0.05		1.71	5.2E-04	ok
Barium	2		0.112	Below Standard	ok
Benzene	0.001	ND	0.05	7.6E-06	ok
Boron	0.32	ND	0.2	Below Standard	ok
Bromoform (tribromomethane)	0.00019	ND	0.05	7.6E-06	ok
Butylbenzyl phthalate	0.1	ND	0.01	Below Standard	ok
Cadmium	0.005		0.04	1.2E-05	ok
Carbofuran	0.036		NT		
Carbon tetrachloride	0.0003	ND	0.05	7.6E-06	ok
Chlordane	2.70E-05	ND	0.004	6.1E-07	ok
Chloride	250		490	1.5E-01	ok
Chlorobenzene	0.05	ND	0.05	7.6E-06	ok
Chloroform (trichloromethane)	0.00019	ND	0.05	7.6E-06	ok
2-Chlorophenol	0.0001	ND	0.01	1.5E-06	ok
Chromium	0.05	ND	0.05	7.6E-06	ok
Cis-1,2-dichloroethene	0.07	ND	0.05	Below Standard	ok
Coliform organisms (total)	1		6225	2	ok
Color (Color Units)	15		1607	4.9E-01	ok
Copper	1	ND	0.01	Below Standard	ok
Cyanide	0.154		0.004	Below Standard	ok
2,4-D (2,4-dichlorophenoxy acetic acid)	0.07	ND	0.012	Below Standard	ok
1,2-Dibromo-3-chloropropane	2.50E-05	ND	0.05	7.6E-06	ok
Dichlorodifluoromethane (Freon-12; Halon)	1.4	ND	0.05	Below Standard	ok
1,1-Dichloroethane	0.7	ND	0.05	Below Standard	ok
1,2-Dichloroethane (ethylene dichloride)	0.00038	ND	0.05	7.6E-06	ok
1,1-Dichloroethylene (vinylidene chloride)	0.007	ND	0.05	7.6E-06	ok
1,2-Dichloropropane	0.00056	ND	0.05	7.6E-06	ok
Di-n-butyl (or dibutyl) phthalate (DBP)	0.7	ND	0.01	Below Standard	ok
Diethylphthalate (DEP)	5	ND	0.01	Below Standard	ok
Di(2-ethylhexyl) phthalate (DEHP)	0.003	ND	0.01	1.5E-06	ok
Di-n-octyl phthalate	0.14	ND	0.01	Below Standard	ok
P-dioxane (1,4-diethylene dioxide)	0.007		NT		
Dioxin	2.2E-10	ND	1.00E-09	1.5E-13	ok
Dissolved solids (total)	500		1,100	3.4E-01	ok
Diundecyl phthalate (Santicizer 711)	0.14		NT		
Endrin	0.002	ND	0.0012	Below Standard	ok
Epichlorohydrin (1-chloro-2,3-epoxypropane)	0.00354	ND	0.025	3.8E-06	ok
Ethylbenzene	0.029	ND	0.05	7.6E-06	ok
Ethylene dibromide (EDB; 1,2-dibromoethane)	4.00E-07	ND	0.00001	1.5E-09	ok

NOTES:
1. ND - Not Detected above indicated reporting limit
2. Initial concentration for "Not Detected" compounds set at one-half of the reporting limit.

Chemical	Standard (mg/l)	Laboratory Result (mg/l)		Estimated Concentration at Bowen Branch (mg/l)	Standard Met
Ethylene glycol	7	ND	10	1.5E-03	ok
Fluorene	0.28	ND	0.01	Below Standard	ok
Fluoride	2		1.6	Below Standard	ok
Foaming agents	0.5		NT		
Gross alpha (adjusted) particle activity (excluding radium-226 and uranium)	15 pCi/l		NT		
Heptachlor	8.00E-06	ND	0.001	1.5E-07	ok
Heptachlor epoxide	4.00E-06	ND	0.016	2.4E-06	ok
Heptane	2.1	ND	0.025	Below Standard	ok
Hexachlorobenzene (perchlorobenzene)	2.00E-05	ND	0.01	1.5E-06	ok
N-hexane	0.42	ND	0.025	Below Standard	ok
Iron	0.3		0.47	1.4E-04	ok
Lead	0.015		0.009	Below Standard	ok
Lindane	0.0002	ND	0.001	1.5E-07	ok
Manganese	0.05		7.1	2.2E-03	ok
Mercury	0.0011	ND	0.0005	Below Standard	ok
Metadichlorobenzene (1,3-dichlorobenzene)	0.62	ND	0.01	Below Standard	ok
Methoxychlor	0.035	ND	0.01	Below Standard	ok
Methylene chloride (dichloromethane)	0.005	ND	0.1	1.5E-05	ok
Methyl ethyl ketone (MEK; 2-butanone)	0.17	ND	1	1.5E-04	ok
Methyl tert-butyl ether (MTBE)	0.2	ND	0.025	Below Standard	ok
Naphthalene	0.021	ND	0.01	Below Standard	ok
Nickel	0.1		0.12	3.7E-05	ok
Nitrate	10	ND	0.2	Below Standard	ok
Nitrite	1		0.05	Below Standard	ok
Orthodichlorobenzene (1,2-dichlorobenzene)	0.62	ND	0.05	Below Standard	ok
Oxamyl	0.175		NT		
Paradichlorobenzene	0.075	ND	0.05	Below Standard	ok
Pentachlorophenol	0.0003	ND	0.05	7.6E-06	ok
pH	6.5 - 8.5		7.7		ok
Phenanthrene	0.21	ND	0.01	Below Standard	ok
Phenol	0.3		0.026	Below Standard	ok
Radium-226 and radium-228 (combined)	5 pCi/l		NT		
Selenium	0.05	ND	0.005	Below Standard	ok
Silver	0.018		0.1	3.0E-05	ok
Styrene (ethenylbenzene)	0.1	ND	0.05	Below Standard	ok
Sulfate	250		660	2.0E-01	ok
Tetrachloroethylene (perchloroethylene; PCE)	0.0007	ND	0.05	7.6E-06	ok
Toluene (methylbenzene)	1		0.054	Below Standard	ok
Toxaphene	3.10E-05	ND	0.0024	3.7E-07	ok
2,4,5-TP (Silvex)	0.05	ND	0.002	Below Standard	ok
Trans-1,2-dichloroethene	0.07	ND	0.05	Below Standard	ok
1,1,1-Trichloroethane (methyl chloroform)	0.2	ND	0.05	Below Standard	ok
Trichloroethylene (TCE)	0.0028	ND	0.05	7.6E-06	ok
Trichlorofluoromethane	2.1	ND	0.05	Below Standard	ok
Vinyl chloride (chloroethylene)	1.50E-05	ND	0.1	1.5E-05	equal
Xylenes (o-, m-, and p-)	0.53	ND	0.05	Below Standard	ok
Zinc	2.1		0.04	Below Standard	ok

NOTES:

1. ND - Not Detected above indicated reporting limit
2. Initial concentration for "Not Detected" compounds set at one-half of the reporting limit.

ATTACHMENT 3

EROSION AND SEDIMENTATION CONTROL PERMIT

GEORGE CAUTON
✓LIZ DICKSON

State of North Carolina
Department of Environment, Health, and Natural Resources
Asheville Regional Office

James G. Martin, Governor
William W. Cobey, Jr., Secretary

Ann B. Orr
Regional Manager

LETTER OF APPROVAL

July 26, 1991

Mr. Louie Justus
Champion International
P. O. Box C-10
Canton, NC 28716

Dear Mr. Justus:

This office has reviewed the erosion and sedimentation control plan submitted for the project listed below. We find the plan to be acceptable and hereby issue this Letter of Approval. Please be advised that Title 15A, North Carolina Administrative Code 4B.0017(a), requires that a copy of the approved soil erosion control plan be on file at the job site. Also, you should consider this letter to give the Notice required by NCGS 113A-61(d) of our right of periodic inspection to ensure compliance with the approved plan.

The State's Sedimentation Pollution Control Program is a performance-oriented program requiring protection of the natural resources and adjoining properties. If, following commencement of this project, it is determined that the plan is inadequate to meet the requirements of NCGS 113A-51 to 66, this office may require revisions to the plan and implementation of the revisions to ensure compliance with the Act.

Please note that this approval is based in part on the accuracy of the information provided in the Financial Responsibility Form which you have provided. You are requested to file an amended form if there is any change in the information included on the form. In addition, it would be helpful if you notify this office of the proposed starting date for this project. Your cooperation is appreciated.

Sincerely,

Richard A. Phillips, P.E.
Regional Engineer

RAP:a

Project name: Champion Landfill 6, Area A
Location: Haywood County
Date received: 7/8/91
Date approved: 7/25/91
New submittal (x) Revision ( )

ORIGINAL TO ... RETURNED
7/29/91 L.J.

CERTIFICATE OF PLAN APPROVAL

The posting of this certificate certifies that an erosion and sedimentation control plan has been approved for this project by the North Carolina Department of Environment, Health, and Natural Resources in accordance with North Carolina General Statute 113A - 57 (4) and 113A - 54 (d) (4) and North Carolina Administrative Code, Title 15A, Chapter 4B.0007 (c). This certificate must be posted at the primary entrance of the job site before construction begins and until establishment of permanent groundcover as required by North Carolina Administrative Code, Title 15A, Chapter 4B.0027(b).

Champion Landfill 6 - Area A - Haywood Co.

Project Name and Location

7-26-91

Date of Plan Approval

Regional Engineer

ATTACHMENT 4

LANDFILL NO. 6 SOLID WASTE PERMIT AND PROPERTY DESCRIPTION

Ronald H. Levine, M.D., M.P.H.
STATE HEALTH DIRECTOR

DIVISION OF HEALTH SERVICES
P.O. Box 2091
Raleigh, N.C. 27602-2091

CERTIFIED COPY OF SOLID WASTE PERMIT

I do hereby certify that the attached PERMIT is an exact and true copy of Permit No. 45-06.

O. W. Strickland, Head
Solid & Hazardous Waste Management Branch
Environmental Health Section

CERTIFIED TRUE COPY
HELEN F. DAVIS
REGISTER OF DEEDS
WAYNESVILLE, NC 28786

Helen F. Davis

North Carolina
Wake County

I, Nell T. Sellers, a Notary Public for said County and State, do hereby certify that O.W. Strickland personally appeared before me this day and acknowledged the due execution of the foregoing instrument.

Witness my hand and official seal, this the 28th day of March, 1984.

(official seal)

Nell T. Sellers
Notary Public

My commission expires July 24, 1987.

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PERMIT NO. 43-06

DATE ISSUED 3/28/84

STATE OF NORTH CAROLINA
DEPARTMENT OF HUMAN RESOURCES
Division of Health Services
P.O. Box 2091 Raleigh 27602

SOLID WASTE PERMIT

CHAMPION PAPERS is hereby issued a permit to operate a SANITARY LANDFILL (No. 6 Areas A-C) located ON S.R. 1550 & I-40 IN HAYWOOD COUNTY in accordance with Article 13B of the General Statutes of North Carolina and all rules promulgated thereunder and subject to the conditions set forth in this permit. The facility is located on the below described property.

BEGINNING on a concrete right of way monument at the point of intersection of the southern right of way line of Interstate Highway 40, with the Southeastern right of way line of the New Thickety Road, said concrete right of way monument being located South 75 deg. 34 min. 14 sec. West 1683.01 feet from North Carolina Geodetic Survey "Station Culvert" have Y coordinate of 677542.47 and an X coordinate of 845996.22, said beginning point being further the Northwestern corner of the "First Tract" described in a deed to Champion International Corporation from Brantley M. Davis and wife, Gladys S. Davis, dated January 8, 1981, and recorded in Deed Book 321 at Page 158, in the Office of the Register of Deeds for Haywood County; runs thence from the beginning point thus established and with the Southern right of way line of Interstate Highway 40, 14 calls as follows: North 79 deg. 12 min. East 561.62 feet to a concrete right of way monument; North 25 deg. 06 min. East 36.88 feet to a concrete right of way monument; North 79 deg. 34 min. East 1207.83 feet to a concrete right of way monument; South 38 deg. 31 min. East 56.18 feet to a concrete right of way monument; North 79 deg. 30 min. East 268.26 feet to a concrete right of way monument; North 78 deg. 40 min. East 204.43 feet to a concrete right of way monument; North 76 deg. 18 min. East 309.93 feet to a concrete right of way

O. W. Strickland, Head
Solid & Hazardous Waste Management Branch
Environmental Health Section

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DHS Form 2677 (Rev. 1/82)
Solid & Hazardous Waste Management Branch

PERMIT NO. 45-06

DATE ISSUED 3/28/84

SOLID WASTE PERMIT

Property Description (Continued):

monument; North 35 deg. 22 min. East 94.51 feet to a concrete right of way monument; North 72 deg. 12 min. East 384.99 feet to a concrete right of way monument; North 69 deg. 25 min. East 255.85 feet to a concrete right of way monument; North 67 deg. 52 min. East 249.62 feet to a concrete right of way monument; North 67 deg. 41 min. East 154.48 feet to a concrete right of way monument; South 39 deg. 50 min. East 31.94 feet to a concrete right of way monument; and on a curve to the right with a radius of 5579.58 feet, an arc distance of 461.78 feet to a concrete right of way monument delineating the intersection of the Southern right of way line of Interstate Highway 40 and the Southern right of way line of the New Thickety Road; thence with the Southern right of way line of the New Thickety Road, six calls as follows: South 45 deg. 07 min. East 44.41 feet to an iron pipe; on a curve to the left with a radius of 285.69 feet, an arc distance of 393.72 feet to a point; North 55 deg. 55 min. East 102.55 feet to a point; North 8 deg. 0 min. West 22.27 feet to a point; North 55 deg. 55 min. East 190.14 feet to a point; and on a curve to the right with a radius of 642.29 feet, an arc distance of 95.58 feet to a point on said right of way line; thence leaving the Southern right of way line of the New Thickety Road and running with a hedgerow, the line of the property claimed by Carroll Smith, South 34 deg. 57 min. East 255.48 feet to a point; thence South 24 deg. 03 min. East, with a fence line and the line of the Claude Smith property, 459.74 feet to an iron pipe at a fence corner; runs thence South 3 deg. 42 min. West, generally with a fence and with the line of Thurman R. Robinson, and passing an iron pipe at 1587.42 feet, 1610.42 feet to the Northern margin of the Pigeon River; thence down the Pigeon River, ten calls as follows: South 82 deg. 06 min. West 338.03 feet to a point on the North Bank of the river, at the mouth of Sorrells Cove Branch; South 76 deg. 33 min. West 275.53 feet to an eight inch walnut on the North bank of the river; South 71 deg. 56 min. West 1057.69 feet to an eight inch leaning willow on the North bank of the river, where the channel of said river forks; South 59 deg. 45 min. West 77.79 feet to a point on the South margin of an island in the river; South 74 deg. 54 min. West 221.50 feet to a point on the Southern margin of said island in the river; South 63 deg. 29 min. West 172.99 feet to a point on the Southern margin of said island in the river; South 60 deg. 19 min. West 46.32 feet to a point on the South bank of said island in the river; South 08 deg. 33 min. West 40 feet to a point in the center of the main channel of the river; South 67 deg. 02 min. West 255.75 feet to a point in the main channel of the river; and South 55 deg. 46 min. West 170 feet to a point in the center of the main channel of the river; runs thence North 01 deg. 43 min. East 60 feet to a point on the Northern edge of the Pigeon River; thence with the North bank of the Pigeon River, twelve calls as follows: South 57 deg. 32 min. West 168.50 feet to an eighteen inch sycamore; South 43 deg. 22 min. West 354.67 feet to a point; South 73 deg. 36 min. West 196.84 feet to an eighteen inch sycamore; North 78 deg. 57 min. West 116.62 feet to a forked maple; South 85 deg. 37 min., West 50.33

PERMIT NO. 45-06

DATE ISSUED 3/23/84

SOLID WASTE PERMIT

Property Description (Continued):

feet to a six inch forked bean tree; South 69 deg. 24 min. West 213.22 feet to a twelve inch locust; South 78 deg. 47 min. West 117.36 feet to a twelve inch sycamore; North 88 deg. 45 min. West 83.07 feet to an eight inch sycamore; North 83 deg. 14 min. West 90.49 feet to a ten inch sycamore; North 81 deg. 52 min. West 192.91 feet to a twelve inch locust; South 89 deg. 16 min. West 142.72 feet to a twenty inch walnut; and South 87 deg. 45 min. West 113.37 feet to a point on the bank of said river, in the Eastern boundary line of the property of George H. Cogburn, Jr.; runs thence with the Eastern and Northeastern boundary line of the Cogburn property; three calls as follows: North 02 deg. 24 min. East 1434.14 feet to an iron pipe in a fence stump in a fence corner; North 33 deg. 04 min. West 752.69 feet to a point in a maple stump; and, generally with a branch, South 41 deg. 18 min. West 203.57 feet to an iron pipe in the center of said branch at the Easternmost corner of a tract of land conveyed by James L. Henderson and wife, to Casmer A. Bolniak and wife, by deed dated August 12, 1974, and recorded in Deed Book 270 at Page 423, Records of Haywood County; runs thence with the Northern and Northwestern boundary line of the Bolniak tract, four calls as follows: North 60 deg. 29 min. West 337.85 feet to an iron pipe in the center of a sixty foot private road right of way; North 60 deg. 03 min. West 57 feet to an iron pipe in the center of said private road right of way; South 29 deg. 47 min. West 201.58 feet to a hub; and South 14 deg. 11 min. West 155.06 feet to a hub in a fence line; thence leaving the Bolniak line, and running North 66 deg. 04 min. West 288.55 feet to an iron pipe on the Southeastern right of way line of the New Thickety Road; thence with said right of way, three calls as follows: on a curve to the left with a radius of 755.94 feet, an arc distance of 206.87 feet to an iron pipe; on another curve to the left with a radius of 465.63 feet, an arc distance of 258.76 feet to an iron pipe; and North 30 deg. East 83.72 feet to the place of BEGINNING, according to a survey by Webb A. Morgan, R.L.S., containing 235.051 acres.

PERMIT NO. 63-06

DATE ISSUED 3/28/84

SOLID WASTE PERMIT

Conditions of Permit:

1. This permit may be subject to review at an administrative hearing upon petition of anyone whose legal rights, privileges and duties may have been affected by the issuance thereof.

2. This permit shall not be effective unless the certified copy is filed in the register of deeds' office, in the grantor index under the name of the owner of the land in the county or counties in which the land is located. After recordation, the certified copy shall be returned to the Solid & Hazardous Waste Management Branch and shall have indicated on it the page and book number, date of recordation and registrar's seal.

3. The following requirements shall be met prior to receiving solid waste at the site:

   a. Site preparation shall be in accordance with construction plan.

   b. Site inspection shall be made by a representative of the Division of Health Services.

4. This solid waste disposal site is permitted to receive solid waste as defined in 10 NCAC 10C, .0101(31), except that hazardous waste, liquid waste and any other wastes that may pose a threat to the environment or the public health are prohibited from disposal at this site unless prior authorization is obtained from the Division of Health Services.

5. This permit is for construction according to plans prepared by Law Engineering Testing Co. dated January, 1983. Any modification or deviation from the approved plans shall be approved by the N.C. Solid and Hazardous Waste Management Branch.

6. Ground water monitoring wells are installed per the DHS monitoring well standard.

PERMIT NO. 43-06

DATE ISSUED 3/28/84

SOLID WASTE PERMIT

Conditions of Permit:

7. The northwest corner of area E shall be limited to 30' south of the existing stream unless the stream, after proper approval is obtained, is relocated so that it is outside landfill construction activity.

8. The groundwater and surface water sampling plan is adequate with the exception of the following items:

1. Sampling frequency should be no less than annually.

2. Parameters to be evaluated are:

A. EPA Interim Primary Drinking Water Standards*

Arsenic
Barium
Cadmium
Chromium
Fluoride
Lead
Mercury
Nitrite (as N)
Selenium
Silver

*Maximum allowable concentrations can be found in the May 19, 1980 Federal Register, Appendix III, page 33357.

B. Groundwater Quality Parameters*

Chloride
Iron
Manganese
Sulfate
Phenols

*Allowable concentrations based on 1962 Drinking Water Standards and background water quality data.

PERMIT NO. 63-06

DATE ISSUED 7/28/86

SOLID WASTE PERMIT

Conditions of Permit:

C. Groundwater Contamination Indicators*

pH
Specific conductance
Elevation of groundwater surface
Total organic carbon
Total organic halogen
Total dissolved solids

*Allowable concentrations determined by background comparison, see Part 265.93(b) Appendix B.

Filed for registration 2
day of April 19 84
4:20 o'clock PM and registered
in office of the Register of Deeds for
Haywood County, North Carolina.
This 2 day of April 19 84
in Book No. 349 on Page 842
Barbara G. Harwell
Register of Deeds
By Jewell M. Justice asst.

DHS Form 2871 (Rev. 1/82)
Solid & Hazardous Waste Management Branch

SECTION 02200

EARTHWORK

1. GENERAL

1.1 RELATED DOCUMENTS:

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK:

Extent of earthwork is indicated on drawings.

Definition: "Excavation" consists of removal of material encountered to subgrade elevations indicated and subsequent disposal or replacement (backfill) of materials removed.

1.3 QUALITY CONTROL:

1.3.1 Codes and Standards: Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

1.3.2 Testing and Inspection Service: Contractor will engage soil testing and inspection service for quality control testing during earthwork operations.

1.4 SUBMITTALS:

1.4.1 Test Reports-Earth Materials: Test reports on the following borrow materials to be utilized.

- o #78M Stone:
  - Grain Size (D422) - 1/3000 cy
- o #57 Stone:
  - Grain Size (D422) - 1/3000 cy
- o Common Borrow (silty sand, sandy silt or clayey soil):
  - Grain Size (D422) - 1/3000 cy

1.5 JOB CONDITIONS:

1.5.1 Site Information: Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data are made available for convenience of Contractor.

Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.

1.5.2 Existing Utilities: Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations.

Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

Do not interrupt existing utilities serving facilities occupied and used by Owner or others, during occupied hours, except when permitted in writing by Owner's Representative and then only after acceptable temporary utility services have been provided.

Provide minimum of 48-hour notice to Owner's Representative, and receive written notice to proceed before interrupting any utility.

Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.

Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

2. PRODUCTS

2.1 SOIL MATERIALS:

2.1.1 General: Excavations made at the site for the construction of project facilities will generate unspecified quantities of soil materials. These soils will either be suitable or unsuitable for use as fill in the construction of earth-related portions of the project.

Suitable Materials: Those materials generated from outside excavations that satisfy the specifications for the material for which it is to be used (i.e., compacted silt clay, common borrow, etc.). Specifications for suitable project materials follow.

Unsuitable Materials: Those materials generated from on-site excavations that do not satisfy the specifications for the project materials identified below. Generally these materials will consist of objectionable quantities of vegetation, organic matter, large stones, debris and frozen material.

2.1.2 #57 Stone: Durable, clean angular rock fragments obtained by breaking and crushing rock material, furnished and placed to the lines and grades as shown on the Drawings. Sieve analysis by weight:

Sieve Designation	% Passing by Weight
1 1/2"	100
1"	95-100
1/2"	25-60
#4	0- 10
#8	0-5
#200	0-0.6

2.1.3 #78M Stone: #78M Stone shall be furnished and placed to the lines and dimensions as shown on the Drawings to provide a drainage blanket between the synthetic liner and the waste, as identified in the Drawings.

Sieve Designation	% Passing by Weight
3/4"	100
1/2"	98-100
3/8"	75-100
#4	20-45
#8	0-15
#200	0-0.6

2.1.4 Common Borrow (silty sand, sandy silt): Screened material shall be furnished and placed to the lines and dimensions as shown on the Drawings to construct the cell division berm and any base filling requirements. The soil shall not contain particles of rock which will not pass the 1-inch square mesh sieve. The soil shall have greater than 20 passing the U.S. Standard No. 200 Sieve.

3. EXECUTION

3.1 EXCAVATION:

3.1.1 Unclassified Excavation includes excavation of materials and obstructions encountered to subgrade elevations indicated, regardless of character.

3.1.2 Excavation Classifications: The following classifications of excavation will be made when rock excavation is encountered in work:

3.1.3 Earth Excavation includes excavation of pavements and other obstructions visible on ground surface; underground structures, utilities and other items indicated to be demolished and removed; together with earth and other materials encountered that are not classified as rock or unauthorized excavation.

3.1.4 Rock Excavation: Rock excavation in trenches and pits includes removal and disposal of materials and obstructions encountered which cannot be excavated with a 1.0 cubic yard (heaped) capacity, 42" wide bucket on track-mounted power excavator equivalent to Caterpillar Model 215, rated at not less than 90HP flywheel power and 30,000 lb. drawbar pull. Trenches in excess of 10'- 0" in width and pits in excess of 30'-0" in either length or width are classified as open excavation.

Rock excavation in open excavations includes removal and disposal of materials and obstructions encountered which cannot be dislodged and excavated with modern track-mounted heavy-duty excavating equipment without ripping. Rock excavation equipment is defined as Caterpillar Model No. 973 or No. 977K, or equivalent track-mounted loader, rated at not less than 170HP flywheel power and developing 40,000 lb. break-out force (measured in accordance with SAE J732C).

Typical of materials classified as rock are boulders 10 cu. yd. or more in volume, solid rock, rock in ledges, and rock hard cementitious aggregate deposits.

Intermittent ripping performed to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation.

Do not perform rock excavation work until material to be excavated has been cross-sectioned and classified and worksheets submitted to the Owner's Representative.

Rock payment lines are limited to the following:

In pipe trenches, 6 inches below invert elevation of pipe and 18 inches wider than inside diameter of pipe, but not less than 3 ft.

In open areas, 48 inches below base grade elevation.

3.1.5 Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Owner's Representative. Unauthorized excavation, as well as remedial work directed by Owner's Representative, shall be at Contractor's expense.

Backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Owner's Representative.

3.1.6 Additional Excavation: When excavation has reached required subgrade elevations, notify Owner's Representative who will make an inspection of conditions. Do not backfill excavations without notifying Owner's Representative.

If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated material as directed by Owner's Representative.

Removal of unsuitable material and its replacement as directed will be paid on basis of contract conditions relative to changes in work.

3.1.7 Stability of Excavations: Slope sides of excavations to comply with federal and local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.

Maintain sides and slopes of excavations in safe condition until completion of backfilling.

3.1.8 Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.

Establish requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction.

Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.

Provide permanent steel sheet piling or pressure creosoted timber sheet piling wherever subsequent removal of sheet piling might permit lateral movement of soil under adjacent structures. Cut off tops as required and leave permanently in place.

3.1.9 Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.

Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.

Use appropriate erosion control in temporary ditches, as described in Section 02270, Erosion Control.

3.1.10 Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage. Cover or seed stockpiles when long-term storage indicates the potential for wind or water erosion from the stockpile. Place silt fence around downstream edge of stockpile to prevent transportation of soil.

Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain.

Dispose of excess soil material and waste materials as herein specified by Owner's Representative.

3.1.11 Excavation for Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10', and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.

3.1.12 Excavation for Trenches: Dig trenches to the uniform width required for particular item to be installed, sufficiently wide to provide ample working room. Provide a minimum 6" to 9" clearance on both sides of pipe or conduit as indicated on Drawings.

Excavate trenches to depth indicated or required. Carry depth of trenches for piping to establish indicated flow lines and invert elevations.

Where rock or unsuitable material is encountered, carry excavation 6" below required elevation and backfill with a 6" layer of crushed stone or gravel, as approved by Owner's Representative, prior to installation of pipe.
For pipes or conduit 6" or larger in nominal size, tanks and other work indicated to receive subbase, excavate to subbase depth or, if not otherwise indicated, to 6" below bottom of work to be supported.

Grade bottoms of trenches as indicated, notching under pipe bells to provide solid bearing for entire body of pipe.

Do not backfill trenches until tests and inspections have been made and backfilling authorized by Owner's Representative. Use care in backfilling to avoid damage or displacement of pipe systems. Owner's Representative must be notified of any intention to backfill trench or otherwise permanently cover pipe.

3.1.13 Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35° F. (1°C).

3.1.14 Base Grade Excavation: During excavation to base grades, if ground water is encountered the design engineer will be immediately notified. The design engineer will either: re-design the base grading contours to maintain the four foot separation; request a variance from the Division of the four foot separation requirement; and/or design an under-drain system to lower the local ground water elevation to abide by the four foot separation requirement.

3.2 COMPACTION:

3.2.1 General: Control soil compaction during construction providing minimum percentage of density specified for each area classification indicated below.

3.2.2 Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture density relationship (cohesive soils) determined in accordance with ASTM D 1557; and not less than the following percentages of relative density, determined in accordance with ASTM D 2049, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).

Pipeline: Compact top 6" of subgrade and each 12" layer of backfill or fill material at 90% maximum density.

Dikes: Compact each 12-inch layer of fill material at 90% maximum density.

Base Grade: Compact top 6" of subgrade at 90 percent maximum density and wet to between optimum and 4 percent above optimum for water content. Maintain these conditions until geomembrane is installed.

3.2.3 Moisture Control: Where subgrade or layer of soil material must be moisture conditioned to meet the allowable range of water content to achieve compaction, uniformly

apply water to surface of subgrade, or layer of soil material. Apply water in manner to prevent free water appearing on surface during or subsequent to compaction operations.

Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.

3.3 BACKFILL AND FILL:

3.3.1 General: Place acceptable soil material in layers to required subgrade elevations, for each area classification listed below.

In excavations, use satisfactory excavated or borrow material free of frozen material, stones larger than 6 inches in diameter, brush, roots, sod, or other unsuitable material.

Under grassed areas, use satisfactory excavated or borrow material.

Under piping and conduit, use subbase material where subbase is indicated under piping or conduit; shape to fit bottom 90^{o} of cylinder.

3.3.2 Backfill excavations as promptly as work permits, but not until completion of the following:

Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.

Inspection by Owner's Representative, testing, approval, and recording locations of underground utilities.

Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.

Removal of trash and debris.

Permanent or temporary horizontal bracing is in place on horizontally supported walls.

3.3.3 Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow, strip, or break-up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.

When existing ground surface has a density less than that specified under "Compaction" for particular area classification, break up ground surface, pulverize, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.

3.3.4 Placement and Compaction: Place backfill and fill materials in layers not more than 12" in loose depth for material compacted by heavy compaction equipment, and not more than 6" in loose depth for material compacted by hand-operated tampers.

Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
Place backfill and fill materials evenly adjacent to structures, piping or conduit to required elevations. Take care to prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping or conduit to approximately same elevation in each lift.

3.4 FIELD QUALITY ASSURANCE

3.4.1 Quality Assurance Testing During Construction: Allow testing service to inspect and approve subgrades and fill layers before further construction work is performed.

Testing shall be as follows:

- o #78M Stone:
  - Grain Size (D422) - 1/3000 cy
- o #57 Stone:
  - Grain Size (D422) - 1/1000 cy
- o Common Borrow (silty sand, sandy silt, etc.):
  - Grain Size (D422) - 1/1000 cy
  - Standard Proctor (D1557) - 1/3000 cy
  - Moisture/Density (D2922) - 10/acre/lift

If in opinion of Owner's Representative, based on testing service reports and inspection, subgrade or fills which have been placed are below specified density, provide additional compaction, wetting, drying or removal of material as necessary, and testing at no additional expense.

3.5 MAINTENANCE:

3.5.1 Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction.

3.5.2 Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn, gravel road, or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.6 DISPOSAL OF EXCESS AND WASTE MATERIALS:

3.6.1 Removal to Designated Areas on Owner's Property: Transport acceptable excess excavated material to designated soil storage areas on Owner's property. Stockpile soil and seed or spread and seed as directed by Owner's Representative.

Transport waste material, including unacceptable excavated material, trash and debris to designated spoil areas on Owner's property and dispose of as directed.

END OF SECTION

SECTION 02270

EROSION CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

Work covered by this Section includes the control of erosion, siltation, and sedimentation.

1.2 PROJECT REQUIREMENTS

1.2.1 Prevention: Take every reasonable precaution and do whatever is necessary to avoid any erosion and to prevent silting of rivers, streams, lakes, reservoirs, impoundment's, and drainage ditches and swales.

1.2.2 Exposure: The exposure of uncompleted cut slopes, embankments, trench excavations, and site graded areas shall be kept as short as possible. Initiate seeding and other erosion control measures on each segment as soon as reasonably possible.

1.2.3 Temporary Protection: Should it become necessary to suspend construction for any length of time, shape all excavated and graded areas in such a manner that runoff will be intercepted and diverted to points where minimal erosion will occur. Provide and maintain temporary erosion and sediment control measures, such as berms, dikes, slope drains, silt stops, and sedimentation basins, until permanent drainage facilities or erosion control features have been completed and are operative.

1.2.4 Handling of Fine Material: Fine material placed or exposed during the work shall be so handled and treated as to minimize the possibility of its reaching any surface waters. Use diversion channels, dikes, sediment traps, or any other effective control measures.

1.2.5 Silt Stops: Provide silt stops wherever erosion control measures may not be totally capable of controlling erosion, such as in drainage channels and where steep slopes may exist.

1.2.6 Special Precautions: Take special precautions in the use of construction equipment to minimize erosion. Do not leave wheel tracks where erosion might begin.

1.2.7 Off-Site Erosion Control: The requirements of this Section also apply to Project-related construction activities away from the Project site, such as at borrow pits, off-site storage areas, and haul and work roads.

1.2.8 Mulching: Mulching shall follow the seeding operation by not more than 24 hours.

1.2.9 Remedial Action: Should any protective measures employed indicate any deficiencies or erosion taking place, immediately provide additional materials or employ different techniques to correct the situation and to prevent subsequent erosion.

1.2.10 Discontinuation: Continue erosion control measures until the permanent measures have been sufficiently established and are capable of controlling erosion on their own.

1.2.11 Federal Permits: Comply with all Federal, state and local laws, ordinances, rules and regulations.

1.3 QUALITY CONTROL:

Provide at least one person who shall be present at all times during erosion control operations and who shall be thoroughly familiar with the types of materials being installed and the best methods for their installation and who shall direct all work performed under this Section.

Material manufacturers and vendors shall be reputable, qualified firms regularly engaged in producing the required types of materials.

Protect and maintain all areas disturbed by the Work, such that erosion is adequately controlled and silt and sediments are not allowed to flow into any watercourse, onto adjacent properties, or into storm drains.

PART 2 - PRODUCTS

2.1 HAY AND STRAW MULCH:

2.1.1 General: Hay and straw mulches shall be reasonably free from swamp grass, weeds, twigs, debris and other deleterious material, and free from rot, mold, primary noxious weed seeds, and rough or woody materials. Mulches containing mature seed of species which would volunteer and be detrimental to the permanent seeding, or would result in overseeding, or would produce growth which is aesthetically unpleasing, is not permitted.

2.1.2 Hay Mulch: Properly aired native hay, Sudan grass hay, broomsedge hay, legume hay, or similar hay or grass mowings. When air-dried in the loose state, the contents of the representative bale shall lose not more than fifteen (15) percent of the resulting air-dry weight of the bale. Apply at the rate of 2 tons/ac.

2.1.3 Mulch Stabilizers: "Curasol" applied at the rate of 40 gal/ac. or Dow "Mulch Binder" applied at the rate of 45 gal/ac.

2.1.4 Permanent Type Mulch Nets: "Curlex" blanket as manufactured by American Excelsior, or equal.

2.2 SEED AND SOD FOR EROSION CONTROL:

2.2.1 For Temporary Control Use annual or perennial ryegrass.

2.2.2 For Permanent Control See Section "Seeding".

2.3 HAY BALES FOR EROSION CONTROL:

Rectangular shaped bales of hay or straw, weighing at least 40 lbs per bale, free from primary noxious weed seeds and rough or woody materials.

2.4 SILT FENCES:

"Envirofence" by Mirafi, Inc. or an approved equal.

PART 3 - EXECUTION

3.1 HAY AND STRAW MULCHING:

3.1.1 Install hay or straw mulch immediately after each area has been properly prepared. When permanent seed or seed for temporary erosion control is shown prior to placing the mulch, place mulch on seeded areas within 24 hours after seeding. Engineer may authorize the blowing of chopped mulch provided that 95% of the mulch fibers will be 6" or more in length and that it can be applied in such a manner that there will be a minimum amount of matting that would retard the growth of plants. Hay mulch should cover the ground enough to shade it, but the mulch should not be so thick that a person standing cannot see the ground through the mulch. Remove matted mulch or branches.

3.1.2 Apply a system of pegs and strings, a chemical stabilizer, or temporary type netting to the mulch, where mild winds may blow the mulch, or when ground slopes exceed 15%, or when otherwise required to maintain the mulch firmly in place. Unless otherwise directed, remove the strings and netting prior to the acceptance of the Work.

3.1.3 Apply temporary type netting over the mulch and take whatever measures are necessary to maintain the mulch firmly in place, where high winds exist, or heavy rainstorms are likely, or where ground surfaces are steep, or where other conditions require.

3.1.4 The use of permanent type netting is not permitted without the prior approval of Engineer, unless otherwise specified.

3.2 HAY BALES AND SILT FENCES:

3.2.1 Provide hay bales or silt fences, as required, for the temporary control of erosion and to stop silt and sediment from reaching surface waters, adjacent properties, or entering catch basins, or damaging the Work.

3.2.2 Stake the hay bales as shown in the details to hold them firmly in place. Use a sufficient number of bales to accommodate runoff without causing any flooding and to adequately store any silt, sediment and debris reaching them (minimum of 1 every 50 feet).

3.2.3 Erect silt fences and bury bottom edge in accordance with the manufacturer's recommended installation instructions. Provide a sufficient length of fence to accommodate runoff without causing any flooding and to adequately store any silt, sediment, and debris reaching it.

3.2.4 Leave hay bales and silt fences in place until permanent erosion control measures have stopped all erosion and siltation, then remove and dispose of properly.

3.3 MAINTENANCE

If any temporary erosion and sediment control measures are disturbed, repair them immediately. Check erosion control devices weekly and after any heavy rain storms.

If seed is washed out before germination, repair any damage, refertilize, and reseed.

Maintain mulched and matted areas, silt stops, and other temporary control measures until the permanent control measures are established and no further erosion is likely.

END OF SECTION

SECTION 02480

SEEDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK:

All areas disturbed by the construction shall be seeded as specified in this Section.

1.3 QUALITY ASSURANCE:

1.3.1 General: Ship seeding materials with certificates of inspection required by governing authorities. Comply with regulations applicable to seeding materials.

1.3.2 Substitutions. If specified seeding material is not obtainable, submit non-availability to Owner's Representative, together with proposal for use of equivalent material.

1.3.3 Analysis and Standards: Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.

1.3.4 Topsoil: Before delivery of topsoil, furnish Owner's Representative with written statement giving location of properties from which topsoil is to be obtained, names and addresses of owners, depth to be stripped, and crops grown during past 2 years. Onsite soil strippings may be used subject to approval of Owner's Representative.

1.4 SUBMITTALS:

1.4.1 Certification: Submit certificates of inspection as required by governmental authorities. Submit other data substantiating that materials comply with specified requirements. Submit other data substantiating that materials comply with specified requirements.

Submit seed vendor's certified statement for each grass seed mixture required, stating botanical and common name, percentage by weight, and percentages of purity, germination, and weed seed for each grass seed species.

1.4.2 Planting Schedule: Seeding will occur between May 15 and September 15. If not, add 35 lbs/acre annual ryegrass to the seeding mixture.

1.5 DELIVERY, STORAGE AND HANDLING:

1.5.1 Packaged Materials: Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.

1.6 JOB CONDITIONS:

1.6.1 Proceed with and complete seeding as rapidly as portions of site become available, working within seasonal limitations for work required.

1.6.2 Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Owner's Representative before planting.

1.6.3 Planting Time: Plant or install materials during normal planting seasons. Correlate planting with expected germination periods.

1.7 WARRANTY:

1.7.1 Warranty seeded areas for one full year.

PART 2 - PRODUCTS

2.1 TOPSOIL:

2.1.1 Topsoil (strippings) for landscape work is available at site.

2.2 SOIL AMENDMENTS:

2.2.1 Lime: Natural dolomitic limestone containing not less than 85% of total carbonates with a minimum of 30% magnesium carbonates, ground so that not less than 90% passes a 10-mesh sieve and not less than 50% passes a 100-mesh sieve. Contractor shall apply lime at a rate based on testing of soil performed by Contractor.

2.2.2 Mulch: 3 tons/acre.

2.2.3 Commercial Fertilizer: 1300 lbs/acre (10-10-10 analysis).

2.3 GRASS MATERIALS:

2.3.1 Grass Seed: Provide fresh, clean, new-crop seed complying with tolerance for purity and germination established by Official Seed Analysts of North America. Provide seed mixture composed of grass species, proportions and minimum percentages of purity, germination, and maximum percentage of weed seed, as specified below:

Kentucky 31 Fescue	25 lbs/acre
Red Fescue	40 lbs/acre
Kentucky Bluegrass	25 lbs/acre
White Clover	10 lbs/acre
	100 lbs/acre

2.4 MISCELLANEOUS LANDSCAPE MATERIALS:

2.4.1 Mulch Binder: Material for mulch binder may be latex based of a type acceptable to the Owner's Representative. Other types of approved mulch binders may be used when authorized.

PART 3 - EXECUTION

3.1 PREPARATION:

3.1.1 Preparation for Planting:

Loosen subgrade of areas to be seeded to a minimum depth of 4". Remove stones over 6" in any dimension and sticks, roots, rubbish and other extraneous matter. Limit preparation to areas which will be planted promptly after preparation.

Spread top soil to minimum depth required to meet lines, grades and elevations shown, after light rolling and natural settlement. Add specified soil amendments and mix thoroughly into upper 4" of topsoil.

Moisten prepared areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.

Restore areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.

3.2 SEEDING:

3.2.1 Do not use wet seed or seed which is moldy or otherwise damaged in transit or storage.

3.2.2 Sow seed using a spreader or seeding machine. Do not seed or mulch when wind velocity exceeds 5 mi. per hr. Distribute seed evenly over entire area by sowing equal quantity in 2 directions at right angles to each other.

3.2.3 Sow not less than the quantity of seed specified or scheduled.

3.2.4 Rake seed lightly into top 1/8" of soil, roll lightly, and water with a fine spray.

3.2.5 Protect seeded slopes against erosion with erosion netting or other methods acceptable to the Owner's Representative as specified in Section 02270, Erosion Control.

3.2.6 Protect seeded areas against erosion by spreading specified mulch after completion of seeding operations. Spread uniformly to form a continuous blanket not less than 1-1/2" loose measurement over seeded areas.

3.3 HYDROSEEDING:

3.3.1 Mix specified seed, fertilizer and pulverized mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogenous slurry suitable for hydraulic application.

3.3.2 Apply slurry uniformly to all areas to be seeded. Rate of application as required to obtain specified seed sowing rate.

3.4 CLEANUP AND PROTECTION:

3.4.1 During seeding, keep work area in an orderly condition.

3.4.2 Protect seeded area and materials from damage due to adjacent operations, operations by other contractors and trades and trespassers. Maintain protection during installation and germination periods. Treat, repair or replace damaged work as directed.

3.5 INSPECTION AND ACCEPTANCE:

When seeding is completed, including germination, Owner's Representative will, upon request, make an inspection to determine acceptability.

Seeded areas may be inspected for acceptance in parts agreeable to Owner's Representative, provided work offered for inspection is complete.

Where inspected landscape work does not comply with requirements, replace rejected work and continue maintenance until reinspected by Owner's Representative and found to be acceptable.

END OF SECTION

SECTION 02730

PIPING SYSTEMS

1. GENERAL

1.1 RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK:

1.2.1 Extent of leachate system work is indicated on drawings and schedules, and by requirements of this section including excavation and backfill required for leachate system.

1.3 QUALITY ASSURANCE:

1.3.1 Manufacturer's Qualifications: Firms regularly engaged in manufacture of products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.4 SUBMITTALS:

1.4.1 Product Data: Submit manufacturer's technical product data and installation instructions for leachate system materials and products.

1.4.2 Record Drawings: At project closeout, submit record drawings of installed piping and products, including stationing and inverts as requested by the Owner's Representative, and in accordance with requirements of Division 1.

1.4.3 Maintenance Data: Submit maintenance data and parts lists of system materials and products. Include this data, product data, and record drawings in maintenance manual; in accordance with requirements of Division 1.

2. PRODUCTS

2.1 PIPES AND PIPE FITTINGS:

2.1.1 General: Provide pipes of one of the following materials, of weight/class indicated. Provide pipe fittings, cleanouts and all accessories of same material and weight/class as pipes, with joining method as indicated on Drawings.

2.1.2 High Density Polyethylene Pipe (HDPE): ASTM D1248,

12" SDR 7.3 Solid HDPE Pipe
12" SDR 7.0 Perforated HDPE Pipe
12" SDR 9.0 Solid HDPE Pipe

Available Manufacturers: Subject to compliance with requirements, manufacturers offering HDPE pipe which may be incorporated in the work include, but are not limited to, the following:

Manufacturers: Subject to compliance with requirements, provide HDPE pipe of one of the following:

Fifepipe, supplier of Driscopipe;
M.L. Sheldon Plastics Corporation; Plastic Pipeline Division;
Plexco; Division of Amsted Industries;
or approved equal

2.2 MANHOLES AND CATCH BASINS:

2.2.1 General: Provide precast reinforced concrete structures as indicated, and complying with ASTM C 478.

2.2.2 Top: Precast concrete, of concentric cone, eccentric cone, or flat slab top type, as indicated.

2.2.3 Base: Precast concrete, with base riser section and separate base slab, or base riser section with integral floor, as indicated.

2.2.4 Steps: Ductile-iron or aluminum, integrally cast into manhole sidewalls.

2.2.5 Frame and Cover: Ductile-iron, heavy-duty as indicated on Drawings.

2.2.6 Pipe Connectors: Resilient, complying with ASTM C 923.

2.2.7 Access Risers: Precast concrete eccentric cone, with steps at 12" o.c., as indicated.

3. EXECUTION

3.1 INSTALLATION OF PIPE AND FITTINGS:

3.1.1 General: Install piping in accordance with governing authorities having jurisdiction, except where more stringent requirements are indicated.

3.1.2 Inspect piping before installation to detect apparent defects. Mark defective materials with white paint and promptly remove from site.

3.1.3 Lay piping beginning at low point of system, true to grades and alignment indicated, with unbroken continuity of invert.

3.1.4 Place bell ends or groove ends of piping facing upstream.

3.1.5 Install gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements.

3.1.6 HDPE Pipe: Install 12-in. pipe using manufacturer's recommended method unless otherwise indicated.

3.1.7 Cleaning Pipe: Clear interior of piping of dirt and other superfluous material as work progresses. Maintain swab or drag in line and pull past each joint as it is completed.

In large, accessible piping, brushes and brooms may be used for cleaning.

Place plugs in ends of uncompleted conduit at end of day or whenever work stops.

Flush lines between manholes if required to remove collected debris.

3.1.8 Joint Adapters: Make joints between different types of pipe with standard manufactured adapters and fittings intended for that purpose.

3.1.9 Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.

Make inspections after lines between manholes, or manhole locations, have been installed and approximately 2-ft of backfill is in place, and again at completion of project.

If inspection indicates poor alignment, debris, displaced pipe, infiltration, or other defects, correct such defects, and reinspect.

3.2 INSTALLATION OF MANHOLES

3.2.1 General: Place precast concrete sections as indicated. Where manholes occur in roadways, set tops of frames and covers flush with finish surface. Elsewhere, set tops 3" above finish surface, unless otherwise indicated.

3.2.2 Install in accordance with ASTM C 891.

3.2.3 Provide rubber joint gasket complying with ASTM C443 at joints of sections.

3.2.4 Apply bituminous mastic coating at joints of sections.

3.3 BACKFILLING:

3.3.1 General: Conduct backfilling operations of open-cut trenches closely following laying, jointing, and bedding or pipe, and after initial inspection and testing are completed.

3.4 FIELD QUALITY CONTROL:

3.4.1 Leakage and Testing: After the completed solid pipeline has been installed, the trench has been compacted to specification requirements, and manhole or joints showing noticeable streams or jets have been repaired and/or replaced the Contractor shall perform all exfiltration tests. The Contractor shall be responsible for furnishing all labor, materials and equipment so that such tests can be accomplished at the times and locations the Engineer deems necessary. The rate of exfiltration shall not exceed 200 gallons per inch of pipe diameter per mile of pipe per day.

THE ATTENTION OF THE CONTRACTOR IS DIRECTED TO THE STRICT REQUIREMENTS RELATIVE TO MAXIMUM RATES OF EXFILTRATION AND TO THE IMPORTANCE OF THESE SPECIFICATIONS RELATIVE TO TIGHT JOINTS REQUIRED. SEWERS NOT MEETING THE ABOVE REQUIREMENTS SHALL BE REPAIRED AS NECESSARY AT THE CONTRACTOR'S EXPENSE.

3.4.2 Exfiltration Tests:

3.4.2.1 Liquid Test:

Water tests shall be performed by filling the pipe with water to a point four feet above the top of the pipe at the upper end and measuring the water loss during a one-hour period.

3.4.2.2 Air Test:

For making low-pressure air tests, the Contractor shall use equipment specifically designed and manufactured for the purpose of testing sewer pipelines using low-pressure air. The equipment shall be provided with an air regulator valve or air safety valve so set that the internal air pressure in the pipeline cannot exceed eight psig.

The leakage test using low-pressure air shall be made on each manhole-to-manhole section of pipeline.

Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be tested. Pneumatic plugs shall resist internal test pressure without requiring external bracing or blocking.

All air used shall pass through a single control panel.

Low-pressure air shall be introduced into the sealed line until the internal air pressure reaches four psig greater than the maximum pressure exerted by groundwater that may be above the invert of the pipe at the time of the test. However, the internal air pressure in the sealed line shall not be allowed to exceed eight psig.

At least two minutes shall be allowed for the air pressure to stabilize in the section under test. After the stabilization period, the low-pressure air supply hose shall be quickly disconnected from the control panel. The time required in minutes for the pressure in the section under test to decrease from 3.5 to 3.0 psig (greater than the maximum pressure exerted by groundwater that may be above the invert of the pipe) shall not be less than that shown in the following table:

Pipe diameter in inches	Minutes
6	4.0
8	5.0
10	6.5
12	7.5
14	9.0
15	9.5
18	11.5

Note: For larger diameter pipe, minimum time = 7.7 x dia. (ft).

When the sewer section to be tested contains more than one size of pipe, the minimum allowable time shall be based on the largest diameter pipe in the section.

END OF SECTION

SECTION 02731

GEOTEXTILES

1. GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of section.

1.2 DESCRIPTION OF WORK

Extent of geotextile work is indicated on drawings and schedules, and by requirements of this section.

1.3 QUALIFICATIONS AND WARRANTIES

1.3.1 Manufacturer's Qualifications: Firms regularly engaged in manufacture of products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.3.2 Installer's Qualifications: Firms regularly engaged in installation of products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.4 QUALITY CONTROL DOCUMENTATION

1.4.1 Product Data: Prior to the installation of any geotextile, the Manufacturer or Installer shall provide the Project Manager with the following information:

1. Written certification that minimum average roll values given in the specification are guaranteed by the Manufacturer.

2. For non-woven geotextiles, written certification that the Manufacturer has continuously inspected the geotextile for the presence of needles and found the geotextile to be needle free.

3. Quality control certificates, signed by a responsible party employed by the Manufacturer. The quality control certificates shall include roll identification numbers, sampling procedures and results of quality control testes. At a minimum, results shall be given for:

a. Mass per unit area
b. Grab strength
c. Trapezoidal tear strength
d. Burst strength
e. Puncture strength
f. Apparent Opening Size

Quality control tests shall be performed in accordance with the test methods specified in the project specifications for at least every 100,000 ft^2 of geotextile produced.

The Manufacturer shall identify all rolls of geotextiles with the following:

1. Manufacturer's name
2. Product identification
3. Roll number
4. Roll dimensions

1.4.2 Product Review: The Owner's Representative shall verify that:

1. Property values certified by the Manufacturer meet all of its guaranteed specifications.

2. Measurements of properties by the Manufacturer are properly documented and that the test methods used are acceptable.

3. Quality control certificates have been provided at the specified frequency for all rolls, and that each certificate identifies the rolls related to it.

4. Roll packages are appropriately labeled.

5. Certified minimum average roll properties meet the project specifications.

2. PRODUCTS

2.1 GEOTEXTILE:

2.1.1 General: Provide geotextiles as indicated on Drawings.

2.1.2 Non-Woven Geotextile: 16 oz/sy - The geotextile between the 60-mil textured HDPE geomembrane and the #57 stone shall be Nicolon S1600, or meet the minimum requirements listed below:

PROPERTY	TEST PROCEDURE	MINIMUM VALUE[1]
Weight	ASTM D 3776	16 oz/sy
Grab Strength	ASTM D 4632	500 lbs
Tear Strength	ASTM D 4533	150 lbs
Mullen Burst	ASTM D 3786	800 psi
Puncture Resistance	ASTM D 4833	240 lbs
AOS	ASTM D 4751	60 - 100 U.S Sieve

(1) Values in weaker principle direction. All minimum values represent minimum average roll values (i.e. test results from any sampled roll in a lot, tested in accordance with ASTM D 4759-88 shall meet or exceed the minimum values listed.)

3.0 QUALITY ASSURANCE

3.1 GEOTEXTILE DEPLOYMENT

During shipment and storage, the geotextile shall be protected from ultraviolet light exposure, precipitation or other inundation, mud, dirt, dust, puncture, cutting, or any other damaging or deleterious conditions. Geotextile rolls shall be shipped and stored in relatively opaque and watertight wrappings. Wrappings shall be removed shortly before deployment.

The Owner's Representative shall observe rolls upon delivery at the site and any deviation from the above requirements shall be reported to the Project Manager.

The Installer shall handle all geotextiles in such a manner as to assure they are not damaged in any way, and the following shall be complied with:

1. On slopes, the geotextiles shall be securely anchored and then rolled down the slope in such a manner as to continually keep the geotextile sheet in tension.

2. In the presence of wind, all geotextiles shall be weighted with sandbags or the equivalent. Such sandbags shall be installed during deployment and shall remain until replaced with cover material.

3. Geotextiles shall be cut using a geotextile cutter (hook blade) only. If in place, special care shall be taken to protect other materials from damage which could be caused by the cutting of the geotextiles.

4. The Installer shall take any necessary precautions to prevent damage to underlying layers during placement of the geotextile.

5. During placement of geotextiles, care shall be taken not to entrap, in or beneath the geotextile, stones, excessive dust, or moisture that could damage the geomembrane, cause clogging of drains or filters, or hamper subsequent seaming.

6. A visual examination of the geotextile shall be carried out over the entire surface, after installation, to assure that no potentially harmful foreign objects, such as needles, are present.

3.2 SEAMING PROCEDURES

On slopes steeper than 10(horizontal):1(vertical), all geotextiles shall be continuously sewn (i.e. spot sewing is not allowed). Geotextiles shall be overlapped a minimum of 3 inches (75 mm) prior to seaming. In general, no horizontal seams shall be allowed on sideslopes (i.e. seams shall be along, not across, the slope), except as part of a patch.

On bottoms and slopes shallower than 10 (horizontal):1 (vertical), geotextiles shall be seamed as indicated above (preferred), or thermally bonded with the written approval of the Owner's Representative.

The Installer shall pay particular attention at seams to assure that no earth cover material could be inadvertently inserted beneath the geotextile.

Any sewing shall be done using polymeric thread with chemical and ultraviolet light resistance properties equal to or exceeding those of the geotextile.

3.3 DEFECTS AND REPAIRS

Any holes or tears in the geotextile shall be repaired as follows:

On slopes, a patch made from the same geotextile shall be sewn into place in accordance with the project specifications. Should any tear exceed 10 percent of the width of the roll, that roll shall be removed from the slope and replaced.

Care shall be taken to remove any soil or other material which may have penetrated the torn geotextile.

The Owner's Representative shall observe any repair and report any noncompliance with the above requirements in writing to the Project Manager.

3.4 GEOTEXTILE PROTECTION

All soil materials located on top of a geotextile shall be deployed in such a manner as to assure:

1. The geotextile and underlying lining materials are not damaged.

2. Minimal slippage of the geotextile on underlying layers occurs.

3. No excess tensile stresses occur in the geotextile.

Unless otherwise specified by the Owner's Representative, all lifts of soil material shall be in conformance with the guidelines given in Section 02200 and 02771-4.7.1.

END OF SECTION

SECTION 02771

GEOMEMBRANE (HIGH DENSITY POLYETHYLENE (HDPE))

1. GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of section.

1.2 DESCRIPTION OF WORK

Extent of flexible membrane lining work is shown on drawings.

Refer to other Division-2 sections for earthwork related to lining work.

1.3 QUALITY ASSURANCE, QUALIFICATIONS, AND WARRANTIES

1.3.1 Manufacturer's Experience: The manufacturer supplying the membrane shall satisfactorily demonstrate previous experience by letter of certification. Certification shall indicate that the manufacturer has produced, and has in service in similar applications for a period of not less than two (2) years, at least five (5) million sq ft of HDPE material meeting these Specifications.

1.3.2 Installer's Experience: The Installer proposing to install the lining shall satisfactorily demonstrate previous experience by letter of certification. Certification shall indicate the Installer's successful past installation of at least 5,000,000 sq ft of HDPE membrane lining.

Installation shall be performed under the direction of a single installation supervisor who shall remain on site and be in responsible charge throughout the liner installation, including subgrade acceptance, liner layout, seaming, testing and repairs, and all other activities contracted for with the Installer. The installation supervisor shall have supervised the installation of at least 2,000,000 sf of polyethylene geomembrane. Actual seaming shall be performed under the direction of a master seamer who may be the same person as the installation supervisor, and who has a minimum of 1,000,000 sf polyethylene geomembrane seaming experience using the same type of seaming apparatus as that specified in this project. The installation supervisor or master seamer must be on site whenever seaming is being performed.

1.3.3 Manufacturer's Guarantee: The manufacturer of the membrane liner shall enter into agreement with the Owner guaranteeing the membrane as follows:

> The manufacturer warrants the HDPE liner which is manufactured, sold as first quality, and installed with technical assistance and/or by an approved installation contractor to be (1) furnished free of manufacturing defects in workmanship or material for a period of one year from the time of delivery with the basis for judgment of defects being the applicable product specifications in effect at the time the order was placed unless modified by mutual written agreement; (2) shall not develop cracks/holes which go completely through the membrane due to the effects of normal service for a period of twenty (20) years from the date of delivery. "Normal service" does not include physical damage caused by acts of God, casualty, or catastrophe such as (but not limited to) earthquakes, fire, explosion, floods, lightning, piercing hail, tornadoes, corrosive air

pollution, mechanical abuse by machinery, equipment, people or animals, or excessive flexures, pressures or stress from any source other than faulty installation, and (3) immune to chemical attack and degradation by chemicals, specified in the manufacturer's literature, as compatible with, and as not having an adverse effect on the membrane; and (4) immune to chemicals tested by the manufacturer for the Owner.

Should defects or weathering degradation within the scope of the above warranty occur, the manufacturer shall refund to the purchaser-user the pro-rata part for the unexpired term of the warranty of the purchaser-user's original cost of such product, or will supply repair or replacement materials at the then-current price. In the event the manufacturer supplies repair or replacement materials, against the then- current price, the manufacturer will credit the lesser of (1) the pro-rata part of the original sales price of the material so repaired or replaced for the unelapsed period of the warranty, or (2) the pro-rata part of the then-current price of the material so repaired or replaced to the unelapsed period of the warranty. The warranty shall continue in effect on the repaired or replaced material for the unelapsed term of the original warranty. To enable the manufacturer's technical staff to properly determine the cause of any alleged defect and to take appropriate steps to effect timely corrective measures if such defect is within the warranty, any claim for alleged breach of warranty will be made and presented in writing to manufacturer and the installing Contractor within thirty (30) days after the alleged defect was first noticed.

1.4 QUALITY CONTROL DOCUMENTATION

1.4.1 Product Data: Prior to the installation of any geomembrane, the manufacturer or Installer shall provide the Owner's Representative with the following information:

1. Copies of the quality control certificates issued by the resin supplier which include resin supplier's name and production plant, brand name and number, and production date of the resin.

2. Reports on tests conducted by the Manufacturer to verify that the quality of the resin used to manufacture the geomembrane meets the specifications.

3. Reports on quality control tests conducted by the Manufacturer to verify that the geomembrane manufactured for the project meets the project specifications.

4. Written certification that minimum values given in the specification are guaranteed by the Manufacturer.

5. Quality control certificates, signed by a responsible party employed by the Manufacturer. Each quality control certificate shall include roll identification numbers, sampling procedures, and results of quality control tests. At a minimum, results shall be given for:

    a. Density
    b. Carbon black content
    c. Carbon black dispersion
    d. Thickness
    e. Tensile properties
    f. Tear resistance

These quality control tests shall be performed in accordance with the test methods specified in the specifications, for every 40,000 ft^2 (4,000 m^2) of geomembrane produced.

The Manufacturer shall identify all rolls of geomembranes with the following:

1. Manufacturer's name
2. Product identification
3. Thickness
4. Roll number
5. Roll dimensions

1.4.2 Product Review: The Owner's Representative shall verify that:

1. Property values certified by the Manufacturer meet all of its guaranteed specifications.

2. Measurements of properties by the Manufacturer are properly documented and that the test methods used are acceptable.

3. Quality control certificates have been provided at the specified frequency for all rolls, and that each certificate identifies the rolls related to it.

4. Roll packages are appropriately labeled.

5. Certified minimum properties meet the specifications.

2. PRODUCTS

2.1 HIGH DENSITY POLYETHYLENE (HDPE) MEMBRANE

2.1.1 General: The materials supplied under these Specifications shall be first quality products designed and manufactured specifically for the purposes of this work, and which have been satisfactorily demonstrated by prior use to be suitable and durable for such purposes.

2.1.2 Description of HDPE Material: The membrane shall be a High density polyethylene (HDPE) of 60-mils thickness and textured, containing no additives, fillers or extenders. Carbon black 2 to 3 percent shall be added to the resin for ultraviolet resistance.

The lining material shall be manufactured a minimum of 20 feet seamless widths.

2.1.3 Physical Characteristics: The HDPE materials shall have the following physical characteristics:

PROPERTY	TEST METHOD	MINIMUM VALUE
Thickness	ASTM D 5199	54-66 mils nominal
Density	ASTM D 1505	0.940 g/cubic cm
Tensile Properties	ASTM D 638[1]	
Yield Strength		132 lb/in
Yield Elongation		12 percent
Break Strength		300 lb/in
Break Elongation		600 percent
Tear Strength	ASTM D 1004	50 lbs
Puncture Resistance	FTMS 101c, Mthd 2065	80 lbs
Low Temperature	ASTM D 746	-94 degrees F
Carbon Black		
Content	ASTM D 1603	2 - 3 percent
Dispersion	ASTM D 3015	A1 or A2
Environmental		
Stress Crack	ASTM D 5397[2]	200 hrs
Seam Strength	ASTM D 4437[1]	
Shear		.90*PM[3]
Peel		.65*PM[3] Fusion .55*PM[3]Extrusion

(1) As modified by NSF Standard 54, Appendix A
(2) Value of time to failure under load of 30% yield stress of parent geomembrane
(3) PM is Parent Material yield strength as found from the average of the Roll Certificate values minus two (2) standard deviations.

The geomembrane shall be produced as to be free of holes, blisters, undispersed raw materials, or any sign of contamination by foreign matter, and shall not have striations, roughness, pinholes or bubbles on the surface.

2.1.4 Factory Bonded Seam: Calendered HDPE sheeting may not be fabricated into large sections at the factory.

2.1.5 Extrusion Joining Resin: Resin for extrusion joining sheets shall be HDPE produced from the same material as the sheet resin. Physical properties shall be the same as those of the resin used in the manufacture of the HDPE liner. The resin shall be supplied in black and/or natural color. Natural resin shall be colored black through addition of 2.0 to 3.0 percent master batch colorant before use.

2.1.6 Documentation: Prior to delivery of the geomembrane to the job site, the Installer shall provide the Owner with a written certification that the product delivered was extruded from the specified resin. The manufacturer shall provide quality control certificates for each batch of resin and each shift's production of geomembrane, and shall follow the quality control testing program as described in Section 4.1. These quality control certificates shall be signed by responsible parties employed by the Manufacturer, and shall be supplied to the Owner. No geomembrane will be permitted to be delivered until the Owner has in his possession such certification.

2.1.7 Roll Identification: Each roll shall have permanently affixed both inside and outside the roll the following information: name of manufacturer; date of manufacture; resin batch code; thickness of the material; roll number; roll length; and roll width.

2.2 MISCELLANEOUS MATERIALS

2.2.1 Pipe Boots, Vents, and Patches: All such devices shall be of the same material as the lining or a compatible approved equal.

2.2.2 Mechanical Fastenings: Mechanical fastenings shall be of the material, size, and type as detailed on the plans or approved shop drawings.

3. QUALITY ASSURANCE

3.1 CONFORMANCE TESTING

Upon delivery of the rolls of geomembrane, the Owner's Representative shall assure that conformance test samples are obtained for the geomembrane. These samples shall then be forwarded to the independent laboratory for testing to assure conformance to the specifications.

At a minimum the following conformance tests shall be conducted:

1. Density
2. Carbon black content
3. Carbon black dispersion
4. Thickness
5. Tensile characteristics

These conformance tests shall be performed in accordance with the test methods specified in section 2.1.3.

3.1.1 Sampling Procedures: The rolls to be sampled shall be selected by the Owner's Representative. Samples shall be taken across the entire width of the roll and shall not include the first 3 feet. Unless otherwise specified, samples shall be 3 feet long by the roll width. The Owner's Representative shall mark the machine direction on the samples with an arrow.

Unless otherwise specified, samples shall be taken at a rate of one per 100,000 ft^2 of geomembrane.

3.1.2 Test Results. All conformance test results shall be reviewed and accepted or rejected by the Owner's Representative prior to the deployment of the geomembrane.

The Owner's Representative shall examine all results from laboratory conformance testing and shall report any nonconformance to the Project Manager. The Owner's Representative shall be responsible for checking that all test results meet or exceed the property values listed in Section 2.1.3.

4. EXECUTION

4.1 SUBGRADE PREPARATION

4.1.1 Surface Preparation: The earthwork contractor shall be responsible for preparing the supporting soil for geomembrane placement. The Project Manager shall coordinate the work of the earthwork contractor and the Installer so that the requirements of the specification are met.

Before the geomembrane installation begins, the Owner's Representative shall verify that:

1. A qualified land survey has verified all lines and grades.

2. A qualified geotechnical engineer has verified that the supporting soil meets the density specified in the project specifications.

3. The surface to be lined has been rolled, compacted, or handworked so as to be free of irregularities, protrusions, loose soil, and abrupt changes in grade.

4. The surface of the supporting soil does not contain stones which may be damaging to the geomembrane.

5. There is no area excessively softened by high water content.

6. There is no area where the surface of the soil contains desiccation cracks with dimensions exceeding those allowed by the project specifications.

The Installer shall certify in writing that the surface on which the geomembrane will be installed is acceptable. A certificate of acceptance shall be given by the Installer to the Owner's Representative prior to commencement of geomembrane deployment in the area under consideration. The Project Manager shall be given a copy of this certificate by the Owner's Representative.

After the supporting soil has been accepted by the Installer, it is the Installer's responsibility to indicate to the Owner's Representative any change in the supporting soil condition that may require repair work.

4.1.2 Anchor: The Owner's Representative shall verify that the geomembrane anchor has been constructed according to the design drawings and specifications.

4.2 GEOMEMBRANE DEPLOYMENT

4.2.1 Panel Nomenclature: A field panel is defined as a unit of geomembrane which is to be seamed in the field, i.e. a field panel is a roll or a portion of roll cut in the field.

It shall be the responsibility of the Owner's Representative to assure that each field panel is given an identification code (number or letter-number) consistent with the layout plan.

4.2.2 Panel Deployment Procedure: The Owner's Representative shall review the panel deployment progress of the Installer (keeping in mind issues relating to wind, rain, clay liner desiccation, and other site-specific conditions).

The Owner's Representative shall record the identification code, location, and date of installation of each field panel.

4.2.3 Deployment Weather Conditions: Geomembrane deployment shall not proceed at an ambient temperature below 32°F or above 104°F unless otherwise authorized, in writing, by the Owner's Representative. Geomembrane placement shall not be performed during any precipitation, in the presence of excessive moisture (e.g. fog, dew), in an area of ponded water, or in the presence of excessive winds. Geomembrane deployment shall not be undertaken if weather conditions will preclude material seaming following deployment.

4.2.4 Method of Deployment: Before the geomembrane is handled on site, the Owner's Representative shall verify that handling equipment to be used on the site is adequate and does not pose risk of damage to the geomembrane. During handling, the Owner's Representative shall observe and verify that the Installer's personnel handle the geomembrane with care.

The Owner's Representative shall verify the following:

1. Any equipment used does not damage the geomembrane by handling, trafficking, excessive heat, leakage of hydrocarbons, or other means.

2. The prepared surface underlying the geomembrane has not deteriorated since previous acceptance, and is still acceptable immediately prior to geomembrane placement.

3. Any geosynthetic elements immediately underlying the geomembrane are clean and free of debris.

4. All personnel do not smoke or wear damaging shoes while working on the geomembrane, or engage in other activities which could damage the geomembrane.

5. The method used to unroll the panels does not cause excessive scratches or crimps in the geomembrane and does not damage the supporting soil.

6. The method used to place the panels minimized wrinkles (especially differential wrinkles between adjacent panels).

7. Adequate temporary loading and/or anchoring (e.g. sand bags, tires), not likely to damage the geomembrane, has been placed to prevent uplift by wind. In case of high winds, continuous loading, e.g. by sand bags, is recommended along edges of panels to minimize risk of wind flow under the panels.

8. Direct contact with the geomembrane is minimized, and the geomembrane is protected by geotextiles, extra geomembrane, or other suitable materials, in areas where excessive traffic may be expected.

4.2.5 Damage and Defects: Upon delivery to the site, the Owner's Representative shall conduct a surface observation of all rolls for defects and for damage. This inspection shall be conducted without unrolling rolls unless defects or damages are found or suspected.

4.3 FIELD SEAMING

4.3.1 Seam Layout: Before installation begins, the Installer must provide the Owner's Representative with a panel layout drawing, i.e. a drawing of the facility to be lined showing all

expected seams. The Owner's Representative shall review the panel layout drawing and verify that it is consistent with accepted state-of-practice.

In general, seams should be oriented parallel to the line of maximum slope, i.e. oriented along, not across, the slope. In corners and odd-shaped geometric locations, the number of seams should be minimized. No horizontal seam should be less than 5 feet (1.5 m) from the toe of the slope, or areas of potential stress concentrations, unless otherwise authorized by the Owner's Representative.

4.3.2 Accepted Seaming Methods: Approved processes for field seaming are extrusion welding and fusion welding. Proposed alternate processes shall be documented and submitted by the Installer to the Owner's Representative for approval. Only apparatus which have been specifically approved by make and model shall be used.

4.3.2.1 Extrusion Process:

The Owner's Representative shall verify that:

1. The Installer maintains on-site the number of spare operable seaming apparatus decided upon at the pre-construction meeting.

2. Equipment used for seaming is not likely to damage the geomembrane.

3. Prior to beginning a seam, the extruder is purged until all heat-degraded extrudate has been removed from the barrel.

4. Clean and dry welding rods or extrudate pellets are used.

5. The electric generator is placed on a smooth base such that no damage occurs to the geomembrane.

6. Grinding shall be completed no more than 1 hour prior to seaming.

7. A smooth insulating plate or fabric is placed beneath the hot welding apparatus after usage.

8. The geomembrane is protected from damage in heavily trafficked areas.

9. Exposed grinding marks adjacent to an extrusion weld shall be minimized. In no instance shall exposed grinding marks extend more than 1/4 inch from the seamed area.

10. In general, the geomembrane panels are aligned to have a nominal overlap of 3 inch for extrusion welding. In any event, the final overlap shall be sufficient to allow peel tests to be performed on the seam.

11. No solvent or adhesive is used unless the product is approved in writing by the Owner's Representative prior to use.

12. The procedure used to temporarily bond adjacent panels together does not damage the geomembrane; in particular, the temperature of hot air at the nozzle of any temporary welding apparatus is controlled such that the geomembrane is not damaged or degraded.

4.3.2.2 Fusion Process:

The Owner's Representative shall also verify that:

1. The Installer maintains on-site the number of spare operable seaming apparatus decided upon at the pre-construction meeting.

2. Equipment used for seaming is not likely to damage the geomembrane.

3. For cross seams, the edge of the cross seam is ground to an incline prior to welding.

4. The electric generator is placed on a smooth base such that no damage occurs to the geomembrane.

5. A smooth insulating plate or fabric is placed beneath the hot welding apparatus after usage.

6. The geomembrane is protected from damage in heavily trafficked areas.

7. A movable protective layer is used as required by the Installer directly below each overlap of geomembrane that is to be seamed to prevent buildup of moisture between the sheets and prevent debris from collecting around the pressure rollers.

8. In general, the geomembrane panels are aligned to have a nominal overlap of 5 inches for fusion welding. In any event, the final overlap shall be sufficient to allow peel tests to be performed on the seam.

9. No solvent or adhesive is used unless the product is approved in writing by the Owner's Representative.

4.3.3 Seam Preparation: The Owner's Representative shall verify that prior to seaming, the seam area is clean and free of moisture, dust, dirt, debris or foreign material of any kind. If seam overlap grinding is required, the Owner's Representative must assure that the process is completed according to the Manufacturer's instructions within one hour of the seaming operation, and in a way that does not damage the geomembrane. The Owner's Representative shall also verify that seams are aligned with the fewest possible number of wrinkles and "fishmouths".

4.3.4 Trial Seams: Trial seams shall be made on fragment pieces of geomembrane liner to verify that conditions are adequate for production seaming. Such trial seams shall be made at the beginning of each seaming period, and at least once each five hours, for each production seaming apparatus used that day. Each seamer shall make at least one trial seam each day. Trial seams shall be made under the same conditions as actual seams.

The trial seam sample shall be at least 5 feet long by 1 foot wide (after seaming) with the seam centered lengthwise. Seam overlap shall be as indicated in Section 4.3.2.

Five specimens shall be cut from the sample with a 1 inch wide die. The specimens shall be cut by the Installer at locations selected randomly along the trial seam sample by the Owner's Representative. The specimens shall be tested in peel using a field tensiometer. The tensiometer shall be capable of maintaining a constant jaw separation rate of two (2) inches per minute and be calibrated to provide accurate results. They should not fail in the seam. If a specimen fails, the entire operation shall be repeated. If the additional specimen fails, the seaming apparatus and seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive successful trial welds are achieved. The Owner's Representative shall observe all trial seam procedures.

4.3.6 Seaming Weather Conditions:

4.3.6.1 Normal Weather Conditions: The normal required weather conditions for seaming are as follows:

1. Ambient temperature between 32°F and 104°F.
2. Dry conditions, i.e. no precipitation or other excessive moisture, such as fog or dew.
3. No excessive winds.

4.3.6.2 Cold Weather Conditions: To assure a quality installation, if seaming is conducted when the ambient temperature is below 32°F, the following conditions must be met:

1. Geomembrane surface temperatures shall be determined by the Owner's Representative. For extrusion welding, preheating is required if the surface temperature of the geomembrane is below 32°F.
2. Preheating may be waived by the Owner's Representative based on if the Installer demonstrates that welds of equivalent quality may be obtained without preheating at the expected temperature of installation.
3. If preheating is required, the Owner's Representative shall inspect all areas of geomembrane that have been preheated by a hot air device prior to seaming, to assure that they have not been overheated.
4. Care shall be taken to confirm that the surface temperatures are not lowered below the minimum surface temperatures specified for welding due to winds or other adverse conditions. It may be necessary to provide wind protection for the seam area.
5. All preheating devices shall be approved prior to use by the Owner's Representative.
6. Additional destructive tests (as described in Section 4.5) shall be taken at the discretion of the Owner's Representative.
7. Sheet grinding may be performed before preheating, if applicable.

8. Trial seaming, as described in Section 4.3.4, shall be conducted under the same ambient temperature and preheating conditions as the actual seams. Under cold weather conditions, new trial seams shall be conducted if the ambient temperature drops by more than 10°F from the initial trial seam test conditions.

4.3.6.3 Warm Weather Conditions: At ambient temperatures above 104°F, no seaming of the geomembrane shall be permitted unless the Installer can demonstrate to the satisfaction of the Owner's Representative that geomembrane seam quality is not compromised.

Trial seaming, as described in Section 4.3.4, shall be conducted under the same ambient temperature conditions as the actual seams.

At the option of the Owner's Representative, additional destructive tests (as described in Section 4.5) may be required for any suspect areas.

4.4 NONDESTRUCTIVE SEAM TESTING

4.4.1 Concept: The Installer shall nondestructively test all field seams over their full length using a vacuum test unit, air pressure test (for double fusion seams only), or other approved method. Vacuum testing and air pressure testing are described in Sections 4.4.2 and 4.4.3, respectively. The purpose of nondestructive tests is to check the continuity of seams. It does not provide quantitative information on seam strength. Nondestructive testing shall be carried out as the seaming work progresses, not at the completion of all field seaming.

For all seams, the Owner's Representative shall:

1. Observe nondestructive testing procedures.

2. Record location, data, test unit number, name of tester, and outcome of all testing.

3. Inform the Installer of any required repairs.

4.4.2 Vacuum Testing. The following procedures are applicable to vacuum testing.

1. The equipment shall consist of the following:
   a. A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, a porthole or valve assembly, and a vacuum gauge.
   b. A pump assembly equipped with a pressure controller and pipe connections.
   c. A rubber pressure/vacuum hose with fittings and connections.
   d. A soapy solution.
   e. A bucket and wide paint brush, or other means of applying the soapy solution.

2. The following procedures shall be followed:

   a. Energize the vacuum pump and reduce the tank pressure to approximately 5 psi gauge.

b. Wet a strip of geomembrane approximately 12 inches by 48 inches with the soapy solution.
c. Place the box over the wetted area.
d. Close the bleed valve and open the vacuum valve.
e. Assure that a leak-tight seal is created.
f. For a period of not less than 10 seconds, apply vacuum and examine the geomembrane through the viewing window for the presence of soap bubbles.
g. If no bubble appears after 10 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum 3 inches overlap, and repeat the process.
h. All areas where soap bubbles appear shall be marked and repaired in accordance with Section 4.6.

4.4.3 Air Pressure Testing: The following procedures are applicable to double fusion welding which produces a double seam with an enclosed space.

1. The equipment shall consist of the following:

   a. An air pump (manual or motor driven), equipped with pressure gauge capable of generating and sustaining a pressure between 25 and 30 psi and mounted on a cushion to protect the geomembrane.
   b. A rubber hose with fittings and connections.
   c. A sharp hollow needle, or other approved pressure feed device.

2. The following procedures shall be followed:

   a. Seal both ends of the seam to be tested.
   b. Insert needle or other approved pressure feed device into the air channel created by the fusion weld.
   c. Insert a protective cushion between the air pump and the geomembrane.
   d. Energize the air pump to a pressure between 25 and 30 psi, close valve, allow 2 minutes for pressure to stabilize, and sustain pressure for at least 5 minutes.
   e. If loss of pressure exceeds 4 psi or does not stabilize, locate faulty area and repair in accordance with Section 4.6.
   f. Cut opposite end of tested seam area once testing is completed to verify continuity of the air channel. If air does not escape, locate blockage and retest unpressurized area. Seal the cut end of the air channel.
   g. Remove needle or other approved pressure feed device and seal.

4.4.4 Test Failure Procedures: The Installer shall complete any required repairs in accordance with Section 4.6. For repairs, the Owner's Representative shall:

1. Observe the repair and testing of the repair.

2. Mark on the geomembrane that the repair has been made.

3. Document the repair procedures and test results.

4.5 DESTRUCTIVE SEAM TESTING

4.5.1 Concept: Destructive seam tests shall be performed to evaluate seam strength. Seam strength testing shall be done as the seaming work progresses, not at the completion of all field seaming.

4.5.2 Sampling Procedures: Samples shall be located by the Owner's Representative on average every 500 linear feet of seaming. The samples shall be cut by the Installer in a timely fashion, field tested and shipped to the independent laboratory so that test results are available as the work is performed.

All holes in the geomembrane resulting from destructive seam sampling shall be repaired in accordance with repair procedures described in Section 4.6. The continuity of the new seams in the repaired area shall be tested according to Section 4.4.

4.5.3 Sample Dimensions: At each sampling location the installer will cut a portion of the seam, 12" wide by 48" long, centered on the seam. The sample will cut into four sections, one for the independent laboratory, one for the Owner archive, one for the installer, and one for the field testing. The field testing portion of the sample will be cut into 5 coupons and tested in peel, according to Section 2.1.3.

4.5.4 Field Testing: The tensiometer shall be capable of maintaining a constant jaw separation rate of two (2) inches per minute. If the test fails the specification, the failed seam should be bound by two passing tests and the area between the two test repaired in accordance with Section 4.6. Final judgment regarding seam acceptability, based on the failure criteria, rests with the Owner's Representative.

The Owner's Representative shall witness all field tests and mark all samples and portions with their number. The Owner's Representative shall also log the date and time, ambient temperature, number of seaming unit, name of seamer, welding apparatus temperatures and pressures, and pass or fail description, and attach a copy to each sample portion.

4.5.5 Laboratory Testing: Samples will be tested according to section 2.1.3. Specimens shall be selected alternately by test from the samples (i.e. peel, shear, peel, shear...). The independent laboratory shall provide verbal test results no more than 24 hours after they receive the samples. The Owner's Representative shall review laboratory test results as soon as they become available.

4.5.6 Destructive Test Failure Procedures: The following procedures shall apply whenever a sample fails a destructive test, whether that test is conducted by the independent laboratory, or by field tensiometer. The Installer has two options:

1. The Installer can repair the seam between two passing test locations.

2. The Installer can trace the welding path to an intermediate location (at 10 feet minimum from the point of the failed test in each direction) and take a sample with a 1 inch wide die for an additional field test at each location (independent laboratory testing only). In the event of a field test failure, the installer shall perform an additional trial weld to verify the settings of the welding machine.

The Owner's Representative shall document all actions taken in conjunction with destructive test failures.

4.6 DEFECTS AND REPAIRS

4.6.1 Identification: All seams and non-seam areas of the geomembrane shall be examined by the Owner's Representative for identification of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. Because light reflected by the geomembrane helps to detect defects, the surface of the geomembrane shall be clean at the time of examination. The geomembrane surface shall be cleaned by the Installer if the amount of dust or mud inhibits examination.

4.6.2 Evaluation. Each suspect location both in seam and non-seam areas shall be nondestructively tested using the methods described in Section 4.5 as appropriate. Each location which fails the nondestructive testing shall be marked by the Owner's Representative and repaired by the Installer. Work shall not proceed with any materials which will cover locations which have been repaired until appropriate nondestructive and laboratory test results with passing values are available.

4.6.3 Repair Procedures: Any portion of the geomembrane exhibiting a flaw, or failing a destructive or nondestructive test, shall be repaired. Several procedures exist for the repair of these areas.

1. The repair procedures available include:

    a. Patching, used to repair large holes, tears, undispersed raw materials, and contamination by foreign matter.
    b. Spot welding or seaming, used to repair small tears, pinholes, or other minor, localized flaws.
    c. Capping, used to repair large lengths of failed seams.
    d. Extrusion welding the flap, used to repair areas of inadequate fusion seams, which have an exposed edge. Repairs of this type shall be approved by the Owner's Representative and shall not exceed 50 feet in length.
    e. Removing bad seam and replacing with a strip of new material welded into place.

2. For any repair method, the following provisions shall be satisfied:

    a. Surfaces of the geomembrane which are to be repaired using extrusion methods shall be abraded no more than one hour prior to the repair.
    b. All surfaces shall be clean and dry at the time of the repair.
    c. All seaming equipment used in repairing procedures shall meet the requirements of the project manual.
    d. Patches or caps shall extend at least 6 inches beyond the edge of the defect, and all corners of patches shall be rounded with a radius of approximately 3 inches.

4.6.4 Repair Verification: Each repair shall be numbered and logged. Each repair shall be nondestructively tested using the methods described in Section 4.5 as appropriate. Repairs which pass the nondestructive test shall be taken as an indication of an adequate repair. Repairs more than 150 feet long may be of sufficient extent to require destructive test sampling, at the discretion of the Owner's Representative. Failed tests indicate that the repair shall be redone and

retested until a passing test results. The Owner's Representative shall observe all nondestructive testing of repairs and shall record the number of each repair, date, and test outcome.

4.6.5 Large Wrinkles: When seaming of the geomembrane is completed, and prior to placing overlying materials, the Owner's Representative shall indicate to the Project Manager which wrinkles should be cut and reseamed by the Installer. The number of wrinkles to be repaired should be kept to an absolute minimum. Therefore, wrinkles should be located during the coldest part of the installation process, while keeping in mind the forecasted weather to which the uncovered geomembrane may be exposed. Wrinkles are considered to be large when the geomembrane can be folded over onto itself. This is generally the case for a wrinkle that extends 12 inches from the subgrade. Seams produced while repairing wrinkles shall be tested as outlined above.

When placing overlying material on the geomembrane, every effort must be made to minimize wrinkle development. If possible, cover should be placed during the coolest weather available. In addition, small wrinkles should be isolated and covered as quickly as possible to prevent their growth. The placement of cover materials shall be observed by the Owner's Representative to assure that wrinkle formation is minimized.

4.7 GEOMEMBRANE PROTECTION

The quality assurance procedures indicated in this Section are intended only to assure that the installation of adjacent materials does not damage the geomembrane.

4.7.1 Soils:

1. Placement of soils on the geomembrane shall not proceed at an ambient temperature below 32°F (0°C) nor above 104°F (40°C) unless otherwise specified.

2. Placement of soil on the geomembrane should be done during the coolest part of the day to minimize the development of wrinkles in the geomembrane.

3. Equipment used for placing soil shall not be driven directly on the geomembrane.

4. A minimum thickness of 1 foot of soil is specified between a light dozer (ground pressure of 5 psi or lighter) and the geomembrane.

5. In any areas traversed by any vehicles other than low ground pressure vehicles shall have a minimum thickness of 3 feet. This requirement may be waived if provisions are made to protect the geomembrane through an engineered design. Drivers shall proceed with caution when on the overlying soil and prevent spinning of tires or sharp turns.

END OF SECTION

TEST PAD PROCEDURE

LANDFILL NO. 6
AREA A-WEST
CANTON, NORTH CAROLINA

FEBRUARY 17, 1999

Prepared by

Sevee & Maher Engineers, Inc.
Cumberland Center, Maine

CHAMPION INTERNATIONAL CORPORATION
CANTON, NORTH CAROLINA
LANDFILL #6, AREA A-WEST

TEST PAD PROCEDURE

As part of the permitting for Area A-West, the NCDENR, Department of Solid Waste, is requiring construction of a test pad for the soil-bedding layer in the base of the landfill. The test pad will provide the necessary field data (e.g., density and moisture content) to guide the contractor in constructing a soil bedding layer meeting an average hydraulic conductivity less than or equal to $5x10^{-5}$ cm/sec in the landfill base. The procedures to construct the test pad are attached in Appendix A.

The process of constructing the test pad will be monitored by the Owner's Representative. The Owner's Representative will document the following items:

1. Test pad size;
2. Equipment used to compact the soil;
3. Number of passes by compaction equipment;
4. Location of field tests and sample locations; and
5. Sample collection and management.

Upon completion of the test pad, the field observations, field test results, and laboratory test results will be compiled and sent to the design engineers. The design engineers will use all the test pad results to determine allowable ranges for soil density and moisture content in order to develop construction specifications necessary to assure an average hydraulic conductivity less than or equal to $5x10^{-5}$ cm/sec.

APPENDIX A

TEST PAD PROCEDURE

1. Test Pad Procedures

A. Objective: The objectives of the test pad procedures are to:

1. Determine the moisture content and density ranges within which the soil should meet the desired hydraulic conductivity.

2. Determine the minimum number of passes with specific compaction equipment necessary to provide a homogeneous soil barrier meeting the specified criteria for thickness, density, moisture content, and hydraulic conductivity.

B. Size: The proposed test pad will be approximately 5,000 square feet in area (50 feet by 100 feet). The placement of the soil layer will be performed in two lifts, with the first lift being scarified prior to placement of the second lift.

C: Material: Soil material used for the construction of the test pad shall be the same material (common borrow #1 – silty sand, sandy silt) as specified for the base filling requirements within two (2) feet of the synthetic liner (Sevee & Maher Engineers, Inc., Permit to Construct Landfill No. 6A-West, Canton, North Carolina, Volume II – Design Report, Appendix D – Engineering Specifications, January 1997). 100 percent of this soil (common borrow) shall be able to pass through the 1-inch square mesh sieve. Greater than 20 percent of the soil, by weight, shall be able to pass the U.S. Standard No. 200 sieve.

D: Quality Assurance Testing: The following quality assurance testing will be performed on the test pad. Test locations will be field determined.

1. Ten moisture density tests (ASTM D 2922 and 3017 or ASTM D 1556 and 2216) per lift, with the following goals:

Density - 90 percent of maximum (as predetermined in accordance with ASTM D 1557)
Moisture Content - 0 to 4 percent above optimum (as pre-determined in accordance with ASTM D 1557)

2. Four undisturbed samples per lift to determine in-place hydraulic conductivity (ASTM D 5084), having an average hydraulic conductivity less than or equal to 5×10^{-5} cm/sec. In the event that it is not possible to collect and test undisturbed samples, field densities shall be measured (ASTM D 2922) and samples shall be collected at each of the four locations, per lift. These samples shall then be reconstituted in the laboratory and hydraulic conductivities shall be determined (ASTM D 5084 or ASTM D 2434).

3. Five thickness tests in each lift, each having a minimum thickness of twelve inches.

4. Ten inspection holes per lift, to evaluate the homogeneous nature of the soil meeting the following criteria:

   a. No soil clods exceeding a diameter of 1 inch;

   b. No voids; and

   c. No distinguishing lines, seams, or fissures.

Upon completion of the test pad quality-assurance testing, the test pad will be removed and used as fill in another portion of the site prior to constructing the soil bedding system.

2. Zone of Acceptability: The designer will use all test pad results to develop a plot of density versus moisture content to determine an allowable zone for moisture density, necessary to assure an average hydraulic conductivity less than or equal to $5x10^{-5}$ cm/sec.

This zone may vary from the preliminary target values of 90 percent of maximum dry density and 0 to 4 percent above optimum moisture content.