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Mooresville Regional Office

PERMIT APPLICATION

FOR

PHASE 3 PERMIT TO CONSTRUCT

CHARLOTTE MOTOR SPEEDWAY
LANDFILL V
CITY OF CONCORD, NORTH CAROLINA

FOR

REPUBLIC SERVICES OF SOUTH CAROLINA, LLC

MAY 2009

VOLUME 1 OF 2

NORTH CAROLINA PROFESSIONAL SEAL 16146 ENGINEER WILLIAM F. HODGES 4/30/09

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PERMIT APPLICATION
FOR
CHARLOTTE MOTOR SPEEDWAY LANDFILL V
PHASE 3 PERMIT TO CONSTRUCT

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STATEMENT OF COMPLIANCE WITH ENGINEERING PLAN REQUIREMENTS

This Construction Permit Application has been prepared by a Professional Engineer licensed to practice engineering in accordance with N.C.G.S. 89C and the Administrative Rules developed thereunder. It is our opinion that the design described in this Permit Application including Engineering Plans meets the intent of the requirements of 15A NCAC 13B .1620 of the Solid Waste Management Plan.

Respectfully Submitted,
HODGES, HARBIN, NEWBERRY & TRIBBLE, INC.

William F. Hodges, P.E.
Professional Engineer

NORTH CAROLINA PROFESSIONAL SEAL 16146 ENGINEER WILLIAM F. HODGES
4/30/09

I. PERMIT REQUIREMENT CHECK LIST

Facility: Charlotte Motor Speedway Landfill V - Phase 3

PERMIT TO CONSTRUCT REGULATORY REVIEW CHECKLIST
NORTH CAROLINA SOLID WASTE MANAGEMENT RULES
CHAPTER 13 SOLID WASTE MANAGEMENT

Rule No.	Requirement	Application Location
REQUIREMENTS FOR MSWLFs - SECTION .1600		
.1620 ENGINEERING PLAN		
(b)	Prepared and sealed by a Professional Engineer	Cover, Section I
(c)	The engineering plan shall contain a report and a set of drawings which represent the engineering design.	Volume 1 and 2 of 2
(d)(1)(A)(B)(C)	The engineering report must contain: An analysis of the facility design that conforms to the standards for the foundation and the base liner system; Standards for the cap system, and Standards for the leachate storage facilities.	Design Hydrogeologic Report David Garrett & Associates Section II Narrative Section VI Operation Plan Section VIII Report of Geotechnical Evaluation
(d)(2)(A)(B)(C)(D)	A summary of the facility design that includes: A discussion of the analytical methods used to evaluate the design; Definition of the critical conditions evaluated and assumptions made; a List of technical references used in the evaluation, and Completion of any applicable location restriction demonstration.	Incorporated throughout Section VI Operation Plan, Section VII Design Calcs and Location restriction demonstration was previously submitted and approved during Site Suitability
(d)(3)	A description of the materials and construction practices that conforms to the requirements of Rule .1624.	Section IV Technical Specs
(d)(4)	A copy of the Design Hydrogeologic Report.	Previously submitted under separate cover
(e)(1)	Engineering drawings must clearly illustrate existing conditions (site topography, features, existing disposal areas, roads, buildings).	Section X Engineering Plans
(e)(2)	Grading plans (proposed limits of excavation, subgrade elevations, boring locations, intermediate grading for partial construction).	Section X Engineering Plans
(e)(3)	Base liner system (grades for top of composite liner, slopes, anchor configuration, liner penetration locations and details).	Section X Engineering Plans
(e)(4)	Leachate collection system (base elevations, piping system grade and inverts, cleanouts, valves, sumps, top of protection cover elevations, and details).	Section X Engineering Plans
(e)(5)	Stormwater segregation system (location and detail of features).	Section X Engineering Plans
(e)(6)	Cap system (base and top elevations, landfill gas collection, infiltration barrier, surface water removal, protective and vegetative cover, and details).	Section X Engineering Plans
(e)(7)	Temporary and permanent sedimentation and erosion control plans.	Section X Engineering Plans
(e)(8)	Vertical separation requirements with boring locations, cross sections, maps used in the Hydrogeologic report (ground-water contour map and bedrock contour map), and grading plans.	Section X Engineering Plans
(e)(9)	Additional engineering features and details.	Section X Engineering Plans

Rule No.	Requirement	Application Location
.1621 CONSTRUCTION QUALITY ASSURANCE PLAN		
(a)	The construction quality control and quality assurance (CQA) plan must describe the observations and tests used before, during and upon completion of construction to ensure construction materials meet the design specifications and the construction and certification requirements outlined in the construction requirements for MSWLF facilities (Rule .1624). The CQA plan must describe the procedures to ensure the integrity of the landfill systems will be maintained prior to waste placement.	Section III CQA Plan
(b)(1)	For construction of each cell, the CQA plan shall include: The plan shall establish responsibilities and authorities for the construction management organization. A pre-construction meeting shall be conducted prior to beginning construction on the base liner system for a new cell in order to determine the construction management organization, respective duties during construction, and periodic reporting requirements for test results and construction activities.	Section III CQA Plan
(b)(2)	For inspection activities, the CQA plan shall include a description of all field observations, tests, equipment and calibration procedures for field testing equipment.	Section III CQA Plan
(b)(3)	For sampling strategies the CQA plan must include a description of all sampling protocols, sample size, methods for determining sample locations and frequency of sampling.	Section III CQA Plan
(b)(4)	Reporting requirements for CQA activities must be described in detail in the CQA plan and must include progress and trouble shooting meetings (daily and monthly) and the contents of the meetings must be documented.	Section III CQA Plan

Rule No.	Requirement	Application Location
.1625 OPERATIONAL PLAN FOR MSWLF FACILITIES		
(b)	An operation plan shall be prepared for each phase of landfill development and include drawings and a report clearly defining the information proposed for the Division approved plan.	Section VI Operation Plan Section X Engineering Plans
(b)(1)	Drawings shall be prepared for each phase of landfill development and be consistent with the engineering plan and include the following:	Section X Engineering Plans
(b)(1)(A)	Existing Conditions (include known limits of existing disposal areas).	Section X Engineering Plans
(b)(1)(B)	Progression of construction cells for incremental or modular construction.	Section X Engineering Plans
(b)(1)(C)	Progression of operation (include initial waste placement, daily operations, transition contours, and final contours).	Section X Engineering Plans
(b)(1)(D)	Leachate and stormwater controls for active and inactive subcells.	Section X Engineering Plans
(b)(1)(E)	Special waste areas within the MSWLF unit.	Section X Engineering Plans
(b)(1)(F)	Buffer zones, noting restricted use.	Section X Engineering Plans
(b)(1)(G)	Stockpile and borrow operations.	Section X Engineering Plans
(b)(2)	The operation report shall provide a narrative discussion of the operation drawings and contain a description of the facility operation that conforms to the requirements of Rule .1626.	Section VI Operation Plan
3(A)(B)(C)	The operation plan shall include a program for detecting and preventing the disposal of hazardous and liquid waste that meets the requirements of Rule .1626(1)(f) and a routine methane monitoring program meeting the requirements of Rule .1626 (4); a Sedimentation and Erosion Control plan which incorporates adequate measures to control surface water run-off and run-on generated from the 24 hour, 25 year storm event, and operation drawings that illustrate annual phases of development which are consistent with the minimum and maximum slope requirements set forth in Subparagraph (c)(3) of Rule .1627.	Section VI Operation Plan Section X Engineering Plans

Rule No.	Requirement	Application Location
.1629 CLOSURE AND POST-CLOSURE PLAN		
(b)(1)	Describe steps necessary to close all MSWLF units at any point during its active life in accordance with the cap system requirements described below:	Section II Narrative and Section VI Operation Plan Section IX Closure & Post-Closure Care
(b)(1)(A)	Describe the cap system and the methods and procedures to be used to install the cap that conforms to the requirements set forth in Paragraph (c) of the Closure and Post-Closure Requirements section (Rule .1627).	Section II Narrative and Section VI Operation Plan Section IX Closure & Post-Closure Care
(b)(1)(B)(i)(ii)	Estimate the largest area of the MSWLF unit ever requiring the specified cap system at any time during the active life that is consistent with the drawings prepared for the Engineering Plans.	Section II Narrative and Section VI Operation Plan Section IX Closure & Post-Closure Care
(b)(1)(C)	Estimate the maximum inventory of waste ever on-site over the active life of the landfill facility.	Section II Narrative and Section VI Operation Plan Section IX Closure & Post-Closure Care
(b)(1)(D)	Include a schedule for completing all activities necessary to satisfy the closure criteria set forth in Paragraph (c) of the Closure and Post-Closure Requirements section (Rule .1627).	Section II Narrative and Section VI Operation Plan Section IX Closure & Post-Closure Care
(b)(2)	Existing MSWLF units not designed and constructed with a base liner system permitted by the Division shall provide the following information:	N/A
(b)(2)(A)(i)(ii)(iii)(iv)(v)	A local characterization study which includes the landfill facility and a 2000 ft. perimeter measured from the permitted facility boundary, a topography map prepared at a scale of at least one in. equals 400 ft. which provides current topographic information for the permitted facility, identify all water supply intakes (ground and surface water), identify underground utilities lines, identify private residences, and identify any known or potential sources of contamination.	N/A
(b)(2)(B)	The proposed final capacity of the existing MSWLF unit must be calculated from October 9, 1993, and shall be consistent with the criteria set forth in Subparagraph (c)(1) of Closure and Post-Closure Requirements section (Rule .1627). The method, data, and assumptions used to calculate the remaining capacity shall be clearly stated.	N/A
(b)(2)(C)(i)(ii)(iii)	A compliance report that demonstrates compliance with Paragraphs (1), (2) and (6) of Rule .1622 (Location Restrictions for MSWLF Facility Siting) and containing a summary of the facility's compliance record for the past five years and contains the water quality and explosive gas monitoring data for the past five years.	N/A
(b)(3)	The cost estimate for closure required under the Financial Assurance Rule (Rule .1628) shall be included as a component of the plan.	Section II Narrative and Section VI Operation Plan Section IX Closure & Post-Closure Care

(c)	Prepare a written post-closure plan that includes, at a minimum, the following information:	Section II Narrative and Section VI Operation Plan Section IX Closure & Post-Closure Care
(c)(1)	A description of the monitoring and maintenance activities required in Paragraph (d) of the Closure and Post-Closure Requirements section (Rule.1627) for each MSWLF unit and the frequency at which these activities shall be performed.	Section II Narrative and Section VI Operation Plan Section IX Closure & Post-Closure Care
(c)(2)	The name, address and telephone number of the person or office to contact about the facility during the post-closure period.	Section II Narrative and Section VI Operation Plan Section IX Closure & Post-Closure Care
(c)(3)	A description of the planned uses of the property during the post-closure period. Post-closure use of the property shall not disturb the integrity of the cap system, base liner system, or any other components of the containment system, or the function of the monitoring systems unless necessary to comply with the requirements in this Section. The Division may approve any other disturbance if the owner or operator demonstrates that disturbance of the cap system, base liner system, or other component of the containment system, including any removal of waste, will not increase the potential threat to human health or the environment.	Section II Narrative and Section VI Operation Plan Section IX Closure & Post-Closure Care
(c)(4)	As a component of the plan, the owner or operator shall submit the cost estimate for post-closure required under the Financial Assurance Rule (Rule .1628).	Section II Narrative and Section VI Operation Plan Section IX Closure & Post-Closure Care

Rule No.	Requirement	Application Location
.1680 LEACHATE STORAGE REQUIREMENTS		
Construction of Leachate Storage Tanks and Surface Impounds/Liquid Treatment and Disposal at SWLF		
(b)	Applications for a permit to construct a landfill facility which includes leachate storage facilities shall contain the following:	
(b)(1-7)	1. Description of liquid 2. Estimated volume of liquid generated and proposed recordkeeping of actual quantities stored. 3. Schedule for liquid removal 4. Description of final treatment and disposal of liquid stored 5. Description of liquid storage facility design 6. Contingency plan for unexpected surges in liquid quantities 7. Closure plan	Section VI Operation Plan and Section VII Design Calculations Section V Facility Plan Section II Narrative
(c)(2)(A)(B)	A secondary containment system which may consist of dikes, liners, pads, ponds, impoundments, curbs, ditches, sumps, or other systems capable of containing the liquid stored. (A) The design volume for secondary containment systems shall be 110% of the volume of either the largest tank within the containment system or the total volume of all interconnected tanks, whichever is greater. The secondary containment system shall be constructed of a material compatible with the liquid being stored and equipped with an overfill prevention system which may include: level sensors and gauges, high level alarms or automatic shutoff controls.	Section VI Operation Plan and Section VII Design Calculations Section V Facility Plan Section II Narrative
(c)(3)	A system shall be designed to contain and remove stormwater from the secondary containment area. Provisions shall be included for the removal of any accumulated precipitation and be initiated within 24 hours or when 10% of the storage capacity is reached, whichever occurs first.	Section VI Operation Plan and Section VII Design Calculations Section V Facility Plan Section II Narrative
(c)(4)	All aboveground and onground tanks shall be equipped with an overfill prevention system which may include, but not be limited to: level sensors and gauges, high level alarms or automatic shutoff controls. The overfill control equipment shall be inspected weekly.	Section VI Operation Plan and Section VII Design Calculations Section V Facility Plan Section II Narrative
(c)(6)	All uncovered tanks shall have a minimum of 2 ft of freeboard. Odor and vector control shall be practiced when necessary.	Section VI Operation Plan and Section VII Design Calculations Section V Facility Plan Section II Narrative

II. NARRATIVE

NARRATIVE

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I. INTRODUCTION

This report was prepared on behalf of Republic Services of South Carolina, LLC, in accordance with the North Carolina Solid Waste Management Rules, 15A NCAC 13B, Section .1600, et seq. The purpose of this report is to demonstrate compliance with the applicable permit application requirements so that a Permit to Construct may be issued for the proposed Phase 3 at the Charlotte Motor Speedway Landfill V.

The Charlotte Motor Speedway Landfill V is owned and operated by Republic Services of South Carolina, LLC (Republic Services). The facility is located on Morehead Road, south of Concord, N.C. The facility encompasses approximately 703 acres of which approximately 679.5 acres is included in the permitted property boundary. The area permitted for landfill disposal includes approximately 328.4 acres and approximately 215.2 acres of this area is constructed. Approximately 56.7 acres of the constructed area has been closed in accordance with NCDENR Rules.

The facility was originally permitted in 1991 and is currently operating under North Carolina Solid Waste Permit No. 13-04. Based on the current waste stream and a capacity analysis performed for Republic, the life of the existing Phase 2 area is projected to extend into 2011. In order for Republic Services to continue operating, a new permitted area within the facility is needed for waste disposal. At this time, the facility is seeking a Permit to Construct to include engineering and operation plans for Phase 3, Cells No. 2I, 2J, 2K and 2M, which will cover approximately 54.25 acres of lined cell area plus related infrastructure. This permit application is being handled under the .1600 Rules, and the expected life of Phase 3 will be approximately five years.

The MSWLF unit is permitted to dispose of household, industrial and commercial solid waste. Hazardous or other banned waste such as yard waste and white goods are not approved for disposal. The facility service area encompasses the state of North Carolina and

other areas within a seventy-five (75) mile radius of the Charlotte Motor Speedway Landfill V. Phase 3 of the facility will have a permitted waste capacity of approximately 8,850,000 cubic yards with a total facility gross capacity of approximately 61,531,035 cubic yards, over the entire life of the site. This capacity corresponds to an average annual disposal rate of 14,400,000 tons of waste per year, for the next 10 years or a daily average of approximately 4,000 tons per day, based on 365 days per year or 120,000 tons per month (not to exceed a maximum of 140,000 tons per month).

This report contains information pertinent to the design and construction of additional waste disposal footprint immediately South of the active landfill cells, as well as information related to operations and closure of the facility. Information related to landfill siting requirements was submitted and approved previously, and is therefore not included in this report except as may be necessary to support the design. This permit application is intended to provide the information necessary to allow the Solid Waste Section to issue a Permit to Construct for 54.25 acres (Phase 3).

This application consists of eleven sections.

- Permit Requirement Checklist
- Narrative
- Construction Quality Assurance Plan
- Technical Specifications
- Facility Plan
- Operation Plan
- Design Calculations
- Report of Geotechnical Evaluation
- Closure & Post-Closure Care
- Engineering Plans
- Correspondence

This document incorporates the appropriate .1600 Rules and the Facility Plan. (.1617 (e)). In accordance with the North Carolina General Statutes Chapter 130A-295.8 as amended by the General Assembly of North Carolina Senate Bill 1492 Section 13.(a) regarding fees applicable to permits for Solid Waste Management Facilities, an application fee of $30,000 shall be paid in conjunction with the Construction Permit Application for the Charlotte Motor Speedway Landfill V.

II. .1617 APPLICATION REQUIREMENTS FOR MSWLF FACILITIES

(e) Permit renewal. A complete application for a permit to construct a lateral expansion or a new MSWLF unit shall contain the following:

(1) A Facility Plan that describes comprehensive development of the MSWLF facility prepared in accordance with Rule .1619 of this section;

A Facility Plan prepared by ESP Associates, P.A. dated May 2004 in accordance with Rule .1619 of this section has been approved by the Solid Waste Section. A copy of this plan is included in Section V. of this document.

(2) An Engineering Plan that is prepared for the initial phase of landfill development prepared in accordance with Rule .1620 of this section;

An Engineering Plan prepared for this phase of landfill development prepared in accordance with Rule .1620 of this section is included in this document.

(3) A Construction Quality Assurance Plan prepared in accordance with Rule .1621 of this section;

A Construction Quality Assurance (CQA) Plan prepared in accordance with Rule .1621 of this section is included in this document.

(4) *An Operation Plan prepared in accordance with Rule .1625 of this section;*

An Operation Plan prepared in accordance with Rule .1625 of this section is included in this document.

(5) *A Closure and Post-Closure Plan prepared in accordance with Rule .1629 of this section; and*

A Closure and Post-Closure Plan prepared in accordance with Rule .1629 of this section is included in this document.

(6) *A Water Quality Monitoring Plan prepared as set forth in Paragraph (b) of Rule .1623.*

A Water Quality Monitoring Plan prepared as set forth in Paragraph (b) of Rule .1623 has been prepared and submitted under separate cover with the Design Hydrogeologic Report prepared by David Garrett and Associates dated August 2008.

III. .1619 FACILITY PLAN

(a) Purpose. As required under Rule .1617 of this section, a permit applicant shall prepare a facility plan which meets the requirements of this Rule.

(b) Scope.

(1) The facility plan defines comprehensive development of the property proposed for permit or described in the permit of an existing facility. The plan includes a set of drawings and a report which present the long-term, general design concepts related to construction, operation, and closure of the MSWLF unit(s), including leachate management. The scope of the plan spans the active life of the MSWLF unit(s). Additional solid waste management facilities located at the MSWLF facility shall be identified in the plan and shall meet the requirements of this Subchapter. The facility plan defines the waste stream proposed for management at the MSWLF facility. If different types of landfill units or non-disposal facilities are included in the facility design, the plan must describe general waste acceptance procedures.

(2) The aerial limits of the MSWLF unit(s), total capacity of the MSWLF unit(s), and the proposed waste stream shall be consistent with the Section's approval set forth:

(A) In accordance with Rule .1618 (a)(1) of this section for a new facility: or,

(B) In accordance with the current permit for an existing facility applying for permit renewal.

(c) *Use of Terms. The terminology used in describing areas of the landfill unit shall be defined in the facility plan and shall be used consistently throughout a permit application. The Section recommends the use of the following terms:*

(1) *A "phase" is an area constructed with a base liner system that provides no more than approximately five years of operating capacity.*

(2) *A "cell" is a subdivision of a phase which describes modular or partial construction.*

(3) *A "subcell" is a subdivision of a cell which describes leachate and stormwater management for active or inactive areas of the constructed MSWLF.*

(d) *Facility Drawings. The facility plan shall include the following drawings:*

(1) *Site Development. The two drawings which plot site development shall be prepared on a topographic map representative of existing site conditions; the map shall locate the physical features referenced in Rule .1622 of this section and shall incorporate a survey locating all property boundaries for the proposed landfill facility certified by an individual licensed to practice land surveying in the State of North Carolina.*

(A) *Landfill units and leachate facilities. This drawing shall delineate the aerial limits of all landfill units and leachate facilities and incorporate the buffer requirements set forth in Subparagraph (b)(3) of Rule .1624.*

(B) *All facilities. This drawing shall locate all solid waste management facilities and facility infrastructure, including landfill units and leachate facilities.*

The approved Facility Drawings prepared by ESP Associates show each item required by the Rules.

(2) *Landfill Construction. All on-site grading activities related to the construction and operation of the MSWLF unit(s) shall be illustrated in facility drawings which:*

(A) *Delineate the limits of grading, including borrow and stockpile areas;*

(B) *Define phases of development which do not exceed approximately five years of operating capacity;*

(C) *Propose base grades for the MSWLF unit(s);*

(D) *Delineate the location of access roads, sedimentation basins, leachate pipeline and storage or treatment facilities and other structures related to the operation of the MSWLF unit; and*

(E) *Propose final contours for the MSWLF unit(s) and facility features for closure.*

The approved Facility Drawings prepared by ESP Associates show each item required by the Rules.

(3) Landfill Operation. The following information related to the long-term operation of the MSWLF units shall be included in facility drawings;

(A) General grade and flow direction for the drainage layer component of the leachate collection system;

(B) Size, location, and general grade for the leachate piping system, including on-site pipelines to leachate management facilities;

(C) Proposed transitional contours for each phase of development, including operational grades for existing phase(s) and construction grading for the new phase; and

(D) If included in the design, stormwater segregation features and details for inactive landfill subcells.

The approved Facility Drawings prepared by ESP Associates show each item required by the Rules.

(e) Facility Report. The facility plan shall include the following information:

(1) Waste stream. A discussion of the characteristics of the wastes received at the facility and facility specific management plans shall incorporate:

(A) The types of waste specified for disposal;

This facility will accept municipal solid waste, non-hazardous industrial waste, and other non-hazardous waste types allowed by the Rule.

(B) Average monthly disposal rates and estimated variance;

The facility will have an average annual disposal rate of 120,000 tons per month (not to exceed a maximum of 140,000 tons per month).

(C) The area served by the facility;

The area to be served by the facility includes the City of Concord, Cabarrus County, the State of North Carolina, and other areas within a seventy-five (75) mile radius of the Charlotte Motor Speedway Landfill V.

(D) Procedures for segregated management at different on-site facilities; and

All waste will be managed at the working face of the landfill. A waste solidification operation is currently operational at this site. The site currently has two borrow areas available for use.

(E) Equipment requirements for operation of the MSWLF unit.

The facility will utilize the following equipment:

Steel Wheel Compactors
Excavator
Dozers
Motor Grader

Pick-up Trucks

Water Trucks

All-Purpose Tractor

Mowers

Haul Trucks

Pumps

In addition to this basic equipment, other equipment will be utilized or substituted on-site when necessary.

(2) Landfill Capacity. An analysis of landfill capacity and soil resources shall be performed.

(A) The data and assumptions used in the analysis shall be:

(i) Consistent with the facility drawings and disposal rates specified in the facility plan; and

(ii) Representative of operational requirements and conditions.

Calculations shown in the appendix demonstrate that data and assumptions used in the analysis are consistent with the facility drawings and disposal rates in the facility plan; and that they are representative of operational requirements and conditions.

(B) The conclusions shall provide accurate volumetric estimates of:

(i) Total operating capacity;

(ii) Operating capacity for each phase of development;

iii) In-Place ratio of waste to soil;

(iv) Available soil resources from on-site or specific off-site sources;

(v) Required quantities of soil for landfill construction, operation, and closure; and

(vi) The estimated operating life of all MSWLF units in years.

This information is included in the previously approved Facility Plan prepared by ESP Associates.

(3) Containment and environmental control systems. A general description of the systems designed for proper landfill operation, system components, and corresponding functions shall be provided.

This facility is designed as a lined MSW landfill system. During landfill development, cell filling, and closure; a liner and leachate collection system will be utilized to assure that all precipitation contacting waste will be collected, and managed as leachate. Leachate collected on the liner will drain to side slope riser pumps where it will be pumped to a leachate storage lagoon. The in-cell leachate collection system is designed to collect and remove leachate from the cell, while assuring leachate head on the liner will not exceed 12 inches.

The base liner system will be a composite system of a 24 inch thickness of $k \leq 1x10^{-7}$ cm/sec or less clay, covered by a 60 mil HDPE flexible membrane liner. An alternate liner system consisting of an 18 inch thickness of $k \leq 1x10^{-5}$ cm/sec or less clay overlain with a reinforced geosynthetic clay liner, and covered by a 60 mil HDPE flexible membrane liner can also be used. Quality Control and Quality Assurance procedures will be utilized to demonstrate liner construction quality.

The leachate collection and removal system will utilize a permeable soil media above the liner, with a piping network, to assure complete removal of leachate. All components will be sized to adequately manage flows and surges.

Once leachate is removed from the liner, it will be transferred by force mains to the leachate storage lagoon for pre-treatment, and then pumped via force main to the Rocky River Regional Wastewater Treatment Plant for treatment and disposal.

(4) Leachate Management. An analysis of the leachate management requirements and plans for the MSWLF facility shall incorporate the information required under this Subparagraph.

(A) The performance of and design concepts for the leachate collection system within active areas of the MSWLF unit and any storm water segregation included in the engineering design shall be described.

The leachate collection system is designed with pipes and filter media to promote leachate drainage, and to assure sustained leachate head on the liner does not exceed 12 inches.

(B) Normal operating conditions. Normal operating conditions shall be defined and must consider:

(i) Average monthly values for leachate generation representative of the landfill's environment and operation using:

(I) empirically derived estimates; or

Leachate volumes have been estimated based on the U.S. Army Corp of Engineers HELP Model (Hydraulic Evaluation of Landfill Performance). The HELP Model calculations indicate the maximum average monthly leachate production will be 21,720 gallons per acre per month for the ±54 acre Phase 3 landfill footprint. This corresponds to 34,843 cubic feet per acre per year, which is higher than the historical records on this landfill and other MSW landfills of similar size.

(II) for landfill expansions, actual leachate generation data from the existing landfill.

Since this is an existing landfill, estimates of actual volume are utilized for determining leachate

volume. Historical leachate generation data indicates an average of 4,566 cubic feet per acre per year of leachate collected (2003 data).

(ii) Surge volumes generated by storm events.

Surge volumes are estimated by inserting the 24-hour, 25-year storm event (approximate 6" rainfall event) into the HELP Model manually, and utilizing this technique, indicates a maximum daily peak volume of about 6,713 gallons per acre per day at this facility.

(C) Leachate management system. A description of the leachate management system components and their engineered function shall be provided, including:

(i) Leachate pipeline operating capacity;

All piping has been designed to handle the greater of the peak daily flow or the pump capacity feeding these pipes.

(ii) Capacity of the storage and if applicable, the treatment facilities;

The leachate lagoon storage capacity is approximately 2.9 million gallons, or 390,000 cubic feet. The storage lagoon contains two (2) floating aerators to introduce oxygen into the leachate and begin the pre-treatment process. Additional treatment is available in the pre-treatment

facility located on-site adjacent to the storage lagoon. This facility includes a pH adjustment tank, flocculation tank, clarifier, and surge tank. Historically, the aeration process alone has been sufficient in meeting the discharge requirements specified in the Industrial User Pre-Treatment Permit.

(iii) Final disposal plans and applicable discharge limits, including documented prior approval of the waste water treatment plant which may be designated in the plan.

Leachate will be pre-treated in the storage lagoon and the pre-treatment facility located adjacent to the storage lagoon, if necessary, prior to being pumped via force main to the Rocky River Regional Wastewater Treatment Plant for secondary treatment and final disposal. A copy of the Industrial User Pre-Treatment Permit No. 1024 is included in Section V. of this Report.

(D) A contingency plan shall be prepared for storm surges or other considerations exceeding design parameters for the storage or treatment facilities.

The Industrial User Pre-Treatment Permit allows discharge from the pre-treatment facility at an average rate of 150,000 gallons per day, which far exceeds the daily discharge rate from this facility. This "over capacity" provides a contingency for this site.

(5) Special engineering features.

This facility utilizes engineering features shown on the engineering drawings. Also, as detail design is completed, other engineering features may be added which enhance the facility operations.

IV. .1620 ENGINEERING PLAN

(a) *Purpose. The engineering plan incorporates the detailed plans and specifications relative to the design and performance of the landfill's containment and environmental control systems. This plan sets forth the design parameters and construction requirements for the components of the landfill's systems and establishes the responsibilities of the design engineer. The engineered components are described in Rule .1624 of this section. As required under Rule .1617 of this section, the owner or operator shall submit an engineering plan which meets the requirements of this Rule.*

(b) *Responsibilities of the design engineer. The engineering plan shall be prepared by a Professional Engineer licensed to practice engineering in accordance with GS 89C and the Administrative Rules developed thereunder. The plan shall meet the requirements of this Rule; the design engineer shall incorporate a statement certifying this fact and bearing his or her seal of registration.*

(c) *Scope. An engineering plan shall be prepared for a phase of development not to exceed approximately five years of operating capacity, consistent with the development phases and design criteria defined in the facility plan. The original and subsequent plans must incorporate the design of leachate management and other environmental control facilities. The engineering plan shall contain a report and a set of drawings which consistently represent the engineering design.*

(d) *An engineering report must contain:*

(1) *An analysis of the facility design that conforms to:*

(A) The standards for the foundation and the base liner system set forth in Rule .1624 of this section;

These items are discussed in the Design Hydrogeologic Report prepared by David Garrett and Associates, dated August 2008.

(B) The standards for the cap system set forth in Paragraph (c) of Rule .1627 of this section; and

These items are discussed in this document.

(C) The standards for the leachate storage facilities set forth in Rule .1680 of this section.

These items are discussed in this document.

(2) A summary of the facility design that includes:

(A) a discussion of the analytical methods used to evaluate the design;

The calculations include discussion of the analytical methods used to evaluate the design. Additionally, this is discussed in the Operation Plan.

(B) definition of the critical conditions evaluated and assumptions made;

The critical conditions evaluated and the assumptions made are clearly shown with the calculations to which they pertain.

(C) a list of technical references used in the evaluation; and

Technical references are listed with the calculations to which they pertain. Additionally, this is discussed in the Operation Plan.

(D) completion of any applicable location restriction demonstrations in accordance with Rule .1622 of this section.

The location restriction demonstrations were completed during the site suitability phase of the application process. (These are also discussed in the Design Hydrogeologic Report by David Garrett and Associates, dated August 2008.)

(3) A description of the materials and construction practices that conforms to the requirements set forth in Rule .1624 of this section, and is consistent with the analysis of the facility design prepared in accordance with this Part.

Materials and construction practices that conform to the requirements set forth in Rule .1624 are included in the Technical Specifications.

(4) A copy of the Design Hydrogeologic Report prepared in accordance with Paragraph (b) of Rule .1623.

The Design Hydrogeologic Report prepared in accordance with Paragraph (b) of Rule .1623 is attached to the permit documents. This report was prepared by David Garrett and Associates, dated August 2008.

(e) Engineering drawings must clearly illustrate:

(1) Existing conditions; site topography, features, existing disposal areas, roads, buildings;

These items are shown in the Engineering Plans which are attached.

(2) Grading plans; proposed limits of excavation, subgrade elevations, boring locations, intermediate grading for partial construction;

These items are shown in the Engineering Plans which are attached.

(3) Base liner system; grades for top of composite liner, slopes, anchor configuration, liner penetration locations and details;

These items are shown in the Engineering Plans which are attached.

(4) Leachate collection system; base elevations, piping system grade and inverts, cleanouts, valves, sumps, top of protective cover elevations, and details;

These items are shown in the Engineering Plans which are attached.

(5) Stormwater segregation system; location and detail of features;

These items are shown in the Engineering Plans and are discussed in the Operation Plan.

(6) *Cap system; base and top elevations, landfill gas collection, infiltration barrier, surface water removal, protective and vegetative cover, and details;*

These items are shown in the Engineering Plans and are discussed in the Operation Plan.

(7) *Temporary and permanent sedimentation and erosion control plans;*

These items are shown in the Engineering Plans which are attached.

(8) *Vertical separation requirements incorporating boring locations, cross sections, the maps prepared in accordance with Rules .1623(b)(2)(E) and (F) of this section, and the grading plans; and*

A vertical separation demonstration incorporating cross sections, prepared in accordance with Rules .1623(b)(2)(E) and .1623(b)(2)(F) is attached. It is shown on the Engineering Plans which are attached.

(9) *Additional engineering feature and details.*

The Engineering Plans, the Technical Specifications, the Operation Plan, and this application document discuss all engineering features and details.

V. .1621 CONSTRUCTION QUALITY ASSURANCE PLAN

(a) Purpose. The construction quality control and quality assurance (CQA) plan must describe the observations and tests that will be used before, during, and upon completion of construction to ensure that the construction materials meet the design specifications and the construction and certification requirements set forth in Rule .1624 of this section. The CQA plan must also describe the procedures to ensure that the integrity of the landfill systems will be maintained prior to waste placement.

(b) For construction of each cell, the CQA plan shall include, but not be limited to:

(1) Responsibilities and authorities. The plan shall establish responsibilities and authorities for the construction management organization. A pre-construction meeting shall be conducted prior to beginning construction of the base liner system for a new cell. The meeting shall include a discussion of the construction management organization, respective duties during construction, and periodic reporting requirements for test results and construction activities.

(2) Inspection activities. A description of all field observations, tests, equipment, calibration procedures for field testing equipment that will be used to ensure that the construction and installation meets or exceeds all design criteria established in accordance with Rules .1620 and .1624 of this section must be presented in the CQA plan.

(3) Sampling strategies. A description of all sampling protocols, sample size, methods for determining sample locations and frequency of sampling must be presented in the CQA plan.

(4) Documentation. Reporting requirements for CQA activities must be described in detail in the CQA plan. Progress and troubleshooting meetings, daily and monthly, must be addressed in the plan and the contents of the meetings must be documented.

A Construction Quality Assurance Plan (CQA) is attached to this permit document. This CQA plan meets the requirements of Rule .1621.

VI. .1624 CONSTRUCTION REQUIREMENTS FOR MSWLF FACILITIES

(a) This Rule establishes the performance standards and minimum criteria for designing and constructing a new MSWLF unit or lateral expansion of existing MSWLF units. Additional standards for the cap system are described in Rule .1627 of this section.

The Charlotte Motor Speedway Landfill V is designed to meet the performance standards and the minimum criteria established by the Rules. The design is shown in the Engineering Plans, the Technical Specifications, the CQA Plan, the Design Calculations, and the Construction Permit Application.

(b) New MSWLF units and lateral expansions shall comply with the following design and construction criteria:

(1) Base liner system description. The base liner system is constructed on the landfill subgrade and shall be designed to efficiently contain, collect, and remove leachate generated by the MSWLF unit. At a minimum, the components of the liner system shall consist of the following:

(A) A Base Liner. The base liner shall consist of one of the following designs. The design described in Subpart (b)(1)(A)(i) of this Rule is the standard composite liner. If a landfill owner or operator proposes to utilize one of the alternative composite liner designs described in Subparts (b)(1)(A)(ii) and (iii) of this Rule, the owner or operator shall demonstrate through a model that the proposed design will ensure that maximum concentration levels (MCLs) listed in Table 1 will not be exceeded in the uppermost aquifer at the relevant point of compliance as established in Rule .1631(a)(2) of this section. For these two designs, the Section may waive the site-specific modeling

requirement if it can be demonstrated that a previous site for which a model was approved had similar hydrogeologic characteristics, climatic factors and volume and physical and chemical leachate characteristics. If an alternative liner design other than Subparts (b)(1)(A)(ii) and (iii) of this Rule is proposed, the Section shall require site-specific, two-phase modeling as described in Subpart (b)(1)(A)(iv) of this Rule.

(i) A composite liner utilizing compacted clay liner (CCL). The composite liner is one liner that consists of two components; a geomembrane liner installed above and in direct and uniform contact with a compacted clay liner with a minimum thickness of 24 inches (0.61 m) and a permeability of no more than 1.0×10^{-7} cm/sec. The composite liner shall be designed and constructed in accordance with Subparagraphs (b)(8) and (10) of this Rule.

(ii) A composite liner utilizing a geosynthetic clay liner (GCL). The composite liner is one liner that consists of three components: a geomembrane liner installed above and in uniform contact with a GCL overlying a compacted clay liner with a minimum thickness of 18 inches (0.46 m) and a permeability of no more than 1.0×10^{-5} cm/sec. The composite liner shall be designed and constructed in accordance with Subparagraphs (b)(8), (9), and (10) of this Rule.

This alternative liner system will be utilized by the facility.

(iii) A composite liner utilizing two geomembrane liners. The composite liner consists of three components; two geomembrane liners each with an overlying leachate drainage system designed to reduce the maximum predicted head acting on the lower membrane liner to less than one inch. The lower membrane liner shall overlie a compacted clay liner with a minimum thickness of 12 inches (0.31 m) and a permeability of no more than 1.0 x 10^{-5} cm/sec. The composite liner system shall be designed and constructed in accordance with Subparagraphs (b)(8) and (10) of this Rule.

(iv) An Alternative base liner. An alternative base liner system may be approved by the Section if the owner or operator demonstrates through a two-phase modeling approach that the alternative liner design meets the following criteria:

(I) The rate of leakage through the alternative liner system will be less than or equal to the composite liner system defined in Subparts (b)(1)(A)(i) of this Rule; and

(II) The design will ensure that concentration values listed in Table 1 will not be exceeded in the uppermost aquifer at the relevant point of compliance as established in Rule .1631 (a)(2) of this section.

This liner system will not be utilized at this facility.

(B) A leachate collection system (LCS). The LCS is constructed directly above the base liner and shall be designed to effectively collect and remove leachate from the MSWLF unit. The secondary function of the LCS is to establish a zone of protection between the base liner and the waste, The LCS shall be designed and constructed in accordance with Subparagraphs (b)(2), (11), (12) and (13) of this Rule.

The LCS utilized on the Charlotte Motor Speedway Landfill V is designed to conform to the Rules. This LCS is shown in the Engineering Plans.

(2) Leachate collection system design and operation.

(A) The leachate collection system shall be hydraulically designed to remove leachate from the landfill and ensure that the leachate head on the composite liner does not exceed one foot. A means of quantitatively assessing the performance of the leachate collection system must be provided in the engineering plan. The performance analysis must evaluate the flow capacities of the drainage network necessary to convey leachate to the storage facility or off-site transport location. The engineering evaluation shall incorporate the following criteria:

(i) At a minimum, the geometry of the landfill shall be designed to control and contain the volume of leachate generated by the 24-hour, 25-year storm.

The geometry of the Charlotte Motor Speedway Landfill V and the LCS are designed to control and contain the leachate generated by the 24-hour, 25-year storm event.

(ii) The performance analysis shall evaluate the leachate collection system for the flow capacities during conditions when the maximum impingement rate occurs on the LCS. The LCS flow capacity shall be designed to reduce the head on the liner system generated by the 24-hour, 25-year storm to less than one foot within 72 hours after the storm event.

(B) The leachate collection system shall be designed to provide a zone of protection at least 24 inches separating the composite liner from landfilling activities, or shall be subject to approval from the Section upon a demonstration of equivalent protection for the liner system.

The leachate collection system utilizes a 24 inch thick layer of protective cover material to separate the composite liner from landfilling activities.

(C) The leachate collection system shall be designed to resist clogging and promote leachate collection and removal from the landfill.

The LCS utilizes a 24 inch thick drainage layer, and stone filter system, a geocomposite with geonet drainage system, and a network of pipes with cleanouts. This system is detailed in the Engineering Plans and is designed to prevent physical clogging and promote leachate collection and removal from the landfill.

(D) The leachate collection system shall be operated to remove leachate from the landfill in such a way as to ensure that the leachate head on the composite liner does not exceed one foot under normal operating conditions.

The leachate collection system design meets this requirement.

(3) Horizontal separation requirements.

(A) Property line buffer. New MSWLF units at a new facility shall establish a minimum 300-foot buffer between the MSWLF unit and all property lines.

The Charlotte Motor Speedway Landfill V has minimum 300-foot buffers between the MSWLF unit and all property lines as shown on the Engineering Plans.

(B) Private residences and wells. All MSWLF units at a new facility shall establish a minimum 500-foot buffer between the MSWLF unit and existing private residences and wells.

The Charlotte Motor Speedway Landfill V has minimum 500-foot buffers between the MSWLF unit and existing private residences and wells as shown on the Engineering Plans.

(C) Surface waters. All MSWLF units at new facilities shall establish a minimum 50-foot buffer between the MSWLF unit and any stream, river, or lake unless the owner or operator can demonstrate:

(i) *To the Section that the alternative management of the water and any discharge will adequately protect the public health and environment; and*

The Charlotte Motor Speedway Landfill V maintains minimum 50' buffers between the MSWLF unit and any perennial stream, river or lake.

(ii) *That the construction activities conform to the requirements of Sections 404 and 401 of the Clean Water Act.*

The Charlotte Motor Speedway Landfill V maintains minimum 50' buffers between the MSWLF unit and any stream, river or lake. All construction activities will conform to the requirements of Sections 404 and 401 of the Clean Water Act.

(D) *Existing landfill units. An adequate buffer distance shall be established between a new MSWLF unit and any existing landfill units to establish a ground water monitoring system as set forth in Rule .1631 of this section.*

The Charlotte Motor Speedway Landfill V is not adjacent to or in the immediate vicinity of any existing separate landfill unit, and as such, its ground water monitoring system can meet the requirements of Rule .1631.

(E) Existing facility buffers. At a minimum, a lateral expansion or new MSWLF unit at an existing facility shall conform to the requirements of the effective permit.

Buffers are shown on the Engineering Plans.

(4) Vertical separation requirements. A MSWLF unit shall be constructed so that the post-settlement bottom elevation of the base liner system is a minimum of four feet above the seasonal high ground-water table and bedrock datum plane contours established in the Design Hydrogeological Report prepared in accordance with Rule .1623(b) of this section.

The Charlotte Motor Speedway Landfill V Units are designed to maintain a post-settlement bottom elevation of the base liner system a minimum of four feet above the seasonal high ground water table and final bedrock contours. Any materials other than in-place soil utilized for this separation will be compacted soil from on-site and off-site borrow. This compaction effort shall be in accordance with the methods detailed in the Technical Specifications.

(5) Survey control. One permanent benchmark of known elevation measured from a U.S. Geological Survey benchmark shall be established and maintained for each 50 acres of developed landfill, or part thereof, at the landfill facility. This benchmark shall be the reference point for establishing vertical elevation control.

Benchmarks are established as required by this Rule and are shown on the Engineering Plans.

(6) *Location coordinates. The North Carolina State Plane (NCSP) Coordinates shall be established and one of its points shall be the benchmark of known NCSP coordinates.*

The benchmarks for the site have known and established North Carolina State Plane Coordinates. Benchmarks are shown on the Engineering Plans with the State Plane Coordinates.

(7) *Landfill subgrade. The landfill subgrade is the in-situ soil layer(s), constructed embankments, and select fill providing the foundation for construction of the unit. A foundation analysis shall be performed to determine the structural integrity of the subgrade to support the loads and stresses imposed by the weight of the landfill and to support overlying facility components and maintain their integrity of the components. Minimum post-settlement slope for the subgrade shall be two percent. Safety factors shall be specified for facilities located in a Seismic Impact Zones.*

A structural analysis of the subgrade, along with the project design has taken into account the foundation strength and the integrity of the components. These items are included in the permit application. Post-settlement slope for the subgrade floor exceeds two percent. This site is located in a Seismic Impact Zone according to the definition of Seismic Impact Zones in 15A NCAC 13B.1622(5). However, the landfill structural components were designed using conventional construction methods to resist this seismic magnitude. Other specifics on this subject are discussed in the Report of Geotechnical Evaluation by Bunnell-Lammons Engineering, Inc., dated April 28, 2009, included in the design calculations.

(A) *Materials required. The landfill subgrade shall be adequately free of organic material and consist of in-situ soils or a select fill approved by the Section in accordance with the performance standards contained in Subparagraph (b)(7) of this Rule.*

This requirement of the Rules is specified in the project Technical Specifications. A construction quality assurance program will certify compliance.

(B) *Construction requirements.*

(i) *The landfill subgrade shall be graded in accordance with the approved plans and specifications, which are incorporated into the permit to construct in accordance with Rule .1604(b) of this section.*

The Charlotte Motor Speedway Landfill V will be graded and constructed in accordance with the Section approved plans and specification.

(ii) *The owner or operator of the MSWLF units may be required by the permit to notify the Section's hydrogeologist and inspect the subgrade when excavation is completed or if bedrock or other unpredicted subsurface conditions are encountered during excavation.*

If directed by the Section, the Charlotte Motor Speedway Landfill V will notify the Section's Hydrogeologist so the subgrade can be inspected. If unpredicted subsurface

conditions are encountered during construction, the Section will be notified.

(C) Certification requirements. At a minimum, the subgrade surface shall be inspected in accordance with the following requirements:

(i) Before beginning construction of the base liner system, the project engineer shall visually inspect the exposed surface to evaluate the suitability of the subgrade and document that the surface is properly prepared and that the elevations are consistent with the Section approved engineering plans incorporated into the permit to construct in accordance with Rule .1604(b) of this section;

The certification is detailed in the CQA Plan. This certification meets the requirements of this Rule.

(ii) The subgrade shall be proof-rolled using specified procedures and equipment specified by the design or project engineer; and

The certification is detailed in the CQA Plan. This certification meets the requirements of this Rule.

(iii) The subgrade shall be tested for density and moisture content at a minimum frequency as specified in the plans incorporated into the permit to construct in accordance with Rule .1604(b) of this section.

The certification is detailed in the CQA Plan. This certification meets the requirements of this Rule.

(8) Compacted clay liners. Compacted clay liners are low permeability barriers designed to control fluid migration in a cap liner system or base liner system.

(A) Materials required. The soil materials used in constructing a compacted clay liner may consist of on-site or off-site sources, or a combination of sources; sources may possess adequate native properties or may require bentonite conditioning to meet the permeability requirement. The soil material shall be free of particles greater than three inches in any dimension.

The compacted clay liner and low permeability soil liner are designed and will be installed to meet the requirements of this section of the Rule. This is detailed in the Technical Specifications.

(B) Construction requirements. Construction methods for the compacted clay liner shall be based upon the type and quality of the borrow source and shall be verified in the field by constructing test pad(s). The project engineer shall ensure that the compacted clay liner installation conforms with the Section approved plans including following minimum requirements:

(i) A test pad shall be constructed prior to beginning installation of the compacted clay liner and whenever there is a significant change in soil material properties. The area and equipment, liner thickness, and subgrade slope and

conditions shall be representative of full scale construction. Acceptance and rejection criteria shall be verified for the test specified in accordance with Part (C) of this Subparagraph. For each lift, a minimum of three test locations shall be established for testing moisture content, density, and a composite sample for recompacted lab permeability. At least one shelby tube sample for lab permeability testing, or another in-situ test that is approved by the Section as equivalent for permeability determination shall be obtained per lift.

The Technical Specifications for the test pad meet this Rule requirement. This is shown in the Technical Specifications. The test pad may be eliminated if contractor and material source do not change from a prior cell.

(ii) Soil conditioning, placement, and compaction shall be maintained within the range identified in the moisture-density-permeability relation developed in accordance with Subparagraph (C) of this Paragraph.

The compacted clay liner and low permeability soil liner placement is specified to be in accordance with this Rule. This is defined in the Technical Specifications.

(iii) The final compacted thickness of each lift shall be a maximum of six inches.

This condition is met as defined in the Technical Specifications.

(iv) Prior to placement of successive lifts, the surface of the lift in place shall be scarified or otherwise conditioned to eliminate lift interfaces.

This condition is met as defined in the Technical Specifications.

(v) The final lift shall be protected from environmental degradation.

This condition is met as defined in the Technical Specifications.

(C) Certification requirements. The project engineer shall include in the construction quality assurance report a discussion of all quality assurance and quality control testing required in this Subparagraph. The testing procedures and protocols shall be submitted in accordance with Rule .1621 of this section and approved by the Section. The results of all testing shall be included in the construction quality assurance report including documentation of any failed test results, descriptions of the procedures used to correct the improperly installed material, and statements of all retesting performed in accordance with the Section approved plans including the following requirements:

(i) *At a minimum, the quality control testing for accepting materials prior to and during construction of a compacted clay liner should include: particle size distribution analysis, Atterberg limits, triaxial cell laboratory permeability, moisture content, percent bentonite admixed with soil, and the moisture-density-permeability relation. The project engineer shall certify that the materials used in construction were tested according to the Section approved plans.*

This Rule will be conformed with as defined in the Engineering Plans, Technical Specifications, and Construction Quality Assurance Plan. Final reporting will conform to this format.

(ii) *At a minimum, the quality assurance testing for evaluating each lift of the compacted clay liner shall include: moisture content and density, and permeability testing. For each location the moisture content and density shall be compared to the appropriate moisture-density-permeability relation. The project engineer shall certify that the liner was constructed using the methods and acceptance criteria consistent with test pad construction and tested in accordance with the plans incorporated into the permit to construct in accordance with Rule .1604 (b) of this section.*

This Rule will be conformed with as defined in the Engineering Plans, Technical Specifications, and Construction Quality Assurance Plan. Final reporting will conform to this format.

(iii) Any tests resulting in the penetration of the compacted clay liner shall be repaired using bentonite or as approved by the Section.

This Rule will be conformed with as defined in the Engineering Plans, Technical Specifications, and Construction Quality Assurance Plan. Final reporting will conform to this format.

(9) Geosynthetic Clay liners. Geosynthetic clay liners are geosynthetic hydraulic barriers manufactured in sheets and installed by field seaming techniques.

(A) Materials required. Geosynthetic clay liners shall consist of natural sodium bentonite clay or equivalent, encapsulated between two geotextiles or adhered to a geomembrane. The liner material and any seaming materials shall have chemical and physical resistance not adversely affected by environmental exposure, waste placement, leachate generation and subgrade moisture composition. Accessory bentonite, used for seaming, repairs and penetration seaming shall be made from the same sodium bentonite as used in the geosynthetic clay liner or as recommended by the manufacturer. The type of geosynthetic clay liner shall be approved by the Section according to the criteria set forth in this Part.

(i) Reinforced geosynthetic clay liners shall be used on all slopes greater than 10H:1V.

This requirement will be met.

(ii) The geosynthetic clay liner material shall have a demonstrated hydraulic conductivity of not more than 5 x 10^{-9} cm/sec under the anticipated confining pressure.

Geosynthetic clay liners being utilized at this facility will meet this permeability requirement.

(B) Design and Construction requirements. The design engineer shall ensure that the design of the geosynthetic clay liner installation conforms to the requirements of the manufacturer's recommendations and the Section approved plans. The Section approved plans shall provide for and include the following provisions:

(i) The surface of the supporting soil upon which the geosynthetic clay liner will be installed shall be reasonably free of stones, organic matter, protrusions, loose soil, and any abrupt changes in grade that could damage the geosynthetic clay liner;

This is discussed in the Technical Specifications and this requirement will be complied with.

(ii) Materials placed on top of the GCL shall be placed in accordance with the plans incorporated into the permit to construct in accordance with Rule .1604(b) of this section. Equipment used to install additional geosynthetics shall be specified by the design engineer and as recommended by the manufacturer. A minimum of 12 inches of separation between the application equipment and the geosynthetic clay liner shall be provided when applying soil materials;

This requirement will be complied with.

(iii) *Materials that become prematurely hydrated shall be removed, repaired, or replaced, as specified by the project engineer and in accordance with the plans incorporated into the permit to construct prepared in accordance with Rule .1604(b) of this section;*

This requirement will be complied with. Any prematurely hydrated reinforced GCL will be removed and replaced.

(iv) *Field seaming preparation and methods, general orientation criteria, and restrictive weather conditions;*

This condition will be complied with and it is discussed in the Technical Specifications.

(v) *Anchor trench design;*

The anchor trench design is shown in the Engineering Plans. Calculations have been previously completed which indicate a 12 inch deep anchor trench is adequate.

(vi) *Critical tensile forces and slope stability, including seismic design;*

The calculations of tensile forces and slope stability are attached. These demonstrate the system will perform satisfactorily.

(vii) Protection from environmental damage; and

The reinforced GCL will be adequately protected from weather and other environmental exposure.

(viii) Physical protection from the materials installed directly above the geosynthetic clay liner.

Only 60 mil HDPE will be installed directly above the reinforced geosynthetic clay liner (GCL). This material will not damage the GCL.

(C) Certification requirements.

(i) Before beginning installation of the geosynthetic clay liner, the project engineer shall visually inspect the exposed surface to evaluate the suitability of the subgrade and document that the surface is properly prepared and that the elevations are consistent with the approved engineering plans incorporated into the permit to construct in accordance with Rule .1604 (b) of this section.

This will be complied with.

(ii) The project engineer shall ensure that the geosynthetic clay installation conforms to the requirements of the manufacturer's recommendations and the plans incorporated into the permit to construct in accordance with Rule .1604 (b) of this section.

This will be complied with.

(iii) *The project engineer shall include in the construction quality assurance report a discussion of quality assurance and quality control testing to document that material is placed in accordance with plans incorporated into the permit to construct in accordance with Rule .1604(b) of this section.*

This will be complied with.

(iv) *The project engineer shall include in the construction quality assurance report a discussion of the approved data resulting from the quality assurance and quality control testing required in this Subparagraph.*

This will be complied with.

(v) *The testing procedures and protocols for field installation shall be submitted in accordance with Rule .1621 of this section and approved by the Section.*

This will be complied with.

(vi) *The results of all testing shall be included in the construction quality assurance report, including documentation of any failed test results, descriptions of the procedures used to correct the improperly installed material, and performance documentation of all retesting, in accordance with the plans incorporated into the permit to construct in accordance with Rule .1604 (b) of this section, including the following:*

This will be complied with.

(I) *Quality control testing of the raw materials and manufactured product;*

This will be complied with.

(II) *Field and independent laboratory destructive testing of geosynthetic clay liner samples;*

This will be complied with.

(III) *Documentation prepared by the project engineer in accordance with Subpart (b)(9)(C)(i) of this Rule.*

This will be complied with.

(10) Geomembrane liners. Geomembrane liners are geosynthetic hydraulic barriers manufactured in sheets and installed by field seaming techniques.

(A) Materials required. The liner material and any seaming materials shall have chemical and physical resistance not adversely affected by environmental exposure, waste placement and leachate generation. The type of geomembrane shall be approved by the Section according to the criteria set forth in this Part.

(i) High density polyethylene geomembrane liners shall have a minimum thickness of 60 mils.

High density polyethylene (HDPE) geomembrane liners will be utilized on the Charlotte Motor Speedway Landfill V. The HDPE material utilized will have a minimum thickness of 60 mils. This is defined in the Technical Specifications.

(ii) The minimum thickness of any geomembrane approved by the Section shall be greater than 30 mils.

This is not applicable since HDPE material is being utilized.

(B) Construction requirements. The project engineer shall ensure that the geomembrane installation conforms to the requirements of the manufacturer's recommendations and the Section approved plans including the following:

(i) The surface of the supporting soil upon which the geomembrane will be installed shall be reasonably free of stones, organic matter, protrusions, loose soil, and any abrupt changes in grade that could damage the geomembrane;

This requirement is detailed in the Technical Specifications. The CQA Engineer will provide assurance this condition is met.

(ii) Field seaming preparation and methods, general orientation criteria, and restrictive weather conditions;

The Technical Specifications define the methods and conditions for geomembrane installation.

(iii) Anchor trench design;

These conditions are met as described in the Technical Specifications.

(iv) *Critical tensile forces and slope stability;*

These conditions are met as described in the Technical Specifications.

(iii) *Protection from environmental damage; and*

These conditions are met as described in the Technical Specifications.

(vi) *Physical protection from the materials installed directly above the geomembrane.*

These conditions are met as described in the Technical Specifications.

(C) *Certification requirements. The project engineer shall include in the construction quality assurance report a discussion of the approved data resulting from the quality assurance and quality control testing required in this Subparagraph. The testing procedures and protocols for field installation shall be submitted in accordance with Rule .1621 of this section and approved by the Section. The results of all testing shall be included in the*

construction quality assurance report including documentation of any failed test results, descriptions of the procedures used to correct the improperly installed material, and statements of all retesting performed in accordance with the plans incorporated into the permit to construct in accordance with Rule .1604(b) of this section, including the following:

These conditions are met as described in the Technical Specifications.

(i) Quality control testing of the raw materials and manufactured product;

These conditions are met as described in the Technical Specifications.

(ii) At a minimum, test seams shall be made upon each start of work for each seaming crew, upon every four hours of continuous seaming, every time seaming equipment is changed or if significant changes in geomembrane temperature and weather conditions are observed;

These conditions are met as described in the Technical Specifications.

(iii) Nondestructive testing of all seams; and

These conditions are met as described in the Technical Specifications.

(iv) Field and independent laboratory destructive testing of seam samples.

These conditions are met as described in the Technical Specifications.

(11) Leachate collection pipes. A leachate collection pipe network shall be a component of the leachate collection system and shall be hydraulically designed to convey leachate from the MSWLF unit to an appropriately sized leachate storage or treatment facility or a point of off-site transport. Leachate collection piping shall comply with the following:

(A) Materials required.

(i) The leachate collection piping shall have a minimum nominal diameter of six inches.

The Engineering Plans and detail drawings show the leachate pipe diameter. All primary leachate collection pipe shall have a nominal minimum of eight inches in diameter. Supplemental

pipes with smaller diameter may be used for short term enhancement of the system.

(ii) The chemical properties of the pipe and any materials used in installation shall not be adversely affected by waste placement or leachate generated by the landfill.

The leachate collection piping is HDPE material which is not adversely affected by waste placement or leachate generated by a MSW landfill.

(iii) The physical properties of the pipe shall provide adequate structural strength to support the maximum static and dynamic loads and stresses imposed by the overlying materials and any equipment used in construction and operation of the landfill. Specifications for the pipe shall be submitted in the engineering report.

Calculations and specifications for the leachate pipe are included in the Design Calculations and the Technical Specifications.

(B) Construction requirements.

(i) Leachate collection piping shall be installed according to the plans incorporated into the permit to construct in accordance with Rule .1604(b) of this section.

The Charlotte Motor Speedway Landfill V will install leachate piping in accordance with the plans approved by the Section.

(ii) The location and grade of the piping network shall provide access for periodic cleaning.

Required leachate piping has appropriate cleanouts and access for periodic cleaning of the pipe. These cleanouts are shown and detailed in the Engineering Plans.

(iii) The bedding material for the leachate collection pipe shall consist of a coarse aggregate installed in direct contact with the pipe. The aggregate shall be chemically compatible with the leachate generated and shall be placed to provide adequate support to the pipe. The bedding material for main collector lines should be extended to and in direct contact with the waste layer or a graded soil or granular filter.

The pipe bedding is a stone coarse aggregate installed in direct contact with the pipe. This is shown and detailed in the Engineering Plans.

(C) Certification requirements. The project engineer shall include in the construction quality assurance report a discussion of the quality assurance and quality control testing to ensure that the material is placed according to the approved plans. The testing procedures and protocols for field installation shall be submitted in accordance with Rule .1621 of this section and approved by the Section. The results of all testing shall be included in the construction quality assurance report including documentation of any failed test results, descriptions of the procedures used to correct the improperly installed material, and statements of all retesting performed in

accordance with plans incorporated into the permit to construct in accordance with Rule .1604(b) of this section, including the following::

(i) All leachate piping installed from the MSWLF unit to the leachate storage or treatment facility shall be watertight.

This requirement of the Rules is met. The piping between the landfill unit and leachate storage or treatment is shown on the Engineering Plans. Watertightness requirements are contained in the Technical Specifications.

(ii) The seal where the piping system penetrates the geomembrane shall be inspected and non-destructively tested for leakage.

No penetration assemblies are used at this facility in Phase 3.

(12) Drainage layers. Any soil, granular, or geosynthetic drainage nets used in the leachate collection system shall conform to the following requirements:

(A) Materials required.

(i) The chemical properties of the drainage layer materials shall not be adversely affected by waste placement or leachate generated by the landfill.

Materials used will be HDPE, geotextile, natural soils, sand, and gravels that are not adversely affected by waste placement or leachate generated by the landfill.

(ii) *The physical and hydraulic properties of the drainage layer materials shall promote lateral drainage of leachate through a zone of relatively high permeability or transmissivity under the predicted loads imposed by overlying materials.*

The materials specified have adequate hydraulic conductivities after being loaded which will promote lateral drainage of the leachate.

(B) *Construction requirements.*

(i) *The drainage layer materials shall be placed in accordance with the approved plans prepared in accordance with Rule .1604(b) of this section and in a manner that prevents equipment from working directly on the geomembrane.*

The Technical Specifications and CQA Plan specify methods for drainage layer placement which prevent equipment from working directly on the geomembrane.

(ii) *The drainage layer materials shall be stable on the slopes specified on the engineering drawings.*

The drainage layer materials are stable on all landfill bottom areas. Drainage media shall be placed on sideslopes in an incremental manner that prevents excessive loading of the sideslopes. This is detailed in the Operations Plan, Technical Specifications, and the Engineering Plans.

(C) Certification requirements. The project engineer shall include in the construction quality assurance report a discussion of the quality assurance and quality control testing to ensure that the drainage layer material is placed according to the approved plans. The testing procedures and protocols for field installation shall be submitted in accordance with of Rule .1621 of this section and approved by the Section. The results of all testing shall be included in the construction quality assurance report including documentation of any failed test results, descriptions of the procedures used to correct the improperly installed material, and statements of all retesting performed in accordance with the approved plans prepared in accordance with Rule .1604(b) of this section.

The CQA for drainage layer installation and reporting is defined in the CQA Plan and the Technical Specifications.

13) Filter layer criteria. All filter collection layers used in the leachate collection system shall be designed to prevent the migration of fine soil particles into a courser grained material, and permit water or gases to freely enter a drainage medium (pipe or drainage layer) without clogging.

(A) Materials required.

(i) Graded cohesionless soil filters. The granular soil material used as a filter shall have no more than five percent by weight passing the No. 200 sieve and no soil particles larger than three inches in any dimension.

(ii) Geosynthetic filters. Geosynthetic filter materials shall demonstrate adequate permeability and soil particle retention, and chemical and

physical resistance which is not adversely affected by waste placement, any overlying material or leachate generated by the landfill.

(B) Construction requirements. All filter layers shall be installed in accordance with the engineering plan and specifications incorporated into the permit to construct prepared in accordance with Rule .1604(b) of this section. Geosynthetic filter materials shall not be wrapped directly around leachate collection piping.

(C) Certification requirements. The project engineer shall include in the construction quality assurance report a discussion of the quality assurance and quality control testing to ensure that the filter layer material is placed according to the approved plans. The testing procedures and protocols for field installation shall be submitted in accordance with Rule .1621 of this section and approved by the Section. The results of all testing shall be included in the construction quality assurance report including documentation of any failed test results, descriptions of the procedures used to correct the improperly installed material, and statements of all retesting performed in accordance with the approved plans prepared in accordance with Rule .1604(b) of this section.

These requirements will be complied with where applicable. The filter system used with the leachate collection piping is adequate to prevent fines from entering the pipes.

(14) Special engineering structures. Engineering structures incorporated in the design and necessary to comply with the requirements of this section shall be specified in the engineering plan. Material, construction, and certification requirements

necessary to ensure that the structure is constructed according the design and acceptable engineering practices shall be included in the Section approved plan.

The Engineering Plans and Technical Specifications describe, specify, and detail special engineering structures utilized in the design/construction of this facility. The Technical Specifications provide the basis of material, construction, and certification requirements.

(15) Sedimentation and erosion control. Adequate structures and measures shall be designed and maintained to manage the run-off generated by the 24-hour, 25-hour *storm event, and conform to the requirements of the Sedimentation Pollution Control Law (15A NCAC 4).*

An erosion and sedimentation control plan is incorporated into the Engineering Plans which details the requirements to meet the Sediment Pollution Control Law (15 A NCAC 4). These plans have been or will be submitted for approval to the Land Division. A copy of the Land Division approval will be placed in the facility operating record.

(16) Construction quality assurance (CQA) report.

(A) A CQA report shall be submitted:

(i) after completing landfill construction in order to qualify the constructed MSWLF unit for a permit to operate:

This CQA Plan will be filed in a timely manner to qualify the constructed MSWLF unit for a Permit to Operate.

(ii) after completing construction of the cap system in accordance with the requirements of Rule .1629; and

Upon completion of fill within various areas of the landfill facility, and these areas being appropriately capped in accordance with Rule .1629, a CQA Plan on that activity will be filed in a timely manner.

(iii) according to the reporting schedule developed in accordance with Rule .1621 of this section.

These reports will be filed according to the reporting schedule developed and defined in Rule .1621.

(B) The CQA report shall include, at a minimum, the information prepared in accordance with the requirements of Rule .1621 of this section containing results of all construction quality assurance and construction quality control testing required in this Rule including documentation of any failed test results, descriptions of procedures used to correct the improperly installed material and results of all retesting performed. The CQA report shall contain as-built drawings noting any deviation from the approved engineering plans and shall also contain a comprehensive narrative including but not limited to daily reports from the project engineer and a series of color photographs of major project features.

The reports will be filed as described in this Rule section.

(C) The CQA report shall bear the seal of the project engineer and a certification that construction was completed in accordance with:

(i) *the CQA plan;*

(ii) *the conditions of the permit to construct;*

(iii) *the requirements of this Rule; and*

(iv) *acceptable engineering practices.*

A CQA Plan with a certification letter meeting the requirements delineated above will be filed to comply with this Rule.

(D) *The Section shall review the CQA report within 30 days of a complete submittal to ensure that the report meets the requirements of this Subparagraph.*

VII. .1625 OPERATION PLAN FOR MSWLF FACILITIES

(a) The operator of a MSWLF unit shall maintain and operate the facility according to the operation plan prepared in accordance with this Rule.

(1) Existing MSWLF units. The operator of an existing MSWLF unit shall meet the following requirements.

(A) The operation plan shall be prepared as the information becomes available.

Not Applicable.

(B) The operation plan shall be completed and submitted on or before April 9, 1994.

Not Applicable.

(C) The operation plan shall describe the existing phase of landfill development through the final receipt of wastes established in accordance with Subparagraph (c)(10) of the Rule .1627.

Not Applicable.

(D) The operator of an existing MSWLF unit which will reach permitted capacity prior to October 9, 1996 as set forth in the effective permit shall:

(i) Complete the operation plan and submit five copies to the Section at least 60 days prior to reaching permitted capacity; and

Not Applicable.

(ii) Receive at least partial approval from the Section as set forth in Part (d)(2)(B) of Rule .1603 in order to continue operation of the existing MSWLF unit.

Not Applicable.

(2) New MSWLF units and lateral expansions. The Operation Plan shall be submitted in accordance with Rules .1617 and .1604(b)(2)(P) of this section. Each phase of operation shall be defined by an area which will contain approximately five years of disposal capacity.

The Operation Plan is submitted as part of this Permit to Construct Application. The Operation Plan was developed in accordance with Rules .1617 and .1604(b)(2)(P).

(b) Operation Plan. The owner or operator of a MSWLF unit shall prepare an Operation Plan for each phase of landfill development. The plan shall include drawings and a report clearly defining the information proposed for the Section approved plan.

(1) Operation drawings. Drawings shall be prepared for each phase of landfill development. The drawings shall be consistent with the engineering plan and

prepared in a format which is useable for the landfill operator. The operation drawings shall illustrate the following:

(A) existing conditions, including the known limits of existing disposal areas;

A drawing showing existing conditions including the existing disposal areas is included in the Engineering Plans.

(B) progression of construction cells for incremental or modular construction;

The cell construction sequencing is shown in the Engineering Plans.

(C) progression of operation, including initial waste placement, daily operations, transition contours, and final contours;

The progression of operation including initial waste placement, daily operations, transition contours, and final contours are shown on the Engineering Plans, and further described in the Operation Plan.

(D) leachate and stormwater control for active and inactive subcells;

Leachate management/stormwater control is discussed in the Operation Plan and the Design Calculations.

(E) special waste areas within the MSWLF unit;

No special waste areas are designated within the MSWLF units.

(F) buffer zones, noting restricted use; and

Buffer areas are shown on the Engineering Plans with restrictions noted.

(G) stockpile and borrow operations.

The cover and construction soil materials will be borrowed from the cell areas and other soil borrow areas during construction and operation of the cells.

(2) Operations report. The report shall provide a narrative discussion of the operation drawings and contain a description of the facility operation that conforms to the requirements of Rule .1626 of this section.

The operations report is a part of the Operation Plan. This report provides a discussion of the facility operation that conforms to the requirements of Rule .1626.

(3) The Operation Plan for an existing MSWLF unit shall include:

(A) The facility's programs set forth in Parts (1)(f), (2)(b), and (4)(b) of Rule .1626;

The Operation Plan complies with these Rule sections.

(B) *A Sedimentation and Erosion Control Plan which incorporates adequate measures to control surface water run-off and run-on generated from the 24-hour, 25-year storm event;*

The facility design includes a Erosion and Sedimentation (E&S) Control Plan which incorporates adequate measures to control surface water run-off and run-on generated from the 24-hour, 25-year storm event.

(C) *Operation drawings that illustrate annual phases of development which are consistent with the minimum and maximum slope requirements set forth in Subparagraph (c)(3) of Rule .1627;*

The operation drawings comply with this Rule section.

(D) *The remaining permitted capacity approved by the Section prior to October 9, 1993, and calculated from October 9, 1993 using reasonable methods, data, and assumptions, and*

The estimate of remaining capacity is included in this Construction Permit Application.

(E) *Documented closure of the landfill unit(s) which stopped receiving waste before October 9, 1991.*

Not Applicable.

VIII. .1626 OPERATIONAL REQUIREMENTS FOR MSWLF FACILITIES

The owner or operator of any MSWLF unit must maintain and operate the facility in accordance with the requirements set forth in this Rule and the Operation Plan as described in Rule .1625 of this section.

(1) Waste Acceptance and Disposal Requirements.

(a) A MSWLF shall only accept those solid wastes which it is permitted to receive. The landfill owner or operator shall notify the Section within 24 hours of attempted disposal of any waste the landfill is not permitted to receive, including waste from outside the area the landfill is permitted to serve.

The Charlotte Motor Speedway Landfill V will evaluate all incoming wastes at the scale facility. Records will be maintained of any attempt to dispose of non-permitted waste, and the facility will notify the Section as called for in this Rule. The methods for screening waste are discussed in the Operation Plan.

(b) The following wastes are prohibited from disposal at a MSWLF unit:

(i) Hazardous waste as defined within 15A NCAC 13A, to also include hazardous waste from conditionally exempt small quantity generators.

These wastes will not be allowed into the Charlotte Motor Speedway Landfill V for disposal.

(ii) Polychlorinated biphenyls (PCB) wastes as defined in 40 CFR 761.

These wastes will not be allowed into the Charlotte Motor Speedway Landfill V for disposal, except as allowed in 40CFR Part 761.

(iii) Liquid wastes unless they are managed in accordance with Rule .1626(9) of this section.

These wastes will not be allowed into the Charlotte Motor Speedway Landfill V for disposal. Only liquids managed in accordance with .1626(9) will be accepted for disposal in the landfill.

(c) Spoiled foods, animal carcasses, abattoir waste, hatchery waste, and other animal waste delivered to the disposal site shall be covered immediately.

This condition will be complied with.

(d) Asbestos waste shall be managed in accordance with 40 CFR 61, which is hereby incorporated by reference including any subsequent amendments and additions. Copies of 40 CFR 61 are available for inspection at the Department of Environment, Health, and Natural Resources, Solid Waste Section, 401 Oberlin Road, Raleigh, N.C. at no cost. The waste shall be covered immediately with soil in a manner that will not cause airborne conditions and must be disposed of separate and apart from other solid wastes:

(i) At the bottom of the working face or;

This condition will be complied with.

(ii) In an area not contiguous with other disposal areas. Separate areas shall be clearly designated so that asbestos is not exposed by future land-disturbing activities.

This condition will be complied with.

(e) Wastewater treatment sludges may only be accepted for disposal in accordance with the following conditions:

(i) Utilized as a soil conditioner and incorporated into or applied onto the vegetative growth layer but, in no case greater than six inches in depth.

Wastewater treatment sludge may be utilized in this manner.

(ii) Co-disposed if the facility meets all design requirements contained within Rule .1624, and approved within the permit, or has been previously approved as a permit condition.

The Charlotte Motor Speedway Landfill V proposes to co-dispose wastewater treatment sludge in accordance with the approved Permit to Operate.

(f) *Owners or operators of all MSWLF units must implement a program at the facility for detecting and preventing the disposal of hazardous and liquid wastes. This program must include, at a minimum:*

(i) *Random inspections of incoming loads or other comparable procedures;*

Inspection procedures are discussed in the Operation Plan.

(ii) *Records of any inspections;*

Recordkeeping is discussed in the Operation Plan.

(iii) *Training of facility personnel to recognize hazardous and liquid wastes.*

The training procedures are outlined in the Operation Plan.

(iv) *Development of a contingency plan to properly manage any identified hazardous and liquid wastes. The plan must address identification, removal, storage and final disposition of the waste.*

The procedures for handling hazardous and liquid waste are described in the Operation Plan. The Operation Plan also discusses procedures for identifying prohibited waste types.

(g) Waste placement at existing MSWLF units shall meet the following criteria:

(i) Waste placement at existing MSWLF units not designed and constructed with a base liner system approved by the Section shall be within the areal limits of the actual waste boundary established prior to October 9, 1993 and in a manner consistent with the effective permit.

Not Applicable since the entire facility has an approved base liner system.

(ii) Waste placement at existing MSWLF units designed and constructed with a base liner system permitted by the Section prior to October 9, 1993 and approved for operation by the Section shall be within the areal limits of the base liner system and in manner consistent with the effective permit.

The waste placement is in a manner consistent with the effective permit.

(2) Cover material requirements.

(a) Except as provided in (2) (B) of this Paragraph, the owners or operators of all MSWLF units must cover disposed solid waste with six inches of earthen material at the end of each operating day, or at more frequent intervals if necessary, to control disease vectors, fires, odors, blowing litter, and scavenging.

Both soil and alternative daily cover are proposed for use at this facility. See section (b) below.

(b) *Alternative materials of an alternative thickness (other than at least six inches of earthen material) may be approved by the Section if the owner or operator demonstrates that the alternative material and thickness control disease vectors, fires, odors, blowing litter, and scavenging without presenting a threat to human health and the environment. A MSWLF owner or operator may apply for a generic approval of an alternative cover material, which would extend to all MSWLF units.*

Charlotte Motor Speedway Landfill V proposes to utilize tarps, posi-shell, petroleum contaminated soil (PCS), foundary sand, and automotive shredder fluff mixed with soil for an alternative daily cover in accordance with the approved Permit to Operate. All ADC's shall meet the requirements of Rule .1626(2)(b).

(c) *Areas which will not have additional wastes placed on them for 12 months or more, but where final termination of disposal operations has not occurred, shall be covered with a minimum of one foot of intermediate cover.*

Intermediate cover will be utilized as described by this section.

(3) *Disease vector control.*

(a) *Owners or operators of all MSWLF units must prevent or control on-site populations of disease vectors using techniques appropriate for the protection of human health and the environment.*

(b) For purposes of this Item, "disease vectors" means any rodent, flies, mosquitoes, or other animals, including insects, capable of transmitting disease to humans.

Vector control will be accomplished through appropriate use of daily cover on the facility.

(4) Explosive gases control.

(a) Owners or operators of all MSWLF units must ensure that:

(i) The concentration of methane gas generated by the facility does not exceed 25 percent of the lower explosive limit for methane in facility structures (excluding gas control or recovery system components); and

(ii) The concentration of methane gas does not exceed the lower explosive limit for methane at the facility property boundary.

(b) Owners or operators of all MSWLF units must implement a routine methane monitoring program to ensure that the standards of (4)(a) are met. A permanent monitoring system shall be constructed on or before October 9, 1994. A temporary monitoring system shall be used prior to construction of the permanent system.

(i) The type and frequency of monitoring must be determined based on the following factors:

(A) Soil conditions;

(B) The hydrogeologic conditions surrounding the facility;

(C) The hydraulic conditions surrounding the facility;

(D) The location of facility structures and property boundaries.

(ii) The minimum frequency of monitoring shall be quarterly.

(c) If methane gas levels exceeding the limits specified in (4)(a) are detected, the owner or operator must:

(i) Immediately take all necessary steps to ensure protection of human health and notify the Section;

(ii) Within seven days of detection, place in the operating record the methane gas levels detected and a description of the steps taken to protect human health; and

(iii) Within 60 days of detection, implement a remediation plan for the methane gas releases, place a copy of the plan in the operating record, and notify the Section that the plan has been implemented. The plan shall describe the nature and extent of the problem and the proposed remedy.

(iv) Based on the need for an extension demonstrated by the operator, the Section may establish alternative schedules for demonstrating compliance with (4)(c)(ii) and (iii) of this Rule..

(d) *The purposes of the Item, "lower explosive limit" means the lowest percent by volume of a mixture of explosive gases in air that will propagate a flame at 25°C and atmospheric pressure.*

Explosive gas control is discussed in the Operation Plan.

(5) *Air Criteria*

(a) *Owners or operators of all MSWLF's must ensure that the units do not violate any applicable requirements developed under a State Implementation Plan (SIP) approved or promulgated by the U.S. EPA Administrator pursuant to Section 110 of the Clean Air Act, as amended.*

Air regulations (North Carolina SIP - NSPS for landfills) will be complied with.

(b) *Open burning of solid waste, except for the infrequent burning of land clearing debris generated on site or debris from emergency clean-up operations, is prohibited at all MSWLF units. Any such infrequent burning must be approved by the Section.*

Charlotte Motor Speedway Landfill V will request approval from the Section prior to any infrequent burning of land clearing debris generated on-site or debris from emergency clean-up operations. No burning of solid waste will be performed.

(c) *Equipment shall be provided to control accidental fires or arrangements shall be made with the local fire protection agency to immediately provide fire-fighting services when needed.*

Charlotte Motor Speedway Landfill V will provide fire fighting equipment on-site for small fires. In addition, arrangements will be made with the local fire departments for fire fighting services.

(d) *Fires that occur at a MSWLF require verbal notice to the Section within 24 hours and written notification shall be submitted within 15 days.*

Appropriate notice will be given.

(6) *Access and safety requirements.*

(a) *The MSWLF shall be adequately secured by means of gates, chains, berms, fences and other security measures approved by the Section to prevent unauthorized entry.*

Access will be controlled by natural and manmade barriers. These controls will be maintained by the facility operator.

(b) *An attendant shall be on duty at the site at all times while it is open for public use to ensure compliance with operational requirements.*

This item will be complied with and is discussed in the Operation Plan.

(c) *The access road to the site shall be of all-weather construction and maintained in good condition.*

The site roads will be constructed for all weather use as shown on the Engineering Plans.

(d) *Dust control measures shall be implemented when necessary.*

Dust control will be provided as described in the Operations Plan on the roads as necessary.

(e) *Signs providing information on dumping procedures, the hours during which the site is open for public use, the permit number and other pertinent information shall be posted at the site entrance,*

Appropriate signs will be posted.

(f) *Signs shall be posted stating that no hazardous or liquid waste can be received.*

Appropriate signs will be posted.

(g) *Traffic signs or markers shall be provided as necessary to promote an orderly traffic pattern to and from the discharge area and to maintain efficient operating conditions.*

Appropriate signs will be posted.

(h) *The removal of solid waste from a MSWLF is prohibited unless the owner or operator approves and the removal is not performed on the working face.*

This is discussed in the Operation Plan.

(i) *Barrels and drums shall not be disposed of unless they are empty and perforated sufficiently to ensure that no liquid or hazardous waste is contained therein, except fiber drums containing asbestos.*

This is discussed in the Operation Plan.

(7) *Erosion and sedimentation control requirements.*

(a) *Adequate sediment control measures (structures or devices), shall be utilized to prevent silt from leaving the MSWLF facility.*

(b) *Adequate sediment control measures (structures or devices), shall be utilized to prevent excessive on-site erosion.*

(c) *Provisions for a vegetative ground cover sufficient to restrain erosion must be accomplished within 30 working days or 120 calendar days upon completion of any phase of MSWLF development.*

Each of the erosion and sedimentation controls is detailed in the Erosion and Sedimentation (E&S) Control Plan to be approved for this site.

(8) *Drainage control and water protection requirements.*

(a) *Surface water shall be diverted from the operational area.*

This item will be complied with.

(b) *Surface water shall not be impounded over or in waste.*

This item will be complied with.

(c) *Solid waste shall not be disposed of in water.*

This item will be complied with.

(d) *Leachate shall be contained on site or properly treated prior to discharge. An NPDES permit may be required prior to the discharge of leachate to surface waters.*

Leachate will be pre-treated on-site and then transported via force main to the Rocky River Regional Wastewater Treatment Plant. This is discussed under leachate management in the Operation Plan.

(e) *MSWLF units shall not:*

(i) *Cause a discharge of pollutants into waters of the United States, including wetlands, that violates any requirements of the Clean Water Act, including, but not limited to, the National Pollutant Discharge Elimination System (NPDES) requirements, pursuant to Section 402.*

(ii) *Cause the discharge of a nonpoint source of pollution to waters of the United States, including wetlands, that violated any requirement of an area-wide or State-wide water quality management plan that has been approved under Section 208 or 319 of the Clean Water Act, as amended.*

These conditions will be complied with.

(9) Liquids restrictions.

(a) Bulk or non-containerized liquid waste may not be placed in MSWLF units unless:

(i) The waste is household waste other than septic waste and waste oil, or,

(ii) The waste is leachate or gas condensate derived from the MSWLF unit, whether it is a new or existing MSWLF unit or lateral expansion, is designed with a composite liner and leachate collection system as described within Rule .1624 of this section.

This condition will be complied with.

(b) Containers holding liquid wastes may not be placed in the MSWLF unit unless:

(i) The container is a small container similar in size to that normally found in household waste:

(ii) The container is designed to hold liquids for use other than storage; or

(iii) The waste is household waste.

(c) For the purpose of this Paragraph:

(i) Liquid waste means any waste material that is determined to contain "free liquids" as defined by Method 9095 (Paint Filter Liquids Test), S.W. 846.

(ii) Gas Condensate means the liquid generated as a result of gas recovery processes at the MSWLF unit.

This liquid waste conditions will be complied with.

(10) Recordkeeping requirements.

(a) The owner or operator of a MSWLF unit must record and retain at the facility, or an alternative location near the facility approved by the Section, in an operating record the following as it becomes available:

(i) Inspection records, waste determination records, and training procedures required in Item (1) of this Rule;

(ii) Amounts by weight of solid waste received at the facility to include source of generation;

(iii) Gas monitoring results and any remediation plans required by Item (4) of this Rule;

(iv) Any demonstration, certification, finding, monitoring, testing, or analytical data required by Rule .1630 thru .1637 of this section;

(v) Any monitoring, testing, or analytical data as required by Rule .1627 of this section.

(vi) Any cost estimates and financial assurance documentation required by Rule .1628 of this section.

(b) All information contained in the operating record must be furnished upon request to the Section or be made available at all reasonable times for inspection by the Section.

(c) The owner or operator must maintain a copy of the Operation Plan required by Rule .1625 of this section at the facility.

These conditions will be complied with, and they are discussed in the Operation Plan.

(11) Spreading and Compacting requirements.

(a) MSWLF units shall restrict solid waste into the smallest area feasible.

(b) Solid waste shall be compacted as densely as practical into cells.

(c) Appropriate methods such as fencing and diking shall be provided within the area to confine solid waste subject to be blown by the wind. At the conclusion of each day of operation, all windblown material resulting from the operation shall be collected and returned to the area by the owner or operator.

These conditions will be complied with, and they are discussed in the Operation Plan.

(12) Leachate management plan. The owner or operator of a MSWLF unit designed with a leachate collection system must establish and maintain of leachate management plan which, at a minimum, includes the following:

(a) Periodic maintenance of the leachate collection system;

(b) Maintaining records for the amounts of leachate generated;

(c) Semi-annual leachate quality sampling;

(d) Approval for final leachate disposal; and

(e) A contingency plan for extreme operational conditions.

This is included in the Operation Plan for this facility.

IX. .1627 CLOSURE AND POST-CLOSURE REQUIREMENTS FOR MSWLF FACILITIES

(a) Purpose. This Rule establishes criteria for the closure of all MSWLF units and subsequent requirements for post-closure compliance. The owner or operator is required to develop specific plans for the MSWLF facility under Rule .1629.

(b) Scope

(1) Closure. Standards are established for the scheduling and documenting closure of all MSWLF units, and designing the cap system. Construction requirements for the cap system incorporate specific requirements from Rule .1624 of this section.

(2) Post-Closure. Standards are established for the monitoring and maintenance of the MSWLF unit(s) following closure.

(c) Closure criteria

(1) New and existing MSWLF units and lateral expansions shall install a cap system that is designed to minimize infiltration and erosion. The cap system shall be designed and constructed to:

(A) have a permeability less than or equal to the permeability of any base liner system or the in-situ subsoils underlaying the landfill, or the permeability specified for the final cover in the effective permit, or a permeability no greater than 1×10^{-5} cm/sec, whichever is less;

(B) minimize infiltration through the closed MSWLF by the use of low-permeability barrier that contains a minimum 18 inches of earthen material; and

(C) minimize erosion of the cap system and protect the low-permeability barrier from root penetration by use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.

The Charlotte Motor Speedway Landfill V has an approved cap system which meets the requirements of this Rule. This cap system is shown in the Engineering Plans.

(2) The Section may approve an alternative cap system if the owner or operator can adequately demonstrate the following:

(A) The alternative cap system will achieve an equivalent or greater reduction in infiltration as the low-permeability barrier specified in Subparagraph (1) of this Paragraph; and

(B) The erosion layer will provide equivalent or improved protection as the erosion layer specified in Subparagraph (3) of this Paragraph.

The Charlotte Motor Speedway Landfill V proposes to utilize an alternative cap system. Demonstrations for each alternate cap have been provided to the Section with copies placed in the Facility Operating Record.

(3) Construction of the cap system for all MSWLF units shall conform to the requirements set forth in Subparagraphs (b)(8), (b)(9) and (b)(15) of Rule .1624 and the following requirements:

(A) post-settlement surface slopes shall be a minimum of five percent and a maximum of 25 percent;

The facility proposed an alternate cap system with post-settlement surface slopes between a minimum of five percent and a maximum of 3 Horizontal to 1 Vertical slope.

(B) a gas venting or collection system shall be installed below the low-permeability barrier to minimize pressures exerted on the barrier.

This facility has an active gas collection system. The active gas collection system will comply with New Source Performance Standard (NSPS) requirements.

(4) Prior to beginning closure of each MSWLF unit as specified in Subparagraph (5) of this Paragraph, an owner or operator shall notify the Section that a notice of the intent to close the unit has been placed in the operating record.

This notice of intent to close a unit will be sent to the Section, and placed in the facility operating record. Previous closed units have been in compliance with this Rule.

(5) The owner or operator shall begin closure activities of each MSWLF unit no later than 30 days after the date on which the MSWLF unit receives the known final receipt of wastes or, if the MSWLF unit has remaining capacity

and there is a reasonable likelihood that the MSWLF unit will receive additional wastes, no later than one year after the most recent receipt of wastes. Extensions beyond the one-year deadline for beginning closure may be granted by the Section if the owner or operator demonstrates that the MSWLF unit has the capacity to receive additional wastes and the owner or operator has taken and will continue to take all steps necessary to prevent threats to human health and the environment from the unclosed MSWLF unit.

This item will be complied with at the time of MSWLF unit closure.

(6) *The owner or operator of all MSWLF units shall complete closure activities of each MSWLF unit in accordance with the closure plan within 180 days following the beginning of closure as specified in Subparagraph (5) of this Paragraph. Extensions of the closure period may be granted by the Section if the owner or operator demonstrates that closure will, of necessity, take longer than 180 days and they have taken and will continue to take all steps to prevent threats to human health and the environment from the unclosed MSWLF unit.*

This item will be complied with at the time a MSWLF unit is closed.

(7) *Following closure of each MSWLF unit, the owner or operator shall notify the Section that a certification, signed by the project engineer verifying that closure has been completed in accordance with the closure plan, has been placed in the operating record.*

The engineer's certifications will be placed in the facility operating record, and the Section will be notified of this.

(8) Recordation

(A) Following closure of all MSWLF units, the owner or operator shall record a notation on the deed to the landfill facility property, or some other instrument that is normally examined during title search, and notify the Section that the notation has been recorded and a copy has been placed in the operating record.

(B) The notation on the deed shall in perpetuity notify and potential purchaser of the property that:

(i) The land has been used as a landfill facility; and

(ii) Its use is restricted under the closure plan approved by the Section.

The notations and language in this section will be affixed to the deed to the property following closure of all MSWLF units.

(9) The owner or operator may request permission from the Section to remove the notation from the deed if all wastes are removed from the facility.

Should all waste be removed from this facility, this request will be made in a timely manner.

(10) Existing MSWLF units. The following criteria shall apply to existing MSWLF units not designed and constructed with a base liner system permitted by the Section.

(A) The existing MSWLF unit shall cease receiving solid waste on or before January 1, 1998.

(B) The Section shall schedule closure of the existing MSWLF unit based on its review of the application submitted in accordance with Paragraph (d) of Rule .1617 and reviewed in accordance with Subparagraph (d) of Rule .1603.

(C) Final contours for the existing MSWLF unit shall be consistent with the capacity requirements necessary to close the unit in accordance with the requirements of this Subparagraph.

These requirements do not apply since all units are designed and constructed with a base liner system.

(d) Post-closure criteria

(1) Following closure of each MSWLF unit, the owner or operator shall conduct post-closure care. Post-closure care shall be conducted for 30 years, except as provided under Subparagraph (2) of this Paragraph, and consist of at least the following:

(A) Maintaining the integrity and effectiveness of any cap system, including making repairs to the cover as necessary to correct the effects of settlement, subsidence, erosion, or other events, and

preventing run-on and run-off from eroding or otherwise damaging the cap system;

(B) Maintaining and operating the leachate collection system in accordance with the requirements in Rules .1624 and .1626. The Section may allow the owner or operator to stop managing leachate if the owner or operator demonstrates that leachate no longer poses a threat to human health and the environment;

(C) Monitoring the ground water and surface water in accordance with the requirements of Rules .1631 through .1637 and maintaining the ground water monitoring system, if applicable; and monitoring the surface water in accordance with the requirements of Rule .0602; and

(D) Maintaining and operating the gas monitoring system in accordance with the requirements of Rule .1626 of this section.

During the post-closure period, requirements (A), (B), (C) and (D) will be complied with by the landfill operator.

(2) The length of the post-closure care period may be:

(A) Decreased by the Section if the owner or operator demonstrates that the reduced period is sufficient to protect human health and the environment and this demonstration is approved by the Section; or

(B) Increased by the Section if the Section determines that the lengthened period is necessary to protect human health and the environment.

The time length of post-closure will be determined by the Section.

(3) *Following completion of the post-closure care period for each MSWLF unit, the owner or operator shall notify the Section that a certification, signed by a registered professional engineer, verifying that post-closure care has been completed in accordance with the post-closure plan, has been placed in the operating record.*

This certification will be placed in the facility operating record and notice will be provided to the Section.

X. .1680 LEACHATE STORAGE REQUIREMENTS

(a) Applicability.

(1) Construction of leachate storage tanks and surface impoundments located at solid waste landfill facilities after October 9, 1993 shall meet the requirements set forth in this Rule.

The existing on-site leachate storage lagoon was constructed when operations began at this facility in the early 1990's. The storage lagoon was constructed with a composite liner system and maintains a grout filled geosynthic (fabric form) above the liner section to protect the integrity of the liner. Future modifications to leachate storage facilities at this site will meet the previsions of this Rule.

NARRATIVE APPENDIX

LANDFILL CAPACITY

ASSUMPTIONS:

1.	Waste Stream	4,000 tons/day
2.	Waste Density Estimate	1,600 lbs/c.y.
4.	Total Cover Consumes	Final Cap +15% of landfill volume
5.	Capacity of Phase 3	8,850,000 c.y.

Part 1 - Five Year Requirements

365 days/year x 4,000 tpd x (2,000 lbs/ton / 1,600 lbs/c.y.)
x 5 years ÷ 0.85 (cover) = 10,735,000 c.y.

∴ Use 10,735,000 c.y. for 5 years capacity or 2,147,000 c.y. per year.

Part 2 – Phase 3 Life

Phase 3 Gross Capacity	=	9,068,000 c.y.
Soil Cap	=	218,000 c.y.
Phase 3 Capacity	=	8,850,000 c.y.

8,850,000 c.y. ÷ 2,147,000 c.y./year = ±4.1 years

NOTE: These calculations are based on the maximum waste disposal as allowed in the current Franchise Agreement. Some fluctuations in waste stream are anticipated which could extend the life of the facility to more than the 4.1 years calculated above.

SOIL REQUIREMENTS

Part One – Phase 3 Structural Fill Requirements

Calculated Cut		186,000 c.y.
Calculated Fill including 30% shrinking	(minus)	825,250 c.y.
Clay Liner	(minus)	180,000 c.y.
Potential Off-Site Borrow Soil on Property owned by CMSLF	(plus)	1,917,000 c.y.
Net Soil Available		1,097,750 c.y.

Part Two – Phase 3 Cover Requirements

Assume 7:1 waste to soil ratio for daily and intermediate cover

Total Volume of Waste and Cover = ±8,850,000 c.y.	
Daily & Intermediate Cover = 8,850,00 c.y. x (15%) =	± 1,327,500 c.y.
Final Cover	± 218,000 c.y.
Drainage Berms on Final Cover	± 102,000 c.y.
Net Soil Cover Required =	± 1,665,500 c.y.

TOTAL SOIL REQUIREMENTS = 1,097,750 c.y. – 1,665,500 c.y. = -567,750c.y.

∴ The Phase 3 area has a soil deficit of 567,750 c.y. which will come from the facility borrow areas.

*Use of Alternate Daily Cover could substantially reduce borrow soil requirements.

III. CONSTRUCTION QUALITY ASSURANCE PLAN

CQA PLAN
CONSTRUCTION QUALITY ASSURANCE PLAN

CHARLOTTE MOTOR SPEEDWAY LANDFILL V
PHASE 3 PERMIT TO CONSTRUCT
CITY OF CONCORD, NORTH CAROLINA

FOR

REPUBLIC SERVICES OF SOUTH CAROLINA, LLC

MAY 2009

NORTH CAROLINA PROFESSIONAL SEAL 16146 ENGINEER WILLIAM F. HODGES 4/30/09

NORTH CAROLINA PROFESSIONAL SEAL 32249 ENGINEER K. MATTHEW CHEEK 4/30/09

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I. GENERAL

A. Republic Services of South Carolina, LLC, (the OWNER) will retain an engineering consulting firm (CQA Firm) to assure that proper construction techniques and procedures are used and to verify that the materials used meet the Contract Specifications. The CQA Firm must employ engineers licensed to practice engineering in the State of North Carolina and experienced in the field of solid waste management and sanitary landfill construction. At the completion of the work, the program requires certification reports indicating that the facility has been constructed in accordance with the Construction Specifications and approved design. It is the responsibility of the certifying Engineer(s) to prepare these reports.

B. To implement the construction project, a CONTRACTOR, familiar with earthwork and geomembrane construction, will serve as a general contractor (CONTRACTOR) providing construction services. In addition, a CQA ENGINEER will be retained to serve as an independent third party to ensure project conformance of all construction activities to established CQA standards. In most instances, the CONTRACTOR will perform all earthwork activities, and may retain a geomembrane contractor for installation of geosynthetic materials. Republic may, at their discretion, directly contract with a geomembrane contractor for installation of geosynthetic materials. The CQA Plan provides guidance information and procedures that should be undertaken by Republic, the DESIGN ENGINEER, and the CONTRACTOR so the work will be of the quality necessary to meet the project objectives and will be responsive to the requirements of Republic Services of South Carolina, LLC.

C. This CQA Plan is a supplemental document to the Construction Plans and Specifications for each project. Where a conflict arises, the Contract Documents will govern.

D. The activities addressed under this CQA Plan include the following activities:

- Grading;
- Clay liner or Low Permeability Soil Liner (Alternate Base Liner) construction;
- Reinforced Geosynthetic Clay Liner (GCL) (Alternate Base Liner Only);
- Installation of a HDPE geomembrane liner and leachate collection system;
- Soil cap construction;
- Installation of a geomembrane cap and drainage layer; and
- Placement of soil protective cover and vegetative support layer

E. Definitions

- Quality Control: A planned system of activities, or the use of such a system, whose purpose is to provide a level of quality that meets the needs of users. The objective of quality control is to provide construction quality control that

is safe, adequate, dependable, and economical. The overall system involves integrating the quality factors of several related steps including: the proper specification of what is wanted, production to meet the full intent of the specification, inspection to determine whether the resulting material, product, service, etc. is in accordance with the Construction Specifications, and review of usage to determine necessary revisions of the Construction Specifications.

In practice, Quality Control refers to those procedures, criteria, and tests employed and paid for by the CONTRACTOR(s) to confirm that the work satisfies the CONTRACTOR's standards and is in compliance with the Construction Plans and Specifications. This CQA Plan does not address quality control procedures, criteria, and/or tests employed by the CONTRACTOR.

- Quality Assurance: A planned system of activities whose purpose is to provide assurance that the overall quality control program is in fact being effectively implemented. The system involves a continuing evaluation of the adequacy and effectiveness of the overall quality control program with the ability to have corrective measures initiated where necessary. For a specific material, product, service, etc., this involves verifications, audits, and the evaluation of the quality factors that affect the specification, production, inspection, and use of the product, service, system, or environment.

  In practice, Quality Assurance refers to those procedures, criteria, and tests required and paid for by the OWNER to confirm that the work performed by the CONTRACTOR(s) is in compliance with the approved Construction Plans and Specifications and any additional requirements of this CQA Plan.

- Lot: A quantity of resin (usually the capacity of one rail car) used in the manufacture of polyethylene geomembrane rolls. The finished roll will be identified by a roll number traceable to the resin lot used.

- Panel: The unit area of geomembrane that will be seamed in the field. A panel is identified as a roll or portion of a roll that is larger than 100 square feet.

- Subgrade Surface: The soil layer surface which immediately underlies the structural fill, compacted clay liner/cap, or geomembrane liner/cap.

F. Parties referenced in this CQA Plan shall consist of the following:

1. DESIGN ENGINEER: The DESIGN ENGINEER is the official representative of the OWNER. The DESIGN ENGINEER is responsible for the preparation of the construction plans and specifications of the project and for the preparation of the CQA Plan. The DESIGN ENGINEER is also

responsible for the interpretation of these documents and for resolution of construction matters that arise during construction. The DESIGN ENGINEER shall review and approve shop drawings, authorize minor variations in the work from the contract documents and reject defective work (duties and responsibilities are described in the General Conditions as "ENGINEER"). The DESIGN ENGINEER shall be a registered professional engineer licensed in North Carolina.

2. CQA ENGINEER: Responsible for defining quality assurance requirements compatible with the project objectives, verifying basic data as reasonable and complete, outlining procedures to process data, development of statistical procedures for the analysis of test data and preparing quality assurance memoranda and quality control reports. The CQA ENGINEER shall report to the DESIGN ENGINEER. The CQA ENGINEER shall be a registered professional engineer licensed in North Carolina. Reference to the CQA ENGINEER, for the purpose of this document, shall include the CQA ENGINEER or his representative.

3. Engineering Technicians: Responsible for field observations, testing and inspection. Technicians will be assigned to the project as deemed necessary by the CQA ENGINEER and will be responsible to the CQA ENGINEER. The CQA ENGINEER, Technician or the CQA ENGINEER's representative shall be on-site during all construction activities, except clearing and grubbing and initial cell excavation. A daily log of all field technicians, testing and inspection shall be maintained by the Technician.

4. OWNER: The OWNER is the individual, entity, or private company with whom the CONTRACTOR has entered into the Agreement and for whom the Work is performed. For this project, the OWNER is Republic Services of South Carolina, LLC.

5. CONTRACTOR: The CONTRACTOR has the primary responsibility for ensuring that the landfill cell is constructed in accordance with the Construction Plans and Specifications developed by the ENGINEER and approved by the permitting agency. Other responsibilities include the performance of all construction activities at the site including site facilities, administration, material purchasing, procurement, supervision, construction quality control, installation, and subcontracting. The CONTRACTOR is responsible for the protection of completed work until it is accepted by the OWNER. The CONTRACTOR is also responsible for informing the OWNER and CQA Consultants of the scheduling and occurrence of all construction activities.

6. Geomembrane Manufacturer (Manufacturer): The party responsible for manufacturing the geomembrane rolls.

7. Geosynthetic CQA Laboratory (Testing Laboratory): Party, independent from the OWNER, Manufacturer and Installer, responsible for completing laboratory tests on samples of geosynthetics obtained at the site or during manufacturing usually under the direction of the OWNER.

8. Geotechnical CQA Laboratory: Party, independent from the OWNER or CONTRACTOR, responsible for completing laboratory tests on soil samples obtained at the site or source usually under the direction of the OWNER.

9. Geomembrane Installer (Installer): The Installer is responsible for field handling, sorting, placing, seaming, loading (against wind), and other aspects of the geosynthetics installation, including geomembranes, geotextiles, geonets, geosynthetic clay liners, and geonet composites.

II. GRADING

A. GENERAL

The CQA ENGINEER shall test the grading, placement, and compaction of in-situ materials and structural fill. The CQA ENGINEER shall certify the materials and construction were in accordance with the plans, specifications, and this CQA Plan.

B. RELATED WORK

The CQA ENGINEER should reference the grading section of the technical specifications for pertinent soil materials, physical properties and construction requirements.

C. SUBGRADES

During construction, conformance and performance testing of the subgrade soil materials shall be performed by the CQA ENGINEER. The CQA ENGINEER shall monitor proofrolling of areas that are cut to achieve grade. Material placed to achieve grades indicated on the plans shall be tested by the CQA ENGINEER in accordance with the test methods and frequencies listed herein to verify that the compacted fill materials used by the CONTRACTOR complies with the technical specifications. Areas of proofrolling or compacted fill that do not conform to the technical specifications will be delineated and reported to the CONTRACTOR. These areas will be re-worked by the CONTRACTOR and re-tested until passing results are achieved.

The CQA ENGINEER shall monitor the repair and re-work of subgrade which is damaged by excess moisture (causing softening) and insufficient moisture (causing dessiccation and shrinkage) or be freezing. If such conditions are found to exist, the

CQA ENGINEER shall evaluate the suitability of the subgrade by the following methods as applicable:

- moisture / density testing;
- continuous visual inspection during proof-rolling;
- other test methods identified herein.

D. CONFORMANCE TESTING

It will be necessary for the CQA ENGINEER to observe and test the structural fill soils to ensure they are uniform and conform to the requirements of the technical specifications. For soil materials obtained from on-site or off-site borrow areas, visual inspections and conformance tests shall be performed by the CQA ENGINEER prior to the materials being used. Borrow area inspections may also be utilized by the CQA ENGINEER to ensure that only suitable soil materials are transported to the site. For both on-site and off-site borrow areas containing non-uniform materials, it shall be necessary for the CONTRACTOR and the CQA ENGINEER to coordinate excavation and monitoring of the segregation of substandard materials. All materials failing to comply with conformance standards shall be rejected for use.

Initial evaluation of various soil types by the CQA personnel during construction shall be largely visual; therefore, the CQA personnel must be experienced with visual-manual soil classification procedures. CQA personnel shall observe soils for deleterious materials (e.g., roots, stumps, rocks, and large objects). When necessary, the visual-manual procedure for the description and identification of soils shall be conducted by the CQA ENGINEER and the description shall be in accordance with test method ASTM D2488.

E. TEST METHODS AND FREQUENCY

All testing shall be conducted in accordance with the technical specifications or as directed by the DESIGN ENGINEER. The field testing methods, used to evaluate the suitability of soils during their installation, shall be performed by the CQA ENGINEER in accordance with current ASTM test procedures indicated in the table below. Documentation and reporting of the test results shall be the responsibility of the CQA ENGINEER.

The Standard Proctor Test (ASTM D698) shall be used for the determination of moisture / density relationships unless otherwise indicated. In-place surface moisture / density nuclear test method ASTM D2922 or drive cylinder test method ASTM D2937 shall be used for in-situ field testing. The sand cone test method ASTM D1556 or drive cylinder test method ASTM D2937 shall be used to establish correlations of moisture and density in cases of uncertainty, and as a check of the

nuclear surface moisture / density gauge calibration. Any conflict regarding acceptance of test results shall be resolved by the DESIGN ENGINEER.

Testing shall be conducted during the course of the work. The minimum construction testing frequencies are presented in the table below. The frequency may be increased at the discretion of the CQA ENGINEER or if variability of the materials is observed by the CQA ENGINEER. Sampling locations shall be selected by the CQA ENGINEER. If necessary, the location of routine in-place density tests shall be determined using a non-biased sampling approach.

A special testing frequency shall be used at the discretion of the CQA ENGINEER when visual observations of construction performance indicate a potential problem.

MINIMUM TESTING REQUIREMENTS FOR STRUCTURAL FILL	
TEST	**FREQUENCY**
Laboratory Moisture-Density / ASTM D698	1 test for each type of soil encountered
Field Density and Moisture Content / Sand Cone, ASTM D1556 Drive Cylinder, ASTM D2937 Nuclear, ASTM D2922	1 test per 1,000 c.y. of structural fill

F. COMPACTION

The CQA ENGINEER shall confirm that structural fill conforms to compaction requirements as follows:

Description	**General Compaction**
Sediment Basin Embankments	95%
Roadways	95%
Shoulders and Embankments	95%
Utilities Under Structures	95%
Other Areas	95%

G. PROTECTION OF SUBGRADES AND FILL SURFACES

The CQA ENGINEER shall monitor newly graded areas to verify the CONTRACTOR is protecting these areas from traffic and erosion until construction is complete.

III. LOW PERMEABILITY SOIL BASE LINER (ALTERNATE BASE LINER)

A. GENERAL

1. The CQA ENGINEER shall certify the materials and installation are in accordance with the plans, specifications, and this CQA Plan.

B. MATERIAL

1. The soil liner material shall consist of on-site cohesive soils, synthetically improved soils, or imported cohesive soils meeting the permeability criteria of $k \leq 1.0 \times 10^{-5}$ cm/sec. Soils used in compacted soil liners shall consist of clean, select material free of debris, excessive coarse particles or other deleterious matter. Liner material shall be clayey soil, classified according to the United Soil Classification System as SC, CL, CH, ML, or MH (ASTM D2487).

C. STOCKPILING AND MATERIAL APPROVAL

1. All material to be used as the soil liner shall be approved in advance by the CQA ENGINEER. Approval is based upon successful completion of CQA testing outlined herein. Such testing can be performed either during excavation and stockpiling or from existing stockpiles prior to use.

2. The procedures for testing during excavation and stockpiling is outlined below:

   a. Each load of soil will be examined either at the borrow source or the stockpile area. Any unsuitable material will be rejected or routed to separate stockpiles consistent with its end use.

   b. During stockpiling operations, one (1) bulk sample of material placed will be collected. The following tests will be performed prior to placement of any soil liner material.

      1. Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures, ASTM D2216.

2. Method for Particle - Size Analysis of Soils, ASTM D422.

3. Test Method for Liquid Limit, and Plasticity Index of Soils, ASTM D4318.

c. One (1) sample for every 10,000 cubic yards of material stockpiled will be selected for moisture – density relationship (ASTM D698) and corresponding permeability testing (ASTM D 5084-90 Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Parameter).

3. Reports for soil liner will be prepared by the CQA ENGINEER and shall include:

a. Summary of laboratory test data.

b. A summary of construction, sampling and testing method, and recommendations.

D. TEST FILL

1. A test fill will be constructed using the same construction methods, equipment, and material to be used for the soil liner component. The test fill construction will be conducted prior to or coincide with the beginning of construction of soil liner component.

2. Construction equipment and methods shall be reviewed by the CQA ENGINEER prior to test fill placement.

3. Construction methods, sampling, and testing, including permeability testing, shall be specified by the CQA ENGINEER.

E. SUBGRADE

1. The CQA ENGINEER shall verify that the soil liner subgrade is constructed in accordance with Grading Specifications.

2. The landfill cell shall be excavated to the lines and grades as indicated on the drawings. The subgrade shall be scarified to a depth of 6" and compacted to 95% as determined by the Standard Proctor Test, ASTM D-698.

3. The subbase shall be reasonably free of large rocks, large roots, stumps, and other debris.

F. CONSTRUCTION

1. The Soil Liner shall be placed to conform to the $k \leq 1.0 \times 10^{-5}$ cm/sec or less permeability criteria.

2. Only soil previously approved by the CQA ENGINEER shall be used in construction of the soil liner. Unsuitable material will be removed prior to acceptance by the CQA ENGINEER.

3. All required field density and moisture content tests shall be completed before the overlying lift of soil is placed. The surface preparation (e.g., wetting, drying, scarification, etc.) shall be completed before the CQA ENGINEER will allow placement of subsequent lifts.

4. Moisture content will be monitored by the CQA ENGINEER or his representative prior to compaction. If the soil is drier than the specified minimum moisture content, water will be added and the lift will be disced to distribute the moisture evenly.

   The surface of each lift shall be scarified prior to placement of subsequent lifts.

5. The thickness of the loose lift shall be measured at random locations after spreading and leveling is complete. Loose lift thickness should not exceed ten (10") inches for a final six (6") inch compacted lift thickness.

   Each lift shall be checked visually for rocks, debris, plant materials, and other foreign material. The upper 6" of soil liner shall be reasonably free of material which will not pass through a 1" screen. The remaining 12" of compacted soil liner (below the top 6") shall be free of material which will not pass through a 3" screen. This may require mechanical pulverizing of these soils.

6. The exposed surface of the soil liner shall be rolled with a smooth drum roller or equivalent at the end of each work day or when required to protect the compacted soil from adverse weather conditions.

7. The finished soil liner shall be reasonably free of all rock or rock fragments within 6" of the surface. Rock or rock fragments are defined as the material retained by a standard 1" screen. Protrusions shall be removed and all cracks and voids shall be filled and the surface made uniform. Rock or other material protruding more than ½" shall not be allowed. This shall be accomplished by final dressing of the soil liner with smooth drum rollers and hand raking.

8. The surface on which the geosynthetic clay liner (GCL) is to be placed shall be maintained in a firm, clean, dry and smooth condition before and during the liner installation.

9. The CQA ENGINEER shall inspect the soil liner and certify that it is in accordance with the specifications and approved plans and receive concurrence of the state prior to the CONTRACTOR beginning installation of geomembrane. This may require separate certifications of liner sections. If this is required, surveys of each section shall be provided by the CONTRACTOR to define the limits of these sections. Placement of GCL on any portion of the soil liner surface by the GCL installer will constitute his acceptance of the surface.

G. SAMPLING AND TESTING FOR SOIL LINER

1. The CQA ENGINEER or his representative will perform field density tests to assure that the soil density and moisture content are within the prescribed limits. The frequency of testing is noted below.

2. Bottom and Sidewall of Cell

   a. Field density tests shall be performed at the rate of one per 10,000 square feet of lined area for each lift of the soil liner base and the subgrade.

   b. The field density tests will be performed using a nuclear density gauge or drive tube method. The location of each test will be randomly determined by the CQA ENGINEER or his representative. All holes shall be repaired as described below.

   c. Perforations in the soil liner resulting from sampling or testing procedures, survey stakes or other activities shall be identified and backfilled by the CQA ENGINEER. The perforations shall be filled with a soil-bentonite mix consisting of 10% minimum by weight bentonite powder or granules mixed with soil liner material. The perforations shall be backfilled with the soil-bentonite mixture in 3" loose lifts and thoroughly compacted by hand tamping by the CQA ENGINEER.

   d. Two (2) bulk samples of the soil liner for each lift will be collected during placement or compaction. The following tests will be performed:

1. Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures ASTM D2216.

2. Method for Particle - Size Analysis of Soils ASTM D422.

3. Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils, ASTM D4318.

4. Moisture Density Relationship (ASTM D698)

e. One (1) sample per acre per each lift of soil liner component will be selected by the CQA ENGINEER for permeability testing (ASTM D5084 - 90).

f. A one square foot section of soil liner for every 20,000 square feet of liner shall be screened with acceptance of the liner based on the following criteria:

UPPER 6" SOIL LINER

Percentage of Material Passing (by weight)	Screen Size
95% (all tests)	1"
100% (avg. of all tests)	3"

LOWER 12" SOIL LINER

Percentage of Material Passing (by weight)	Screen Size
100% (avg. of all tests)	3"

Should any sample fail the 95% or 100% passing requirement, then four (4) additional test areas within the 20,000 square foot test area shall be selected by the CQA ENGINEER and tested in like manner. If the four (4) areas pass, then all test areas shall be repaired and the 20,000 square foot area accepted. If any of the four (4) areas fail, then the 20,000 square foot area shall be reworked and retested. Alternatively, the entire 20,000 square foot area represented by the failing test may be reworked and resampled with one single test. Rocks or roots remaining on or protruding through the surface shall be removed and the surface repaired. These rocks or roots will not be cause for rejection.

g. The following procedure shall be used in the event of density or permeability test failure. If density tests do not meet minimum requirements of the specifications, recompaction of the failed area

(minimum 100' x 100') shall be performed and retested until the area meets or exceeds requirements outlined in the specifications. If a permeability sample fails to meet the minimum hydraulic conductivity requirements outlined in the specifications, at least five (5) replicate samples shall be obtained in the immediate vicinity of the failed test. Should the replicate samples confirm the failure of the soil to meet specifications, the area of failure shall be localized and reconstructed in accordance with the specifications. This area shall be retested as outlined within the plan. Alternatively, the 40,000 square foot area represented by the failing permeability sample may be reworked and retested for density, moisture, and permeability.

IV. COMPACTED CLAY BASE LINER (Subtitle D Base Liner System)

A. GENERAL

1. The CQA ENGINEER shall certify the materials and installation are in accordance with the plans, specifications, and this CQA Plan.

B. MATERIAL

1. The clay liner material shall consist of on-site cohesive soils, synthetically improved soils, or imported cohesive soils meeting the permeability criteria of $k \leq 1.0 \times 10^{-7}$ cm/sec. Soils used in compacted clay liners shall consist of clean, select material free of debris, excessive coarse particles or other deleterious matter. Liner material shall be clayey soil, classified according to the United Soil Classification System as SC, CL, CH, ML, or MH (ASTM D2487).

C. STOCKPILING AND MATERIAL APPROVAL

1. All material to be used as the clay liner shall be approved in advance by the CQA ENGINEER. Approval is based upon successful completion of CQA testing outlined herein. Such testing can be performed either during excavation and stockpiling or from existing stockpiles prior to use.

2. The procedure for testing during excavation and stockpiling is outlined below.

   a. Each load of soil will be examined either at the borrow source or the stockpile area. Any unsuitable material will be rejected or routed to separate stockpiles consistent with its end use.

b. During stockpiling operations, one bulk sample of material placed will be collected. The following tests will be performed prior to placement of any compacted clay liner material:

1. Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures, ASTM D2216.

2. Method for Particle - Size Analysis of Soils, ASTM D422.

3. Test Method for Liquid Limit, and Plasticity Index of Soils, ASTM D4318.

c. One (1) sample for every 10,000 cubic yards of material stockpiled will be selected for moisture – density relationship (ASTM D698) and corresponding permeability testing (ASTM D 5084-90 Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Parameter).

3. Reports for clay liner will be prepared by the CQA ENGINEER and shall include:

a. Summary of laboratory test data,

b. A summary of construction, sampling and testing method, and recommendations.

D. TEST FILL

1. A test fill will be constructed using the same construction methods, equipment, and material to be used for the clay liner component. The test fill construction will be conducted prior to or coincide with the beginning of construction of clay liner component.

2. Construction equipment and methods shall be reviewed by the CQA ENGINEER prior to test fill placement.

3. Construction methods, sampling, and testing, including permeability testing, shall be specified by the CQA ENGINEER.

E. SUBGRADE

1. The CQA ENGINEER shall verify that the clay liner subgrade is constructed in accordance with the grading specifications.

2. The landfill cell shall be excavated to the lines and grades as indicated on the drawings. The subgrade shall be scarified to a depth of 6" and compacted to 95% as determined by the Standard Proctor Test, ASTM-D698.

3. The subgrade shall be reasonably free of large rocks, roots, stumps and other debris.

F. CONSTRUCTION

1. Clay Liner shall be placed to conform to the $k \leq 1.0 \times 10^{-7}$ cm/sec permeability criteria.

2. Only soil previously approved by the CQA ENGINEER shall be used in construction of the clay liner. Unsuitable material will be removed prior to acceptance by the CQA ENGINEER.

3. All required field density and moisture content tests shall be completed before the overlying lift of soil is placed. The surface preparation (e.g. wetting, drying, scarification, etc.) shall be completed before the CQA ENGINEER will allow placement of subsequent lifts.

4. Moisture content will be monitored by the CQA ENGINEER or his representative prior to compaction. If the soil is drier than the specified minimum moisture content, water will be added and the lift will be mixed to distribute the moisture evenly.

   The surface of each lift shall be scarified prior to placement of subsequent lifts.

5. The thickness of the loose lift shall be measured at random locations after spreading and leveling is completed. Loose lift thickness should not exceed 10" for a final 6" compacted lift thickness.

   Each lift shall be checked visually for rocks, debris, plant materials, and other foreign material. The upper 6" of clay liner shall be reasonably free of material which will not pass through a 1" screen. The remaining 18" of compacted clay liner (below the top 6") shall be free of material which will not pass through a 3" screen. This may require mechanical pulverizing of these soils.

6. The exposed surface of the clay liner shall be rolled with a smooth drum roller or equivalent at the end of each work day or when required to protect the compacted clay from adverse weather conditions.

7. The finished clay liner shall be reasonably free of all rock or rock fragments within 6" of the surface. Rock or rock fragments are defined as the material retained by a standard 1" screen. Protrusions shall be removed and all cracks and voids shall be filled and the surface made uniform. Rock or other material protruding more than ½" shall not be allowed. This shall be accomplished by final dressing of the soil liner with smooth drum rollers and hand raking.

8. The surface on which the geomembrane is to be placed shall be maintained in a firm, clean, dry and smooth condition before and during the liner installation.

9. The CQA ENGINEER shall inspect the clay liner and certify that it is in accordance with the specifications and approved plans and receive concurrence of the state prior to the CONTRACTOR beginning installation of geomembrane. This may require separate certifications of liner sections. If this is required, surveys of each section shall be provided by the CONTRACTOR to define the limits of these sections. Placement of geomembrane on any portion of the soil liner surface by the geomembrane installer will constitute his acceptance of the surface.

G. SAMPLING AND TESTING

1. The CQA ENGINEER or his representative will perform field density tests to assure that the soil density and moisture content are within the prescribed limits. The frequency of testing is noted below.

2. Bottom and Sidewall of Cell

   a. Field density tests shall be performed at the rate of one per 10,000 square feet of lined area for each lift of the clay liner base and the subgrade.

   b. The field density tests will be performed using a nuclear density gauge or drive tube method. The location of each test will be randomly determined by the CQA ENGINEER or his representative. All holes shall be repaired as described below.

   c. Perforations in the clay liner resulting from sampling or testing procedures, survey stakes or other activities shall be identified and backfilled by the CQA ENGINEER. The perforations shall be filled with a soil-bentonite mix consisting of 10% minimum by weight bentonite powder or granules mixed with clay liner material. The perforations shall be backfilled with the soil-bentonite mixture in 3-

inch loose lifts and thoroughly compacted by hand tamping by the CQA ENGINEER.

d. Two bulk samples of the clay liner for each lift will be collected during placement or compaction. The following tests will be performed:

1. Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures, ASTM D2216.

2. Method for particle-Size Analysis of Soils, ASTM D422.

3. Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils, ASTM D4318.

4. Moisture - Density Relationship, ASTM D 698.

e. One sample per acre per each lift of clay liner component will be selected by the CQA ENGINEER for permeability testing (ASTM D5084-90).

f. A one square foot section of clay liner for every 20,000 square feet of liner shall be screened with acceptance of the liner will be based on the following criteria:

Upper 6" Clay Liner

Percentage of Material Passing (by weight)	Screen Size
95% (all tests)	1"
100% (avg. of all tests)	3"

Lower 18" Clay Liner

Percentage of Material Passing (by weight)	Screen Size
100% (avg. of all tests)	3"

Should any sample fail the 95% or 100% passing requirement, then four (4) additional test areas within the 20,000 square foot test area shall be selected by the CQA ENGINEER and tested in like manner. If the four (4) areas pass, then all test areas shall be repaired and the 20,000 square foot area accepted. If any one (1) of the four (4) areas fails, then the 20,000 square foot area shall be reworked and retested.

Alternatively, the entire 20,000 square foot area represented by the failing sample may be reworked and resampled with a single test. Rocks or roots remaining on or protruding through the surface shall be removed and the surface repaired. These rocks or roots will not be cause for rejection.

g. The following procedure shall be used in the event of density or permeability test failure. If density tests do not meet minimum requirements of the specifications, recompaction of the failed area (minimum 100' x 100') shall be performed and retested until the area meets or exceeds requirements outlined in the specifications. If a permeability sample fails to meet the minimum hydraulic conductivity requirements outlined in the specifications, at least five (5) replicate samples shall be obtained in the immediate vicinity of the failed test. Should the replicate samples confirm the failure of the soil to meet specifications, the area of failure shall be localized and reconstructed in accordance with the specifications. This area shall be retested as outlined within the plan. Alternatively, the entire one (1) acre area represented by the failing permeability sample may be reworked and retested for density, moisture, and permeability.

V. REINFORCED GEOSYNTHETIC CLAY LINER (GCL) FOR ALTERNATE BASE LINER

A. INTRODUCTION

This section of the CQA Plan addresses reinforced geosynthetic clay liner (GCL) and outlines the CQA Program to be implemented with regard to material approval, material control tests, repairs, and resolution of problems.

B. GCL MANUFACTURER AND INSTALLER APPROVAL

The CONTRACTOR or Material Supplier shall submit the qualifications of the GCL Manufacturer and the GCL Installer, as described in the specifications, to the CQA ENGINEER for approval.

C. GCL MATERIAL APPROVAL

1. GCL Product Data

The CQA ENGINEER will review the GCL Manufacturer's and GCL Installer's submittals for conformance with the project specifications.

2. Shipment and Storage

The CQA ENGINEER shall verify that all GCL delivered to the project site is stored in a dry area protected from precipitation and direct sunlight. The GCL shall be placed on pallets to assure drainage beneath the rolls. The GCL shall be completely covered with polyethylene, maintained in good condition, until the GCL is deployed. GCL which has become wet prior to deployment shall be rejected.

3. Quality Control Certificates

Upon delivery, the CQA ENGINEER will:

* verify that the Manufacturer's quality control certificates have been provided at the specified frequency and that each certificate identified the rolls related to it, and

* review the Manufacturer's quality control certificates and verify that the certified properties meet the project technical specifications.

4. GCL Material Control Tests

The CQA ENGINEER shall perform the following Material Control Tests:

REQUIRED GCL PROPERTIES				
Property	Test Method	Units	Value[1]	Test Frequency
Hydraulic Conductivity	ASTM D5084[2]	cm/s	$k \leq 5.0 \times 10^{-9}$	100,000 ft^2 or 1 per lot[4]
Bentonite Content	ASTM D5993[3]	psf	0.75 (@ 0% moisture)	100,000 ft^2 or 1 per lot[4]
Grab Tensile Strength	ASTM D4632	lbs	90	100,000 ft^2 or 1 per lot[4]
Interface Friction Test	ASTM D5321	degrees	$\geq$26.4[5]	2 per cell
Interface Friction Test	ASTM D5321	degrees	$\geq$26.4[6]	2 per cell
Shear Strength	ASTM D5321	psf	500 psf (hydrated)	2 per cell

[1] Minimum Average Roll Values (MARV)
[2] Conduct test at 30 psi effective stress.
[3] Alternatively, the new ASTM Draft Standard on Standard Test Method for measuring the mass per unit area of Geosynthetic Clay Liner.
[4] Whichever provides the larger number of tests.
[5] GCL against the soil liner.
[6] GCL (non-woven geotextile) against the smooth FML.

Note: The interface friction (shear) resistance shall be $\geq 26.4^{\circ}$ or an equivalent shear strength (combination of friction angle (ø) and cohesion, (c))

Samples for material control tests will be obtained by the CQA ENGINEER prior to shipment to the site or upon delivery of the GCL.

Samples will be taken across the entire width of the roll and will not include the first three (3) linear feet. Unless otherwise specified, samples will be 3 feet long by the roll width. The CQA ENGINEER will mark the machine direction on the samples with an arrow.

All material control tests will be performed by the Geosynthetics CQA Laboratory.

All test results must be available at the site prior to the deployment of any GCL roll. The CQA ENGINEER will examine all results from laboratory testing.

a. Material Control Test Failure

The following procedure will apply whenever a sample fails a material control test:

1. The Geosynthetic Installer will replace the roll of GCL that is in non-conformance with the project specifications with a roll that meets project specifications.

2. The Geosynthetic Installer will remove samples for testing by the Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the failed roll. These two samples must both conform to project specifications. If either of these samples fail, then the next numerical roll will be tested until a passing roll is found. This additional testing will be at the expense of the Geosynthetic Manufacturer. If either of the two closest rolls fail, the CQA ENGINEER will dictate the frequency of additional testing.

The CQA ENGINEER will document actions taken in conjunction with material control test failures.

D. GCL Installation

1. Handling and Placement

The Geosynthetic Installer will handle and place all GCL in such a manner as required by the project specifications.

2. Seams and Overlaps

All GCL will be seamed or overlapped in accordance with project specifications or as approved by the CQA ENGINEER and Engineer.

3. Repairs

Any holes or tears in the GCL will be repaired in accordance with the project specifications. The CQA ENGINEER will observe any repair.

4. Premature Hydration

If the GCL becomes hydrated prior to placement of the geomembrane liner, the hydrated GCL shall be removed or replaced with unused GCL as directed by the CQA ENGINEER. Hydration is defined by a moisture content of 40 percent or greater when measured in accordance with these specifications.

5. Placement of Overlying Material

All materials located on top of the GCL shall be placed in accordance with the project specifications.

E. DEFICIENCIES

The CQA ENGINEER will immediately determine the extent and nature of all defects and deficiencies and report them to the Owner and DESIGN ENGINEER. All defects and deficiencies shall be properly documented by the CQA ENGINEER. The CONTRACTOR will correct defects and deficiencies to the satisfaction of the CQA ENGINEER. The CQA ENGINEER shall observe all retests on repaired defects.

VI. HDPE GEOMEMBRANE LINER

A. GENERAL

Stringent quality assurance and careful documentation are required in the production and installation of all geosynthetic materials. The work addressed under this section shall facilitate proper construction of all geosynthetic components of the liner for the landfill. All work shall be constructed to the lines, grades, and dimensions indicated on the project plans, in accordance with the Construction Specifications, or as required by the OWNER or DESIGN ENGINEER.

The CQA ENGINEER shall issue a written daily report of activities to the DESIGN ENGINEER. These reports shall include, at a minimum, observations and test results as well as problems encountered and solutions achieved. Construction reports summarizing significant events, as well as addressing all problems encountered and their solutions, shall be issued to the DESIGN ENGINEER. The format of these reports and frequency shall be established at the pre-construction meeting.

The CQA ENGINEER shall certify the materials and installation are in accordance with the plans, specifications, and this CQA Plan.

B. MATERIAL

1. The geomembrane will be 60 mil High Density Polyethylene (HDPE) supplied and installed by firms approved by the OWNER.

2. Seams for providing watertight joints will be extrusion or double hot wedge fusion seams using techniques approved by the CQA ENGINEER.

3. Construction Quality Assurance shall confirm the material meets the minimum physical properties and test frequencies of the Geosynthetic Research Institute GRI Test Method GM-13, as latest revised, for 60 mil High Density Polyethylene (HDPE) Geomembrane. The minimum thickness requirement shall be for the lowest individual measurement, not the average.

4. The CQA ENGINEER or his representative will sample two (2) rolls from each shipment of geomembrane at the manufacturing plant prior to shipment to the site.

5. The random samples must be representative of the material supplied and exclude the outer wrap of geomembrane if signs of scuffing or other damage is observed. Samples should be full roll width and at least 2 feet long.

6. The laboratory testing of the samples selected by the CQA representative shall be directed by the CQA ENGINEER and shall confirm conformance with the following properties:

a.	Thickness	(ASTM D5199 for smooth sheet (ASTM D5994 for textured sheet)
b.	Density	(ASTM D1505)
c.	Melt Index	(ASTM D1238)
d.	Carbon Black Content	(ASTM D1603)
e.	Tensile Properties	(ASTM D6693 or GRI GM-13)
f.	Tear Resistance	(ASTM D1004, DIE C)
g.	Asperity Height	(GRI GM-12)

7. The CQA ENGINEER or his representative will measure geomembrane thickness of each roll made for the project at the manufacturing plant prior to shipment. Material that does not fall within acceptable thickness criteria will be rejected.

C. GEOMEMBRANE MANUFACTURER AND INSTALLER

1. The Geomembrane Installer will submit the following as obtained from the Geomembrane Manufacturer to the CQA ENGINEER:

   a. Production Certification including project references

   b. Testing Program of Compound Ingredients

   c. Material Certification

   d. Test Data for Material and Resin

   e. All of the above submittals will be reviewed and retained by the CQA ENGINEER

2. The Geomembrane Installer will submit the following to the CQA ENGINEER prior to the installation:

   a. Qualifications of Geomembrane Installer Superintendent and Foreman

   b. Resumes of Geomembrane CONTRACTOR field crew

   c. Six (6) sets of geomembrane panel layout drawings

D. DELIVERY AND STORAGE

1. Upon delivery at the site, the CQA ENGINEER shall inventory all rolls and conduct a surface observation of each roll or factory panel for defects or damage. The inspection will be performed without unrolling rolls or unfolding factory panels unless defects or damages are found or suspected. The CQA ENGINEER will indicate those rolls with severe flaws that should be removed from the site and those rolls with minor flaws.

2. The CONTRACTOR will be responsible for the storage of the geomembrane on-site upon arriving at the site. The OWNER will provide storage space in a location (or several locations) such that on-site transportation and handling are minimized. Storage space should be protected from theft, vandalism, passage of vehicles, etc.

3. The CQA ENGINEER will verify that storage space selected is in a well-drained area and that cribbing techniques have been used as needed to ensure that the materials will not be sitting in ponded water in the event of rainfall.

E. GEOMEMBRANE INSTALLATION

1. An initial CQA meeting will be held prior to installation (pre-deployment meeting). The Geomembrane Installer, CQA ENGINEER or his representative, and a representative of the OWNER will be in attendance. The following issues will be discussed and agreed upon by all parties and shall be included in a report in the CQA documentation.

   a. Testing of welds

   b. Characteristics of "good" weld, and

   c. Repair procedures

2. The CQA ENGINEER or his representative will mark all areas where grinding is considered to be excessive. The location and repair method for the excessive grinding will be recorded in the daily field reports. The method or repair will be determined by the CQA ENGINEER.

3. Overheating of the geomembrane will be monitored by the CQA ENGINEER or his representative. At the discretion of the CQA ENGINEER, coupons will be cut from the end of the extrusion seams and the bottom side of the seam will be observed for visible warping or deformation. The location and repair method of overheated areas will be recorded in the daily field reports. The method of repair will be determined in the field by the CQA ENGINEER.

4. During seaming, the CQA ENGINEER or his representative will observe the seams for the following:

   a. proper preparation
   b. grinding technique, where applicable, and
   c. overheating

5. The CQA ENGINEER or his representative will observe the geomembrane during the coolest part of the day to check for slack. Any areas where excessive "trampolining" occurs will be marked by the CQA ENGINEER for repair by the Geomembrane Installer.

6. The CQA ENGINEER or his representative will mark all areas where the geomembrane indicates a protrusion from the compacted clay liner. The method of repair will be determined in the field by the CQA ENGINEER.

F. TEST SEAMS

1. Test seams shall be made each day prior to commencing field seaming. The seams shall be made on fragment pieces of geomembrane under the same surface and environmental conditions as the production seams to verify that seaming conditions are adequate. The test seams shall be made at the beginning of each seaming period; at changes of equipment, equipment settings, operator, weather, or sheet temperature; at the CQA ENGINEER's discretion, and at least once every four to six hours during continuous operation of each welding machine; or at change in material type (i.e., smooth-to-smooth seam versus smooth-to-textured seam).

2. The test seam sample shall be at least five feet long by one foot wide with the seam centered lengthwise. For dual track fusion welds nine, one-inch wide by six-inch long test strips shall be cut from the test seam. Quantitatively test three specimens for inside peel adhesion (peel), three for outside peel, and then three specimens for bonded seam strength (shear). For extrusion welds six, one-inch wide by six-inch long test strips shall be cut from the trial seam. Quantitatively test three specimens for peel and three specimens for bonded seam strength (shear).

3. A test seam sample shall pass when the results of the tests in both peel and shear achieve the strengths provided in the seam strength table in Section G and when the break can be described as a film tear bond. A film tear bond is defined as a failure in the ductile mode of one of the bonded sheets by tearing prior to complete separation to the bonded area.

   - Peel strength (fusion) – ASTM D6392
   - Peel strength (extrusion) – ASTM D6392
   - Shear strength (fusion & extrusion) – ASTM D6392

4. Test seams shall be repeated, in its entirety, when any of the test seam samples fail in either peel or shear. If additional test seams fail, the seaming apparatus or seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive successful full test seams are achieved. No welding equipment or welder shall be allowed to begin production welds until equipment and welders have a successfully completed test seam. Seaming shall not proceed when ambient air temperature or adverse weather conditions jeopardize the integrity of the liner installation. Installer shall demonstrate that acceptable seaming can be achieved by completing passing trial seams.

5. The remainder of the successful test seam shall be assigned a number and marked accordingly by the CQA ENGINEER, who shall also log the date, hour, ambient temperature, number of seaming apparatus, name of seamer, and pass or fail description. The sample itself should be archived until project completion.

G. FIELD DESTRUCTIVE TESTING

1. The Geomembrane Installer will obtain 12" x 60" samples of field seams, suitable for testing, at an average frequency of one sample per 500 linear feet of weld. The date, time and equipment, seam number, and seaming parameters will be marked on each sample and recorded by the CQA ENGINEER.

2. Samples retained will be tested in the field by the Geomembrane Installer. A minimum of five specimens from each sample will be tested in peel and shear (ASTM D6392) for the properties in the Seam Strength Table in this section.

SEAM STRENGTH AND RELATED PROPERTIES OF THERMALLY BONDED SMOOTH AND TEXTURED HIGH DENSITY POLYETHYLENE (HDPE) GEOMEMBRANE 60 MIL SHEET

Property	Units	Value
Hot Wedge Seams (1)		
shear strength (2)	lb/in	120
shear elongation at break (3)	%	50
peel strength (2)	lb/in	91
peel separation	%	25
Extrusion Fillet Seams		
shear strength (2)	lb/in	120
shear elongation at break (3)	%	50
peel strength (2)	lb/in	78
peel separation	%	25

(1) Value listed for shear and peel strengths are for 4 out of 5 test specimens; the 5th specimen can be as low as 80% of the listed values. Average of all 5 must meet minimum specified value
(2) Elongation measurements should be omitted for field testing
(3) A maximum of one non-film tear bond failure out of a set of 5 tests is acceptable provided the non-film tear specimen meets strength requirements

If unresolved discrepancies exist between the CQA ENGINEER's and CONTRACTOR's test results, the archived sample may be tested by the CQA ENGINEER. Samples which do not pass the shear and peel tests will be resampled from locations at least 10 feet on each side of the original location. These two re-test samples must pass both shear and peel testing. If

these two samples do not pass, then additional samples will continue to be obtained until the questionable seam area is defined.

3. The CQA ENGINEER or the OWNER may require additional random samples to be taken for testing in areas which visually appear defective and not in accordance with the project requirements.

   At the end of each double wedge welded field seam of 100' or more in length, a 1" wide coupon is to be cut from near the end of the seam. This coupon is to be tested in peel using a field tensiometer. The CQA ENGINEER will observe this test and FTB type failures will be the criteria for preliminary acceptance of the production seam. (Final seam acceptance is contingent on air and destructive testing).

H. NON-DESTRUCTIVE TESTING

1. The CQA ENGINEER shall confirm that the geomembrane installer has conducted non-destructible testing of the entire length of all field seams in accordance with Section 02750 of the Technical Specifications. The testing method shall be approved by the CQA ENGINEER in advance.

2. Non-destructive testing will be observed by the CQA ENGINEER or his representative on a full-time basis.

I. DESTRUCTIVE LABORATORY TESTING

1. Destructive seam samples will be laboratory tested by the CQA ENGINEER. Testing frequency shall average one sample per 500 linear feet of field seam.

   a. Test samples will be at least 12" x 36". A minimum of five peel specimens will be tested for each sample in accordance with ASTM D6392 for the properties in the Seam Strength table in this section. At least five specimens from each sample will be tested for bonded shear strength (shear) in accordance with ASTM D6392. These test samples shall be taken at the same locations as the CONTRACTOR's destructive testing samples.

   b. All laboratory specimens will be conditioned for a minimum of one hour prior to testing at the Standard Atmosphere for Testing Geosynthetics, that is, air maintained at a relative humidity of 65 $\pm$5% and a temperature of 21 $\pm$2°C (70 $\pm$4°F).

2. The load and elongation at failure will be measured for each specimen. FTB is the qualifying criterion.

a. The CQA ENGINEER will describe the type of failure for each specimen and record the presence of any disbonding, delamination, foreign material in the bond area, etc.

b. The criteria for determining passing welded seam shall be as stated in the "Seam Strength" table in this section.

c. If unresolved discrepancies exist between the CQA ENGINEER's and CONTRACTOR's test results, the archived sample may be tested by the CQA ENGINEER. Samples which do not pass the shear and peel tests will be resampled from locations at least 10 feet on each side of the original location. These two re-test samples must pass both shear and peel testing. If these two samples do not pass, then additional samples will continue to be obtained until the questionable seam area is defined.

SEAM STRENGTH AND RELATED PROPERTIES OF THERMALLY BONDED SMOOTH AND TEXTURED HIGH DENSITY POLYETHYLENE (HDPE) GEOMEMBRANE 60 MIL SHEET

Property	Units	Value
Hot Wedge Seams (1)		
shear strength (2)	lb/in	120
shear elongation at break (3)	%	50
peel strength (2)	lb/in	91
peel separation	%	25
Extrusion Fillet Seams		
shear strength (2)	lb/in	120
shear elongation at break (3)	%	50
peel strength (2)	lb/in	78
peel separation	%	25

(1) Value listed for shear and peel strengths are for 4 out of 5 test specimens; the 5th specimen can be as low as 80% of the listed values. Average of all 5 must meet minimum specified value
(2) Elongation measurements should be omitted for field testing
(3) A maximum of one non-film tear bond failure out of a set of 5 tests is acceptable provided the non-film tear specimen meets strength requirements

J. REPAIRS

Any portion of unsatisfactory geomembrane or seam area failing a destructive or non-destructive test shall be repaired. Damaged geomembrane shall be removed and replaced with acceptable geomembrane materials if damage cannot be satisfactorily repaired. Installer shall be responsible for repair of damaged or defective areas. Agreement upon the appropriate repair method shall be decided between the CQA ENGINEER and the Installer. Procedures available include the following:

- Patching - Used to repair large holes, tears, undispersed raw materials and contamination by foreign matter;

- Spot Welding - Used to repair localized flaws (minor) or where geomembrane thickness has been reduced;
- Capping - Used to repair large lengths of failed seams; and
- Replacement - Used to remove the unacceptable seam and replace with new material.

In addition, surfaces of the geomembrane which are to be repaired by extrusion welds shall be lightly abraded with disc grinder or equivalent to assure cleanliness. All geomembrane surfaces shall be clean and dry at the time of repair. Patches or caps shall be extended at least six inches for extrusion weld and four inches for wedge weld beyond the edge of the defect. All corners of patch material shall be rounded.

The CQA ENGINEER shall number and log each patch repair, and the Installer shall non-destructively test each repair using methods specified in this CQA Plan.

K. FINAL INSPECTION

A final inspection shall be completed by the Installer, DESIGN ENGINEER, CQA ENGINEER and OWNER prior to the Installer demobilizing from the site. All identified problem areas shall be repaired by the Installer and accepted by the CQA ENGINEER prior to the Installer demobilizing from the site.

VII. LEACHATE COLLECTION SYSTEM

A. GENERAL

The CQA ENGINEER shall certify the materials and installation are in accordance with the plans, specifications, and this CQA Plan.

B. MATERIALS

1. Leachate collection piping shall be in accordance with Section 02745 - Leachate Piping of the Technical Specifications.

2. Gravel for leachate pipe encasement and for the leachate sump shall be clean washed gravel composed of a hard non-carbonate mineral such as quartz. Gravel size shall be No. 57 in accordance with ASTM D448-86.

3. The Cushion Geotextile shall be a non-woven geotextile of polypropylene fibers or polyester yarns which are intended to be and shall be suitable for separation and cushioning. Geotextile shall be 12 ounce per square yard cushioning fabric.

4. The transition media when sand protective cover is used shall be gravel of a clean washed, hard, non-carbonaceous mineral such as quartz. The gravel

size shall be ASTM No. 89 and in accordance with ASTM D448-86, NC DOT size No. 89, or NC DOT size No. 78M.

5. The CQA ENGINEER or his representative shall verify that all materials provided are those specified or are equal and are in accordance with the approved plans, specifications and this CQA Plan.

C. INSTALLATION

1. The CQA ENGINEER will allow installation of the leachate collection system to proceed after he has received all of the destructive test results of the FML and has reviewed and approved the FML as built survey.

2. The CQA ENGINEER shall verify there is no damage to the geomembrane during the installation of the leachate collection system. Should damage occur the CQA ENGINEER shall direct the CONTRACTOR to make the required repairs.

3. The CQA ENGINEER or his representative shall be present during all phases of the leachate collection system construction and shall verify that all work is in accordance with the approved plans, specifications and this CQA Plan.

D. QUALITY ASSURANCE

The CQA ENGINEER or his representative shall verify that the following are provided and installed in accordance with the approved plans, specifications and this CQA Plan. This shall include:

1. High Density Polyethylene Pipe

   a. Receipt of CONTRACTOR's submittals on materials

   b. Review of submittals for pipe
      1. compliance with applicable ASTM standard
      2. unit weight
      3. diameter and SDR
      4. physical dimensions
      5. method of jointing with instructions
      6. nominal pipe joint lengths
      7. re-ended bedding and installation details
      8. instructions and tables or information on strength of each pipe type versus bury
      9. conditions of depth and traffic loadings
      10. certification by manufacturer that material properties meet the values listed in the material properties sheet.

c. Secure certification that pipe supplied is represented by the quality assurance data.

d. Reject pipe which does not meet appropriate ASTM Standards.

e. Results of any samples taken by the CQA ENGINEER for testing.

f. Witness and verify that jointing and installation is in accordance with manufacturer's re-endations and the specifications.

g. Leachate conduits external to the collection system are tested and demonstrated to be leakproof.

2. Gravels

a. Receipt of CONTRACTOR's submittals on gravel.

b. Review of submittals for conformity to specifications including quarry's certification of gradation.

c. Reject material which does not meet specifications.

d. Results of any samples taken by the CQA ENGINEER for testing.

e. Verify that gravel encasement is in accordance with the approved plans, specifications and this CQA Plan.

3. Geotextile

a. Receipt of CONTRACTOR's submittals on geotextile and review for conformity to specifications.

b. Reject material which does not meet specifications.

c. Verify that geotextile is in accordance with the approved plans, specifications and this CQA Plan.

d. Results of any samples taken by the CQA ENGINEER for testing.

VIII. GEOTEXTILE

A. MATERIAL

1. The geotextile shall be a non-woven geotextile of polypropylene fibers or polyester yarns which is intended to be and shall be suitable for cushioning. The geotextile shall conform to the minimum weight requirement in the plans and Technical Specifications.

2. During shipment and storage, the geotextile shall be protected from ultraviolet light exposure, precipitation, contamination or other damaging conditions. Geotextile rolls shall be shipped and stored in relatively opaque and watertight wrappings. The CQA ENGINEER shall verify that rolls of geotextile have been shipped and are stored in accordance with the specifications.

3. All handling on-site is the responsibility of the CONTRACTOR or Installer. The CONTRACTOR or Installer is responsible for the submittal of shipping manifests and all other relevant documents to the CQA ENGINEER.

4. The CQA ENGINEER or his representative shall take random samples from each shipment of geotextile delivered to the site, sampling a minimum of 8 rolls of each shipment. The 3' x 3' samples shall be retained as part of the project records. Should visual inspection by the CQA ENGINEER reveal any apparent deficiencies in the material, the CQA ENGINEER shall at the Owner's expense, take a minimum of two samples and have them tested for the properties listed in Section 02757 of the Technical Specifications.

B. GEOTEXTILE MANUFACTURER AND INSTALLER

1. The CONTRACTOR shall submit the following as obtained from the Geotextile Manufacturer to the CQA ENGINEER to review:

   a. Production Certification
   b. Material Certification
   c. Test Data for Material

2. The CONTRACTOR shall submit the following to the CQA ENGINEER prior to installation:

   a. Qualifications of installer superintendent, foreman and field crew.
   b. Six sets of field installation drawings.

C. INSTALLATION

1. A 12 osy nonwoven geotextile shall be utilized under the leachate collection stone as a cushion as shown in the Plans.

2. A 10 osy nonwoven geotextile shall be utilized over the leachate collection stone as shown on the Plans.

3. The CQA ENGINEER will allow installation of the geotextile to proceed after he has provided certification of the geomembrane liner or a section thereof.

4. The CQA ENGINEER shall monitor the installation of the geotextile to verify there is no damage to the geomembrane liner. Should the liner be damaged the CQA ENGINEER shall direct the CONTRACTOR to make the necessary repairs.

5. The CQA ENGINEER or his representative shall be present during all placement operations and shall verify that all work is in accordance with the plans and specifications.

6. At the conclusion of this activity, the CQA ENGINEER shall provide a written certification that the work has been installed according to plans and specifications.

IX. PROTECTIVE COVER - ON BASE LINER (NATIVE SOILS)

A. GENERAL

The CQA ENGINEER shall certify the materials and installation are in accordance with the plans, specifications, and this CQA Plan.

B. MATERIAL

1. Soil for protective cover - native soils - on liner shall be classified according to the United Soil Classification System (USCS) (ASTM D2487-93). Liquid limit, plasticity index (PI), and percent passing the No. 200 sieve will be considered for proper classification. Construction Quality Assurance shall confirm the following minimum requirements:

Test	Minimum Frequency	Criteria
Permeability (ASTM D2434)	3,000 c.y.	$k \geq 1x10^{-3}$ cm/sec

2. Soil materials shall be reasonably free of gypsum, ferrous, and/or calcareous concretions and nodules, refuse, roots, or other deleterious substances.

3. Continuous and repeated visual inspection of the materials being used will be performed by the CQA ENGINEER to ensure proper soils are being used. In addition, the CQA ENGINEER shall make frequent inspections of the placement operations and materials, and will consult with the site personnel on suitable materials and locations of such. All material shall be taken from select sources or stockpiles.

4. The protective cover native soils shall be uniform, smooth, and reasonably free of debris, rock, plant materials, and other foreign material larger than ¾ inch in diameter. The material should contain no sharp edges.

C. STOCKPILING AND MATERIAL APPROVAL

1. All material to be used as protective cover shall be approved in advance by the CQA ENGINEER. The CQA ENGINEER must verify the protective cover meets all the material requirements.

2. Verification can be accomplished at source and during stockpiling or prior to use at existing stockpiles.

3. The CQA ENGINEER shall prepare reports of all testing, analysis, and verification.

D. CONSTRUCTION

1. The CQA ENGINEER shall provide verification of the following:

a. Approved material was used to construct the cover.

b. The protective cover was constructed in accordance with the approved plans, specifications, and this CQA Plan.

c. The required cover thickness was achieved.

d. The geomembrane and geocomposite drainage media were not damage during the construction of the protective cover.

X. COMPACTED SOIL CAP

A. GENERAL

The CQA ENGINEER shall certify the materials installation is in accordance with the plans, specifications, and this CQA Plan.

B. MATERIAL

1. The compacted soil cap material shall consist of soils meeting the permeability criterion of $k \leq 1.0 \times 10^{-5}$ cm/sec. Soils used in the compacted soil cap shall consist of clean, select material free of debris, excessive coarse particles or other deleterious matter. The cap material shall be classified under the Unified Soil Classification System as MH, ML, CL, CH or SC.

C. STOCKPILING AND MATERIAL APPROVAL

1. All material to be used as the compacted soil cap shall be approved in advance by the CQA ENGINEER. Approval is based upon successful completion of CQA testing outlined herein. Such testing can be performed either during excavation and stockpiling or from existing stockpiles prior to use.

2. The procedures for testing during excavation and stockpiling are outlined below.

   a. Each load of soil will be examined either at the borrow source or the stockpile area. Any unsuitable material will be routed to separate stockpiles consistent with its end use.

   b. During stockpiling operations, one bulk sample of material placed will be collected. The following tests will be performed prior to placement of any compacted soil cap material.

      1. Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures, ASTM D2216.

      2. Method for Particle - Size Analysis of Soils, ASTM D422.

      3. Test Method for Liquid Limit, and Plasticity Index of Soils, ASTM D4318.

   c. One (1) sample for every 10,000 cubic yards of material stockpiled will be selected for Moisture Density Relationship, ASTM D698, and permeability testing (ASTM D5084 - 90 measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Permeameter).

3. Reports for the compacted soil cap will be prepared by the CQA ENGINEER and shall include:

a. Summary of laboratory test data.

b. A summary of construction, sampling and testing method, and recommendations.

D. CONSTRUCTION

1. Compacted soil cap shall be placed to conform to the $k \leq 1.0 \times 10^{-5}$ cm/sec permeability criterion.

2. Only soil previously approved by the CQA ENGINEER shall be used in construction of the compacted soil cap. Unsuitable material will be removed prior to acceptance by the CQA ENGINEER.

3. All required field density and moisture content tests shall be completed before the overlying lift of soil is placed. The surface preparation (e.g., wetting, drying, scarification, etc.) shall be completed before the CQA ENGINEER will allow placement of subsequent lifts.

4. Moisture content will be monitored by the CQA ENGINEER or his representative prior to compaction. If the soil is drier than the specified minimum moisture content, water will be added and the lift will be disced to distribute the moisture evenly. The surface of each lift shall be scarified prior to placement of subsequent lifts.

5. The thickness of the loose lift shall be measured at random locations after spreading and leveling is complete. Loose lift thickness should not exceed 10 inches for a final 6 inch compacted lift thickness. Each lift shall be checked visually for excess rocks, debris, plant materials and other foreign material. Any significant amounts of such material which will not pass through a 3" screen shall be identified and removed prior to and during the compaction process, if such material will be within 6" of the top of the compacted clay surface.

6. The exposed surface of the compacted soil cap shall be rolled with a smooth drum roller or equivalent at the end of each work day or when required to protect the compacted soil from adverse weather conditions.

7. The finished compacted soil cap shall be reasonably free of all rocks, soil clods greater than 3" on the surface. Protrusions shall be removed and all significant cracks and voids shall be filled and the surface made uniform. Rock or other material protruding more than 1 inch shall not be allowed, and should be removed. This shall be accomplished by final dressing of the soil cap with smooth drum rollers and hand raking.

8. The surface on which the geomembrane is to be placed shall be maintained in a firm, clean, dry and smooth condition before and during the cap installation.

9. The CQA ENGINEER shall inspect the compacted soil cap and certify that it is in accordance with the specifications, prior to the CONTRACTOR beginning installation of the geomembrane. Placement of geomembrane on any portion of the soil cap surface by the geomembrane installer will constitute his acceptance of the site.

E. SAMPLING AND TESTING

1. The CQA ENGINEER or his representative will perform field density tests to assure that the soil density and moisture content are within the prescribed limits. The frequency of testing is noted below.

   a. Field density tests shall be performed at the rate of one per 20,000 square feet of lined area for the compacted soil cap.

   b. The field density tests will be performed using a nuclear density gauge, or drive tube. The location of each test will be randomly determined by the CQA ENGINEER or his representative. All holes shall be repaired with bentonite as described below.

      Perforations in the compacted soil cap resulting from sampling or testing procedures, survey stakes or other activities shall be identified and backfilled by the CQA ENGINEER. The perforations shall be filled with a soil-bentonite mix consisting of 10% minimum by weight bentonite powder or granules mixed with soil cap material. The perforations shall be backfilled with the soil-bentonite mixture in 3-inch loose lifts and thoroughly compacted by hand tamping by the CQA ENGINEER.

   c. Two bulk samples of the compacted soil cap for each lift will be collected during placement or compaction. The following tests will be performed:

      1. Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures ASTM D2216.

      2. Method for Particle - Size Analysis of Soils ASTM D422.

      3. Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils, ASTM D4318.

4. Moisture-density relationship (ASTM D698).

d. One sample of the compacted soil cap for every one acre of soil cap area will be selected by the CQA ENGINEER for permeability testing (ASTM D5084-90).

XI. GEOMEMBRANE FML CAP

A. GENERAL

Stringent quality assurance and careful documentation are required in the production and installation of all geosynthetic materials. The work addressed under this section shall facilitate proper construction of all geosynthetic components of the cap for the landfill. All work shall be constructed to the lines, grades, and dimensions indicated on the project plans, in accordance with the Construction Specifications, or as required by the OWNER or DESIGN ENGINEER.

The CQA ENGINEER shall issue a written daily report of activities to the DESIGN ENGINEER. These reports shall include, at a minimum, observations and test results as well as problems encountered and solutions achieved. Construction reports summarizing significant events, as well as addressing all problems encountered and their solutions, shall be issued to the DESIGN ENGINEER. The format of these reports and frequency shall be established at the pre-construction meeting.

The CQA ENGINEER shall certify the materials and installation are in accordance with the plans, specifications, and this CQA Plan.

B. MATERIAL

1. The geomembrane will be 40 mil Linear Low Density Polyethylene (LLDPE) supplied and installed by firms approved by the OWNER.

2. Seams for providing watertight joints will be extrusion or double hot wedge fusion seams using techniques approved by the CQA ENGINEER.

3. Construction Quality Assurance shall confirm the material meets the minimum physical properties and test frequencies of the Geosynthetic Research Institute GRI Test Method GM-17, as latest revised, for 40 mil Liner Low Density Polyethylene (LLDPE) Geomembrane. The minimum thickness requirement shall be the lowest individual measurement, not the average.

4. The CQA ENGINEER or his representative will sample two (2) rolls from each shipment of geomembrane at the manufacturing plant prior to shipment to the site.

5. The random samples must be representative of the material supplied and exclude the outer wrap of geomembrane if signs of scuffing or other damage are observed. Samples should be full roll width and at least 2 feet long.

6. The laboratory testing of the samples selected by the CQA representative shall be directed by the CQA ENGINEER and shall confirm conformance with the following properties:

a.	Thickness	(ASTM D5199 for smooth sheet (ASTM D5994 for textured sheet)
b.	Density	(ASTM D1505)
c.	Melt Index	(ASTM D1238)
d.	Carbon Black Content	(ASTM D1603)
e.	Tensile Properties	(ASTM D6693 or GRI GM-13)
f.	Tear Resistance	(ASTM D1004, DIE C)
g.	Asperity Height	(GRI GM-12)

7. The CQA ENGINEER or his representative will measure geomembrane thickness of each roll made for the project at the manufacturing plant prior to shipment. Material that does not fall within acceptable thickness criteria will be rejected.

C. GEOMEMBRANE MANUFACTURER AND INSTALLER

1. The Geomembrane Installer will submit the following as obtained from the Geomembrane Manufacturer to the CQA ENGINEER:

   a. Production Certification including project references

   b. Testing Program of Compound Ingredients

   c. Material Certification

   d. Test Data for Material and Resin

   e. All of the above submittals will be reviewed and retained by the CQA ENGINEER

2. The Geomembrane Installer will submit the following to the CQA ENGINEER prior to the installation:

a. Qualifications of Geomembrane Installer Superintendent and Foreman

b. Resumes of Geomembrane CONTRACTOR field crew

c. Six (6) sets of geomembrane panel layout drawings

D. DELIVERY AND STORAGE

1. Upon delivery at the site, the CQA ENGINEER shall inventory all rolls and conduct a surface observation of each roll or factory panel for defects or damage. The inspection will be performed without unrolling rolls or unfolding factory panels unless defects or damages are found or suspected. The CQA ENGINEER will indicate those rolls with severe flaws that should be removed from the site and those rolls with minor flaws.

2. The CONTRACTOR will be responsible for the storage of the geomembrane on-site upon arriving at the site. The OWNER will provide storage space in a location (or several locations) such that on-site transportation and handling are minimized. Storage space should be protected from theft, vandalism, passage of vehicles, etc.

3. The CQA ENGINEER will verify that storage space selected is in a well-drained area and that cribbing techniques have been used as needed to ensure that the materials will not be sitting in ponded water in the event of rainfall.

E. GEOMEMBRANE INSTALLATION

1. An initial CQA meeting (pre-deployment meeting) will be held prior to installation. The Geomembrane Installer, CQA ENGINEER or his representative, and a representative of the OWNER will be in attendance. The following issues will be discussed and agreed upon by all parties and shall be included in a report in the CQA documentation.

   a. Testing of welds

   b. Characteristics of "good" weld, and

   c. Repair procedures

2. The CQA ENGINEER or his representative will mark all areas where grinding is considered to be excessive. The location and repair method for the excessive grinding will be recorded in the daily field reports. The method or repair will be determined by the CQA ENGINEER.

3. Overheating of the geomembrane will be monitored by the CQA ENGINEER or his representative. At the discretion of the CQA ENGINEER, coupons will be cut from the end of the extrusion seams and the bottom side of the seam will be observed for visible warping or deformation. The location and repair method of overheated areas will be recorded in the daily field reports. The method of repair will be determined in the field by the CQA ENGINEER.

4. During seaming, the CQA ENGINEER or his representative will observe the seams for the following:

   a. proper preparation
   b. grinding technique, where applicable, and
   c. overheating

5. The CQA ENGINEER or his representative will observe the geomembrane during the coolest part of the day to check for slack. Any areas where excessive "trampolining" occurs will be marked by the CQA ENGINEER for repair by the Geomembrane Installer.

6. The CQA ENGINEER or his representative will mark all areas where the geomembrane indicates a protrusion from the compacted soil cap. The method of repair will be determined in the field by the CQA ENGINEER.

F. TEST SEAMS

1. Test seams shall be made each day prior to commencing field seaming. The seams shall be made on fragment pieces of geomembrane under the same surface and environmental conditions as the production seams to verify that seaming conditions are adequate. The test seams shall be made at the beginning of each seaming period; at changes of equipment, equipment settings, operator, weather, or sheet temperature; at the CQA ENGINEER's discretion, and at least once every four to six hours during continuous operation of each welding machine; or at change in material type (i.e., smooth-to-smooth seam versus smooth-to-textured seam).

2. The test seam sample shall be at least five feet long by one foot wide with the seam centered lengthwise. For dual track fusion welds nine, one-inch wide by six-inch long test strips shall be cut from the test seam. Quantitatively test three specimens for inside peel adhesion (peel), three for outside peel, and then three specimens for bonded seam strength (shear). For extrusion welds six, one-inch wide by six-inch long test strips shall be cut from the trial seam. Quantitatively test three specimens for peel and three specimens for bonded seam strength (shear).

3. A test seam sample shall pass when the results of the tests in both peel and shear achieve the strengths provided in the seam strength table in Section I and when the break can be described as a film tear bond. A film tear bond is defined as a failure in the ductile mode of one of the bonded sheets by tearing prior to complete separation to the bonded area.

   - Peel strength (fusion) – ASTM D6392
   - Peel strength (extrusion) – ASTM D6392
   - Shear strength (fusion & extrusion) – ASTM D6392

4. Test seams shall be repeated, in its entirety, when any of the test seam samples fail in either peel or shear. If additional test seams fail, the seaming apparatus or seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive successful full test seams are achieved. No welding equipment or welder shall be allowed to begin production welds until equipment and welders have a successfully completed test seam. Seaming shall not proceed when ambient air temperature or adverse weather conditions jeopardize the integrity of the cap installation. Installer shall demonstrate that acceptable seaming can be achieved by completing passing trial seams.

5. The remainder of the successful test seam shall be assigned a number and marked accordingly by the CQA ENGINEER, who shall also log the date, hour, ambient temperature, number of seaming apparatus, name of seamer, and pass or fail description. The sample itself should be archived until project completion.

G. FIELD DESTRUCTIVE TESTING

1. The Geomembrane Installer will obtain 12" x 60" samples of field seams, suitable for testing, at an average frequency of one sample per 500 linear feet of weld. The date, time and equipment, seam number, and seaming parameters will be marked on each sample and recorded by the CQA ENGINEER.

2. Samples retained will be tested in the field by the Geomembrane Installer. A minimum of five specimens from each sample will be tested in peel and shear (ASTM D6392).

   Five specimens from each sample shall be tested for Bonded Seam Strength (shear) using ASTM D6392. Failures in grind areas of extrusion seams may require resampling and retesting.

   At least five specimens from each sample shall be tested for Peel Adhesion using ASTM D6392.

The criteria for determining passing welded seam shall be as stated in the "Seam Strength" table in this section. If unresolved discrepancies exist between the CQA ENGINEER's and CONTRACTOR's test results, the archived sample may be tested by the CQA ENGINEER. Samples which do not pass the shear and peel tests will be resampled from locations at least 10 feet on each side of the original location. These two re-test samples must pass both sear and peel testing. If these two samples do not pass, then additional samples will continue to be obtained until the questionable seam area is defined.

3. The CQA ENGINEER or the OWNER may require additional random samples to be taken for testing in areas which visually appear defective and not in accordance with the project requirements.

   At the end of each double wedge welded field seam of 100' or more in length, a 1" wide coupon is to be cut from near the end of the seam. This coupon is to be tested in peel using a field tensiometer. The CQA ENGINEER will observe this test and FTB type failures will be the criteria for preliminary acceptance of the production seam. (Final seam acceptance is contingent on air and destructive testing).

H. NON-DESTRUCTIVE TESTING

1. The CQA ENGINEER shall confirm that the geomembrane installer has conducted non-destructible testing of the entire length of all field seams in accordance with Section 02750 of the Technical Specifications. The testing method shall be approved by the CQA ENGINEER in advance.

2. Non-destructive testing will be observed by the CQA ENGINEER or his representative on a full-time basis.

I. DESTRUCTIVE LABORATORY TESTING

1. Destructive seam samples will be laboratory tested by the CQA ENGINEER. Testing frequency shall average one sample per 500 linear feet of field seam.

   a. Test samples will be at least 12" x 36". A minimum of five peel specimens will be tested for each sample in accordance with ASTM D6392 for the properties listed in the Seam Strength table in this section. At least five specimens from each sample will be tested for bonded shear strength (shear) in accordance with ASTM D6392. These test samples shall be taken at the same locations as the CONTRACTOR's destructive testing samples.

b. All laboratory specimens will be conditioned for a minimum of one hour prior to testing at the Standard Atmosphere for Testing Geosynthetics, that is, air maintained at a relative humidity of 65 $\pm$5% and a temperature of 21 $\pm$2°C (70 $\pm$4°F).

2. The load and elongation at failure will be measured for each specimen. FTB is the qualifying criterion.

   a. The CQA ENGINEER will describe the type of failure for each specimen and record the presence of any disbonding, delamination, foreign material in the bond area, etc.

   b. The criteria for determining passing welded seams shall be as stated in the "Seam Strength" table in this section.

   c. If a peel specimen fails in the grinding or preparation area, this should be clearly noted on the test report. Both sides of the double-wedge fusion seam must pass the testing requirements to constitute a passing test.

   d. If unresolved discrepancies exist between the CQA ENGINEER's and CONTRACTOR's test results, the archived sample may be tested by the CQA ENGINEER. Samples which do not pass the shear and peel tests will be resampled from locations at least 10 feet on each side of the original location. These two re-test samples must pass both shear and peel testing. If these two samples do not pass, then additional samples will continue to be obtained until the questionable seam area is defined.

SEAM STRENGTH AND RELATED PROPERTIES OF THERMALLY BONDED SMOOTH AND TEXTURED LINER LOW DENSITY POLYETHYLENE (LLDPE) GEOMEMBRANE 40 MIL SHEET		
Property	Units	Value
Hot Wedge Seams (1)		
shear strength (2)	lb/in	60
shear elongation at break (3)	%	50
peel strength (2)	lb/in	50
peel separation	%	25
Extrusion Fillet Seams		
shear strength (2)	lb/in	60
shear elongation at break (3)	%	50
peel strength (2)	lb/in	44
peel separation	%	25

(1) Value listed for shear and peel strengths are for 4 out of 5 test specimens; the 5th specimen can be as low as 80% of the listed values. Average of all 5 must meet minimum specified value
(2) Elongation measurements should be omitted for field testing
(3) A maximum of one non-film tear bond failure out of a set of 5 tests is acceptable provided the non-film tear specimen meets strength requirements

J. REPAIRS

Any portion of unsatisfactory geomembrane or seam area failing a destructive or non-destructive test shall be repaired. Damaged geomembrane shall be removed and replaced with acceptable geomembrane materials if damage cannot be satisfactorily repaired. Installer shall be responsible for repair of damaged or defective areas. Agreement upon the appropriate repair method shall be decided between the CQA ENGINEER and the Installer. Procedures available include the following:

- Patching - Used to repair large holes, tears, undispersed raw materials and contamination by foreign matter;
- Spot Welding - Used to repair pinholes, other localized flaws (minor) or where geomembrane thickness has been reduced;
- Capping - Used to repair large lengths of failed seams; and
- Replacement - Used to remove the unacceptable seam and replace with new material.

In addition, surfaces of the geomembrane which are to be repaired by extrusion welds shall be lightly abraded with disc grinder or equivalent to assure cleanliness. All geomembrane surfaces shall be clean and dry at the time of repair. Patches or caps shall be extended at least six inches for extrusion weld and four inches for wedge weld beyond the edge of the defect. All corners of patch material shall be rounded.

The CQA ENGINEER shall number and log each patch repair, and the Installer shall non-destructively test each repair using methods specified in this CQA Plan.

K. FINAL INSPECTION

A final inspection shall be completed by the Installer, DESIGN ENGINEER, CQA ENGINEER and OWNER prior to the Installer demobilizing from the site. All identified problem areas shall be repaired by the Installer and accepted by the CQA ENGINEER prior to the Installer demobilizing from the site.

XII. GEOCOMPOSITE DRAINAGE MEDIA (GDM)

A. GENERAL

The CQA ENGINEER shall certify the materials and installation are in accordance with the plans, specifications, and this CQA Plan.

B. MATERIAL

1. The geocomposite shall be a composite consisting of a HDPE geonet sandwiched between two (2) layers of 6 oz/sy minimum geotextile fabric. Protective cover material must be tested to verify compatibility with 6 oz/sy geotextile fabric. The composite shall meet the physical properties detailed in the table of required geocomposite drainage media properties in this section and be approved by the CQA ENGINEER.

2. During shipment and storage, the geocomposite shall be protected from ultraviolet light exposure, precipitation, contamination or other damaging conditions. Geocomposite rolls shall be shipped and stored in relatively opaque and watertight wrappings. The CQA ENGINEER shall verify that rolls of geocomposite have been shipped and are stored in accordance with the specifications.

3. All handling on-site is the responsibility of the Installer. The CONTRACTOR or Manufacturer is responsible for submittal of shipping manifests and all other relevant documents to the CQA ENGINEER.

4. The CQA ENGINEER or his representative shall take random samples from each shipment of geocomposite delivered to the site, sampling a minimum of 8 rolls from each shipment. The 3' x 3' samples shall be retained as part of the project records. The ENGINEER shall at the OWNER's expense, take a minimum of two samples and have them tested for the properties listed below; should visual inspection by the CQA ENGINEER reveal any apparent deficiencies in the material additional testing may be performed.

REQUIRED GEOCOMPOSITE DRAINAGE MEDIA PROPERTIES AND MANUFACTURER'S QUALITY CONTROL TEST DATA FINAL CAP SYSTEM				
Property	Test Method	Units	Value	Test Frequency
Thickness (geonet only)	ASTM D5199	inches	0.25	Every roll
Resin Density (geonet only)	ASTM D 1505	g/cm^3	0.94	50,000 ft^2
Ply Adhesion	ASTM D 413 or GRI GC7	lb/inch	2.0 (TYP) 1.0 Min. Avg.	50,000 ft^2
Transmisssivity [1]	ASTM D4716	$m^3/m^2/s$	$1x10^{-3}$ m^2/s	100,000 ft^2
Mass Per Unit Area (unit weight) Geotextile Only	ASTM D5216	oz/yd^2	6[2]	100,000 ft^2
Interface Friction	ASTM D5321	degrees	≥ 26.4[3]	2 per cap project

Notes: [1] Conduct test for transmissivity at a normal compressive load of 500 psf and at a hydraulic gradient of 0.25 after a seating period of at least 24 hours. Boundary conditions are soil interface on the upper filter Geotextile and textured geomembrane against the lower filter Geotextile.
[2] Nominal value.
[3] The interface friction (shear) resistance shall be $\geq 26.4°$ or an equivalent shear strength (combination of friction angle (ø) and cohesion (c)). Tests shall be performed on the GDM/Geomembrane interface and the GDM/Protective Cover interface.

REQUIRED GEOCOMPOSITE DRAINAGE MEDIA PROPERTIES AND MANUFACTURER'S QUALITY CONTROL TEST DATA BASE LINER SYSTEM				
Property	Test Method	Units	Value	Test Frequency
Thickness (geonet only)	ASTM D5199	inches	0.25	Every roll
Resin Density (geonet only)	ASTM D 1505	g/cm^3	0.94	50,000 ft^2
Ply Adhesion	ASTM D 413 or GRI GC7	lb/inch	2.0 (TYP) 1.0 Min. Avg.	50,000 ft^2
Transmisssivity (1)	ASTM D4716	$m^3/m^2/s$	$5x10^{-4}$ m^2/s	100,000 ft^2
Mass Per Unit Area (unit weight) Geotextile Only	ASTM D5216	oz/yd^2	6(2)	100,000 ft^2
Interface Friction	ASTM D5321	degrees	≥ 26.4(3)	2 per cap project

Notes: (1) Conduct test for transmissivity at a normal compressive load of 15,000 psf and at a hydraulic gradient of 0.05 after a seating period of at least 24 hours. Boundary conditions are soil interface on the upper filter Geotextile and textured geomembrane against the lower filter Geotextile.
(2) Nominal value.
(3) The interface friction (shear) resistance shall be ≥ 26.4° or an equivalent shear strength (combination of friction angle (ø) and cohesion (c)). Tests shall be performed on the GDM/Geomembrane interface and the GDM/Protective Cover interface.

C. GEONET MANUFACTURER AND INSTALLER

1. The CONTRACTOR shall submit the following as obtained from the Geonet Manufacturer to the CQA ENGINEER to review:

   a. Production Certification
   b. Material Certification
   c. Test Data for Material

2. The CONTRACTOR shall submit the following to the CQA ENGINEER prior to installation:

   a. Qualifications of installer superintendent, foreman and field crew.
   b. Six sets of field installation drawings.

D. INSTALLATION

1. The CQA ENGINEER will allow installation of the geonet to proceed after he has provided certification of the geomembrane cap or a section thereof.

2. The CQA ENGINEER shall monitor the installation of the geonet to verify there is no damage to the geomembrane cap. Should the cap be damaged the CQA ENGINEER shall direct the CONTRACTOR to make the necessary repairs.

3. The CQA ENGINEER or his representative shall be present during all placement operations and shall verify that all work is in accordance with the plans and specifications.

4. At the conclusion of this activity, the CQA ENGINEER shall provide a written certification that the work has been installed according to plans and specifications.

XIII. PROTECTIVE SOIL COVER (ON LANDFILL CAP)

A. GENERAL

The CQA ENGINEER shall certify the materials and installation are in accordance with the plans, specifications and this CQA Plan.

B. MATERIAL

1. Soil that meets all of the following requirements shall be classified as select soil fill for use in construction of the protective soil cover.

   a. Soil shall be classified according to the Unified Soil Classification System (USCS) as ML, MH, CH, SC, or CL (ASTM D2487). Liquid limit, plasticity index (PI), and percent passing the No. 200 sieve will be considered for proper classification.

   b. Select soil fill materials shall be reasonably free of gypsum, ferrous, and/or calcareous concretions and nodules, refuse, roots, or other deleterious substances.

   c. The soil cover shall be uniform, smooth, and free of debris, rock, plant materials, and other foreign material larger than 3" in diameter. The material should contain no sharp edges.

2. The top 6" of soil cover must be capable of supporting growth of vegetative cover. The top 6" may consist of the soils listed in XII.B.1.a, expanded to include SM.

C. STOCKPILING AND MATERIAL APPROVAL

1. All material to be used as soil cover shall be approved in advance by the CQA ENGINEER. The CQA ENGINEER must verify the soil meets all the material requirements.

2. Verification can be accomplished during excavation and stockpiling or prior to use at existing stockpiles.

3. The CQA ENGINEER shall prepare reports of all testing, analysis and verification.

D. CONSTRUCTION

1. The CQA ENGINEER shall provide verification of the following:

a. Approved stockpiled material was used to construct the cover.

b. The soil cover was constructed in accordance with the approved plans, specifications, and this CQA Plan.

c. The geomembrane and GDM were not damaged during the construction of the soil cover.

d. After the soil cover thickness of 18" has been achieved, the layer thickness shall be measured by the test excavation or hard auger boring.

e. Landfill sideslope berms shall be compacted to a density of 95% or more of the Standard Proctor (ASTM D-698) maximum dry density. In-place testing shall be performed by the CQA ENGINEER to confirm the required compaction is achieved.

f. At least one (1) sample for every 5,000 in-place cubic yards will be taken and tested in accordance with ASTM D-422 (Grain Size) by the CQA ENGINEER.

g. Tested samples will meet or exceed the requirements outlined in the specifications.

h. If tests indicate that the in-place material does not meet the required specifications, the material will be removed, replaced, and retested.

i. The final lift of the soil cover layer grades will be measured to plus or minus two-tenths of a foot measured across any 10-foot section.

XIV. CERTIFICATION

A. The CQA ENGINEER will provide certification that the low permeability soil liner, geosynthetic clay liner, the HDPE geomembrane liner, the protective gravel cover, the leachate collection system, and other associated ancillary facilities for the particular landfill area are constructed according to the approved plans, specifications, and this CQA Plan. Said certification shall have the CQA ENGINEER's seal as a professional engineer registered in the State of North Carolina. The report shall be submitted as each cell or section is constructed.

B. A copy of all test reports and field notes outlined in this CQA Plan will be submitted to the North Carolina Department of Environmental and Natural Resources for their review and approval within 30 days of completion of a cell or section.

C. The project will not be deemed complete and acceptable until the North Carolina Department of Environmental Health and Natural Resources has accepted the construction certification and all supplement reports and data as complete. The CONTRACTOR and the CQA ENGINEER should completely familiarize themselves with the Rules and Regulations of the North Carolina Department of Environmental Health and Natural Resources concerning composite liner and closure cap systems.

IV. TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS

CHARLOTTE MOTOR SPEEDWAY LANDFILL V
PHASE 3 PERMIT TO CONSTRUCT
CITY OF CONCORD, NORTH CAROLINA

FOR

REPUBLIC SERVICES OF SOUTH CAROLINA, LLC

MAY 2009

NORTH CAROLINA PROFESSIONAL SEAL 16146 ENGINEER WILLIAM F. HODGES 4/30/09

NORTH CAROLINA PROFESSIONAL SEAL 32249 ENGINEER K. MATTHEW CHEEK 4/30/09

HODGES, HARBIN, NEWBERRY & TRIBBLE, INC.
CONSULTING ENGINEERS
484 MULBERRY STREET
SUITE 265
MACON, GEORGIA 31201

TEL: (478) 743-7175 NC Corp. License No. C-0813 **FAX: (478) 743-1703**

TECHNICAL SPECIFICATIONS

CHARLOTTE MOTOR SPEEDWAY LANDFILL V - PHASE 3

FOR

REPUBLIC SERVICES OF SOUTH CAROLINA, LLC
CITY OF CONCORD, NORTH CAROLINA

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SECTION 01000

PRE-CONSTRUCTION CONFERENCE

1.01 PRE-CONSTRUCTION CONFERENCE

Prior to beginning excavation activities, a pre-construction conference will be held with representatives of:

Contractor
Facility General Manager (Operator)
Design Engineer
CQA Engineer
Solid Waste Section

The purpose of the meeting will be to discuss issues relating to the proper prosecution of the work effort. The contractor shall have a schedule of work effort on either a CPM or Gannt format which defines all major work events, target dates, time of completion, and the interrelationship of work effort.

Special attention shall be given to who can make field changes, approve change orders, stop the work, or otherwise make changes in either the project design or the construction sequence. Attention shall also be given to the relationship with the State Regulatory Agency.

An agenda should be prepared for the meeting which specifically lists each item in the Rules for discussion.

The pre-construction conference will be the first of several project conferences or meetings. A schedule for meetings after the pre-construction conference will be established at the pre-construction conference.

Detailed Minutes of this meeting shall be kept and copies distributed to all parties in attendance.

-- END OF SECTION --

SECTION 01050

CONFIRMATION SURVEYS

PART 1 - GENERAL

1.01 GENERAL

This section covers the confirmation surveys required for the project. Landfill confirmation surveys are required for the cell subgrade, the liner and cap system components, all leachate system and underground pipelines and electrical, structures, roads and other improvements. This will require four (4) separate topographic surveys of the cell area and an overall construction site survey. Elevation data is to be provided to 0.01 feet.

1.02 QUALITY ASSURANCE

The confirmation surveys shall be sealed by a registered land surveyor licensed in this State.

1.03 SHOP DRAWINGS

A. Grade Stakes Numbering System: If grade stakes are used, provide grid numbering methodology for review. Provide method to number and log individual stakes to assure no stakes remain in compacted soil or clay liner.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.01 GRID OVERLAY

The Surveyor shall establish a grid pattern for control over the entire landfill cell area. The grid dimensions for the landfill cell shall be 50 foot by 50 foot. The grid pattern shall remain in the same location for each land survey described below. The Surveyor shall develop and utilize a numbering system for grid points. The Surveyor shall coordinate the establishment of the grid pattern with the grading Contractor and this grid pattern will be used in the construction staking.

3.02 CELL SUBGRADE SURVEY

The Surveyor shall provide a two (2) foot contour map with grid elevations shown for the landfill cell(s) subgrade. The survey shall represent as-built elevations immediately prior

to placement of the compacted soil or clay liner. The survey shall confirm the correct slopes and grades with those given on the drawings.

3.03 COMPACTED SOIL OR CLAY LINER SURVEY

The Surveyor shall provide a two (2) foot contour map with grid elevations shown for the landfill compacted soil or clay liner and subgrade. The grid elevations shall be presented to facilitate confirmation of the required thickness (see Figure 1). The survey shall represent as-built elevations immediately prior to placement of the geomembrane liner. The survey shall confirm the correct layer thickness, slopes, and grades with those given on the drawings. The survey shall include limits of the compacted soil or clay liner.

3.04 GEOSYNTHETICS SURVEY OF LINER

The Surveyor shall provide a map locating the anchor trench and edge-of-liner. The survey shall represent as-built final elevations. The surface area(s) of the geosynthetics shall be shown on the survey.

3.05 PROTECTIVE COVER ON LINER

The Surveyor shall provide a two (2) foot contour map with grid elevations shown for the landfill protective cover layer, compacted soil or clay liner, and subgrade. The grid elevations shall be presented to facilitate confirmation of the required thickness (see Figure 1). The survey shall represent as-built final elevations. The survey shall confirm the correct layer thickness, slopes, and grades with those given on the drawings.

3.06 GEOSYNTHETICS SURVEY OF CAP

The Surveyor shall provide a map locating the anchor trench and edge-of-liner. The surface area(s) of the geosynthetics shall be shown on the survey.

3.07 PROTECTIVE COVER ON CAP

The Surveyor shall provide a two (2) foot contour map with grid elevations shown for the landfill protective cover layer. The survey shall represent as-built final elevations, drainage berms and storm water control piping and features.

3.08 OVERALL CONSTRUCTION SITE SURVEY

The Surveyor shall provide a two (2) foot contour map of the entire construction site outside of the cells. This survey can be shown on one of the cell confirmation surveys or as a separate survey. This survey shall locate all improvements in this project including structures, underground pipelines and electrical lines, and roads.

3.09 GRADE STAKES

If grade stakes are used, the Surveyor shall remove all grade stakes prior to placement of subsequent layer. The Surveyor shall develop and utilize a grade stake numbering system to log and number individual stakes.

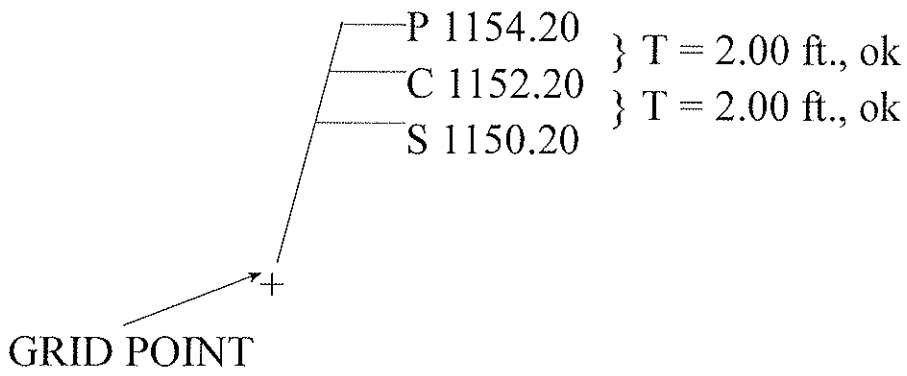
3.10 SURVEYS

The Surveyor shall provide seven (7) sealed and signed prints of each survey and an electronic data file compatible with AutoCad 2007 Software. The surveys shall include the date of surveys, vertical control utilized, and horizontal control utilized. The surveys shall be at a scale not less than 1" - 50'.

3.11 SCHEDULE

The Surveyor shall provide the confirmation surveys within five (5) days of completion of the particular portion of the work to which they pertain.

DATA PRESENTATION EXAMPLE



* The specific minimum thickness is measured perpendicular to surface. A greater difference in elevation will be required on slopes in order to obtain the specified minimum thickness.

KEY

P	**PROTECTIVE SOIL LAYER ELEVATION**
C	**COMPACTED SOIL LINER ELEVATION**
S	**COMPACTED SUBGRADE**
T	**THICKNESS**

FIGURE 1

--END OF SECTION--

SECTION 01051

CONSTRUCTION SURVEYS

PART 1 - GENERAL

1.01 GENERAL

This section covers construction staking and quantity surveys provided by the Contractor. Construction staking is required for horizontal and vertical location of all site improvements including grading, compacted soil liner, and protective cover. Quantity surveys are required for the purpose of determining quantities of excavation.

1.02 QUALITY ASSURANCE

Quantity surveys shall be performed under the direction of a registered land surveyor licensed in this State. Reports of quantity surveys shall be signed and sealed by a registered land surveyor licensed in this State.

1.03 SHOP DRAWING

A. Grade Stakes Numbering System

If grade stakes are used, a grid numbering methodology (in cells) shall be provided for review. This shall be coordinated with the confirmation surveying. Provide method to number and log individual stakes to assure no stakes remain within the cell(s).

B. GPS

If the cell will be constructed using GPS Equipment, no grid numbering methodology is required to be provided for review.

1.04 PAYMENT

Not Applicable.

PART 2 - PRODUCTS

2.01 GENERAL

The CONTRACTOR shall furnish all such stakes, spikes, steel pins, templates, platforms, equipment, instruments, tools, and other materials as may be required for staking and quantity surveys.

PART 3 - EXECUTION

3.01 CONSTRUCTION STAKING

A. General

1. The OWNER will provide benchmarks for vertical and dimensional data for horizontal location.

2. From a baseline and benchmarks, the CONTRACTOR shall complete the layout of the work and shall be responsible for all measurements that may be required for the execution of the work prescribed in the specifications or on the Drawings, subject to such modifications as may be required to meet changed conditions or as a result of necessary modifications to the work.

3. It shall be the responsibility of the CONTRACTOR to maintain and preserve all benchmarks shown on the plans and any other benchmarks provided by the OWNER.

4. All survey data shall be recorded in accordance with standard and approved methods. All field notes, sketches, records, and computations made by the CONTRACTOR in laying out the work shall be available at all times during the progress of the work for the ready examination by the DESIGN ENGINEER or CQA ENGINEER or his duly authorized representative.

5. The DESIGN ENGINEER or CQA ENGINEER may make checks as the work progresses to verify lines and grades established by the CONTRACTOR and to determine the conformance of the completed work as it progresses with the requirements of the Contract Documents and Drawings. Such checking by the DESIGN ENGINEER or CQA ENGINNER or his representative shall not relieve the CONTRACTOR of his responsibility to perform all work in accordance with the Contract Documents and Drawings and the lines and grades given therein. In the event that location marks as established by the CONTRACTOR are found to be inaccurate or inadequate, work shall be suspended until corrections have been made.

B. LANDFILL CELL(S)

The CONFIRMATION SURVEYOR shall establish a grid pattern for control over the entire landfill cell area. The grid dimensions shall be 50 foot by 50 foot. The grid pattern shall remain in the same location for subgrade, compacted soil or clay liner, and protective cover construction. The CONFIRMATION SURVEYOR shall develop and utilize a numbering system for grid points. The CONFIRMATION SURVEYOR shall coordinate the establishment of the grid pattern with the CONTRACTOR so that the same grid pattern may be used for the confirmation

surveys. The grid pattern shall be submitted to the DESIGN ENGINEER for approval prior to any grading activities in the cell area.

3.02 QUANTITY SURVEYS

The CONTRACTOR's surveyor shall develop topographic surveys for the purpose of determining quantities of excavation. Quantities of excavation and fill shall be calculated by the average end area method or utilizing digital terrain modeling software. The CONTRACTOR's surveyor shall develop topographic surveys after completion of clearing, grubbing and stripping topsoil and again after completion of grading. Additional cross surveys may be required depending on sequencing of construction. The OWNER may survey portions of the work for confirmation of quantities.

3.03 GRADE STAKES

If grade stakes are used, the CONTRACTOR shall remove all grade stakes prior to placement of subsequent layers during cell construction. The CONTRACTOR shall develop and utilize a grade stake numbering system to log and number individual stakes.

--END OF SECTION--

SECTION 01400

QUALITY CONTROL

1.01 DESCRIPTION

A. The OWNER shall employ and pay for the services of a third party CQA firm and a geotechnical engineering firm to confirm the installation of the geomembrane and clay liners, and perform soils, concrete and other required testing. The CONTRACTOR shall coordinate his work with the third party firms. The third party CQA firm shall use the CQA Plan for this project which is included as a part of these specifications by reference.

1. Employment of the third party CQA firm and geotechnical firm shall in no way relieve CONTRACTOR's obligations to perform the work of the Contract.

2. While the OWNER will provide all materials testing, any retesting required due to failure of material installation by CONTRACTOR shall be back-charged to the CONTRACTOR.

B. Related requirements specified in other sections:

1. Certification of Products: The respective sections of Specifications.

2. Test, adjust and balance of equipment: The respective section of Specifications.

3. Laboratory tests required, and standards for testing: The respective section of the Specifications.

C. Testing laboratory inspection, sampling and testing is required for but not limited to the following:

1. Section 02210 - Grading
2. Section 02220 - Trenching, Backfilling and Compaction
3. Section 02250 - Compacted Clay Liner
4. Section 02251 - Low Permeability Soil Liner
5. Section 02252 - Protective Soil Cover on Landfill Cap
6. Section 02254 - Protective Cover – On Base Liner Native Soils
7. Section 02260 - Compacted Soil Cap
8. Section 02745 - Leachate Piping
9. Section 02747 - Leachate Collection System
10. Section 02749 – Reinforced Geosynthetic Clay Liner (Alternate Base)

10. Section 02749 – Reinforced Geosynthetic Clay Liner (Alternate Base)
11. Section 02750 - HDPE Geomembrane Liner
12. Section 02754 - Geonet Drainage Media (GDM)
13. Section 02755 - Geomembrane (FML) Cap
14. Section 02757 – Geotextile
15. Section 03312 – Concrete Work

1.02 QUALIFICATION OF LABORATORY

A. Meet "Recommended Requirements for Independent Laboratory Qualifications", published by American Council of Independent Laboratories.

B. Meet basic requirements of ASTM E 329, "Standards of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction, as appropriate.

C. Authorized to operate in the State in which Project is located.

D. Must have established credentials and experience in CQA of geomembrane and compacted clay liners, as appropriate.

E. Testing Equipment

1. Calibrated at reasonable intervals by devices of accuracy traceable to either:

a. National Bureau of Standards
b. Accepted values of natural physical constants

1.03 LABORATORY DUTIES

A. Cooperate with DESIGN ENGINEER and CONTRACTOR: provide qualified personnel after due notice.

B. Perform specified inspections, sampling and testing of materials and methods of construction:

1. Comply with specified standards.

2. Ascertain compliance of materials with requirements of Contract Documents.

C. Promptly notify DESIGN ENGINEER and CONTRACTOR of observed irregularities or deficiencies of work or products.

D. Promptly submit written report of each test and inspection; two copies each to DESIGN ENGINEER, and one copy to CONTRACTOR and record documents file. Each report shall include:

1. Date issued.

2. Project title and number.

3. Testing laboratory name, address and telephone number.

4. Name and signature of laboratory inspector.

5. Date and time of sampling or inspection.

6. Record of temperature and weather conditions.

7. Date of test.

8. Identification of product and specification section.

9. Location of sample or test in the Project.

10. Type of inspection or test.

11. Results of tests and compliance with Contract Documents.

12. Interpretation of test results, when requested by DESIGN ENGINEER.

E. Perform additional tests as required by DESIGN ENGINEER or the OWNER if initial tests are not conclusive to merit acceptance.

1.04 LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

A. Laboratory is not authorized to:

1. Release, revoke, alter or enlarge on requirements of Contract Documents.

2. Approve or accept any portion of the work.

3. Perform any duties of the CONTRACTOR.

1.05 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with laboratory personnel, provide access to work, to manufacturer's operations.

B. Secure and deliver to the laboratory adequate quantities of representational samples of materials proposed to be used and which require testing.

C. Provide to the laboratory the preliminary design mix proposed to be used for concrete, and other material mixes which require control by the testing laboratory.

D. Furnish copies of product test reports as required.

E. Furnish incidental labor and facilities:

1. To provide access to work to be tested.

2. To obtain and handle samples at the Project site or at the source of the product to be tested.

3. To facilitate inspections and tests.

4. For storage and curing of test samples.

--END OF SECTION--

SECTION 01560

EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 WORK INCLUDED

A. Installation of soil erosion control devices.

B. Maintenance of soil erosion devices during construction.

C. Removal of temporary soil erosion control devices after stabilization of disturbed areas.

D. Temporary grassing for soil erosion control.

1.02 QUALITY CONTROL

A. After installing the soil erosion control devices as called for on the Construction Plans, the CONTRACTOR shall assure himself that all reasonable measures possible have been taken to prevent the siltation of nearby water courses.

B. The erosion and sediment control shall conform with the rules and regulations of the Erosion Control Ordinance of the North Carolina Department of Natural Resources and Community Development.

PART 2 PRODUCTS

2.01 SILT FENCE AND INLET PROTECTION

A. Posts

Silt fence posts shall be 1.33 lb/linear foot steel posts, a minimum of five (5') feet long and spaced a maximum of six (6') feet apart.

B. Woven Wire Fence

Wire fence reinforcement shall be a minimum of 14-gauge 4" x 4" hogwire.

C. Filter Fabric

Use a synthetic filter fabric or a pervious sheet of polypropylene, nylon, polyester, or polyethylene yarn, which is certified by the manufacturer or supplier as conforming to the requirements shown in the Table below.

Synthetic filter fabric should contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six (6) months of expected usable construction life at a temperature of 0 to 120°F.

Physical Property	Requirements
Filtering Efficiency	85% (min)
Tensile Strength at 20% (max) Elongation	Standard Strength-30 lb/lin in (min) Extra Strength-50 lb/lin in (min)
Slurry Flow Rate	0.3 gal/sq ft/min (min)

For inlet protection, a 19 gauge hardware cloth with ¼" mesh openings should be used with NCDOT #5 or #57 washed stone around the base as a filter media.

2.02 RIP-RAP FOR STORMWATER CONVEYANCE CHANNELS AND OUTLET PROTECTION

A. Stone

Stone for rip-rap shall be durable, dense, specifically selected and graded, quarried stone. The d_{50} size shall be 6, 9, or 12 inches as called for on the plans.

B. Gravel

Gravel for filter blanket shall be ASTM No. 57.

C. Filter Fabric

Filter fabric for filter blanket shall be a non-woven geotextile suitable for filtration and separation. The fabric weight shall be a minimum of 6.0 ounces per square yard.

2.03 TEMPORARY GRASSING

A. Temporary seed

Temporary seed shall be annual ryegrass and pearl millet at the planting rates specified herein.

B. Mulch

Mulch for temporary grassing shall consist of grain straw or other acceptable material, and shall have been approved by the DESIGN ENGINEER before being used. All mulch shall be reasonably free from mature seedbearing stalks, roots, or bulblets of Johnson Grass, Nutgrass, Sandbur, Wild Garlic, Wild Onion, Bermuda Grass, Crotalaria, and Witchweed, and free from an excessive amount of noxious weeds at the time of use of the mulch, and also there shall be compliance with all applicable State and Federal domestic plant quarantines. Straw mulch that is matted or lumpy shall be loosened and separated before being used.

Material for holding mulch in place shall be an approved binding material. No asphalt tacking material will be allowed.

2.04 TEMPORARY STORMWATER CONVEYANCE CHANNEL LINER

A. Excelsior Matting

Excelsior matting shall be an erosion control blanket consisting of an excelsior mat with a synthetic netting on one side similar and equal to Curlex as manufactured by American Excelsior Company.

PART 3 EXECUTION

3.01 GENERAL

Construct temporary and permanent erosion control measures as shown on the plans, as required by site conditions, regulatory agency or DESIGN ENGINEER. All permanent erosion control work shall be incorporated into the project at the earliest practicable time. Temporary erosion control measures shall be coordinated with permanent erosion control measures and all other work on the project to assure economical, effective, and continuous erosion control throughout the construction and post-construction period and to minimize siltation of rivers, streams, lakes, reservoirs, other water impoundments, ground surfaces, or other property. If active construction ceases for more than 21 days, all disturbed areas shall be seeded and mulched using the temporary seed type and planting rates specified herein.

The CONTRACTOR shall be liable for all damages to public or private property and fines as may be placed on the project by the local regulatory agencies due to soil erosion from the project site. Clear only those areas required to install the soil erosion control devices.

All erosion control devices shall be inspected by the CONTRACTOR after each rainfall, and at least weekly. Any required repairs shall be made immediately. Sediment deposits shall be removed when deposits reach approximately one-half of the capacity of the erosion control.

3.02 SILT FENCE

A. Silt fence shall be installed in accordance with the details in the plans.

B. Should the filter fabric deteriorate or become ineffective prior to the end of the construction as determined by the DESIGN ENGINEER or CQA ENGINEER, the fabric shall be replaced immediately at no additional cost to the OWNER.

3.03 RIP-RAP

A. Prepare subgrade to the required lines and grades as shown or indicated on the Construction Drawings. Place any fill required in the subgrade to a density equal to that of the surrounding area. Place filter fabric on the finished subgrade.

B. Place rip-rap by mechanical methods, augmented by hand placing where necessary to prevent damage to permanent works, provided that when the rip-rap is completed it forms a properly graded, dense, neat layer of stone. The completed rip-rap shall have a thickness as shown on the plans.

3.04 TEMPORARY GRASSING

Temporary grassing procedures will be implemented only under the direction of the DESIGN ENGINEER, a cease of construction in excess of 21 days, or as required by the soil erosion inspector.

Seeding for temporary grassing shall be applied to all shoulders, side stormwater conveyance channels, cut slopes, fill slopes, and any other area disturbed by the CONTRACTOR and not designated for pavement or structures. Temporary seeding shall occur immediately following final land disturbing activities. Any unseeded area which erodes shall be repaired to the satisfaction of the DESIGN ENGINEER at no additional cost to the OWNER. Temporary seeding shall be applied at the following rates:

Temporary Seeding	LBS / Acre	Depth of Cover	Date of Planting
German Millet	40	¼" - ½"	5/1 - 8/15
Rye (Grain)	120	¼" - ½"	1/1 - 5/1

Areas not receiving permanent cover that will be exposed for more than three (3) months shall receive temporary grassing. Temporary grassing shall consist of rye grass. Other cereal grass (i.e., millet) may also be used. Other grassing methods which have proved effective by the operator may be substituted for these.

3.05 INLET PROTECTION

A sump shall be constructed around the drop inlet and silt fence installed in accordance with the details in the plans for Drop Inlet Protection.

3.06 TEMPORARY STORMWATER CONVEYANCE CHANNEL LINER

A. After installation of the utilities, the stormwater conveyance channels shall be reconstructed as near as possible to the original configuration.

B. Apply lime, fertilizer, and seed to the stormwater conveyance channel and adjoining areas in accordance with the grassing specifications.

C. Place the excelsior mat in accordance with the detail and table in the erosion control plan.

D. Start laying the mat from the top of the upstream end of the channel and unroll it downgrade. Do not stretch netting.

E. Bury the upslope end and staple the mat every 12" across the top end, every three (3) feet around the edges and across the mat so that it is held closely against the soil. However, do not stretch the mat when stapling.

F. To join ends of strips, insert the new roll of mat in a trench as with upslope end and overlap it 18" with the previously laid upper roll. Turn under 6" of the 18" overlap and staple every 12" across the end.

3.08 REMOVAL OF TEMPORARY EROSION DEVICES

The CONTRACTOR shall remove all sedimentation and erosion control devices upon the approval of permanent seeding and stabilization by the DESIGN ENGINEER. All sediment deposits remaining in place after the erosion control devices are removed shall be dressed to conform with the existing grade, prepared, and seeded. The cost of removal and cleanup shall be included in the cost of the installation of the device or in the cost for maintenance.

3.09 CLEAN OUT PERMANENT EROSION CONTROL DEVICES

The CONTRACTOR shall clean out permanent sediment and erosion control devices upon approval of permanent seeding and stabilization by the DESIGN ENGINEER. The devices shall be cleaned out to the original condition. The cost of cleanup shall be included in the cost of installation or in the cost of maintenance of the device.

--END OF SECTION--

SECTION 01666

TESTING PIPING SYSTEMS

PART 1 GENERAL

1.01 DESCRIPTION

A. This section covers the requirements for CONTRACTOR's testing gravity and pressure piping systems not specified under other Sections.

B. Tests shall be performed on but not limited to the following:

1. Pressure Leachate Collection Pipes
2. Force Mains
3. Leachate Collection Pipes
4. Gravity Manholes

C. All tests require the presence of the CQA ENGINEER or his representative.

D. If the installation fails to meet test requirements, the CONTRACTOR shall, at his expense, determine the source of leakage and make repairs as necessary to eliminate leakage and retest as directed.

E. All costs for the testing shall be borne by the CONTRACTOR.

F. Advise the CQA ENGINEER at least 48 hours before tests are to be conducted.

PART 2 PRODUCTS

2.01 GENERAL

A. All equipment shall be the best of their particular class and suited for the intended use.

PART 3 EXECUTION

3.01 GENERAL

A. If the specified rate of leakage is exceeded, on test, the CONTRACTOR shall locate the points of excessive leakage and institute appropriate measure of correction, whereupon the length of pipeline shall be retested and this procedure continued until test requirements are met.

B. Unless specified otherwise the following tests shall be performed as directed by CQA ENGINEER.

1. Exfiltration Testing

   a. All gravity leachate piping constructed under this Contract.
   b. All HDPE manholes and other fabricated structures.

2. Hydrostatic Testing:

   a. Pressure Leachate Pipes
   b. Force Mains

3.02 EXFILTRATION TESTING

A. The CQA ENGINEER shall require exfiltration tests on all HDPE manholes and on gravity piping.

B. The section to be tested and the manner of test will be determined by the CQA ENGINEER.

C. Procedure for Exfiltration Testing:

1. Plug each end of section or all openings to manhole to be tested with watertight bulkheads.

2. Insert in each bulkhead at the top of the pipeline a two (2") inch pipe with 90° elbow, that will extend four (4') feet vertically above the top of the pipeline or above the groundwater line, whichever is higher. Manholes shall be tested at full depth with the water level at the cover ring.

3. The elevations of the top of the two (2") inch pipe at each bulkhead shall be the same.

4. Fill the pipeline with clear water until the water level is at the top of the two (2") inch pipe at the upper end of section or at the manhole ring.

5. Maintain the water level by adding accurately measured amounts of water for a period of thirty minutes, not allowing the lower pipe to overflow. The exfiltration test is to run for a minimum 24 hour period.

D. The maximum length of a section of pipeline to be tested by means of an exfiltration test at one time shall be limited to 1,000 linear feet.

E. The maximum permissible leakage determined by exfiltration shall be the rate of 25 gallons per inch interval diameter of pipe per mile of pipe line per 24 hours, inclusive of all appurtenances within the section such as manholes, etc. The length of pipe used in the computation shall be the horizontal distance between manhole centerlines of the section being tested. The maximum permissible leakage for manholes shall be 0.01 gallons per vertical foot per day.

F. Once infiltration is found to be within allowable limits, remove all bulkheads.

3.03 HYDROSTATIC TESTING

A. The following piping system shall be Hydrostatically tested:

1. Leachate force mains; and all other pressure piping systems not specifically requiring testing under other Sections.

2. Do not test piping systems with water where water testing will be harmful to the system operation, such as for air and gas piping systems.

B. After the pipe has been laid and backfilled between fittings, and before any fittings are covered, unless this requirement is waived by the CQA ENGINEER, all newly laid pipe, above ground or below ground, or any valved section thereof, shall be subjected to a hydrostatic gauge pressure as hereinafter tabulated.

1. All piping that will be considered inaccessible or impossible to repair after the completion of all work shall be hydrostatically tested while still accessible.

2. Examples of such piping are those near or under basins, paved roads, concrete structures and concrete foundations.

3. Note: All piping shall have reaction blocking (thrust blocks) in place before testing, as required.

C. Tests shall be under the direction of the CQA ENGINEER. The CONTRACTOR shall furnish a pressure gauge for measuring the pressure on the pipeline, shall provide a corporation cock to attach gauge or pump connection, and shall provide plugs to seal taps after use in testing, and shall also furnish a suitable pump, pipe, appliances, and other appurtenances necessary to make these tests.

D. Each section of pipe shall be filled slowly with water and the specified test pressure, measured at the point of lowest elevation, shall be applied to the pipe in a satisfactory manner. The CONTRACTOR will furnish all test water.

E. Before applying the specified water test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, as directed by the CQA ENGINEER, if necessary, at points of highest elevation, and afterward tightly plugged.

F. The test pressure shall be maintained for a sufficient length of time prior to the test to allow for thorough examination of joints and elimination of leakage where necessary. The pipe line shall be made watertight under the test pressure.

G. All exposed pipes, fittings, valves, hydrants, and joints will be carefully examined during the open trench test. Any cracked or defective pipes, fittings, valves, or hydrants discovered in consequence of this pressure test shall be removed and replaced by the CONTRACTOR with sound material and the test shall be repeated until satisfactory to the CQA ENGINEER.

H. Hydrostatic test pressures shall be as follows:

System	Pressure Test Rating (psi)
Miscellaneous pressure pipe	50
Pressure leachate piping (force main)	100
Secondary Containment Pipe	Actual Maximum Pressure plus 5 psi

1. The test section shall be pressurized to the required test pressure.

2. The test shall be conducted for a minimum of six (6) hours.

I. The tested section will not be accepted if it has any observed leakage or test pressure drops more than one (1) psi during the leakage test.

--END OF SECTION--

SECTION 02110

CLEARING AND GRUBBING

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. Extent of site clearing is shown on Construction Drawings.

B. Site clearing work includes, but is not limited to:

1. Protection of trees outside of clearing limits.
2. Removal of trees and other vegetation within site clearing limits.
3. Grubbing within the clearing limits.
4. Stripping topsoil.
5. Removal of debris on the site.

1.02 RELATED DOCUMENTS

A. Section 02930 - Grassing

B. Construction Drawings and general provisions of Contract, including General and Supplementary Conditions, and Detailed Specification sections, apply to work of this section.

1.03 JOB CONDITIONS

A. Examine areas for conditions under which work is to be performed. Report to the DESIGN ENGINEER all conditions contrary to those shown on the Construction Drawings or specified herein and all other conditions that will affect satisfactory execution of the work. Do not proceed with work until unsatisfactory conditions have been corrected and authorization has been given by OWNER's representative.

B. Conduct site clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction.

C. Provide protection necessary to prevent damage to existing improvements indicated to remain in place on adjoining properties and on OWNER's. Restore damaged improvements to their original condition, as acceptable to parties having jurisdiction, without additional cost to the OWNER.

D. Keep dirt, dust, noise, and other objectionable nuisances to a minimum. Use temporary enclosures, coverings, and sprinkling, or a combination thereof, as necessary to limit dust to lowest practicable level, except do not use water to the extent of causing flooding, contaminated runoff, or icing.

E. Protect existing trees and other vegetation indicated to remain in place, against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, access foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.

1. Water trees and other vegetation to remain within limits of the contract work as required to maintain their health during course of construction operations.

2. Repair or replace trees and vegetation indicated to remain which are damaged by construction operations, in a manner acceptable to OWNER, without additional cost to OWNER. Employ licensed arborist to repair damages to trees and shrubs.

3. Replace trees which cannot be repaired and restored to full-growth status, as determined by arborist.

F. Property corners, iron pipe and/or monuments, shall be located and protected before beginning clearing operations.

1.04 QUALITY ASSURANCE

A. Obtain copy of Land Disturbing Permit and maintain at the site.

B. Obtain the required permits and conform to applicable codes for disposal of debris off-site and burning of debris on-site.

C. Perform all work in accordance with requirements of OSHA and the Environmental Protection Agency in addition to State and local requirement.

PART 2 PRODUCTS

2.01 TOPSOIL

A. Is defined as natural, friable soil, characteristic of representative soils that produce heavy growth of crop, grass, or other vegetation is generally that soil strata found to 24 inches depth.

B. Topsoil for placement on graded areas shall be free from roots, stones, and other materials that may hinder grading, planting, and maintenance operations, and shall be free from objectionable weed seeds and toxic substances.

PART 3 EXECUTION

3.01 CLEARING

A. Clearing shall consist of the cutting, removal, and satisfactory disposal of all trees and shrubs within the clearing limits as designated on the plans and/or within easements and right-of-ways which will require construction work during the project.

B. Clear only those areas required to install the soil erosion control devices as shown on the plans and outlined in Section 01560 - Erosion and Sediment Control of these specifications prior to starting overall clearing operations.

C. Repair and maintain erosion control devices during construction in order to always assure their efficiency.

D. Trees to remain shall be trimmed of branches which will obstruct the new construction or as directed by the DESIGN ENGINEER or CQA ENGINEER. Branches to be trimmed shall be neatly cut close to the bole of the tree or main branch. Cuts more than 1 ½" in diameter shall be painted with a tree wound paint formulated for use on damaged plant tissues.

3.02 GRUBBING

A. Grubbing shall consist of the removal and disposal of stumps, roots larger than three (3) inches in diameter and matted roots from the designated clearing limits to a depth of 18 inches below the original surface level of the ground.

B. For trees to remain, provide protection for roots over 1 ½" in diameter which are cut during grubbing. Coat cut faces with a tree wound paint formulated for use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out, cover with earth as soon as possible.

C. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground, unless further excavation is indicated.

D. Use only hand methods for grubbing inside drip line of trees indicated to be left standing.

3.03 TOPSOIL STRIPPING, STOCKPILING AND SPREADING

A. All topsoil within the clearing limits shall be stripped and stockpiled as directed by the OWNER.

B. Topsoil shall be placed on all shoulders, slopes, stormwater conveyance channels, and other earth areas graded under this contract, unless otherwise specified on the plans. Topsoil shall be uniformly placed on these areas to a compacted depth of not less than 4 inches or more than 6 inches. Topsoil depth on landscape areas shall be no less than 6 inches. The material shall be placed, leveled, and lightly compacted with at least one pass of a cultipacker, or other approved equipment weighing 100 to 160 pounds per linear foot of roller, to required cross sections.

3.04 REMOVAL OF DEBRIS

A. Removal of debris shall consist of the satisfactory disposal of any garbage or rubble within the clearing limits, easements, right-of-way or as specifically designated on the plans.

3.05 DISPOSAL OF MATERIAL

A. All vegetation and debris within the areas to be cleared shall become the property of the CONTRACTOR upon the start of work and shall be removed from the site and properly disposed.

B. Burning of combustible materials removed by clearing and grubbing operations will be allowed providing the CONTRACTOR obtains such permits and approvals required by local authorities, if available. The CONTRACTOR will be responsible for controlling fires in compliance with all Federal, State, and Local laws and regulations. The securing of necessary burning permits shall be the responsibility of the CONTRACTOR. All burning shall be under the constant care of competent watchmen. All materials resulting from clearing and grubbing operations and disposed of by burning on the site shall be thoroughly and completely reduced to ashes.

--END OF SECTION--

SECTION 02210

GRADING

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. Excavation, fill, and preparation of sub-grade for landfill, roadways, embankments, building foundations, and detention basins.

B. All excavation shall conform with the lines and grades as shown on the plans or established by the DESIGN ENGINEER.

1.02 RELATED WORK

Drawings and general provisions of Contract, including General and Supplementary Conditions, and Detailed Specification sections, apply to work specified in this section.

1.03 QUALITY ASSURANCE

A. Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

B. Owner will engage soil testing and inspection service, for quality control testing during earthwork operations.

C. Test reports for the following items shall be given to the DESIGN ENGINEER and will be available for the Contractor directly responsible for earthwork being tested:

1. Field Density Test Reports

2. One (1) optimum moisture-density curve for each type of soil encountered.

3. Other field inspection reports as deemed appropriate.

1.04 APPLICABLE STANDARDS

The most recent publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

American Society for Testing and Materials (ASTM) Publications (Latest Version):

D422	Method of Particle-Size Analysis of Soils
D698	Moisture Density Relations of Soils and Soil Aggregate Mixtures Using 5.5 lb. Rammer/12 inch drop
D1556	Density and Unit Weight of Soil in Place by the Sand-Cone Method
D2922	Density of Soil in Place by the Nuclear Gage
D2937	Density of Soil in Place by the Drive Cylinder Method
D4318	Test Method For Liquid Limit, Plastic Limit and Plasticity Index of Soils

1.05 SUBMITTALS

Submittals are required for proposed technique for rock excavation.

1.06 MEASUREMENT AND PAYMENT

Not applicable.

PART 2 PRODUCTS

2.01 SUITABLE MATERIAL

A. Shall be free from construction material, debris, frozen material, organic matter or unstable material.

B. Shall be suitable for the formation of embankments, subgrades, backfill, shoulders and other places requiring structural fill as may be indicated on the contract drawings or directed by the CQA ENGINEER.

C. No rock greater than 6 inches in diameter shall be placed in any portion of the landfill embankment except as allowed in Section 3.05 C.5. Small rock less than 6 inches, if used, shall be incorporated into the embankment in such a fashion to completely avoid bridging or voids.

2.02 UNSUITABLE MATERIAL

The CQA ENGINEER will designate whether or not a material is unsuitable for the formation of embankments and subgrades. Moisture content of material alone shall not render material unsuitable. It is contractor's responsibility to raise or lower material moisture

content to achieve specified compaction densities or remove and replace at Contractor's expense.

Areas deemed unsuitable by the CQA ENGINEER for subsequent embankment formation operations or other operations due to the presence of unsuitable materials shall be removed, replaced, and compacted using a suitable material.

2.03 BORROW EXCAVATION

Borrow material is available on site which is suitable for formation of embankment and subgrades as determined by the CQA ENGINEER, and shall be obtained from areas designated on the contract drawings.

2.04 SOIL LINER SUBGRADE

This area includes the designated thickness of compacted material to the limits indicated below the compacted soil liner.

2.05 SELECT SOILS FOR MUNICIPAL SOLID WASTE LANDFILL

The CQA ENGINEER shall classify soils suitable for compacted soil / clay liner construction, drainage blanket (protective cover) and daily waste cover during the site excavation. The Contractor shall stockpile the materials at stockpile areas designated by the CQA ENGINEER.

2.06 GRADED AGGREGATE

Graded aggregate for access road construction shall comply with State Department of Transportation specifications for graded aggregate base.

2.07 GEOTEXTILE FABRIC

The geotextile fabric for access road construction shall be a high modulus, woven geotextile suitable for road base stabilization, soil separation, and reinforcement. The fabric shall be Amoco Style 2006, Nicolon Mirafi 600X or equal.

PART 3 EXECUTION

3.01 PREPARATION OF GROUND SURFACE FOR FILL

Before embankment and roadway construction are begun, all vegetation and rubbish shall be removed from the area within the limits of the embankment and roadway.

Following stripping, those areas at grade or designated to receive fill or subsequent materials placement shall be PROOF ROLLED in the presence of the CQA ENGINEER with a loaded

dump truck or similar piece of heavy equipment to identify those areas needing repair due to pumping or yielding. Any area which ruts or pumps excessively in the opinion of the CQA ENGINEER shall be UNDERCUT to firm bearing and backfilled with properly compacted soil fill.

Topsoil shall be stockpiled and utilized in areas to be seeded after completion of grading. Excess topsoil shall be hauled to designated areas.

3.02 DETERMINATION OF IN-PLACE SOIL PROPERTIES

A. Determination of Density

Testing shall be provided by the CQA ENGINEER for the OWNER. Testing shall be performed by an approved commercial testing laboratory. The number of laboratory moisture-density tests and field density tests shall be in accordance with Paragraph 3.02, C to insure the specified density is obtained. Laboratory tests for moisture-density relations shall be performed in accordance with ASTM D698. Field tests for density and moisture content shall be performed in accordance with ASTM D1556, ASTM D2937 or ASTM D2922. Copies of all tests results will be furnished to the CONTRACTOR and the DESIGN ENGINEER. All testing shall comply with minimum construction quality assurance requirements of the State.

B. Number of Density Tests:

The following tests will be performed and are considered to be the number of tests. Additional tests may be required contingent upon weather and/or soil conditions.

1. One (1) laboratory moisture-density relation test and companion classification test for each type of soil encountered.

2. A minimum of one (1) density test shall be performed per 1,000 cubic yards of fill subgrade and other embankment fills.

3.03 DRAINAGE

Satisfactory methods for dewatering and stormwater control during construction shall be installed as required. Cost of dewatering shall be included in the unit (or) lump sum price in the proposal for unclassified excavation. The disposal of water after removal shall be in keeping with the intents of the soil erosion control plan.

3.04 ROCK EXCAVATION

Rock excavation shall be in accordance with Section 02211 - Rock Excavation.

3.05 GENERAL COMPACTION/FILL REQUIREMENTS

Excavation, fill and compaction requirements for this project vary as to the respective subgrade being constructed. Any subgrade not specifically detailed herein or any subgrade requirements that reference this section shall meet the requirements of this section.

A. COMPACTION

1. When tested, embankment and fill material shall be compacted to not less than 95% Standard Proctor (ASTM D698) of the maximum dry density, or as specified in the schedule below. All subgrades will be proof-rolled prior to acceptance of subgrade by the CQA ENGINEER. Proof-rolling will be in accordance with procedures in section 3.01 of this specification. The number of tests shall be in accordance with Section 3.02, C.

DESCRIPTION	COMPACTION
Sediment Basin Embankments	95%
Roadways	95%
Shoulders & Embankments	95%
Soil Liner*	95%
Utilities Under Structures	95%
Other Areas	95%

*As Determined By Test Pad

2. If, in the opinion of the CQA ENGINEER (based upon testing reports, or inspection), subgrade or fills which have been placed are below specified density, the Contractor shall then provide additional compaction or repairs at no additional cost to Owner. Retests may be charged to the CONTRACTOR as determined by the CQA ENGINEER.

3. Subgrade materials shall be compacted at a moisture content within plus or minus 4% of optimum unless more or less moisture is allowed by the CQA ENGINEER. The CONTRACTOR shall dry or add moisture to the subgrade material when required to provide a uniformly compacted subgrade.

B. PROTECTION OF SUBGRADES

Stormwater conveyance channels and drains shall be provided and maintained when required to satisfactorily drain the subgrade. Where previously approved subgrade is damaged by natural causes, by hauling equipment, or by other traffic, the Contractor shall restore the subgrade to the required lines, grades, and typical sections and to the required density at no additional cost to the Owner.

C. EMBANKMENT FORMATION:

1. Areas to receive embankment formations or fill shall be stripped to suitable base material as required in Section 02110 - Clearing and Grubbing.

2. The material shall be deposited and spread in successive, uniform, approximately horizontal layers of not more than ten (10") inches in depth, loose measurement, for the full width of the cross section, and shall be kept approximately level by the use of effective spreading equipment. Each layer of the embankment shall be satisfactorily compacted as hereinafter specified.

3. Hauling shall be distributed over the full width of the embankment, and in no case will deep ruts be allowed to form during the construction of the embankment. The embankment shall be properly drained at all times.

4. Where embankments are to be constructed across wet sandy soil which will not support the weight of trucks or other hauling equipment due to near surface ground water, the first layer of the embankment may be constructed as a bridging lift by placing successive truck or other equipment loads in a uniform distributed layer of a thickness not greater than that necessary to support the trucks or hauling equipment while placing subsequent layers as determined by the DESIGN ENGINEER and CQA ENGINEER. The remainder of such embankments shall then be constructed in layers as above specified.

5. When embankments are being constructed principally of rock, the depth of each layer shall be no greater than 36 inches. The rock shall be carefully distributed throughout the embankment and all voids shall be filled with fine material. The rock shall have a maximum particle size of no more than two (2') feet. No rock lifts shall be placed within three (3') feet vertically of the soil liner subgrade or roadway subgrade and shall only be placed in fill sections totaling greater than 6 feet nor shall rock be placed in proposed underground utility locations.

D. EMBANKMENT COMPACTION:

1. All embankment material shall be compacted to 95% Standard Proctor compaction unless otherwise provided in the Contract Documents or directed by the CQA ENGINEER. Compaction equipment used by the Contractor shall be adequate to produce the required compaction and produce a uniformly constructed embankment with all layers uniformly bound to all preceding layers.

2. Embankment materials shall be compacted at a moisture content within plus or minus four (4%) percent of optimum unless other moisture range is

approved by the CQA ENGINEER. The Contractor shall dry or add moisture to the embankment material when required to provide a uniformly compacted and stable embankment.

3.06 GENERAL GRADING TOLERANCES

Grading tolerances shall be as specified below:

LANDFILL(S)

Soil Liner Subgrade (- 0.1' - 0)

Compacted Soil Liner
A. Rough Grading (+ 0 to 0.2')
B. Fine Grading (+ 0 to 0.1')

Embankment (± 0.1')
Protective Cover Gravel (+ 0.1')

ROADWAYS AND STRUCTURES

Roadway Subgrade
A. Rough Grading (± 0.12')
B. Fine Grading (± 0.04')

Other
A. Rough Grading (± 0.12')
B. Fine Grading (± 0.04')

3.07 ROADWAY SUBGRADE

A. Preparation of Subgrade

The roadway subgrade shall be shaped to the lines, grades and typical sections shown on the plans. Where the CQA ENGINEER directs that areas of the subgrade are to be stabilized, the subgrade surface in such areas may be left uniformly below grade to provide for the addition of the stabilizer material.

All unsuitable material, boulders, and all vegetative matter shall be removed and replaced with suitable material. Suitable material, when not available from the subgrade work, shall be taken from general excavation or borrow sources.

Material excavated in preparing the subgrade shall be stored or stockpiled in such a manner as to not interfere with the proper drainage or any of the subsequent of placing base or pavement.

B. Compaction of Subgrade

When tested, fill material shall be compacted to not less than the following percent of the maximum dry density:

1. Under paved roads 95%.

2. Under shoulders and stoned road 95%.

The subgrade shall be compacted at a moisture content which is approximately that required to produce the maximum density indicated. The Contractor shall dry or add moisture to the subgrade when required to provide a uniformly compacted and acceptable subgrade.

C. Protection of Subgrade

Stormwater conveyance channels and drains shall be provided and maintained when required to satisfactorily drain the subgrade. Where previously approved subgrade is damaged by natural causes, by hauling equipment, or by other traffic, the Contractor shall restore the subgrade to the required lines, grades, and typical sections and to the required density at no cost to the Owner.

D. Rough Grading

The roadway subgrade surface shall to within the specified tolerance of the grades indicated on the contract drawings. The final rough grade surface shall meet the compaction requirements and be graded and sealed to properly drain storm water prior to acceptance by the CQA ENGINEER.

E. Fine Grading

Contractor shall fine grade all roadway surfaces to within the specified tolerance of the grades indicated on the contract drawings. Compaction requirements shall be as described in Section 3.05.

3.08 LANDFILL CELL

The landfill cell shall be excavated to achieve the subgrade elevations equal to the specified liner thickness below the lines and grades indicated on the drawings as the top of clay elevation. The subgrade then shall be scarified to a depth of six (6") inches and compacted to 95% Standard Proctor before acceptance and subsequent placement of the compacted soil liner.

Fine Grading:

Contractor shall fine grade the subgrade prior to placement of the soil liner.

3.09 BUILDING FOUNDATION SUBGRADES

Foundation subgrades shall be excavated to the lines and grades indicated on the plans. Footing subgrades shall be firm, backfill shall be to 95% of Standard Proctor at ±2% of optimum moisture content.

3.10 STOCKPILE AREAS

Surplus and unsuitable excavation shall be hauled, placed and sloped to drain for each material classification.

Material stockpile areas are indicated on the contract drawings. All excavation material shall be placed or stockpiled by one of the means listed below. All material types and classifications shall be subject to the interpretation of the CQA ENGIEER and shall be stockpiled or used for fill as directed by the CQA ENGINEER. All stockpiles remaining over 14 days shall be stabilized with grass.

- Used for structural fill
- Stockpiled as topsoil
- Stockpiled as soil liner material
- Stockpiled as daily cover
- Stockpiled as drainage blanket (protective cover) material

3.11 MOISTURE CONTROL

Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material to prevent free water appearing on surface during or subsequent to compaction operations.

The Contractor shall furnish equipment for modifying the moisture content of the fill material and at times when the moisture content is not within the specified range, shall operate such equipment so as to achieve the necessary correction with minimum loss of time.

The addition of water shall be accomplished by methods which will distribute the added water evenly and in a controlled manner over the fill. Reduction in water content shall be accomplished by methods which are effective for promoting aeration of the fill material. No fill shall be placed until approved types of equipment for aeration and for addition of water are on the job and are demonstrated to be satisfactory of watering and/or dewatering operations.

During placement operations, Contractor shall keep surfaces from drying by addition of water or placement of additional materials.

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.

3.12 PROTECTION OF SUBGRADES AND FILL SURFACES

Newly graded areas shall be protected from traffic and erosion, and all settlement or washing away that may occur from all causes, prior to acceptance, shall be repaired and grades re-established to the required elevations and slopes. Embankments and excavations shall be kept shaped and drained. Ditches and drains along subgrade shall be maintained in such a manner as to drain effectively at all times. The finished subgrade shall not be disturbed by traffic or other operations and shall be protected and maintained by the Contractor in a satisfactory condition until compacted soil liner or road base materials are placed. The storage or stockpiling of materials on the finished subgrade will not be permitted.

--END OF SECTION--

SECTION 02211

ROCK EXCAVATION

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The CONTRACTOR shall furnish all labor, materials, tools, supervision, permitting, transportation, and equipment necessary to excavate rock as necessary and incidental to accomodate lines, grades, and elevations shown on the Drawings. OWNER may elect to perform blasting operations or hoe ram operations to remove rock. This Specification will govern activities pertaining to rock removal operations.

B. The CONTRACTOR shall solely be responsible for the safety of his/her workers, landfill employees, other contractors on site and the general public as it relates to the performance of this Section.

C. The CONTRACTOR shall closely coordinate the Work of this Section with the OWNER to avoid conflicts with the daily operations of the landfill.

D. The CONTRACTOR shall be solely responsible for any damage, direct or indirect, arising from the performance of this Section. Any damage to the existing landfill infrastructure will be repaired immediately at the sole expense of the CONTRACTOR.

1.02 RELATED WORK

A. Section 02210 - Grading

B. Section 02220 - Trenching, Backfilling, and Compaction

1.03 SUBMITTALS

A. All reports required to obtain any and all blasting permits.

B. The Contractor shall prepare a blasting plan showing the work sequence, method to segregate types of rock, safety plan, protection methods, vibration monitoring, and methods employed for wet blasting. The plan shall be submitted to the North Carolina Department of Environment and Natural Resources by the DESIGN ENGINEER for approval prior to blasting.

PART 2 PRODUCTS

2.01 ROCK EXCAVATION

Rock excavation is required for non-rippable rock. Rippable rock is defined as rock that can be ripped using a single tooth ripper mounted on a D-8 dozer, making three (3) passes in perpendicular direction and producing at least 0.5 cubic yards of loosened rock.

PART 3 EXCAVATION

3.01 PREPARATION

A. Prior to implementing any work of this Section, the CONTRACTOR shall carefully inspect the already installed Work of all other Sections and verify that all such Work is complete to the point where installation of the Section may properly commence without adverse impact.

B. The CONTRACTOR is responsible for obtaining all necessary permits required to conduct blasting operations. All blasting operations shall adhere to the requirements of the permit. The CONTRACTOR shall be responsible for meeting all of the requirements of the permits, including conducting necessary surveys, posting notifications, and monitoring and reporting.

3.02 BLASTING OPERATIONS

A. CONTRACTOR shall assume all risk in assessment of the depth and character of the bedrock, and may conduct his/her own investigations as necessary.

B. CONTRACTOR shall develop a blasting plan that will achieve the lines, grades, and elevations shown on the Drawings. All excavations shall comply with OSHA Guidelines.

C. Blasting shall minimize the development of large, oversize boulders. Maximum particle size shall be 1 foot. All oversized materials shall be mechanically broken down to suitable size at CONTRACTOR's expense for incorporation in areas requiring fill or for off-site transportation.

D. CONTRACTOR shall employ controlled blasting procedures to maintain ground vibrations and airblast pressures below the maximum levels specified in the permit, and to minimize fracturing of rock beyond and beneath the limits of excavation. The CONTRACTOR shall revise the blasting plan appropriately if ground vibrations, airblast pressures, fly rock or oversized material exceed the criteria established in the blasting plan.

E. Fly rock shall be controlled through the use of blasting mats or by modifying the blasting plan appropriately.

F. Groundwater may be encountered during the blasting operations. CONTRACTOR is responsible for wet blasting if necessary.

3.03 HOE RAM OPERATIONS

A. The CONTRACTOR shall remove rock by hoe ram to achieve the lines, grades, and elevations shown on the Drawings.

B. The CONTRACTOR shall minimize the development of large, oversize boulders. Maximum particle size shall be 1 foot. All oversized particles shall be broken down to suitable size at CONTRACTOR's expense for incorporation in areas requiring fill or for off-site transportation.

3.04 FINISHING

A. Blend slopes with existing landscape features.

B. Finish to elevations shown to five feet (5') below landfill cell subgrade and six inches (6") below the road subgrade within tolerance of 0.0 to -0.5 feet.

3.05 PROTECTION

A. Notify all area utility companies prior to commencing work in accordance with state and local regulations.

B. Locate, identify, and protect existing utilities from damage.

C. CONTRACTOR shall conduct operations so as not to exceed 65 decibels at property lines adjacent to residential properties at any time.

D. CONTRACTOR is responsible to protect all existing facilities during blasting operations. CONTRACTOR will be fully responsible to repair any and all damage as a direct or indirect result of blasting operations.

--END OF SECTION--

SECTION 02220

TRENCHING, BACKFILLING AND COMPACTION

PART 1 GENERAL

1.01 DESCRIPTION

The work under this Section includes all excavation, backfill, compaction, pavement removal, site restoration and cleanup for the construction of underground pipelines, and their related structures.

1.02 RELATED WORK

A. Section 02720 - Storm Sewer System
B. Section 02745 - Leachate Piping

1.03 DEFINITIONS

A. Pipeline Embedment:

1. Backfill material encasement extending from the full depth of bedding to a distance of twelve (12") inches above the top of the pipe.

2. Embedment is composed of bedding, initial backfill and foundation.

B. Foundation:

1. The load bearing portion of the embedment which underlines the bedding material.

2. Normally the excavated trench bottom except where unstable conditions exist and then alternate methods of foundation stabilization are required.

C. Bedding: Backfill material between a pipe and the foundation on which it rests.

D. Initial Backfill: Backfill placed from the top of the bedding and along the sides of the pipe to a distance of twelve (12") inches above the top of the pipe.

E. Final Backfill: Backfill placed from a distance of twelve (12") inches above the top of the pipe to the finished grade.

F. Embankment: Fill material placed above original ground surface to provide cover over a conduit which is fully or partially exposed.

G. Rock: Where "Rock" is used as the name of an excavated material, it shall mean boulders or pieces of rock, concrete or masonry measuring one (1) cubic yard or more, hard shale or solid ledge rock and masonry which, in the opinion of the CQA ENGINEER, requires for its removal the continuous use of pneumatic tools.

1.04 QUALITY ASSURANCE

A. Tests required by this section shall be performed by a qualified independent testing laboratory meeting the requirements of Section 01400.

B. The CONTRACTOR shall insure that all testing laboratory personnel contact the project representative prior to conducting tests to mutually select the test site. No testing shall commence without this contact.

C. All work shall comply with local development standards and state department of transportation specifications.

D. Regulatory Requirements:

1. Comply with applicable requirements of federal, state, and local laws, regulations and codes having jurisdiction at project site.

E. Reference Standards: Applicable requirements of standards and specifications referenced herein apply to the work of this Section.

1.05 SUBMITTALS

A. A minimum of two (2) copies of all test results shall be submitted to the DESIGN ENGINEER, and one copy to the CONTRACTOR.

1.06 MEASUREMENT AND PAYMENT

Not applicable.

PART 2 PRODUCTS

2.01 BACKFILL MATERIAL

A. The requirements of this Article shall apply to all backfill materials unless otherwise specified.

B. All material shall be suitable and free from roots, wood, scrap material, and other vegetable matter and refuse.

C. Acceptable material shall generally be a natural or artificial mixture of soil types normally found in natural deposits in the project vicinity or material obtained from the CONTRACTOR's excavations.

D. All material shall be sufficiently dry for compaction and shall not contain excessive amounts of soft or highly plastic clays.

E. Maximum size of stone shall not exceed four (4") inches.

2.02 BEDDING MATERIAL

A. Fine granular bedding:

1. Materials for fine granular bedding shall consist of well graded fine to course sands or gravel meeting the gradation requirements of ASTM C 33 for fine aggregates.

2. Natural materials or artificial mixtures, consisting largely of a mixture of sand and clay, found in natural deposits in the project vicinity may be utilized as long as the material meets the proper proportions and gradation requirements.

3. The material shall generally pass a 3/8" sieve with no more than 10% passing a No. 100 sieve, and shall be non-plastic.

B. Gravel Bedding:

1. Materials used for gravel bedding shall consist of natural rounded or angular, graded stone or crushed rock, with little or no fines.

2. Generally, the aggregate size shall range from 1 1/2" to 3/8".

3. ASTM classification shall be No. 57 stone.

2.03 UNSUITABLE MATERIALS

A. General: Any material, which in the opinion of the CQA ENGINEER, contains vegetable matter, muck, roots, and rubbish shall be considered unsuitable.

B. The following, as defined in the United Soils Classification System, shall be considered the basis for classifying unsuitable material unless specifically noted in other sections of the specifications:

1. Highly plastic clay soils of the CH and MH descriptions with moisture contents more than 10% over the standard proctor optimum moisture.
2. Border line soils of the SC-CH description with moisture contents more than 10% over the standard proctor optimum moisture.
3. Organic soils of the OL and OH description with over 5% organics.
4. Highly organic soils of the PT description.

PART 3 EXECUTION

3.01 SITE PREPARATION

A Clearing and Care of Surface Materials:

1. Topsoil shall be stockpiled at a suitable location so that it can be replaced.

B. Trees, plants, and existing structures and utilities shall be protected with appropriate barriers prior to construction.

3.02 GENERAL TRENCH EXCAVATION

A. The requirements of this Article shall apply to all trench excavation unless otherwise specified.

B. Trench excavation shall be of such depth to enable proper installation of embedment materials that will result in construction of the pipeline to the alignment and grade, or depth of cover, as shown on the Construction Drawings.

1. Over-excavation and replacement of materials with proper bedding material shall be required where specified by the CQA ENGINEER.

2. If during the course of construction, the trench is inadvertently over-excavated, that area shall be backfilled with fine granular bedding material, unless gravel bedding is required where unsuitable materials are encountered in the subgrade or where specified by the CQA ENGINEER.

C. All such related structures and appurtenances shall be constructed to the alignment, grade, and position as shown on the Construction Drawings.

D. In all cases where materials are deposited along open excavation they shall be placed so that in the event of rain, no damage will result to the work or adjacent property.

E. Unstable trench bottom:

1. Where an unstable trench bottom condition is encountered due to the presence of muck, quicksand, or other unsuitable materials, the unstable soil material shall be removed to a depth which is sufficient to produce a firm foundation.

2. The unstable soil material shall then be replaced with Class B embedment for the full depth of unstable material excavation.

3. The depth of unstable soil excavation and bedding replacement will be dependent upon the severity of the trench bottom soil conditions.

4. Depths of bedding shall be as a minimum those specified for Class B embedment, contained in Article 3.07 (c) of this Section.

5. Alternate foundations shall be used where required as specified in Article 3.08 of this Section.

F. Regardless of the type of embedment used, all bell holes for bell and spigot pipe shall be excavated at proper intervals so that the barrel of the pipe will rest for its entire length upon the bottom of the trench or bedding material.

G. All bedding materials shall achieve the required densities by tamping with suitable tools and shaped to receive the pipe and support it at the exact elevation and line as shown on the Construction Drawings.

H. Wet excavation:

1. Where the excavation area shown on the Construction Drawings falls under the water surface near the banks of a flowing stream or other body of water or in high ground water areas, the CONTRACTOR may adopt and carry out any method he may deem feasible for the performance of the excavation work and for the protection of the work thereafter; provided the method and equipment to be used has received prior approval of the CQA ENGINEER.

2. During the selected method of construction, the excavation area shall be effectively protected from damage during the excavation period and until all contemplated construction work therein has been completed to the satisfaction of the CQA ENGINEER.

3. The cost of all temporary construction work necessary or incidental thereto, including the cost of installing and removing sand bags, coffer dams, sheet piling, excavation and backfill, pumping and dewatering, shall be considered as an integral part of the cost of excavation and no separate payment therefore shall be allowed or made.

I. Disposal of materials:

1. Disposal of waste materials and smoothing of disturbed material during trenching operations shall be performed as the pipe is laid and shall not be allowed to lag more than 500 feet behind the pipe laying operations.

2. All materials removed by excavation which are suitable for the purpose shall be used whenever practicable for backfilling pipe trenches, foundations and footings, and for such other purposes as may be shown on the Construction Drawings or directed by the CQA ENGINEER.

3. All materials not used for backfilling, foundations, or footings shall be considered as waste materials and disposed of by the CONTRACTOR in an approved manner.

4. Waste materials may be deposited in spoil banks at locations as shown on the Construction Drawings.

5. If no disposal areas are shown on the Construction Drawings, the CONTRACTOR shall provide at his own expense disposal areas satisfactory to the CQA ENGINEER.

6. Waste materials shall not be left in unsightly piles, but shall be spread in uniform layers and neatly leveled and shaped.

7. Spoil banks shall be provided with adequate openings to permit surface drainage of adjacent lands.

8. On completion of any part of the work proper disposal shall be made of all surplus or unused materials left within the construction limits of such work and the surface of the work left in a neat and workmanlike condition.

3.03 WATER IN TRENCHES

A. Trenches shall be reasonably free from water while the pipes are being laid.

1. The CONTRACTOR shall remove and dispose of any water (including storm water), sewage, or any other liquid which may be found or may accumulate in the excavations.

2. This may be done by pumping, an adequate well point system, or other means of dewatering approved by the CQA ENGINEER.

B. The CONTRACTOR shall examine the site after excavating, and before proceeding with the work he shall notify the CQA ENGINEER of any evidence of water rising in such areas.

C. Static water levels shall be drawn down below the bottom of the excavation sufficiently to allow for placement of bedding and backfill.

1. Under certain conditions, the CQA ENGINEER may permit the CONTRACTOR to remove the water with the use of trenchside pumps through the use of an approved bedding.

2. The depth of bedding material will depend upon the amount of water, but care shall be taken to ensure that the trench wall soil material is such that it will not be removed from the area adjacent to the bedding.

D. The CONTRACTOR shall not open up more trench than the available pumping facilities are able to dewater.

E. The CONTRACTOR shall assume responsibility of disposing of all water so as not to injure or interfere with the normal drainage of the territory in which he is working.

F. In no case shall the pipe lines be used as drains for such water, and the ends of the pipe shall be kept properly and adequately blocked during construction by the use of approved stoppers and not by improvised equipment.

G. All necessary precautions shall be taken to prevent the entrance of mud, sand, or other obstructing matters into the pipe lines, and on completion of the work, any such material which may have entered the pipe lines must be cleaned out so that the entire system will be left clean and unobstructed.

H. Release of groundwater to its static level shall be performed in a manner to maintain undisturbed state of natural foundation soils, prevent disturbance of compacted backfill or bedding, and prevent flotation of pipelines.

I. The CONTRACTOR shall at all times have on hand sufficient pumping equipment and machinery in good working condition for all ordinary emergencies, and shall have available at all times competent workmen for operation of pumping equipment.

J. Dewatering systems shall be designed and operated to prevent removal of natural soils and to prevent excessive reductions in the groundwater outside the excavation to the extent that it would damage or endanger adjacent structures or property.

3.04 ROCK EXCAVATION

A. Where rock is encountered in the process of trench excavation it shall be completely uncovered and stripped of all loose material over the area as specified herein.

B. Rock shall be excavated in accordance with Section 02211 Rock Excavation.

C. Ledge rock, boulders, and large stones shall be removed to provide a clearance of not less than six (6") inches in every horizontal direction from all parts of pipe, fittings, and other appurtenances.

D. Where rock is encountered at grade in trenches, the trench shall be excavated not less than six (6") inches below the bottom of the pipe bell, refilled with fine, granular material thoroughly tamped in-place and shaped to the pipe.

E. Excavated rock shall not be mixed with material selected for tamped backfilling under and around the pipe or up to a level at least two (2') feet above the pipe.

3.05 TRENCH SIZE

A. Gravity piping:

1. As soil conditions will permit, the sides of trenches shall be cut in vertical, parallel planes from the bottom of the trench to the top of the pipe and have maximum width of two (2') feet plus the outside diameter of the pipe as shown on the Construction Drawings.

2. The width of the remaining depth of the trench may be as wide as necessary except as restricted by limits of right-of-way or existing improvements that are to be protected; the sides, however, shall be as nearly vertical as practicable or allowable.

3. If the trench width from the bottom of the trench to the top of the pipe is over-excavated in excess of that specified, sewers shall be laid on a gravel bedding at no extra cost to the OWNER.

B. Pressure Piping:

1. Trenches for pressure piping shall provide a minimum of 30 inches cover over the barrel of the pipe, except as otherwise shown.

2. Width of trench at and below top of the pipe shall not exceed twelve (12") inches on either side of pipe.

3. Width of trench above top of pipe may be as wide as necessary within limits of right-of-way, with banks as nearly vertical as practicable or allowable, and except as restricted by existing improvements, that are to be protected.

3.06 EXCAVATION FOR APPURTENANCES AND STRUCTURES

A. Excavation for appurtenances shall be made to a size that will allow at least twelve (12") inches between the outer surfaces of the appurtenance and the excavation wall or shoring.

B. Excavation for precast manholes and other precast structures shall be undercut six (6") inches below the bottom of the precast structure and shall be backfilled with gravel bedding as specified under the bedding material in this section.

C. Undercutting and providing a bedding for structures shall be considered as an integral part of the work and no separate payment shall be allowed or made.

3.07 EMBEDMENT OF PIPE

A. Pipeline embedment shall consist of all bedding materials, including concrete, foundation and initial backfill as shown on the Construction Drawings.

B. Class A Embedment:

1. Concrete Cradle: The pipe shall be embedded in a monolithic cradle of plain or reinforced concrete.

   a. The minimum thickness shall be one-fourth (1/4) the inside pipe diameter or a minimum of four (4") inches under the barrel and extending up the sides for a height equal to one-fourth (1/4) the outside diameter.

   b. The cradle shall have a width at least equal to the outside diameter of the pipe barrel plus eight (8") inches or poured to the full width of the trench.

2. Concrete arch: The pipe shall be embedded in carefully compacted gravel bedding with a monolithic plain or reinforced concrete arch.

   a. The gravel bedding shall have a thickness of one-fourth (1/4) the outside diameter or three (3") inches minimum between the barrel and bottom of trench excavation extending to the springline of the pipe.

   b. The concrete arch shall have a minimum thickness of one-fourth (1/4) the inside diameter at the crown and have a minimum width equal to

the outside pipe diameter plus eight (8") inches or poured to the full width of the trench.

C. Class B Embedment:

1. Class B embedment shall be used where an unstable trench bottom condition is encountered or where established by the CQA ENGINEER or where shown on the Construction Drawings.

2. The pipe shall be laid on gravel bedding placed on a flat trench.

3. The gravel bedding shall have a minimum thickness of one-fourth (1/4) the outside pipe diameter.

4. The gravel bedding shall extend to the springline of the pipe barrel, or one-half (1/2) the outside diameter of the pipe.

D. Class C Embedment:

1. Class C embedment shall be used as the normal or ordinary embedment and shall be used unless unstable trench conditions are present or where otherwise shown on the Construction Drawings.

2. The pipe shall be embedded in fine granular material on a trench bottom which shall be level in cross-section except that a continuous trough shall be shaped in the bedding which will fit the pipe barrel with reasonable closeness.

3. The bedding shall have a minimum thickness beneath the pipe of six (6") inches or one-eighth (1/8) of the outside diameter of the pipe, whichever is greater.

4. The bedding shall extend up the sides of the pipe one-sixth (1/6) of the outside diameter of the pipe.

E. Initial backfill material, which is from the bedding to one (1') foot above the pipe:

1. Shall be carefully deposited in successive horizontal layers of not more than twelve (12") inches in loose depth on each side of the pipe.

2. Shall be thoroughly and carefully tamped or rammed around the pipe with approved tools until reaching a minimum cover of not less than one (1') foot over the top of the pipe.

3.08 ALTERNATE FOUNDATIONS

A. Where the bottom of the trench is found to consist of material which is unstable to such a degree that, in the opinion of the CQA ENGINEER, it cannot be removed and replaced with an adequate bedding material, alternative foundations methods may be required.

B. The CQA ENGINEER may require, depending upon the severity of the unstable soil, to provide special foundations such as piling, concrete mats (or a combination thereof), sheeting with keyed-in plank foundation, or other means of stabilization.

C. The type of alternative foundation methods shall be constructed in accordance with the Construction Drawings or as approved by the CQA ENGINEER.

D. Should additional instructions or Detailed Drawings be required; they will be furnished in accordance with the Supplemental General Conditions.

3.09 BACKFILLING TRENCHES

A. The backfilling of sewer or other pipe line trenches shall be started immediately after the pipe work and embedment preparation has been inspected by the CQA ENGINEER.

B. Final backfill material, which if from a height of one (1') foot above the pipeline upward:

1. Shall be backfilled in well compacted layers.

2. If the trench extends along or across streets, roadways, useable alleys, or sidewalks or any areas to be paved in new construction, the remainder of the trench shall be backfilled and tamped to its full depth in the manner specified for initial backfill.

3. Shall be backfilled in the manner specified for initial backfill where indicated on the Construction Drawings.

C. Placement of backfill material in layers greater than twelve (12") inches loose fill shall require prior approval of compaction methods and equipment.

D. All backfilling shall be done in such manner as will not disturb or injure the pipe or structure over or against which it is being placed.

E. Any pipe or structure injured, damaged or moved from its proper line or grade during backfilling operations shall be opened up and repaired and then re-backfilled as herein specified.

F. Where excavation has been made, the top one (1') foot of backfill material shall consist of fine, loose earth free from large clods, vegetable matter, debris, stone, or other objectionable materials.

G. Temporary surfaces:

1. Where pipe trenches are cut across or along existing pavement, the CONTRACTOR shall construct a temporary surface over the cut by filling and tamping the upper six (6") inches of the cut with selected gravel, crushed stone or reef which will not disintegrate under traffic and which shall be maintained in good condition under traffic until the permanent pavement has been constructed.

2. No specific payment will be allowed for temporary surfacing.

3.10 COMPACTION AND TESTING

A. Compaction and testing for quality control shall be in conformance with Section 01400 and the Specific requirements of this Section.

B. Minimum tests required on all materials to prove compliance with the specifications shall be as follows:

1. A determination of soil classification, sieve analysis, maximum dry density as per ASTM D-698 and optimum moisture content shall be made from each material source.

2. In-place density test shall be made on all materials under roadways, streets, useable alleys, or other similar areas as required by the CQA ENGINEER.

C. Compaction requirements:

1. Unless otherwise specifically noted elsewhere in these Specifications or on the Construction Drawings, material shall meet the following compaction requirements.

a. Bedding and initial backfill material shall be well compacted.

b. Final backfill and embankments shall be compacted to a density equal to or greater than the surrounding undisturbed soil.

c. Compaction on total (initial & final) backfill and base material under roadways shall meet density requirements as indicated in Section 02210.

d. Embedment shall be well compacted.

2. The theoretical maximum density shall be arrived at in the manner prescribed under applicable documents.

3. Material containing excessive moisture shall not be placed.

4. Its placement may be delayed until it has dried out to the proper moisture content, or it may be thoroughly mixed with a drier material to obtain the desired water content.

5. Material with insufficient moisture shall be wetted sufficiently before compaction to obtain the desired moisture content.

6. Adequate equipment for furnishing and sprinkling water shall be kept available at all times during the progress of the work.

--END OF SECTION--

SECTION 02250

COMPACTED CLAY LINER
(SUBTITLE D BASE LINER)

PART 1 - GENERAL

1.01 SCOPE OF WORK

The CONTRACTOR shall furnish all labor, material, supervision, and equipment to complete the Clay Liner for the cell, including hauling, processing, compacting, wetting or drying, removal of rainfall and removal of all previously placed material unsuitable due to moisture or freezing conditions, final grading and sealing and all necessary and incidental items as detailed or required to complete the compacted liner, all in accordance with the plans and specifications.

1.02 QUALITY ASSURANCE

A. Quality assurance shall be in accordance with the requirements of Section 01400 Quality Control and the testing program requirements of this section.

B. A representative of the CQA ENGINEER shall be present at all times during soil liner construction activities.

PART 2 PRODUCTS

2.01 CLAY LINER MATERIAL

A. Soil that meets all of the following requirements shall be classified as select soil fill for use in construction of the secure cell soil liner.

1. Soil shall be classified according to the Unified Soil Classification System (USCS) as ML, MH, SC, CL, or CH (ASTM D2487-83). Liquid limit, plasticity index (PI), and percent passing the No. 200 sieve will be considered for proper classification.

2. Select soil fill materials shall be reasonably free of gypsum, ferrous, and/or calcareous concretions and nodules, refuse, roots, or other deleterious substances.

3. Continuous and repeated visual inspection of the materials being used will be performed by the CONTRACTOR to ensure proper soils are being used. In addition, the CQA ENGINEER shall make frequent inspections of the liner

placement operations and materials, and will consult with the site personnel on suitable liner materials and locations of such.

4. The low permeability soil liner shall be compact, uniform, smooth, and substantially free of debris, rock, plant materials, and other foreign material. The clay liner shall meet the following criteria:

UPPER 6" CLAY LINER

Percentage of Material Passing (by weight)	Screen Size
95% (all tests)	1"
100% (avg. of all tests)	3"

LOWER 18" CLAY LINER

Percentage of Material Passing (by weight)	Screen Size
100% (avg. of all tests)	3"

PART 3 - EXECUTION

3.01 TEST PAD

A. A test pad shall be constructed prior to beginning installation of the clay liner. A separate pad shall be constructed for each soil exhibiting a significant change in material properties as determined by the CQA ENGINEER

B. The test pad shall be constructed at a location selected by the CQA ENGINEER. The location, subgrade slope, equipment, liner thickness, lift thickness, and subgrade condition shall be representative of full scale construction. The test pad shall be constructed in accordance with Section 3.03.

C. The test pad shall have a minimum surface area of 600 square feet (± 20' x 30') or as directed by the CQA ENGINEER. For each of four (4) lifts, a minimum of three test locations shall be established for testing moisture content, density and a composite sample for recompacted lab permeability. At least one shelby tube sample for lab permeability testing shall be obtained per lift.

D. Acceptance and rejection criteria shall be verified in accordance with the tests specified for full scale construction.

3.02 SUBBASE PREPARATION

A. The 6" in-situ clay liner subbase for the clay liner shall be compacted to 95% (or as otherwise directed by the CQA ENGINEER) as determined by the Standard Proctor

Test, ASTM D698. The clay liner subbase shall be free of rocks, roots, stumps, and other debris.

3.03 CONSTRUCTION OF CLAY LINER

A. Select soil fill lift thickness (after compaction) shall be no greater than 6". Thinner lifts are permissible to achieve design grade.

B. Prior to compaction, each lift of select clay liner material shall be thoroughly processed to uniformly distribute moisture and natural in-place stratification and reduce clod size.

C. After scarifying, representative samples will be taken by the CQA ENGINEER and tested for moisture content prior to any compactive efforts. If the moisture content is within the range specified in subparagraph F below, compaction may begin. If the moisture content is outside of this range, the select soil fill will be wetted or dried and reworked accordingly. The select fill should be sprinkled or sprayed with water (from a water truck) and dozed, wind-rowed, and/or disc-plowed, tilled or processed, to uniformly increase the moisture content of the soil if the material is below the required moisture content. The select soil fill should be dozed, wind-rowed, and/or disc-plowed, tilled or processed, to help air dry the soil if the moisture content is too high.

D. Each lift will be thoroughly compacted and must satisfy moisture and density controls through field testing before a subsequent lift is placed.

E. Compaction of lifts shall be as follows:

1. Compaction of lifts shall be performed with an appropriately heavy, properly ballasted penetrating-foot compactor (such as a CAT 815 or equivalent) subject to approval of the CQA ENGINEER. A minimum of six passes will be required on each lift regardless of whether the lift meets density specifications. A pass is defined as one trip of the compacting equipment over the lift and back to the starting point by a single drum roller or one trip across the lift surface from one side to the other if the compacting equipment has front and back compacting rollers. This requirement is to allow thorough remolding of the soil by kneading action and to reduce clod size. Clod size shall not exceed one-half of the lift thickness. The final lift shall have clods no larger than one inch.

2. The daily work area shall extend a distance no greater than necessary to maintain moist soil conditions (facilitate bonding) and continuous operations. Desiccation and crusting of the lift surface shall not be allowed. The surface shall be continuously sprinkled with water as necessary for maintenance.

3. If desiccation and crusting of the lift surface occurs before placement of the next lift, this area shall be sprinkled with water and then scarified and tested for water content to ensure uniform moisture and density before placement of a subsequent lift.

4. Transition from full depth liner to beginning of adjacent new section shall be accomplished by sloping (cutting back) the end of a full depth section at 5H:1V (horizontal to vertical) or flatter for tying in a new lift.

5. The cell bottom shall be constructed initially and completed over the width of the base before beginning the slope. The transition between the bottom and side slopes shall be accomplished by compacting parallel to the slope by running up and down the slope.

6. Dozer or scraper equipment shall not be used for primary compaction efforts, except as specified in subparagraph C above.

F. During compaction, the placement clay moisture content and dry density shall be maintained within the limits specified below.

1. To confirm that the moisture content and dry density requirements of the compacted soil are being satisfied, field drive tube (ASTM D2937) or nuclear gage (ASTM D2922) tests shall be made at locations designated by the CQA ENGINEER at the frequency specified in Section II.G. of the CQA Manual.

2. Compaction moisture content shall be at least 2 percent wet of OMC or wetter as required by the CQA ENGINEER. Should wetter material be used, the CQA ENGINEER may allow density reduction as appropriate.

G. The select fill shall be compacted to a minimum dry density of 95 percent (or as determined by test strip) of the maximum dry density determined by the Standard Proctor Test, ASTM D698. Densities less than 95 percent of the maximum dry density determined from the Standard Proctor Test shall be recompacted and/or removed and reworked to meet density objectives. In addition, the compacted materials dry density/moisture content shall lie within the 90 percent saturation line, to be established from tested specific gravities.

H. The clay liner shall have permeability of $k \leq 1.0 \times 10^{-7}$ cm/sec as determined by ASTM D5084-90. One (1) sample per acre per each lift of clay liner component will be selected by the CQA ENGINEER for permeability testing (ASTM D5084-90).

I. No select fill shall be placed or compacted during sustained periods of temperatures below 32°F. Select fill may not be placed during freezing conditions.

J. During construction, finished lifts or sections of clay liner must be sprinkled with water as needed to prevent drying and desiccation.

K. At the end of each construction day's activities, completed lifts or sections of clay liner shall be sealed by rolling with a rubber tired or smooth drum rollers and sprinkled with water as needed.

L. The clay liner shall be 24 inches thick across the bottom and sideslopes of the cell. Thickness of the clay liner on the sideslopes shall be measured perpendicular to the slope face.

M. Perforations in the clay liner resulting from sampling or testing procedures, survey stakes or other activities shall be identified and backfilled by the CQA ENGINEER. The perforations shall be filled with a soil-bentonite mix consisting of 10% minimum by weight bentonite powder or granules mixed with clay liner material. The perforations shall be backfilled with the soil-bentonite mixture in 3-inch loose lifts and thoroughly compacted by hand tamping by the CQA ENGINEER.

N. The as-built thickness of the clay liner shall be determined by non-destructive survey methods as described below. Samples of the in-place clay liner shall be tested and evaluated prior to acceptance.

O. After completion of a segment (one landfill cell) of clay liner, but before installation of the geomembrane liner, the surface of the clay liner shall be surveyed to ensure:

1. The specified thickness of clay liner has been achieved.

2. The top of the clay liner slopes diagonally across the cell toward the collection assembly at grades specified on the Contract Drawings; and

3. The top of the clay liner in the collection assembly area is at the grades and elevations specified on the Contract Drawings.

Clay liner placed beyond the limits of the lines and grades as shown on the Contract Drawings will not be accepted and must be removed at the CONTRACTOR's expense. Such material which has been determined suitable for liner construction may be re-incorporated into liner if needed.

This work shall be performed by a Surveyor registered in the State the services will be performed in and shall be provided by the OWNER.

--END OF SECTION--

SECTION 02251

LOW PERMEABILITY SOIL LINER
(ALTERNATE BASE LINER)

PART 1 GENERAL

1.01 SCOPE OF WORK

The CONTRACTOR shall furnish all labor, supervision, and equipment to complete the Compacted Soil Liner for the cell, including hauling, discing, compacting, drying, removal of rainfall and removal of all previously placed material unsuitable due to weather conditions, final grading and sealing and all necessary and incidental items as detailed or required to complete the compacted soil liner, all in accordance with the plans and specifications.

1.02 QUALITY ASSURANCE

A. Quality assurance shall be in accordance with the requirements of Section 01400 Quality Control and the testing program requirements of this section.

B. A representative of the CQA ENGINEER shall be present at all times during compacted soil liner construction activities.

1.03 MEASUREMENT AND PAYMENT

Not applicable.

PART 2 PRODUCTS

2.01 COMPACTED SOIL LINER MATERIAL

A. The soils used in compacted soil liners shall meet the following minimum criteria:

1. Reasonably free of oversized particles, such as rocks, roots, limbs, and other foreign substances which would alter the design integrity of the liner (this will require screening by the CONTRACTOR to remove all particles equal to or greater than one-half the lift thickness),

2. Classified under the Unified Soil Classification System as MH, ML, CL, CH or SC (ASTM Standard D2 487-69), and

3. Allow greater than 30 percent passage through a No. 200 sieve (ASTM Test D-1140).

4. The compacted soil liner shall be compact, uniform, smooth, and reasonably free of debris, rock, plant materials, and other foreign material. The compacted soil liner shall be in accordance with the following criteria::

UPPER 6" SOIL LINER

Percentage Of Material Passing (by weight)	Screen Size
95% (all tests)	1"
100% (avg. of all tests)	3"

LOWER 12" SOIL LINER

Percentage Of Material Passing (by weight)	Screen Size
100% (avg. of all tests)	3"

PART 3 EXECUTION

3.01 SUB-GRADE PREPARATION

A. The 6" in-situ subgrade for the compacted soil liner shall be compacted to 95% as determined by the Standard Proctor Test, ASTM D698. The subgrade shall be substantially free of rocks, roots, stumps, and other debris.

3.02 TEST PAD

A. The test pad shall be constructed prior to beginning installation of the compaction soil liner. A separate pad shall be constructed for each soil exhibiting a significant change in material properties as determined by the CQA ENGINEER.

B. The test pad shall be constructed at a location selected by the CQA ENGINEER. The location, subgrade slope, equipment, liner thickness, lift thickness, and subgrade condition shall be representative of full scale construction. The test pad shall be constructed in accordance with Section 3.03.

C. The test pad shall have a minimum surface area of 600 square feet (± 20' x 30') or as directed by the CQA ENGINEER. For each of the three (3) lifts, a minimum of three (3) test locations shall be established for testing moisture content, density, and a composite sample for recompacted lab permeability. At least one (1) shelby tube sample for lab permeability testing shall be obtained per lift.

D. Acceptance and rejection criteria shall be verified in accordance with the tests specified for full scale construction.

3.03 CONSTRUCTION OF COMPACTED SOIL LINER

A. Select soil fill lift thickness (after compaction) shall be no greater than 6 in. Thinner lifts are permissible to achieve design grade.

B. Prior to compaction, each lift of select soil fill material shall be thoroughly disced. Equipment or truck trafficking of the surface shall not be permitted during the period between scarifying and placement of the following lift.

C. After scarifying, representative samples will be taken by the CQA ENGINEER and tested for moisture content prior to any compactive efforts. If the moisture content is within the range specified in F below, compaction may begin. If the moisture content is outside of this range, the select soil fill will be wetted or dried and reworked accordingly. The select fill should be sprinkled or sprayed with water (from a water truck) and dozed, wind-rowed, and/or disc-plowed to uniformly increase the moisture content of the soil if the material is below Optimum Moisture Content (OMC). The select soil fill should be dozed, wind-rowed, and/or disc-plowed to help air dry the soil if the moisture content is too high.

D. Each lift will be thoroughly compacted and must satisfy moisture and density controls through field testing before a subsequent lift is placed.

E. Compaction of lifts shall be as follows:

1. Compaction of lifts shall be performed with an appropriately heavy, properly ballasted penetrating-foot compactor (such as a CAT 815 or equivalent) subject to approval of the CQA ENGINEER. A minimum of six (6) passes will be required on each lift regardless of whether the lift meets density specifications. A pass is defined as one trip of the compacting equipment over the lift and back to the starting point by a single drum roller or one trip across the lift surface from one side to the other if the compacting equipment has front and back compacting rollers. This requirement is to allow thorough remolding of the soil by kneading action and to reduce clod size. Clod size shall not exceed one-half of the lift thickness. The final lift shall have clods no larger than one (1) inch.

2. The daily work area shall extend a distance no greater than necessary to maintain moist soil conditions (facilitate bonding) and continuous operations. Desiccation and crusting of the lift surface shall be avoided as much as possible.

3. If desiccation and crusting of the lift surface occurs before placement of the next lift, this area shall be sprinkled with water and then scarified and tested for water content to ensure uniform moisture before placement of a subsequent lift.

4. Transition from full depth liner to beginning of adjacent new section shall be accomplished by sloping (cutting back) the end of a full depth section at 5H:1V (horizontal to vertical) or flatter for tying in a new lift.

5. The cell bottom shall be constructed initially and completed over the width of the base before beginning the slope. The transition between the bottom and side slopes shall be accomplished by compacting parallel to the slope by running up and down the slope.

6. Dozer or scraper equipment shall not be used for primary compaction efforts, except as specified in (C.) above.

F. During compaction, the placement soil moisture content and dry density shall be maintained within the limits specified below.

1. To confirm that the moisture content and dry density requirements of the compacted soil are being satisfied, field drive tube (ASTM D2937) or nuclear gage (ASTM D2922) tests shall be made at locations designated by the CQA ENGINEER at the frequency specified in Section II.G. of the CQA Manual.

2. Compaction moisture content shall be at least 2 percent wet of OMC or wetter as required by the CQA ENGINEER. Should wetter material be used, the CQA ENGINEER may allow density reduction as appropriate.

G. The select fill shall be compacted to a minimum dry density of 95 percent (or as determined by test strip) of the maximum dry density determined by the Standard Proctor Test, ASTM D698. Densities less than 95 percent of the maximum dry density determined from the Standard Proctor Test shall be recompacted and/or removed and reworked to meet density objectives. In addition, the compacted materials dry density/moisture content shall lie within the 90 percent saturation line, to be established from tested specific gravities.

H. The compacted soil liner shall have a permeability of $k \leq 1.0 \times 10^{-5}$ cm/sec as determined by ASTM D5084-90. One (1) sample per acre per each lift of compacted clay liner component will be selected by the CQA ENGINEER for permeability testing (ASTM D5084-90).

I. No select fill shall be placed or compacted during sustained period of temperatures below 30°F. Select fill <u>may</u> be placed and compacted during periods of early morning and evening freezing temperatures with warming trends above freezing during the day.

J. During construction and until the GCL is placed, finished lifts or sections of compacted soil liner must be sprinkled with water as needed to prevent drying and desiccation.

K. At the end of each construction day's activities, completed lifts or sections of compacted soil liner shall be sealed by rolling with a rubber tired or smooth drum rollers and sprinkled with water as needed.

L. The compacted soil liner shall be 18 inches thick across the bottom and up the sideslopes of the cell. Thickness of the soil liner on the sideslopes shall be measured perpendicular to the slope face.

M. Perforations in the compacted soil liner resulting from sampling or testing procedures, survey stakes or other activities shall be identified and backfilled by the CQA ENGINEER. The perforations shall be filled with a soil-bentonite mix consisting of 10% minimum by weight bentonite powder or granules mixed with soil liner material. The perforations shall be backfilled with the soil-bentonite mixture in 3-inch loose lifts and thoroughly compacted by hand tamping by the CQA ENGINEER.

N. The as-built thickness of the compacted soil liner shall be determined by non-destructive survey methods as described below. Samples of the in-place compacted soil liner shall be tested and evaluated prior to acceptance.

O. After completion of a segment of compacted soil liner, but before installation of the geosynthetic clay liner (GCL), the top of the soil shall be surveyed to ensure:

1. The specified thickness of compacted soil liner has been achieved.

2. The top of the compacted soil liner slopes diagonally across the cell toward the collection assembly at grades specified on the Contract Drawings; and

3. The top of the compacted soil liner in the collection assembly area is at the grades and elevations specified on the Contract Drawings.

Compacted soil liner placed beyond the limits of the lines and grades as shown on the Contract Drawings will not be accepted and must be removed at the CONTRACTOR's expense. Such material which has been determined suitable for liner construction may be re-incorporated into liner if needed.

This work shall be performed by a surveyor registered in the State of North Carolina the services of whom shall be provided by the OWNER.

--END OF SECTION--

SECTION 02252

PROTECTIVE SOIL COVER ON LANDFILL CAP

PART 1 GENERAL

1.01 SCOPE OF WORK

The CONTRACTOR shall furnish all labor, material, supervision, and equipment to install the Protective Soil Cover on the Landfill Cap, including hauling, spreading and final grading and all necessary and incidental items as detailed or required to complete the cover, all in accordance with the plans and specifications.

PART 2 PRODUCTS

2.01 SOIL COVER MATERIAL

A. Soil that meets all of the following requirements shall be classified as select soil fill for use in construction of the secure cell soil cap.

1. Soil shall be classified according to the Unified Soil Classification System (USCS) as SC, ML, MH, CH, or CL (ASTM D2487). Liquid limit, plasticity index (PI), and percent passing the No. 200 sieve will be considered for proper classification.

2. Select soil fill materials shall be reasonably free of gypsum, ferrous, and/or calcareous concretions and nodules, refuse, roots, or other deleterious substances.

3. Continuous and repeated visual inspection of the materials being used will be performed by the CONTRACTOR to ensure proper soils are being used. In addition, the CQA ENGINEER shall make frequent inspections of the placement operations and materials, and will consult with the site personnel on suitable materials and locations of such.

4. The lower 18" of protective soil cover shall be uniform, smooth, and free of debris, rock, plant materials, and other foreign material larger than 3 inches in diameter. The material should contain no sharp edges.

5. The top 6" of soil cover must be capable of supporting growth of vegetative cover.

PART 3 EXECUTION

3.01 CONSTRUCTION OF SOIL COVER

A. Soil for the cover shall be placed and spread with light weight rubber tired or track equipment. When spreading the soil shall be stockpiled at depths of a minimum four feet and thence spread to the thickness indicated utilizing light weight rubber tired or track equipment so as not to damage the geonet or geomembrane.

B. The soil cover shall be a total of 24" thick. On slopes the thickness shall be measured perpendicular to the slope of face.

C. After completion of the soil cover the cap shall be surveyed, or measured with on-site GPS to ensure the specified thickness has been achieved.

D. Soil berms should be compacted to 95% dry density standard proctor.

E. After the specified soil cover thickness has been achieved and verified the CONTRACTOR shall proceed immediately with the grassing.

F. Any damage to the geomembrane and/or GDM shall be repaired in accordance with Section 02755 – Geomembrane (FML) Cap and under the direction of the CQA ENGINEER.

--END OF SECTION--

SECTION 02253

PROTECTIVE COVER – ON BASE LINER - NATIVE SOIL

PART 1 - GENERAL

1.01 SCOPE OF WORK

This section covers the material and placement of the protective cover system for the base liner system.

1.02 QUALITY ASSURANCE

A. Quality assurance shall be in accordance with the requirements of Section 01400 Quality Control and the testing program requirements of this section.

B. A representative of the CQA ENGINEER shall be present at all times during soil cover construction activities.

1.03 RELATED WORK

A. Section 02747 - Leachate Collection System

PART 2 - PRODUCTS

2.01 SOIL COVER MATERIAL

A. Soil that meets all of the following requirements shall be classified as select protective cover native sandy soils for use in construction of the liner protective cover.

1. Soil shall be classified according to the United Soil Classification System (USCS) as SW, SP, SM, or SC (ASTM D2487-83). Liquid limit, plasticity index (PI), and percent passing the No. 200 sieve will be considered for proper classification.

   Construction Quality Assurance shall meet the following minimum requirements:

Test	Minimum Frequency	Criteria
Permeability (ASTM D2434)	3,000 yd^3	$k \geq 1x10^{-3}$ cm/sec

2. Soil materials shall be reasonably free of gypsum, ferrous, and/or calcareous concretions and nodules, refuse, roots, or other deleterious substances.

3. Continuous and repeated visual inspection of the materials being used will be performed by the CQA ENGINEER to ensure proper soils are being used. In addition, the CQA ENGINEER shall make frequent inspections of the placement operations and materials, and will consult with the site personnel on suitable materials and locations of such. All material shall be taken from select sources or stockpiles.

4. The protective cover native sandy soils shall be uniform, smooth, and reasonably free of debris, rock, plant materials, and other foreign material larger than ¾ inch in diameter. The material should contain no sharp edges.

PART 3 - EXECUTION

3.01 CONSTRUCTION OF PROTECTIVE COVER

A. Soil for the cover shall be placed and spread with light weight rubber-tired or tracked equipment. All tracked equipment used in placement of the protective soil cover shall be low ground pressure equipment having a ground contact pressure less than 6 psi. Tracked equipment must be operated in such a manner that sharp turns that cause dragging of the tracks over the protective cover are minimized. Haul trucks delivering sand or stone to the cell shall operate over a minimum thickness of 4 feet of protective cover while in the cell. When spreading, the soil shall be stockpiled at depths of a minimum four feet and thence spread to the thickness indicated utilizing light weight rubber-tired or track equipment, so as not to damage the low permeability soil liner, geomembrane, geotextile, or leachate collection system piping.

B. The soil cover on the floor and side slopes shall be 24 inches thick. The thickness shall be measured perpendicular to the slope of face.

C. After completion of the protective cover, the protective cover system shall be surveyed to ensure the specified thickness has been achieved.

--END OF SECTION--

SECTION 02260

COMPACTED SOIL CAP

PART 1 GENERAL

1.01 SCOPE OF WORK

The CONTRACTOR shall furnish all labor, material, supervision, and equipment to construct the Compacted Soil Cap (infiltration layer) for the cell, including hauling, discing, compacting, drying, removal of rainfall and removal of all previously placed material unsuitable due to weather conditions, final grading and sealing and all necessary and incidental items as detailed or required to complete the compacted cap, all in accordance with the plans and specifications.

1.02 QUALITY ASSURANCE

A. Quality assurance shall be in accordance with the requirements of Section 01400 Quality Control and the testing program requirements of this section.

B. A representative of the CQA ENGINEER shall be present at all times during the soil cap construction activities.

PART 2 PRODUCTS

2.01 SOIL CAP MATERIAL

A. Soil that meets all of the following requirements shall be classified as select soil fill for use in construction of the secure cell compacted soil cap.

1. Soil shall be classified according to the Unified Soil Classification System (USCS) as SC, ML, MH, CH, or CL (ASTM D2487-83). Liquid limit, plasticity index (PI), and percent passing the No. 200 sieve will be considered for proper classification.

2. Select soil fill materials shall be reasonably free of gypsum, ferrous, and/or calcareous concretions and nodules, refuse, roots, or other deleterious substances.

3. Continuous and repeated visual inspection of the materials being used will be performed by the CONTRACTOR to ensure proper soils are being used. In addition, the CQA ENGINEER shall make frequent inspections of the cap placement operations and materials, and will consult with the site personnel on suitable cap materials and locations of such.

PART 3 EXECUTION

3.01 TEST PAD

A test strip may be constructed using the same construction methods, equipment and material to be used for the compacted soil cap. The test fill construction must precede the beginning of placement of the compacted soil cap by a minimum of two (2) weeks. Samples from the test strip must exhibit a permeability of $k \leq 1.0 \times 10^{-5}$ cm/sec.

3.02 CONSTRUCTION OF COMPACTED SOIL CAP

A. Select soil fill lift thickness (after compaction) shall be no greater than six (6") inches. Thinner lifts are permissible to achieve design grade after first lift.

B. Prior to compaction, each lift of select soil fill material shall be thoroughly disced. Equipment or truck trafficking on the surface shall not be permitted during the period between scarifying and placement of the following lift.

C. After scarifying, representative samples will be taken by the CQA ENGINEER and tested for moisture content prior to any compactive efforts. If the moisture content is within the range specified in subparagraph F below, compaction may begin. If the moisture content is outside of this range, the select soil fill will be wetted or dried and reworked accordingly. The select fill should be sprinkled or sprayed with water (from a water truck) and dozed, wind-rowed, and/or disc-plowed to uniformly increase the moisture content of the soil if the material is below Optimum Moisture Content (OMC). The select soil fill should be dozed, wind-rowed, and/or disc-plowed to help air dry the soil if the moisture content is too high.

D. Each lift will be thoroughly compacted and must satisfy moisture and density controls through field testing before a subsequent lift is placed.

E. Compaction of lifts shall be as follows:

1. Compaction of lifts shall be performed with an appropriately heavy, properly ballasted penetrating-foot compactor (such as a CAT 815 or equivalent) subject to approval of the CQA ENGINEER. A minimum of six (6) passes will be required on each lift regardless of whether the lift meets density specifications. A pass is defined as one (1) trip of the compacting equipment over the lift and back to the starting point by a single drum roller or one trip across the lift surface from one side to the other if the compacting equipment has front and back compacting rollers. This requirement is to allow thorough remolding of the soil by kneading action.

2. The daily work area shall extend a distance no greater than necessary to maintain moist soil conditions (facilitate bonding) and continuous operations. Desiccation and crusting of the lift surface shall be avoided as much as possible.

3. If desiccation and crusting of the lift surface occurs before placement of the next lift, this area shall be sprinkled with water and then scarified and tested for water content to ensure uniform moisture before placement of a subsequent lift.

4. Transition from full depth cap to beginning of adjacent new section shall be accomplished by sloping (cutting back) the end of a full depth section at 5H:1V (horizontal to vertical) or flatter for tying in a new lift.

5. Dozer or scraper equipment shall not be used for primary compaction efforts, except as specified in subparagraph C above.

F. During compaction, the placement soil moisture content and dry density shall be maintained within the limits specified below.

1. To confirm that the moisture content and dry density requirements of the compacted soil are being satisfied, field and laboratory tests on shelby tube samples shall be made at locations designated by the CQA ENGINEER and at the frequency specified in the CQA Manual.

2. Compaction moisture content shall be at least two (2%) percent wet of OMC or wetter as required by the CQA ENGINEER.

G. The select fill shall be compacted to a minimum dry density of 95 percent (or as determined by test strip) of the maximum dry density determined by the Standard Proctor Test, ASTM D698. Densities less than 95 percent of the maximum dry density determined from the Standard Proctor Test shall be recompacted and/or removed and reworked to meet density objectives. In addition, the compacted materials dry density/moisture content shall lie within the 90 percent saturation line, to be established from tested specific gravities.

H. The compacted soil cap shall have a maximum permeability of $k \leq 1.0 \times 10^{-5}$ cm/sec as determined by ASTM D5084-90.

I. No select fill shall be placed or compacted during sustained period of temperatures below 30° F. Select fill <u>may</u> be placed and compacted during periods of early morning and evening freezing temperatures with warming trends above freezing during the day.

J. During construction, finished lifts or sections of compacted soil cap must be sprinkled with water as needed to prevent drying and desiccation.

K. At the end of each construction day's activities, completed lifts or sections of compacted soil cap shall be sealed by rolling with a rubber tired or smooth drum rollers and sprinkled with water as needed.

L. The compacted soil cap shall be 18" thick.

M. Perforations in the compacted soil cap resulting from sampling or testing procedures, survey stakes or other activities shall be identified and backfilled by the CQA ENGINEER. The perforations shall be filled with a soil-bentonite mix consisting of 10% minimum by weight bentonite powder or granules mixed with soil cap material. The perforations shall be backfilled with the soil-bentonite mixture in 3-inch loose lifts and thoroughly compacted by hand tamping by the CQA ENGINEER.

N. The as-built thickness of the compacted soil cap shall be determined as described below. Samples of the in-place compacted soil cap shall be tested and evaluated prior to acceptance.

O. After completion of the compacted soil cap, but before installation of the vegetative growth soil, the cap shall be surveyed or measured with on-site GPS to ensure:

1. The specified thickness of compacted soil cap has been achieved.

2. The top of the soil cap slopes at grades specified on the Construction Drawings.

--END OF SECTION--

SECTION 02720

STORM SEWER SYSTEM

PART 1 GENERAL

1.01 WORK INCLUDED

A. Installation of storm sewer lines, flared end sections and other appurtenances.

1.02 RELATED WORK

A. Section 02220 - Trenching, Backfilling and Compaction

B. Construction Drawings and General Provisions of Contract, including General and Supplementary Conditions, Special Conditions, and Detailed Specification Sections, apply to work specified in this section.

PART 2 PRODUCTS

2.01 REINFORCED CONCRETE PIPE (RCP)

Reinforced concrete pipe used for the drainage system shall conform to AASHTO Specifications M-170 and ASTM C76. Diameter and class of pipe shall be as indicated.

2.02 JOINT MATERIAL

Joint material shall be as manufactured by Ram-Nek or equal, and which meets or exceeds all requirements of Federal Specifications SS-S-00210 "Sealing Compound, Preformed Plastic for Pipe Joints, Type I, Rope Form".

2.03 DROP INLETS AND HEADWALLS

Drop inlets and headwalls shall be in accordance with the details in the Construction Drawings.

2.04 ALUMINUM CARRIER PIPE

Corrugated aluminum pipe for carrier pipe and riser pipe shall have annular – corrugated interior and exterior and shall meet the requirements of AASHTO M196.

2.05 CORRUGATED POLYETHYLENE PIPE (CPEP)

Corrugated Polyethylene Pipe for downdrains shall have an annular - corrugated exterior and a smooth interior and shall meet the requirements of AASHTO M294 Type S. Joints shall have silt-tight (gasketed) connections incorporating a rubber gasket meeting the requirements of ASTM D1056 Grade 2A2. Fittings shall conform to AASHTO M294. Pipe and fitting material shall be high density polyethylene meeting the requirements of ASTM D3350 Cell Classification 324420C.

PART 3 EXECUTION

3.01 PIPE INSTALLATION

Pipe shall be protected during handling against impact shocks and free fall. The pipe shall be laid so as to produce a straight line of pipe on a uniform grade, each pipe laid to form a closed joint with the preceding pipe and so as to form a smooth inside flow line.

--END OF SECTION--

SECTION 02745

LEACHATE PIPING

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. This section covers the materials and the installation of all leachate piping.

1.02 RELATED WORK

A. Section 02220 - Trenching, Backfilling and Compaction
Section 02747 - Leachate Collection System

B. Construction Drawings and General Provisions of Contract, including General and Supplementary Conditions, and Detailed Specification Sections, apply to work specified in this section.

1.03 QUALITY ASSURANCE

Quality Assurance shall be in accordance with Section 01400, Quality Control and the Construction Quality Assurance Manual.

1.04 APPLICABLE PUBLICATIONS AND STANDARDS

American Society for Testing and Materials (ASTM Publications)

ASTM D256	Test Methods For Impact Resistance of Plastics and Electrical Insulating Materials
ASTM D638	Test Method For Tensile Properties of Plastics
ASTM D696	Test Method For Coefficient of Line at Thermal Expansion of Plastics
ASTM D746	Test Method For Brittleness Temperature of Plastics and Elastomers By Impact
ASTM D1238	Test Method For Flow Rates of Thermoplastics By Extrusion Plastometer
ASTM D1248	Polyethylene Plastics Molding and Extrusion Materials

ASTM D1505	Test Method For Density of Plastics By The Density-Gradient Technique
ASTM D1525	Test Method For Vicat Softening Temperature of Plastics
ASTM D1693	Test Method For Environmental Stress Cracking of Ethylene Plastics
ASTM D2240	Test Method For Rubber Property - Durometer Hardness
ASTM D2321	Underground Installation of Flexible Thermoplastic Sewer Pipe
ASTM D2412	External Loading Properties of Plastic Pipe by Parallel - Plate Loading
ASTM D2837	Obtaining Hydrostatic Design Basis For Thermoplastic Pipe Materials
ASTM D3350	Polyethylene Plastics Pipe and Fittings Materials also Gasket for push-on Joints

1.05 SUBMITTAL REQUIREMENTS

A. All submittals shall be clearly marked as to what is being provided. Submittals not so marked shall be returned. CONTRACTOR shall submit shop drawings with the following information on each of the pipe types provided:

1. indicate compliance with applicable ASTM standard
2. unit weight
3. SDR
4. diameter
5. physical dimensions
6. method of jointing with instructions
7. nominal pipe joint lengths
8. recommended bedding and installation details
9. instructions and tables or information on strength of each pipe type versus bury conditions of depth and traffic loadings

B. Manufacturer's certificate of compliance.

The DESIGN ENGINEER requires certified lab data from the manufacturer to verify the physical properties of the materials supplied under this specification and at the OWNER's expense may take random samples for testing by an independent laboratory. The DESIGN ENGINEER requires certification that the pipe produced is represented by the quality assurance data.

PART 2 PRODUCTS

2.01 PIPE SCHEDULE

FUNCTION	SDR	DIAMETER	TYPE	MINIMUM PIPE LENGTH
Perforated Leachate Collection Pipe	11	8"	HDPE Smooth Wall	40 Feet
Solid Leachate Collection Pipe	11	8"	HDPE Smooth Wall	40 Feet
Force Main	11 11	3"- 6" Carrier 6"- 10" Container	HDPE Dual Containment	40 Feet
Sump Riser	11	24"	HDPE Smooth Wall	40 Feet
Miscellaneous Piping	As Noted on Construction Drawings			

2.02 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

A. Pipe and Fittings Resin

The pipe supplied under this specification shall be high performance, very high molecular weight, high density polyethylene pipe. All pipe and fitting resins shall be manufactured by the same company which manufactures the pipe itself in accordance with these specifications to ensure complete resin compatibility and total product accountability. The fittings supplied under this specification shall be molded or manufactured from a polyethylene compound having a cell classification equal to or exceeding the compound used in the pipe.

B. Resin physical properties shall comply with the Plastic Pipe Institute (PPI) recommended material Designation PE 3408 and conform to Material Cell Classification (ASTM D3350) or 345464C.

C. Standards

Polyethylene pipe and fittings shall meet all the requirements of NSF listed pipe but are not required to be NSF listed.

D. Quality Control

The resin used for the manufacture of the pipe shall be manufactured by the pipe manufacturer, thus maintaining complete control of the pipe quality. The pipe shall contain no recycled compound except that which is generated in the manufacturer's own plant form the same raw material. The pipe shall be homogenous throughout and free of visible cracks, holes, foreign inclusions, or other deleterious defects, and shall be identifiable in color, density, melt flow and other physical properties throughout.

The polyethylene resin used shall have all ingredients precompounded prior to extrusion of pipe. In-plant blending is not acceptable.

The DESIGN ENGINEER requires certification that the pipe produced is represented by the quality assurance data. Additionally, test results from the manufacturer's testing which show the pipe does not meet appropriate ASTM standards of manufacturer's representation, will be cause for rejection of the pipe represented by the testing. These tests may include density and flow rate measurements form samples taken at selected locations within the pipe wall and thermal stability determinations according to ASTM 3350, 10.1.9.

E. The CQA ENGINEER requires certified lab data from the manufacturer to verify the physical properties of the materials supplied under this specification and at OWNER's expense may take random samples for testing by an independent laboratory.

F. Rejection

Polyethylene pipe and fittings which do not meet the requirements of this specification shall be rejected.

G. Perforations shall be as detailed, factory machined and trimmed by the manufacturer or pipe supplier in the shop under controlled conditions. No pipe perforating will be allowed in the field. All perforated pipe shall be free of trimmings and debris when delivered and prior to installation.

2.03 VALVES

A. Gate valves shall be ASAHI Type O or equal.

PART 3 EXECUTION

3.01 PIPE INSTALLATION

A. All pipe shall be installed in accordance with the manufacturer's recommendations and the requirements of these specifications.

B. Perforations shall be constructed by the manufacturer as detailed in the Construction Drawings no field perforating will be allowed. Perforated leachate pipe shall be laid in the trench as detailed in the Construction Drawings. The CQA ENGINEER shall be allowed to review the perforated leachate pipe prior to backfill and prior to acceptance for payment.

C. The pipe interior shall be kept clean before and after laying. Pipe shall be kept clean before installation by proper storage and handling. After installation by proper storage and handling, pipe shall be encapsulated in geotextile fabric and covered with stone. Any open pipe ends shall be plugged and covered with clean fabric.

3.02 HANDLING OF PIPE

A. Pipe shall be stored on clean, level ground to prevent undue scratching and gouging of the pipe. Polyethylene pipe shall be protected from direct sunlight. If the pipe must be stacked for storage, such stacking shall be done in accordance with the pipe manufacturer's recommendations. The handling of polyethylene pipe shall be done in such a manner that it is not damaged by dragging over sharp objects or cut by chokers or lifting equipment.

3.03 REPAIR OF DAMAGED SECTIONS

A. Polyethylene Pipe (HDPE)

Sections of polyethylene pipe having cuts or gouges in excess of 10% of the wall thickness of the pipe shall be removed. New polyethylene pipe section shall be rejoined using the butt fusion joining method. It is the DESIGN ENGINEER's intent to reduce the number of joints. The CQA ENGINEER shall reject pipe installations where in his opinion installation methodology of CONTRACTOR does not meet this objective.

3.04 PIPE JOINING

A. Perforated and Non-Perforated Leachate Pipe (HDPE)

Sections of polyethylene pipe and fittings shall be joined into continuous lengths on the job site above ground. The joining method shall be the butt fusion method and shall be performed by qualified persons and in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures shall be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements, alignment and fusion pressures. Pipe will be fused at approximately 500°F with 150 psi fusion pressure. On a case by case basis, when approved by the DESIGN ENGINEER, piping may be connected to structures and prefabricated sections with couplings (e.g. electrofusion couplings).

3.05 HANDLING OF FUSED PIPE

Fused segments of polyethylene pipe shall be handled so as to avoid damage to the pipe. When lifting fused sections of pipe, chains or cable type chokers must be avoided. Nylon slings are required. Spreader bars are recommended when lifting long fused sections. Care shall be exercised to avoid cutting or gouging the pipe.

3.06 TRENCHING AND BACKFILL

Leachate collection pipe shall be laid as detailed in the Construction Drawings. Force main and gravity pipe (outside the cell) shall be laid in accordance with Section 02220 – Trenching, Backfill and Compaction.

3.07 HDPE PIPE CLEANOUTS

HDPE pipe cleanouts shall be installed as detailed on the Construction Drawings.

3.08 INSPECTION AND ACCEPTANCE

All work shall be subject to inspection and approval prior to final acceptance and payment. Final acceptance shall be contingent upon the following:

A. OWNER accepts polyethylene pipe installation when the installation is finished, all testing results are satisfactory, installation documentation and site inspection is completed, and pipes have been flushed.

B. CONTRACTOR shall clean by water flushing all HDPE pipe beginning at cleanouts. Lines shall be flushed until completely free of debris. CONTRACTOR shall recover and remove all debris from system and dispose of in an environmentally safe manner.

C. Final cleanup shall meet the approval of the CQA ENGINEER and the OWNER.

--END OF SECTION--

SECTION 02747

LEACHATE COLLECTION SYSTEM

PART 1 GENERAL

1.01 SCOPE OF WORK

The Contractor shall furnish all labor, material, supervision, and equipment to complete the perforated leachate piping collection systems for the cells including collection piping, gravel, and geotextile.

1.02 RELATED WORK

A. Section 02745 - Leachate Piping
B. Section 02254 - Protective Cover - On Liner - Gravel / Sand
C. Section 02757 - Cushion Geotextile

1.03 MEASUREMENT AND PAYMENT

Not applicable.

1.04 QUALITY ASSURANCE

A. Quality assurance shall be in accordance with the requirements of Section 01400 Quality Control and the testing program requirements of this section.

PART 2 PRODUCTS

2.01 LEACHATE COLLECTION PIPING

A. Leachate collection piping shall be in accordance with Section 02745 - Leachate Piping.

2.02 GRAVEL

Gravel for encasing leachate pipe shall be a clean, washed, hard, and non-carbonaceous mineral such as quartz. Gravel size shall be ASTM No. 57 in accordance with ASTM D448-86.

2.03 TRANSITION FILTER

Gravel for the transition filter (required if protective cover sand is used) shall be a clean, washed, hard non-carbonaceous mineral such as quartz. Gravel size shall be No. 89 in accordance with ASTM D448-86 or NC DOT size No. 78M.

2.04 CUSHION GEOTEXTILE FABRIC

Geotextile shall be a non-woven geotextile of polypropylene fibers or polyester yarns which are intended to be and shall be suitable for separation and cushioning. Geotextile shall be 12 ounce per square yard cushioning fabric in accordance with Section 02757 - Cushion Geotextile.

PART 3 EXECUTION

3.01 INSTALLATION

A. The leachate collection system shall be installed in accordance with the construction details in the contract drawings. The leachate pipe shall be embedded in gravel with the gravel providing separation of the pipe from the protective cover.

B. The OWNER shall provide the services of a Registered Land Surveyor to certify that the thickness of the material required by the plans and specifications is actually in place. This surveyor shall also prepare "As-Built" drawings of the site which show the in-place thickness of the collection system. The on-site GPS System may be used to as-built the leachate collection piping system.

--END OF SECTION--

SECTION 02748

HDPE FABRICATION

PART 1 - GENERAL

1.01 SCOPE OF WORK

This section covers the materials and fabrication of HDPE structures used for penetration assemblies.

1.02 RELATED WORK

A. Section 02745 - Leachate Piping

1.03 QUALITY ASSURANCE

The resin used for the manufacture of the pipe and plate products shall be manufactured by the producer of the products, thus maintaining complete control of the quality. The products shall contain no recycled compound except that which is generated in the manufacturer's own plant from the same raw material. The products shall be homogenous throughout and free of visible cracks, holes, foreign inclusions or other deleterious defects, and shall be identifiable in color, density, and other physical properties throughout.

The manufacturer shall provide certification that the products produced are represented by the quality assurance data.

1.04 APPLICABLE PUBLICATIONS AND STANDARDS

American Society for Testing and Materials (ASTM Publications)

ASTM D256	Test Methods For Impact Resistance of Plastics and Electrical Insulating Materials
ASTM D638	Test Method For Tensile Properties of Plastics
ASTM D696	Test Method For Coefficient of Line at Thermal Expansion of Plastics
ASTM D746	Test Method For Brittleness Temperature of Plastics and Elastomers By Impact

ASTM D1238	Test Method For Flow Rates of Thermoplastics By Extrusion Plastometer
ASTM D1248	Polyethylene Plastics Molding and Extrusion Materials
ASTM D1505	Test Method For Density of Plastics By the Density-Gradient Technique.
ASTM D1525	Test Method For Vicat Softening Temperature of Plastics
ASTM D1693	Test Method For Environmental Stress Cracking of Ethylene Plastics
ASTM D2240	Test Method For Rubber Property - Durometer Hardness
ASTM D2321	Underground Installation of Flexible Thermoplastic Sewer Pipe
ASTM D2412	External Loading Properties of Plastic Pipe by Parallel - Plate Loading
ASTM D2837	Obtaining Hydrostatic Design Basis For Thermoplastic Pipe Materials
ASTM D3350	Polyethylene Plastics Pipe and Fittings Materials also Gasket for push-on Joints

1.05 SUBMITTAL REQUIREMENTS

Submittals on fabricated products shall be clearly marked as to what is being provided. CONTRACTOR shall submit fabricator's shop drawings with the following information on each product provided:

1. indicate compliance with applicable ASTM Standard
2. unit weight of material
3. physical dimensions including material thickness
4. method of joining
5. recommended bedding and installation details
6. anti-flotation anchor requirements

PART 2 - PRODUCTS

2.01 BASIC MATERIALS

A. Pipe: The pipe shall be in accordance with Section 02745 - Leachate Piping. The pipe shall be made of high density, high molecular weight polyethylene pipe material meeting the requirements of Type III, Class C, Category 5, Grade P34, as defined in ASTM D-1248 Standard Specification for Polyethylene Plastics Molding and Extrusion Materials. Clean rework material generated by the manufacturer's own production may be used so long as the pipe or fittings produced meet all the requirements of this specification. The pipe shall be Spirolite as manufactured by Chevron Chemical Company or equal.

B. HDPE Plate: Plate used for fabrication shall be made of the same high density, high molecular weight polyethylene material used for pipe to insure compatibility of polyethylene resins in the fabrication process.

C. Leachate Riser Vault shall be made of the same high density high molecular weight polyethylene material used for pipe to insure compatibility of polyethylene resins in the fabrication process.

2.02 FABRICATION

A. Experience: Products shall be constructed by a fabricator or manufacturer with at least five (5) years experience in the construction of products similar to those being provided.

B. Joining: Pipe and plate material shall be joined by the extrusion weld method or the butt fusion method in strict accordance with the manufacturer's recommendations. The equipment used in the joining procedures shall be capable of meeting all conditions of the pipe or plate material manufacturer.

C. Stub-outs: Products shall have HDPE pipe penetrations and stub-outs for flange or butt fusion connections as shown in the construction plans. Penetrations shall be extrusion welded to the wall of the product. All stub-outs and penetrations shall be installed by the manufacturer or fabricator.

D. Testing: Structures shall be tested in accordance with Section 01666 - Testing Piping Systems, and certification shall be provided by the CQA ENGINEER for the OWNER.

PART 3 - EXECUTION

3.01 INSTALLATION

Fabricated products shall be installed in accordance with the fabricator's / manufacturer's recommendations and as shown in the plans.

--END OF SECTION--

SECTION 02749

REINFORCED GEOSYNTHETIC CLAY LINER (GCL)
(ALTERNATE BASE LINER)

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, supervision and equipment to complete the installation of the Reinforced Geosynthetic Clay Liner (GCL), including, but not limited to, liner layout, seaming, patching, and all necessary and incidental items required to complete the Work, in accordance with the Contract Drawings and these Specifications.

B. Sufficient liner material shall be furnished to cover all lined areas shown on the Drawings, including overlaps at field seams and anchor trenches.

C. It is the intent of these Specifications to ensure a quality finished product. It shall be the responsibility of the Contractor to ensure that this requirement is met.

1.02 QUALITY

A. The Contractor will be required to submit a quality control program to the DESIGN ENGINEER prior to initiating field work.

B. The Owner shall employ and pay for the services of a third-party CQA ENGINEER, in accordance with Section 01400 - Quality Control, to confirm the installation of the liner.

C. All installation procedures and testing shall be in accordance with these Specifications and Owner's Independent Construction Quality Assurance (CQA) Manual.

1.03 SUBMITTALS

A. The manufacturer shall submit certification that GCL manufactured for the Project has been produced in accordance with these Specifications along with results from a quality control program. This information must be submitted for review prior to material delivery. The CQA ENGINEER reserves the right to halt installation until proper certification is submitted and determined acceptable for use.

B. The Contractor shall submit to the DESIGN ENGINEER, six (6) full sets of panel layout construction drawings. Drawings shall be submitted to the DESIGN ENGINEER at least two (2) weeks prior to installation.

C. Details shall be included to show the termination of the liner at the perimeter of lined areas, the methods of sealing around penetrations and methods of anchoring. A specific anchor trench detail shall be provided.

D. The Contractor shall submit to the CQA ENGINEER a physical sample of the liner to be used. The sample shall be labeled with the manufacturer's name, product identification, lot number and roll number.

E. The Contractor shall also submit to the CQA ENGINEER inventory tickets, roll numbers or batch identifications, packing papers and invoices for the liner used.

F. The Contractor shall provide personnel resumes demonstrating compliance with the following requirements:

1. A minimum of one field superintendent per shift shall be designated by the Contractor and approved by the CQA ENGINEER. Each field superintendent shall have a minimum of three years and five million square feet of field experience in installing GCL's. Any change or replacement of superintendent during the Project must be approved by the CQA ENGINEER.

2. Liner placement technicians shall have a minimum of one year and one million square feet of GCL placement experience.

1.04 WARRANTY

A. Material

The MANUFACTURER is responsible for guaranteeing its product. The warranty shall include all that is listed below:

1. Shall begin at the time of issuance of DESIGN ENGINEER's Certification of Substantial Completion.

2. The material shall be free from defects and be able to withstand normal weathering and use from the date of installation for a period of 20 years under normal uses and services for which it is designed and manufactured.

3. This limited warranty does not include damages or defects resulting from acts of God, casualty or catastrophe such as, but not limited to earthquake, flood, piercing hail, tornado.

4. "Normal Use" excludes: exposure to harmful chemicals, mechanical abuse by machinery, equipment, or people, excessive pressure beyond that indicated by the final overburden or municipal refuse and cover indicated on the drawings.

1.05 SUBMITTALS

With the bid, the Contractor shall furnish information:

A. Conceptual description of the proposed plan for placement of the GCL panels over the area of installation.

B. GCL manufacturer's affidavit providing assurance that the qualifications of Section 1.5 of this specification have been achieved.

C. At the CQA DESIGN ENGINEER's request:

1. A representative sample of the GCL, suitable for testing.

2. A project reference list consisting of the principal details of at least ten projects totaling at least 10 million square feet in size.

Upon shipment, the Contractor shall furnish the following:

1. GCL manufacturer's Quality Assurance/Quality Control (QA/QC) certifications to verify that the materials supplied for the project are in accordance with the requirements of this specification.

2. Manufacturer's warranty covering materials and workmanship of the GCL.

1.06 QUALIFICATIONS

A. GCL Manufacturer must have produced at least 10 million square feet of GCL, which was installed.

B. GCL Installer must either have installed at least 1 million square feet of GCL, or must provide to the DESIGN ENGINEER satisfactory evidence, through similar experience in the installation of other types of geosynthetics, that the GCL will be installed in a competent, professional manner.

PART 2 PRODUCTS

2.01 GENERAL

The Reinforced GCL shall be Bentomat, as manufactured by Colloid Environmental Technologies Company (CETCO), Arlington Heights, Illinois (708-392-5800), or engineer pre-approved equal. The GCL shall consist of a layer of pure sodium bentonite clay encapsulated between two polypropylene geotextiles, one woven and one non-woven, and shall comply with all of the manufacturing processes and physical/chemical criteria listed in this Section. Prior to using an alternative GCL, the Contractor must furnish independent test results demonstrating that the proposed alternate material meets the requirements of this specification.

2.02 MATERIALS

A. Geosynthetic Clay Liners (GCLs) consist of a bentonite core, encased front and back with a geotextile.

B. Seams for providing watertight joints shall meet GCL manufacturer's recommendations or be approved by the CQA ENGINEER.

C. Physical properties of GCL shall be as follows:

GCL PROPERTY	TEST METHOD	MINIMUM VALUE	MINIMUM FREQUENCY
Hydraulic Conductivity	ASTM D5887	5.0×10^{-9} cm/s*	weekly **
Bentonite Content	ASTM D5993 (@ 0% moisture)	0.75 lb/sf	40,000 s.f.
Grab Tensile Strength	ASTM D4632	90 lbs.	200,000 s.f.
Peel Strength	ASTM D4632 or ASTM D6496	15 lbs. / 2.5 lbs./in.	40,000 s.f.
Minimum Shear Strength	ASTM D5321/D6243	500 psf (When Hydrated)	periodic **
Bentonite Swell Index	ASTM D5890	24 ml / 2g min.	100,000 lbs.

* At 5 psi maximum effective confining stress.
** Results for the last 20 tests shall be provided.

D. The GCL shall be capable of providing an interface friction (shear) resistance of 26.4 or an equivalent shear strength (combination of friction angle (ø) and cohesion (c)) between the GCL/soil liner interface and the GCL/FML interface.

2.03 GCL PANEL DIMENSIONS

The dimensions of the full-size panels shall be 15 feet in width and at least 125 feet in length. "Short" rolls (those manufactured to a length less that 125 feet) are a necessary by-product of the GCL manufacturing process, but will only be allowed at a rate no greater than 5 per truckload or every 36,000 square feet, whichever is less.

2.04 SEAM OVERLAP LINES

A 6-inch "lap" line and a 9-inch "match" line shall be imprinted on both edges of the upper geotextile component of the GCL as a means for providing assurance of the overlap. Lines shall be printed in easily visible, non-toxic ink.

2.05 PRODUCT DOCUMENTATION

Upon request, the manufacturer shall provide the CQA ENGINEER with the QA/QC certifications for each shipment of GCL. The certification shall be signed by a responsible party employed by the manufacturer such as the QA/QC Manager, Production Manager, or Technical Services Manager. The QA/QC certifications shall include:

A. GCL lot and roll numbers (with corresponding shipping information).

B. Manufacturer's test data for raw materials used in GCL production, including, at a minimum, mass/area data and tensile test data.

C. Manufacturer's test data for finished GCL product, including at a minimum, clay mass/area data and tensile testing data.

D. Certificates of analysis for the bentonite clay used in GCL production.

2.06 PRODUCT LABELING

Prior to shipment, the GCL manufacturer shall affix a label to each roll identifying the following characteristics:

A. Product identification information (manufacturer name and address, brand name, product code)

B. Lot number and roll number.

C. Roll length and width.

D. Total roll weight.

2.07 PACKAGING

A. The GCL shall be wound around a cardboard core 4 inches in diameter to facilitate handling. The core is not intended to support the roll for lifting but should be sufficiently strong to prevent collapse during transit.

B. All rolls shall be labeled and bagged in packaging that is resistant to photodegradation by ultraviolet (UV) light and free of tears or holes that may result in hydration of the GCL during transport and storage.

PART 3 EXECUTION

3.01 SHIPPING AND HANDLING

A. The manufacturer assumes responsibility for initial loading and shipping of the GCL. Unloading, on-site handling, and storage are the responsibility of the installer or other designated party.

B. A visual inspection of each roll should be made as it is unloaded to identify if any packaging has been damaged. Rolls with damaged packaging should be marked and set aside for further inspection. The packaging should be repaired prior to being placed in storage.

C. The party responsible for unloading the GCL should contact the manufacturer prior to shipment to ascertain the appropriateness of the proposed unloading methods and equipment to be utilized.

3.02 STORAGE

A. Storage of the GCL rolls shall be the responsibility of the installer. A dedicated storage area shall be selected at the job site that is away from high traffic areas and is level, dry, and well-drained.

B. Rolls should be stored in a manner that prevents sliding or rolling from the stacks and may be accomplished by the use of chock blocks or by use of the dunnage shipped between rolls. Rolls should be stacked at a height no higher than that at which the lifting apparatus can be safely handled (typically no higher than four).

C. All stored GCL materials and the accessory bentonite must be covered with a plastic sheet or tarpaulin until their installation.

3.03 EARTHWORK

A. The surface upon which the GCL is installed shall be prepared and compacted in accordance with the project plans and drawings. All surfaces to be covered with GCL shall be smooth and free of debris, roots and sticks, and sharp rocks larger than two inches. At a minimum, the level of compaction should be such that no rutting is caused by installation equipment or other construction vehicles.

B. Immediately prior to GCL deployment, the subgrade shall be final-graded to fill in all voids or cracks and then smooth-rolled to provide the best practicable surface for the GCL. At completion of this activity no sharp irregularities or abrupt elevation changes shall exist in the subgrade.

C. The project CQA ENGINEER shall certify his acceptance of the subgrade before GCL placement.

D. It shall be the installer's responsibility thereafter to indicate to the CQA Engineer any change in the condition of the subgrade that could cause the subgrade to be out of compliance with any of the requirements listed in A, B, and C above.

E. At the top of sloped areas of the job site, an anchor trench for the GCL shall be excavated in accordance with the project plans. The trench shall be excavated and approved by the CQA ENGINEER prior to GCL placement. No loose soil shall be allowed at the bottom of the trench, and no sharp corners or protrusion shall exist anywhere within the trench.

3.04 GCL PLACEMENT

Placement of the GCL shall be conducted in accordance with the manufacturer's recommendations and with the direction provide herein. Any deviations form these procedures must be pre-approved by the CQA ENGINEER.

A. During start-up of the GCL installation, an agent or representative of the Manufacturer shall provide on-site assistance and instruction to the Contractor and CQA ENGINEER regarding the appropriate installation techniques.

B. The use of equipment capable of freely suspending the GCL roll is required. A spreader bar and core pipe are also required for supporting the roll and allowing it to unroll freely. The core bar and spreader bar shall not bend or flex excessively when a full roll is lifted. A core bar / stinger will be allowed for moving rolls of GCL around the site.

C. GCL panels shall be placed with the white side (non-woven) geotextile facing down. On sloped areas exceeding a steepness of 4H:1V, the long dimension of all panels shall be oriented parallel to the slope, and the ends of these panels shall be secured in

an anchor trench. Panels placed on flat areas require no particular orientation. Panels should be placed from the highest elevation to the lowest within the area to be lined, to facilitate drainage in the event of precipitation. Panels shall be placed free of tension of stress yet without wrinkles or folds. It is not permissible to stretch the GCL in order to fit a designated area. Panels shall not be dragged across the subgrade into position except where necessary to obtain the correct overlap for adjacent panels.

D. Panels may be placed in any weather conditions except for heavy rain and extremely high wind.

E. The Contractor shall unwrap and install only as much GCL in one working day as can be covered with earthen backfill or a geomembrane. In no case shall the GCL be exposed to the elements at the end of the day.

F. Where GCL / FML systems adjoin conventional composite liner systems, the GCL shall extend at least 18" over the conventional composite liner system clay component (i.e., overlap the conventional composite clay liner by 18").

G. The GCL shall be placed in the anchor trench in contact with and the full dimension of the FML overlaying it.

H. Premature Hydration: GCL which becomes hydrated before placement of the geomembrane liner shall be removed and replaced with unused GCL, as directed by the CQA ENGINEER. Hydration is defined by a moisture content of 40 percent or greater when measured in accordance with ASTM D4643. The replacement GCL shall be placed in accordance with these specifications.

3.05 GCL PANEL SEAMING

A. All GCL seams shall be formed by executing a bentonite-enhanced overlap to ensure that a continuous seal is achieved between panels.

B. A 6-inch to 9-inch overlap should exist at seam locations. The lap line and match lines printed on the panels shall be used to assist in obtaining this overlap. The edges of the GCL panels should be adjusted to smooth out any wrinkles, creases, or "fishmouths" in order to maximize contact with the underlying panel.

C. After the overlying panel is placed, its edge shall be pulled back to expose the overlap zone. Any soil or debris present in the overlap zone or entrapped in the geotextiles shall be removed. A fillet of granular or powdered bentonite (i.e., accessory bentonite) shall then be poured in a continuous manner along the overlap zone (between the edge of the panel and the 6-inch line), at a rate of at least one-quarter pound per lineal foot. The use of a line chalker is recommended to improve

the uniformity and consistency of the bentonite enhancement. CQA for this process shall be conducted in accordance with the Manufacturer's CQA plan.

D. On gently sloping areas (gentler than 4H:1V) where seams may be placed across the slope, overlaps should be "shingled" so as to prevent flow into the seam.

3.06 DAMAGE REPAIR

A. Any damage in the form of cuts or tears in the GCL, shall be identified and repaired by the installer by cutting a patch from unused GCL and placing it over the affected area.

B. The damaged area should be removed of all dirt and debris. A patch of GCL shall be cut to fit over the damaged area and to extend one foot in all directions around it. Accessory bentonite shall then be placed around the perimeter of the affected area at the rate of one-half pound per lineal foot, and the patch shall be placed over the damage. Any epoxy-based adhesive shall be used to keep the patch in position during backfill operations.

3.07 DETAIL WORK

A. Detail work, defined as the work necessary to seal the liner to pipe penetrations, foundation walls, drainage structures, spillways, and other appurtenances, shall be performed as recommended by the GCL Manufacturer.

3.08 PLACEMENT OF OVERLAYING MATERIALS

A. Cover material shall be placed as shown in the plans.

B. Soil cover shall be placed with low ground pressure equipment. A minimum thickness of 48" of cover shall be kept between heavy equipment and the GCL at all times, except when final-grading. No vehicles should be driven directly on the GCL until the proper thickness of cover has been placed. Care should be taken to avoid damaging the GCL by making sharp turns or pivots with equipment.

C. To prevent damage to the GCL, the initial lift(s) of soil cover shall not be compacted in excess of 85 percent Modified Proctor density.

D. When covering GCL installed on sloped areas steeper then 4H:1V, the cover should be pushed upslope to minimize tension of the GCL.

E. If the immediate cover material is a geomembrane or other geosynthetic, precautions shall be taken to prevent damage the GCL by restricting heavy equipment traffic. Unrolling the geosynthetic can be accomplished through the use of lightweight, rubber-tired equipment such as a 4-wheel all-terrain vehicle (ATV). This vehicle can

be driven directly on the GCL, provided the ATV makes no sudden stops, starts, or turns.

F. If a textured geomembrane is placed over the GCL, a slip sheet (such as 20-mil smooth HDPE) may first be placed over the GCL in order to allow the geomembrane to slide into its proper position.

G. Any leading edge of panels left uncovered shall be protected at the end of the working day with a waterproof sheet which is adequately secured with sandbags or other ballast.

3.09 HDPE LINER ACCEPTANCE

The Contractor shall retain ownership and responsibility for the GCL until acceptance of the FML by the Owner.

The lining system shall be accepted by the Owner when:

- The installation is complete as determined by the CQA ENGINEER.
- Verification of the adequacy of all repairs is complete;
- All documentation of installation is completed, including all CQA reports;
- The Contractor provides the Owner with record drawings of the panel layout;
- The Contractor, the Manufacturer and the CQA ENGINEER provide written certification that the installation was in accordance with the manufacturer's general recommendations, the Owner's CQA plan, and specifications, with exceptions noted.

--END OF SECTION--

SECTION 02750

HDPE GEOMEMBRANE LINER

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, supervision and equipment to complete the installation of the HDPE Geomembrane Liner, including, but not limited to, liner layout, seaming, patching, and all necessary and incidental items required to complete the work, in accordance with the Construction Drawings and these Specifications.

B. Sufficient liner material shall be furnished to cover all lined areas shown on the Construction Drawings, including overlaps at field seams and anchor trenches.

C. It is the intent of these specifications to ensure a quality finished product. It shall be the responsibility of the CONTRACTOR to ensure that this requirement is met.

1.02 QUALITY

A. The CONTRACTOR will be required to submit a quality control program to the CQA ENGINEER prior to initiating field work.

B. The OWNER shall employ and pay for the services of a third-party CQA ENGINEER, in accordance with Section 01400 - Quality Control, to confirm the installation of the liners.

C. All installation procedures and testing shall be in accordance with these specifications and OWNER's Independent Construction Quality Assurance (CQA) Manual. A copy of this manual is attached.

D. All field destructive and non-destructive testing will be performed by the CONTRACTOR. Samples for laboratory testing will be taken by the CONTRACTOR for testing at the CONTRACTOR's laboratory as well as the CQA ENGINEER's laboratory.

1.03 SUBMITTALS

A. The geomembrane manufacturers shall submit certification that all sheets manufactured for the project have been produced in accordance with these specifications along with results from a quality control program. This information must be submitted for review prior to material delivery. The CQA ENGINEER reserves the right to halt installation until proper certification is submitted and determined acceptable for use.

B. The CONTRACTOR shall submit to the DESIGN ENGINEER, six (6) full sets of panel layout Construction Drawings. Field welds and panels shall have an identification system. Drawings shall be submitted to the DESIGN ENGINEER at least two (2) weeks prior to installation.

C. Details shall be included to show the termination of the liner at the perimeter of lined areas, the methods of sealing around penetrations and methods of anchoring.

D. The CONTRACTOR shall submit to the CQA ENGINEER a physical sample of the liner to be used. The samples shall be labeled with the manufacturer's name, product identification, lot number and roll number.

E. The CONTRACTOR shall also submit to the CQA ENGINEER inventory tickets, roll numbers or batch identifications, packing papers and invoices for the liner used.

F. The CONTRACTOR shall provide personnel resumes demonstrating compliance with the following requirements:

1. A minimum of one (1) field superintendent per shift shall be designated by the CONTRACTOR and approved by the CQA ENGINEER. Each field superintendent shall have a minimum of three years and five million square feet of field experience in installing HDPE geomembranes. Any change or replacement of superintendent during the project must be approved by the CQA ENGINEER.

2. The weld technicians shall have a minimum of one year and one million square feet HDPE geomembrane welding experience.

1.04 WARRANTY

A. Material

The MANUFACTURER is responsible for guaranteeing its product. The warranty shall include all that is listed below:

1. Shall begin at the time of issuance of CQA ENGINEER's Certification of Substantial Completion.

2. The material shall be free from defects and be able to withstand normal weathering and use from the date of installation for a period of 20 years under normal uses and services for which it is designed and manufactured.

3. This limited warranty does not include damages or defects resulting from acts of God, casualty or catastrophe such as, but not limited to earthquake, flood, piercing hail, or tornado.

4. "Normal Use" excludes: exposure to harmful chemicals, mechanical abuse by machinery, equipment, or people, excessive pressure beyond that indicated by the final overburden or municipal refuse and cover indicated on the Construction Drawings.

PART 2 - PRODUCTS

2.01 GEOMEMBRANE LINER

A. The geomembrane shall comprise HDPE material manufactured of new, first-quality products designed and manufactured specifically for the purpose of municipal waste leachate containment in sanitary landfills.

B. The geomembrane material shall be so produced as to be free of holes, blisters, undispersed raw materials or any sign of contamination by foreign matter. Any such defect shall be repaired in accordance with the manufacturer's recommendations. The DESIGN ENGINEER or CQA ENGINEER may reject all or portions of units (or rolls) of geomembrane if significant quantities of production flaws are observed.

C. The geomembrane material shall meet the material properties as specified in the Geosynthetic Research Institute GRI Test Method GM-13, as latest revised for 60 mil HDPE geomembrane. The minimum thickness requirement shall be for the lowest individual measurement, not the average.

D. The geomembrane liner shall be the required minimum liner thickness as shown on the Construction Drawings.

E. If natural colored, the manufacturer shall add carbon black per ASTM D 1248 Specifications, Section 3.1.2.3, Class C.

F. The manufacturer's quality control program shall include the following inspections and tests:

1. Inspection for: Appearance on both sides, manufacturing defects, and thickness at 10 random locations across each sample strip.

2. Testing in accordance with the Geosynthetic Research Institute GRI Test Method GM-13, as latest revised, for 60 mil HDPE Geomembrane. The minimum thickness requirement shall be for the lowest individual measurement, not the average. The results shall be reported.

2.02 PACKAGING AND STORAGE

A. The geomembrane shall be shipped rolled. Folded or otherwise creased liner will not be accepted. The liner shall be marked and tagged with the following information:

1. Serial Number
2. Resin Type
3. Roll Length
4. Gross Weight
5. Inspected By
6. Date of Manufacture
7. Resin Lot Number
8. Roll Width
9. Net Weight

B. Liner which has been delivered to the project site shall be stored in a dry area and protected from precipitation and direct sunlight.

C. Care shall be taken to keep the materials clean and free from debris prior to installation.

PART 3 - EXECUTION

3.01 GENERAL

The geomembrane liner shall be constructed as soon as practical after completion of the compacted clay liner and after certification in writing of the clay liner by the CQA ENGINEER and the CONTRACTOR. The geomembrane liner shall be installed following the manufacturer's printed recommendations, using sound, accepted engineering practices.

All liner installation shall be completed by one crew and shall be installed in no more than 30 calendar days from the date of initiation of installation. The installing crew shall be approved by the manufacturer/fabricator for installation of 60 mil HDPE synthetic liners.

A manufacturer's technical representative shall be at the Pre-Deployment Meeting and on-site at the time of installation.

A. Geomembrane Liner

1. No horizontal seams are allowed within five (5) feet of the toe of the slope.

2. Unroll only those factory-packaged sections which are to be anchored or seamed together in one day. Panels should be positioned with the overlap recommended by the manufacturer, but not less than two (2) inches.

3. After panels are initially in place, remove as many wrinkles as possible. Unroll several panels and allow the liner to "relax" before beginning field seaming. The purpose of this is to make the edges which are to be bonded as smooth and free of wrinkles as possible.

4. Once panels are in-place and smooth, commence field seaming operations.

5. Personnel working on the geomembrane shall not smoke, wear damaging shoes or engage in any activity which damages the geomembrane.

6. The anchor trench shall be excavated, backfilled and compacted. Care should be taken when backfilling the trench to prevent any damage to the geomembrane.

7. Damaged and sample coupon areas of geomembrane shall be repaired by the CONTRACTOR. Any damage to the soil / clay liner component while coupons are open is the responsibility of the CONTRACTOR. Repaired areas will be tested for seam integrity by the CONTRACTOR. Damaged materials are the property of the CONTRACTOR and will be removed from the site at the CONTRACTOR's expense. The CONTRACTOR will retain all ownership and responsibility for the geomembrane until acceptance by the OWNER.

3.02 SEAMING

A. Geomembrane Liner

1. Field Seaming

a. All foreign matter (dirt, water, oil, etc.) shall be removed from the area to be bonded. If the seam is to be bonded by the extrusion process, the bonding surfaces must be thoroughly cleaned by mechanical abrasion or alternate methods approved by the CQA ENGINEER to remove surface cure and prepare the surfaces for bonding. No solvents shall be used to clean the geomembrane liner.

b. Tack welds, if used, shall use heat only; no double-sided tape, glue or other method will be permitted. The geomembrane should be seamed completely to the ends of all panels to minimize the potential of tear propagation along the seam. Seaming of the bottom membrane to the sidewall membrane shall be conducted when conditions minimize thermal expansion effects. The completed liner shall not exhibit "trampolining" and shall be in full contact with the underlying soil liner.

c. At the end of each day or installation segment, all unseamed edges shall be anchored by sand bags or other approved device. Sand bags shall weigh approximately 20 pounds and shall be placed no further apart than 20 foot spacing along the open end of the geomembrane. If high winds are expected, boards along the edge of unseamed panels, with weighted sand bags on top, should be used to anchor the geomembrane on the bottom of the cell. Staples, U-shaped rods, or other penetrating anchors shall not be used to secure the geomembrane. The temporary anchoring of the geomembrane is fully the responsibility of the CONTRACTOR. Any material damaged as the result of weather effects, shall be repaired or replaced at no cost to the OWNER.

d. It is imperative to keep surface water runoff from beneath the geomembrane at all times during installation. The CONTRACTOR's panel placement and seam welding technique and welding schedule shall minimize or eliminate the accumulation of water beneath the geomembrane. Any water found ponded beneath the geomembrane after the geomembrane has been installed shall be removed by the CONTRACTOR at no cost to the OWNER. Any compacted soil liner beneath installed geomembrane that has become excessively

moist, soft or unsuitable to perform its intended function shall be replaced at no cost to the OWNER.

e. After field seaming is complete in a given area, liner edges in the anchor trench should be buried. Do not bury the liner edge in the anchor trench within 30 feet of an incomplete or unbounded field seam.

2. Field seaming may be extrusion or fusion welding or a combination of these methods. Solvent welding is not acceptable. The DESIGN ENGINEER or CQA ENGINEER reserves the right to reject any proposed seaming method believed unacceptable.

a. Extrusion welding applies a molten bead of material to preheated sheets of geomembrane. The sheets are then joined by pressure.

b. The fusion welding process heats the area to be joined to the melting point and then applies pressure to join the melted surfaces.

c. The sheets to be joined shall be overlapped at least two (2) inches after the necessary aligning and cutting.

d. In general, seams should be oriented parallel to the line of maximum slope, i.e., oriented up and down, not across, the slope. In corners and odd shaped geometric locations, the number of field seams should be minimized.

e. No horizontal seams should be within five (5) feet from the toe of the slope.

f. No seaming should be attempted above 40 degrees C (104 degrees F) ambient air temperature. Below five (5) degrees C (41 degrees F) ambient air temperature, preheating of the geomembrane may be required. It shall be the responsibility of the CONTRACTOR to demonstrate that conditions are favorable for seaming by acceptable test (start-up) seams which duplicate, as closely as possible, actual field conditions. Preheating may be achieved by natural and/or artificial means (shelters and heating devices).

g. A moveable protective layer of plastic may be required, as recommended by the CQA ENGINEER, to be placed directly below each overlap of geomembrane that is to be seamed. This is to prevent any moisture build-up between the sheets to be welded.

h. Seaming will extend to the outside edge of panels to be placed in anchor trenches.

i. If required, a firm substrata should be provided by using a flat board, a conveyor belt, or similar hard surface directly under the seam overlap to achieve proper support.

j. Grinding prior to welding shall be as recommended by the geomembrane manufacturer and shall be done perpendicular to the sheet edge. Overground or improperly ground areas shall be replaced at the CONTRACTOR's expense.

k. No folds, wrinkles or "fish-mouths" shall be allowed within the seam area. Where wrinkles or folds occur, the material shall be cut, overlapped and an extrusion-weld shall be applied. During wrinkle or fold repairs, adjacent geomembrane may not necessarily be required to meet the two (2) inch minimum overlap, if approved by the CQA ENGINEER. All welds on completion of the work shall be tightly bonded and sealed.

3.03 TESTING OF HDPE GEOMEMBRANE

A. General

1. Samples of the field seams shall be taken and tested in accordance with ASTM D6392 ensure that tensile strength at yield and break, elongation at yield and break meet the minimum specifications. A quality control certificate shall be issued with the material.

2. The CONTRACTOR shall employ on-site physical non-destructive testing on all welds.

3. A quality control technician employed by the CONTRACTOR shall inspect each sheet and seam. Any area showing a defect shall be marked and repaired in accordance with HDPE repair procedures.

B. Test seams shall be made each day prior to commencing field seaming. The seams shall be made on fragment pieces of geomembrane under the same surface and environmental conditions as the production seams to verify that seaming conditions are adequate. The test seams shall be made at the beginning of each seaming period; at changes of equipment, equipment settings, operator, weather, or sheet temperature; at the CQA ENGINEER's discretion, and at least once every four to six hours during continuous operation of each welding machine; or at change in material type (i.e., smooth-to-smooth seam versus smooth-to-textured seam).

1. The test seam sample will be at least 1.5 m (5 feet) long by 0.3 m (1 foot) wide with the seam centered lengthwise. Ten (10) adjoining specimens 25 mm (1-inch) wide each will be die cut from the test seam sample. These specimens, which will be tested with a tensiometer in the field for shear (five samples) and peel (five samples) by the CONTRACTOR and witnessed by the CQA ENGINEER, should not fail in the seam. If a test seam fails, the entire operation will be repeated. If the additional test seam fails, the seaming apparatus or seamer will not be accepted and will not be used for seaming until the deficiencies are corrected and two (2) consecutive successful full test seams are achieved. Test seam failure is defined as failure of any one of the specimens tested in shear or peel.

2. The CQA ENGINEER will observe all test seam procedures. The remainder of the successful test seam sample will be assigned a number and marked accordingly by the CQA ENGINEER, who will also log the date, hour, ambient temperature, number of seaming unit, name of seamer and pass or fail description. At least one (1) tested specimen from each test as selected by the CQA ENGINEER will be retained by the CQA ENGINEER. The CQA ENGINEER will transmit these specimens to the OWNER following acceptance of the geomembrane materials and installation by the OWNER.

3. The criteria for determining a passing seam shall be the properties shown in the "Seam Strength" table of Geomembrane Liner Section of the CQA Manual.

C. Field Seams: Field seams will be tested by the CONTRACTOR continuously using non-destructive techniques and at specified intervals using destructive tests. Requirements for non-destructive and destructive testing are as follows:

1. Single Weld Seams: The CONTRACTOR shall maintain and use equipment and personnel at the site to perform continuous vacuum box testing on all single weld production seams or when the geometry of the weld makes pressure testing impractical.

a. Equipment for Vacuum Testing:

1. Vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, port hole or valve assembly, and a vacuum gauge.

2. Vacuum pump assembly equipped with a pressure controller and pipe connection.

3. A rubber pressure/vacuum hose with fittings and connections.

4. A bucket and means to apply a soapy solution.

b. Procedure for Vacuum Testing:

1. Trim excess overlap from seam, if any.

2. Turn on the vacuum pump to reduce the vacuum box to approximately five (5) inches of mercury, i.e., three (3) psi gauge.

3. Apply a generous amount of solution of strong liquid detergent and water to the area to be tested.

4. Place the vacuum box over the area to be tested and apply sufficient downward pressure to "seat" the seal strip against the liner.

5. Close the bleed valve and open the vacuum valve.

6. Apply a minimum of five inches Hg. vacuum to the area as indicated by the gauge on the vacuum box.

7. Ensure that a leak tight seal is created.

8. For a period of not less than five (5) seconds, examine the FML through the viewing window for the presence of soap bubbles.

9. If no bubbles appear after 15 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum three (3) inch overlap, and repeat the process.

10. Mark all areas where soap bubbles appear and repair the marked areas. After repairs are made, retest these areas.

2. Double Weld Seams: The CONTRACTOR shall maintain and use equipment and personnel to perform air pressure testing of all double weld seams. The system shall be capable of applying a pressure of at least 30 psi for not less than five minutes. The CONTRACTOR shall perform all pressure and vacuum testing under the supervision of the CQA ENGINEER.

Pressure loss tests shall be conducted in accordance with the procedures outlined in "Pressurized Air Channel Test for Dual Seamed Geomembranes", Geosynthetic Research Institute Test Method GM-6. As outlined by the test method, following a two minute pressurized stabilization period, pressure losses over a measurement period of five (5) minutes shall not exceed the following: 40 mil - 4 psi, 60 mil - 3 psi, 80 mil - 2 psi.

3. Destructive testing will be performed on an average of every 500 linear feet of field seam. The locations will be selected by the CQA ENGINEER. Sufficient size samples will be obtained by the CONTRACTOR to provide one sample to the archive, one sample to the CQA ENGINEER for laboratory testing, and two samples to be retained by the CONTRACTOR for both field and laboratory testing. Testing requirements are as follows: Each sample shall be large enough to test five (5) specimens in peel and five specimens in shear. The criteria for passing seams are shown in the "Seam Strength" table in the Geomembrane Liner Section of the CQA Manual. If unresolved discrepancies exist between the CQA ENGINEER's and CONTRACTOR's test results, the archived sample may be tested by the CQA ENGINEER. Samples which do not pass the shear and peel tests will be re-sampled from locations at least 10 feet on each side of the original location. These two re-test samples must pass both shear and peel testing. If these two samples do not pass, then additional samples will continue to be obtained until the questionable seam area is defined.

   The CQA ENGINEER will observe all production seam field test procedures. The remainder of the successful test seam sample will be assigned a number and marked accordingly by the CQA ENGINEER, who will also log the date, seam number, approximate location in the seam, and field test pass-or-fail description, if applicable. The CQA ENGINEER will be responsible for the archive specimen.

3.04 REPAIRS

A. Repair of failing test seams, damage from pressure testing and sample coupons: Damaged and sample coupon areas, and other damaged areas of geomembrane shall be repaired by the CONTRACTOR by construction of a cap strip. No repairs shall be made to seams by application of an extrusion bead to a seam edge previously welded by integrity. Damaged materials are the property of the CONTRACTOR and will be removed from the site at the CONTRACTOR's expense.

B. Make repairs as follows:

   1. Abrade surfaces of the geomembrane that are to be repaired no more than 20 minutes prior to the repair,

2. Clean and dry all geomembrane surface immediately prior to repair,

3. Only use approved seaming equipment,

4. Extend patches or caps at least 6 inches beyond the edge of the defect, and round corners of patches to a radius of at least 3 inches, and

5. Cut the geomembrane below large caps to avoid potential for water and gas collection between the two sheets.

3.05 ANCHOR TRENCH BACKFILLING

The anchor trench will be backfilled and compacted to a dry density not less than 90 percent of the maximum dry density determined by the Standard Proctor (ASTM D-698). Care should be taken when backfilling the trench to prevent any damage to the geomembrane. Anchor trench spoil shall be used as backfill material, wherever possible.

3.06 PROTECTION OF LEADING EDGES

Between construction of partial sections of the membrane liner, leading edges of the membrane may be exposed or buried for extended periods of time prior to their joining to adjacent, subsequent membrane sections. The combined action of abrasive soil and equipment impact stresses may "etch" unprotected membrane surfaces sufficiently to affect seam strengths. Therefore, it is necessary to protect leading edges in high activity areas with sacrificial layers of HDPE sheet until they are ready for final seaming. As a minimum, each leading edge to be seamed that must be buried or which must be exposed for periods of one (1) month or longer shall be continuously covered by a layer of geotextile overlain by a layer of HDPE sheet. The geotextile shall be non-woven and have a minimum weight of 6 oz. per square yard. The sacrificial HDPE sheet shall have a nominal thickness equal to that of the membrane liner to be protected. Both protective cover sheets layers shall have a minimum width of two feet. The protective cover sheets shall be either covered with soil or weighted with sand bags to prevent displacement by wind. The edge of the sheet to be protected shall be approximately centered beneath the overlying protective layers prior to burial or weighing with sandbags. Leading edges located in areas expected to receive direct traffic from construction equipment shall be buried under a minimum thickness of one foot of buffer soil.

3.07 HDPE LINER ACCEPTANCE

The CONTRACTOR shall retain ownership and responsibility for the geosynthetic lining system until acceptance by the OWNER.

The lining system shall be accepted by the OWNER when:

- The installation is complete as determined by the CQA ENGINEER;
- Verification of the adequacy of all seams and repairs, including associated testing, is complete;
- All documentation of installation is completed, including all CQA reports;
- The CONTRACTOR provides the OWNER with record drawings of the panel layout and seam locations with reference numbers for test locations;
- The CONTRACTOR, the Manufacturer and the CQA ENGINEER provide written certification that the installation was in accordance with the manufacturer's general recommendations, the OWNER's CQA plan, and specifications, with exceptions noted.

--- END OF SECTION ---

SECTION 02754

GEOCOMPOSITE DRAINAGE MEDIA (GDM)

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary for the installation of the geocomposite drainage media (GDM), as specified herein, as shown on the Drawings, and in accordance with the Construction Quality Assurance (CQA) Plan.

B. The Contractor shall be prepared to install the GDM in conjunction with the geomembrane cap and other components of the cap system.

1.02 REFERENCES

The latest revision of the following standards of the American Society of Testing and Materials (ASTM) are hereby made a part of these specifications.

ASTM D413	Standard Test Methods for Rubber Property - Adhesion to Flexible Substrate
ASTM D792	Standard Test Methods for Density and Specific Gravity of Plastic by Displacement.
ASTM D1505	Standard Test Method for Density of Plastics by the Density-Gradient Technique.
ASTM D1777	Standard Test Method for Measuring Thickness of Textile Materials.
ASTM D4716	Standard Test Method for Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextiles Related Products.
ASTM D5199	Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembrane

1.03 CONSTRUCTION QUALITY ASSURANCE (CQA) TESTING

A. The Contractor shall comply with all terms and requirements of the Construction Quality Assurance Plan (contained in this document).

B. GDM that is rejected upon testing shall be removed from the project site and replaced at Contractor's cost. Sampling and quality assurance testing of GDM supplied as replacement for rejected material shall be performed by the CQA ENGINEER at Contractor's cost.

1.04 SUBMITTALS

A. Prior to shipping to the site, the Contractor shall submit to the CQA ENGINEER two (2) copies of a mill certificate or affidavit signed by a legally authorized official of the Manufacturer. The Contractor shall also submit two samples, one yard square in size each, with the mill certificate. The mill certificate or affidavit shall attest that the GDM meets the required properties stated in these Specifications. The samples shall be labeled with the Manufacturer's lot or batch number, machine directions, date of sampling, project number, and Manufacturer and product names.

B. For GDM delivered to the site, quality control certificates, signed by the Manufacturer's quality assurance manager shall be provided for every 50,000 square feet of GDM. Each certification shall have roll identification number(s), sampling procedures, frequency, and test results.

C. The Contractor shall furnish the CQA ENGINEER a copy of delivery tickets or other approved receipts as evidence for materials received that will be incorporated into the construction.

1.05 MEASUREMENT AND PAYMENT

Not Applicable.

PART 2 PRODUCTS

2.01 MATERIALS

A. The Geonet shall be manufactured by extruding two (2) sets of polyethylene strands to form a three dimensional structure to provide planer water flow.

B. A filter geotextile shall be heat bonded to both sides of the Geonet. Heat bonding shall be performed by the Manufacturer prior to shipping to the site. The filter geotextile shall have a minimum weight of 6 oz/sy. Protective cover material shall be tested to insure compatibility with the 6 oz/sy geotextile.

C. The Geonet shall contain UV inhibitors to prevent ultraviolet light degradation.

D. The Geonet conforms to the following minimum properties:

REQUIRED GEOCOMPOSITE DRAINAGE MEDIA PROPERTIES AND MANUFACTURER'S QUALITY CONTROL TEST DATA FINAL CAP SYSTEM

PROPERTY	TEST METHOD	UNITS	VALUE	FREQUENCY
Thickness (geonet only)	ASTM D 5199	inches	0.25	Every roll
Resin Design (geonet only)	ASTM D 1505	g/cm^3	0.94	50,000 ft^2
Ply Adhesion	ASTM D 413	lb/inch	2.0	50,000 ft^2
Transmissivity	ASTM D 4716	$m^3/m^2/s$	$1x10^{-3}$	100,000 ft^2

Notes: Conduct test for transmissivity at a normal compressive load of 500 psf and at a hydraulic gradient of 0.25 after a seating period of at least 24 hours. Boundary conditions are soil interface on the upper filter Geotextile and smooth geomembrane against the lower filter Geotextile.

REQUIRED GEOCOMPOSITE DRAINAGE MEDIA PROPERTIES AND MANUFACTURER'S QUALITY CONTROL TEST DATA BASE LINER SYSTEM

PROPERTY	TEST METHOD	UNITS	VALUE	FREQUENCY
Thickness (geonet only)	ASTM D 5199	inches	0.25	Every roll
Resin Design (geonet only)	ASTM D 1505	g/cm^3	0.94	50,000 ft^2
Ply Adhesion	ASTM D 413	lb/inch	2.0	50,000 ft^2
Transmissivity	ASTM D 4716	$m^3/m^2/s$	$5x10^{-4}$	100,000 ft^2

Notes: Conduct test for transmissivity at a normal compressive load of 15,000 psf and at a hydraulic gradient of 0.05 after a seating period of at least 24 hours. Boundary conditions are soil interface on the upper filter Geotextile and smooth geomembrane against the lower filter Geotextile.

E. The GDM shall be capable of providing an interface friction (shear) resistance of $\geq 26.4°$ or an equivalent shear strength (combination of friction angle (ø) and cohesion (c)) between the GDM/Geomembrane interface and the GDM/Protective Cover interface.

F. Each roll of GDM delivered shall have the following identification information:

1. Manufacturer's name
2. Product identification
3. Thickness
4. Roll number
5. Lot number
6. Roll dimensions

PART 3 EXECUTION

3.01 SHIPPING, HANDLING AND STORAGE

A. During periods of shipment and storage, all GDM shall be protected from direct sunlight, temperature greater than 140° F, water, mud, dirt, dust, and debris. To the extent possible, the GDM shall be maintained wrapped in heavy-duty protective covering until use. GDM delivered to the project site without protective wrapping shall be rejected.

B. GDM that are damaged during shipping or storage shall be rejected and replaced at Contractor expense.

3.02 INSTALLATION

A. GDM shall be placed to the lines and grades shown on the Contract Drawings. At the time of installation, the GDM shall be rejected, if it has defects, rips, holes, flaws, evidence of deterioration, or other damage.

B. The GDM shall be placed only on Geomembrane that has been accepted by the CQA ENGINEER.

C. The Contractor shall provide temporary anchorage of the GDM during installation to prevent movement during construction. Such anchorage may include sandbags and the like, as approved by the CQA ENGINEER. Permanent bonding to the Geomembrane shall be prohibited.

D. In general, seams shall be oriented parallel to the line of maximum slope, i.e., oriented up and down the slope.

E. Adjacent rolls of GDM shall be overlapped a distance of at least three (3) inches and secured using polyethylene ties. Tie spacing shall be every ten (10) feet.

The overlaying filter geotextile, where applicable, shall extend at least six (6) inches past the geonet joint and shall be permanently bonded by heat bonding or sewing as approved by the CQA ENGINEER.

F. Any GDM that is torn, crushed, or punctured shall be repaired or replaced by the Contractor at no additional cost to the Owner. The repair shall consist of a patch of the same type of material, placed over the failed area and shall overlap the existing material a minimum of twelve (12) inches from any point of the rupture. The patch shall be connected to the Geonet using polyethylene ties at a five (5) foot spacing.

G. The installing crew shall be approved by the manufacturers/fabricator for the installation of the GDM.

-- END OF SECTION--

SECTION 02755

GEOMEMBRANE (FML) CAP

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, supervision and equipment to complete the installation of the Linear Low Density Polyethylene (LLDPE) Geomembrane Cap, including, but not limited to, layout, seaming, patching, and all necessary and incidental items required to complete the Work, in accordance with the Contract Drawings and these specifications.

B. Sufficient material shall be furnished to cover all lined areas shown on the Construction Drawings, including overlaps at field seams and anchor trenches.

C. It is the intent of these specifications to ensure a quality finished product. It shall be the responsibility of the CONTRACTOR to ensure that this requirement is met.

1.02 QUALITY

A. The CONTRACTOR will be required to submit a quality control program to the CQA ENGINEER prior to initiating field work.

B. The OWNER shall employ and pay for the services of a third-party CQA ENGINEER, in accordance with Section 01400 - Quality Control, to confirm the installation of the liners.

C. All installation procedures and testing shall be in accordance with these specifications and OWNER's independent Construction Quality Assurance (CQA) Manual. A copy of this manual is enclosed.

D. All field destructive and non-destructive testing will be performed by the CONTRACTOR. Samples for laboratory testing will be taken by the CONTRACTOR for testing at the CONTRACTOR's laboratory as well as the CQA ENGINEER's laboratory.

1.03 SUBMITTALS

A. The geomembrane manufacturer shall submit certification that all materials manufactured for the project have been produced in accordance with these specifications along with results from a quality control program. This information

must be submitted for review prior to material delivery. The CQA ENGINEER reserves the right to halt installation until proper certification is submitted and determined acceptable for use.

B. The CONTRACTOR shall submit to the CQA ENGINEER, six full sets of panel layout construction drawings. Field welds and panels shall have an identification system. Construction Drawings shall be submitted to the CQA ENGINEER at least two weeks prior to installation.

C. The manufacturer of the geomembrane used in this work shall approve all shop drawings and a proposed cap layout to cover the cap area shown on the Construction Drawings.

D. Details shall be included to show the termination of the geomembrane at the perimeter of capped areas, the methods of sealing around penetrations and methods of anchoring.

E. The CONTRACTOR shall submit to the CQA ENGINEER a physical sample of the geomembrane and geonet to be used. The samples shall be labeled with the manufacturer's name, product identification, lot number and roll number.

F. The CONTRACTOR shall also submit to the CQA ENGINEER inventory tickets, roll numbers or batch identifications, packing papers and invoices for the geomembrane and geonet used.

G. The CONTRACTOR shall provide personnel resumes demonstrating compliance with the following requirements:

1. A minimum of one field superintendent per shift shall be designated by the CONTRACTOR and approved by the CQA ENGINEER. Each field superintendent shall have a minimum of three years and five million square feet of field experience in installing geomembranes. Any change or replacement of superintendent during the Project must be approved by the CQA ENGINEER.

2. The weld technicians shall have a minimum of one year and one million square feet geomembrane welding experience.

1.04 WARRANTY

A. Material

The MANUFACTURER is responsible for guaranteeing it's product. The warranty shall include all that is listed below:

1. Shall begin at the time of issuance of CQA ENGINEER's Certification of Substantial Completion.

2. The material shall be free from defects and be able to withstand normal weathering and use from the date of installation for a period of 20 years under normal uses and services for which it is designed and manufactured.

3. This limited warranty does not include damages or defects resulting from acts of God, casualty or catastrophe such as, but not limited to earthquake, flood, piercing hail, or tornado.

4. "Normal Use" excludes: exposure to harmful chemicals, mechanical abuse by machinery, equipment, or people, excessive pressure beyond that indicated by the final overburden or municipal refuse and cover indicated on the drawings.

PART 2 PRODUCTS

2.01 GEOMEMBRANE CAP

A. The geomembrane shall comprise linear low density polyethylene material manufactured of new, first-quality products designed and manufactured specifically for the purpose of capping in landfills.

B. The geomembrane material shall be so produced as to be free of holes, blisters, undispersed raw materials or any sign of contamination by foreign matter. Any such defect shall be repaired in accordance with the manufacturer's recommendations. The CQA ENGINEER may reject all or portions of units (or rolls) of geomembrane if significant quantities of production flaws are observed.

C. The geomembrane material shall meet the material properties and testing frequencies as specified in the Geosynthetic Research Institute GRI Test Method GM-17, as latest revised, for 40 mil Liner Low Density Polyethylene (LLDPE) geomembrane. The minimum thickness requirement shall be the lowest individual measurement, not the aversage.

D. The geomembrane cap shall be the required minimum liner thickness as shown on the Construction Drawings.

E. If natural colored, the manufacturer shall add carbon black per ASTM D 1248 Specifications, Section 3.1.2.3, Class C.

F. The manufacturer's quality control program shall include the following inspections and tests:

1. Inspection for: Appearance on both sides, manufacturing defects, and thickness at 10 random locations across each sample strip.

2. Testing shall be conducted in accordance with the Geosynthetic Research Institute GRI Test Method GM-17, as latest revised, for 40 mil Liner Low Density Polyethylene (LLDPE) geomembrane. The minimum thickness requirement shall be the lowest individual measurement, not the average. The results shall be reported.

3. A quality chart of each roll of sheet shall be prepared and a copy attached to the roll. Information plotted on the chart shall include the location and type of defect, if any.

G. The geomembrane shall be shipped rolled. Folded or otherwise creased material will not be accepted. The material shall be marked and tagged with the following information:

1. Serial Number
2. Resin Type
3. Roll Length
4. Gross Weight
5. Inspected By
6. Date of Manufacture
7. Resin Lot Number
8. Roll Width
9. Net Weight

H. Material which has been delivered to the project site shall be stored in a dry area and protected from precipitation and direct sunlight.

I. Care shall be taken to keep the materials clean and free from debris prior to installation.

PART 3 EXECUTION

3.01 GENERAL

The geomembrane cap shall be constructed as soon as practical after filling of the cell. The cap shall be installed following the manufacturer's printed recommendations, using sound, accepted engineering practices. The entire geomembrane cap installation shall be completed by one crew. The installing crew shall be approved by the manufacturer/fabricator for installation of 40 mil geomembrane.

A manufacturer's technical representative shall be at the Pre-Deployment Meeting and on site at the time of installation.

A. Geomembrane

1. No horizontal seams are allowed within five feet of the toe of the slope.

2. Unroll only those factory-packaged sections which are to be anchored or seamed together in one day. Panels should be positioned with the overlap recommended by the manufacturer, but not less than 2-inches.

3. After panels are initially in place, remove as many wrinkles as possible. Unroll several panels and allow the geomembrane to "relax" before beginning field seaming. The purpose of this is to make the edges, which are to be bonded, as smooth and free of wrinkles as possible.

4. Once panels are in-place and smooth, commence field seaming operations.

5. No support equipment used by any CONTRACTOR shall be allowed on the geomembrane. Personnel working on the geomembrane shall not smoke, wear damaging shoes or engage in any activity which damages the geomembrane.

6. The anchor trench shall be excavated, backfilled and compacted. Care should be taken when backfilling the trench to prevent any damage to the geomembrane.

7. Damaged and sample coupon areas of geomembrane shall be repaired by the CONTRACTOR. Repaired areas will be tested for seam integrity by the CONTRACTOR. Damaged materials are the property of the CONTRACTOR and will be removed from the site at the CONTRACTOR's expense. The CONTRACTOR will retain all ownership and responsibility for the geomembrane until acceptance by the OWNER.

3.02 SEAMING

A. Geomembrane

1. Field Seaming

a. All foreign matter (dirt, water, oil, etc) shall be removed from the area to be bonded. If the seam is to be bonded by the extrusion process, the bonding surfaces must be thoroughly cleaned by mechanical abrasion or alternate methods approved by the CQA

ENGINEER to remove surface cure and prepare the surfaces for bonding. No solvents shall be used to clean the geomembrane.

b. Tack welds, if used, shall use heat only; no double-sided tape, glue or other method will be permitted. The geomembrane should be seamed completely to the ends of all panels to minimize the potential of tear propagation along the seam. The completed cap shall not exhibit "trampolining" and shall be in full contact with the underlying soil cap.

c. At the end of each day or installation segment, all unseamed edges shall be anchored by sand bags or other approved device. Sand bags shall weigh approximately 20 pounds and shall be placed no further apart than 20 foot spacing along the open end of the geomembrane. Sand bags securing the geomembrane on the side slopes should be connected by a rope fastened at the top of the slope by a temporary anchor. If high winds are expected, boards along the edge of unseamed panels, with weighted sand bags on top, should be used to anchor the geomembrane. Sand bags fastened by rope should be used to secure unseamed edges on the side slopes. Staples, U-shaped rods or other penetrating anchors shall not be used to secure the geomembrane. The temporary anchoring of the geomembrane is fully the responsibility of the CONTRACTOR. Any material damaged as the result of weather effects, shall be repaired or replaced at no cost to the OWNER.

d. It is imperative to keep surface water runoff from beneath the geomembrane at all times during installation. The CONTRACTOR's panel placement and seam welding technique and welding schedule shall minimize or eliminate the accumulation of water beneath the geomembrane. Any water found ponded beneath the geomembrane after the geomembrane has been installed shall be removed by the CONTRACTOR at no cost to the OWNER. Any soil subgrade beneath installed geomembrane that has become excessively moist, soft or unsuitable to perform its intended function shall be replaced at no cost to the OWNER.

e. After field seaming is complete in a given area, geomembrane edges in the anchor trench should be buried. Do not bury the geomembrane edge in the anchor trench within 30 feet of an incomplete or unbounded field seam.

2. Field seaming may be extrusion or fusion welding or a combination of these methods. Solvent welding is not acceptable. The CQA ENGINEER reserves the right to reject any proposed seaming method believed unacceptable.

   a. Extrusion welding applies a molten bead of material to preheated sheets of geomembrane. The sheets are then joined by pressure.

   b. The fusion welding process heats the area to be joined to the melting point and then applies pressure to join the melted surfaces.

   c. The sheets to be joined shall be overlapped at least 2-inches after the necessary aligning and cutting.

   d. In general, seams should be oriented parallel to the line of maximum slope, i.e. oriented up and down, not across, the slope. In corners and odd shaped geometric locations, the number of field seams should be minimized.

   e. No horizontal seams should be within 5 feet from the toe of the slope.

   f. No seaming should be attempted above 40 degrees C (104 degrees F) ambient air temperature. Below five (5) degrees C (41 degrees F) ambient air temperature, preheating of the geomembrane may be required. It shall be the responsibility of the CONTRACTOR to demonstrate that conditions are favorable for seaming by acceptable test (start-up) seams which duplicate, as closely as possible, actual field conditions. Preheating may be achieved by natural and/or artificial means (shelters and heating devices).

   g. A moveable protective layer of plastic may be required, as recommended by the CQA ENGINEER, to be placed directly below each overlap of geomembrane that is to be seamed. This is to prevent any moisture build-up between the sheets to be welded.

   h. Seaming will extend to the outside edge of panels to be placed in anchor trenches.

   i. If required, a firm substrata should be provided by using a flat board, a conveyor belt, or similar hard surface directly under the seam overlap to achieve proper support.

   j. Grinding prior to welding shall be as recommended by the geomembrane manufacturer and shall be done perpendicular to the sheet edge. Overground or improperly ground areas shall be replaced at the CONTRACTOR's expense.

k. No folds, wrinkles or "fish-mouths" shall be allowed within the seam area. Where wrinkles or folds occur, the material shall be cut, overlapped and an extrusion-weld shall be applied. During wrinkle or fold repairs, adjacent geomembrane may not necessarily be required to meet the 2-inch minimum overlap, if approved by the CQA ENGINEER. All welds on completion of the work shall be tightly bonded and sealed.

3.03 TESTING OF GEOMEMBRANE

A. General

1. Samples of the field seams shall be taken and tested in accordance with ASTM D6392 to ensure that tensile strength at yield and break, elongation at yield and break meet the minimum specifications. A quality control certificate shall be issued with the material.

2. The CONTRACTOR shall employ on-site physical non-destructive testing on all welds.

3. A quality control technician shall inspect each sheet and seam. Any area showing a defect shall be marked and repaired in accordance with geomembrane repair procedures.

B. Test Seams: Test seams will be made each day prior to commencing field seaming. These seams will be made on fragment pieces of geomembrane to verify that seaming conditions are adequate. Such test seams will be made at the beginning of each seaming period and, at the CQA ENGINEER's discretion, at least once every four hours, for each seaming apparatus used that day. Also, each seamer will make at least one test seam each day.

1. The test seam sample will be at least 1.5 m (5 feet) long by 0.3 m (1 foot) wide with the seam centered lengthwise. Six adjoining specimens 25 mm (1-inch) wide each will be die cut from the test seam sample. These specimens, which will be tested with a tensiometer in the field for shear (three samples) and peel (three samples) by the CONTRACTOR and witnessed by the CQA ENGINEER, should not fail in the seam. If a test seam fails, the entire operation will be repeated. If the additional test seam fails, the seaming apparatus or seamer will not be accepted and will not be used for seaming until the deficiencies are corrected and two consecutive successful full test seams are achieved. Test seam failure is defined as failure of any one of the specimens tested in shear or peel.

2. The CQA ENGINEER or his representative will observe all test seam procedures. The remainder of the successful test seam sample will be assigned a number and marked accordingly by the CQA ENGINEER, who will also log the date, hour, ambient temperature, number of seaming unit, name of seamer and pass or fail description. At least one tested specimen from each test as selected by the CQA ENGINEER will be retained by the CQA ENGINEER. The CQA ENGINEER will transmit these specimens to the OWNER following acceptance of the geomembrane materials and installation by the OWNER.

3. The criteria for determining passing welded seams shall be as stated in the "Seam Strength" table in the Geomembrane Liner Section of the CQA Manual.

C. Field Seams: Field seams will be tested by the CONTRACTOR continuously using non-destructive techniques and at specified intervals using destructive tests. Requirements for non-destructive and destructive testing are as follows:

1. Single Weld Seams: The CONTRACTOR shall maintain and use equipment and personnel at the site to perform continuous vacuum box testing on all single weld production seams or when the geometry of the weld makes pressure testing impractical.

a. Equipment for Vacuum Testing:

1. Vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, port hole or valve assembly, and a vacuum gauge.

2. Vacuum pump assembly equipped with a pressure controller and pipe connection.

3. A rubber pressure/vacuum hose with fittings and connections.

4. A bucket and means to apply a soapy solution.

b. Procedure for Vacuum Testing:

1. Trim excess overlap from seam, if any.

2. Turn on the vacuum pump to reduce the vacuum box to approximately 5 in. of mercury, i.e. 3 psi gauge.

3. Apply a generous amount of solution of strong liquid detergent and water to the area to be tested.

4. Place the vacuum box over the area to be tested and apply sufficient downward pressure to "seat" the seal strip against the liner.

5. Close the bleed valve and open the vacuum valve.

6. Apply a minimum of 3 psi vacuum to the area as indicated by the gauge on the vacuum box.

7. Ensure that a leak tight seal is created.

8. For a period of not less than 5 seconds, examine the geomembrane through the viewing window for the presence of soap bubbles.

9. If no bubbles appear after 15 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum 3 inch overlap, and repeat the process.

10. Mark all areas where soap bubble appear and repair the marked areas. After repairs are made, retest these areas.

2. Double Weld Seams: The CONTRACTOR shall maintain and use equipment and personnel to perform air pressure testing of all double weld seams. The system shall be capable of applying a pressure of at least 30 psi for not less than five minutes. The CONTRACTOR shall perform all pressure and vacuum testing under the supervision of the CQA ENGINEER. Pressure loss tests shall be conducted in accordance with the procedures outlined in "Pressurized Air Channel Test for Dual Seamed Geomembranes", Geosynthetic Research Institute Test Method GM-6. As outlined by the test method, following a two minute pressurized stabilization period, pressure losses over a measurement period of five minutes shall not exceed the following: 40 mil - 4 psi.

3. Destructive testing will be performed on a maximum of every 500 linear feet of field seam. The locations will be selected by the CQA ENGINEER. Sufficient size samples will be obtained by the CONTRACTOR to provide one sample to the archive, one sample to the CQA ENGINEER for laboratory testing, and two samples to be retained by the CONTRACTOR for both field and laboratory testing. Testing requirements are as follows: Each sample

shall be large enough to test five specimens in peel and five specimens in shear. The criteria for determining passing welded seams shall be as stated in the "Seam Strength" table in the Geomembrane FML Cap Section of the CQA Plan.

a. Tests shall be conducted in peel and shear using a tensiometer. No strain measurements from field tests of seams will be accepted. Field tests will be evaluated for the criteria described above in paragraph B. 3. or 4.

b. The CQA ENGINEER will observe all production seam field test procedures. The remainder of the successful test seam sample will be assigned a number and marked accordingly by the CQA ENGINEER, who will also log the date, seam number, approximate location in the seam, and field test pass-or-fail description, if applicable. The CQA ENGINEER will be responsible for the archive specimen.

3.04 REPAIRS OF DAMAGED AND SAMPLED AREAS

A. Damaged and sample coupon areas of geomembrane shall be repaired by the CONTRACTOR by construction of a cap strip. No repairs shall be made to seams by application of an extrusion bead to a seam edge previously welded by integrity. Damaged materials are the property of the CONTRACTOR and will be removed from the site at the CONTRACTOR's expense. The CONTRACTOR will retain all ownership and responsibility for the geomembrane until acceptance by the OWNER.

3.05 ANCHOR TRENCH BACKFILLING

The anchor trench will be backfilled and compacted to a dry density not less than 90 percent of the maximum dry density determined by the Standard Proctor (ASTM D-698). Care should be taken when backfilling the trench to prevent any damage to the geomembrane. Anchor trench spoil shall be used as backfill material, wherever possible.

3.06 PROTECTION OF LEADING EDGES

Between construction of partial sections of the membrane cap, leading edges of the membrane may be exposed or buried for extended periods of time prior to their joining to adjacent, subsequent membrane sections. The combined action of abrasive soil and equipment impact stresses may "etch" unprotected membrane surfaces sufficiently to affect seam strengths. Therefore, it is necessary to protect leading edges in high activity areas with sacrificial layers of geomembrane sheet until they are ready for final seaming. As a minimum, each leading edge to be seamed that must be buried or which must be exposed for periods of one month or longer shall be continuously covered by a layer of geotextile overlain by a layer of geomembrane sheet. The geotextile shall be nonwoven and have a minimum weight of 6 oz. per square yard. The sacrificial geomembrane sheet shall have a minimum thickness equal to that of the membrane

liner to be protected. Both protective cover sheet layers shall have a minimum width of 2 feet. The protective cover sheets shall be either covered with soil or weighted with sand bags to prevent displacement by wind. The edge of the sheet to be protected shall be approximately centered beneath the overlying protective layers prior to burial or weighing with sandbags. Leading edges located in areas expected to receive direct traffic from construction equipment shall be buried under a minimum thickness of one foot of buffer soil.

3.07 CAP ACCEPTANCE

The CONTRACTOR shall retain ownership and responsibility for the geomembrane cap system until acceptance by the OWNER.

The cap system shall be accepted by the OWNER when:

- The installation is complete as determined by the CQA ENGINEER;
- Verification of the adequacy of all seams and repairs, including associated testing, is complete;
- All documentation of installation is completed, including all CQA reports;
- The CONTRACTOR provides the OWNER with record drawings of the panel layout and seam locations with reference numbers for test locations;
- The CONTRACTOR, the Manufacturer and the CQA ENGINEER provide written certification that the installation was in accordance with the manufacturer's general recommendations, the OWNER's CQA plan, and specifications, with exceptions noted.
- The cap system has been accepted by the North Carolina Division of Environment and Natural Resources Solid Waste Section.

--END SECTION--

SECTION 02757

CUSHION GEOTEXTILE

PART 1 - DESCRIPTION

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary for the installation of the geotextile layer, as specified herein, as shown on the Construction Drawings, and in accordance with the Construction Quality Assurance (CQA) Manual.

B. The CONTRACTOR shall be prepared to install the geotextile in conjunction with the earthwork and other components of the liner system.

1.02 REFERENCES

(Note: For geotextile test standards please refer to the current ASTM Annual Book of ASTM Standards, Volume 04.08 Section 4 for the Latest version of the American Society for Testing and Materials (ASTM) Standards.)

PART 2 - PRODUCTS

2.01 MATERIALS

A. This section sets forth the requirements for geotextiles.

B. Physical Properties

The geotextile shall be manufactured using a spunbonded process in which continuous polypropylene filaments are mechanically needled to produce a non-woven geotextile. Manufacturer's certification shall be required stating the geotextile has been inspected for broken needles. This inspection shall be via metal detectors permanently installed on-line at the production facility.

The geotextile shall meet or exceed the properties listed in Table 1. Unless noted otherwise, all numerical values indicate minimum average roll values (i.e., test results from any sampled roll in the lot, when tested in accordance with ASTM D 4759-88 shall meet or exceed the minimum average roll value listed). All strength values are for the weaker principle direction.

TABLE 1

Physical Property	Test Method	Unit	Minimum Value
Mass Per Unit Area	ASTM D 3776	oz/sy	12*
Puncture Resistance	ASTM D4833	lbs.	95.00

ASTM - American Society for Testing and Materials

* As shown on construction drawings

C. Submittals

Prior to bid, the CONTRACTOR shall submit the geotextile manufacturer's specification sheet(s) which indicate the property values of the product(s) that are submitted for use on the project. A swatch (12" x 12") of each geotextile shall be submitted along with the specification sheets.

Prior to arrival of the geotextile(s) on site, upon request the geotextile manufacturer shall supply quality control/quality assurance documents to the OWNER's representative.

Quality control/quality assurance sampling and testing shall be conducted in accordance with ASTM D 4354 and applicable test standards as found in Table 1. Recommended tests and test frequencies are found in Table 2.

TABLE 2

Property	Minimum Frequency
Mass Per Unit Area	every 100,000 ft^2
Puncture Resistance	every 400,000 ft^2

Additional Supporting Documentation: CONTRACTOR shall supply additional documentation which shall include: supporting test date and EPA 9090 test data which will assist the DESIGN ENGINEER in determining the suitability of the geotextile for the intended application.

D. Plant Inspection

A representative of the OWNER may visit the manufacturing plant at any time during the project to observe and inspect the manufacturing process and quality control monitoring, sampling and testing. The OWNER will notify the CONTRACTOR at least forty-eight (48) hours in advance of the intended visit. The CONTRACTOR shall be responsible for making all necessary arrangements for the visit with the

manufacturer. All costs of travel, lodging and meals incurred by the OWNER's representative will be borne by the OWNER.

2.02 SHIPPING, STORAGE AND HANDLING

A. General

Geotextile shall be shipped, stored and handled in accordance with ASTM D 4873, and as specified herein. CONTRACTOR shall be completely responsible for shipping, storage and handling of all geotextiles.

B. Roll Identification

Each roll shall be labeled (by printing directly on the geotextile) or tagged with roll identification number, lot identification number, name of manufacturer, product type and grade, and physical dimensions. The label or tag information shall be affixed or attached to the roll at all times during deployment of the roll. The roll identification number and manufacturer name shall also be marked on the protective covering.

C. Shipping

Geotextile shall be shipped and stored in opaque protective covering. CONTRACTOR shall notify the CQA ENGINEER at least 24 hours prior to schedule delivery. No materials shall be unloaded without the presence of the OWNER's representative. Geotextile(s) delivered to the site shall be inspected for damage, unloaded and stored with minimal handling. CONTRACTOR shall assist the OWNER's representative in conducting inventory, handling and sampling of geotextile at no additional cost to the OWNER.

D. Handling

No hooks, tongs or other sharp tools or instruments shall be used for handling geotextile roll(s). CONTRACTOR shall use slings or a pole which extends a minimum of 1 foot beyond each end to unload or handle individual rolls. Geotextile shall not be dragged along the ground.

E. Site Storage

Geotextile roll(s) whose protective covering has been damaged during handling shall be protected from ultraviolet light exposure, precipitation or other inundation, soil, mud, dirt, debris, puncture, cutting or other damaging or deleterious conditions. Geotextile shall not be stored directly on the ground.

2.03 CONFORMANCE TESTING

A. Sampling Procedures

Upon delivery to the site, samples of the geotextile(s) shall be removed and sent to a laboratory, chosen by the OWNER, for testing to ensure conformance to these specifications. Samples shall be selected by the OWNER's representative in accordance with these specifications. Conformance testing, as detailed, in subparagraph 2.01C, Table 2.

B. Interpretation of Conformance Test Results

Test specimens will be obtained from each conformance sample. The minimum number of specimens tested per conformance sample for each tested geotextile property will be determined in accordance with the respective ASTM Standard. The average value will be calculated from the specimen test values of each conformance sample and compared to the minimum average roll value of the tested geotextile property. A conformance sample that yields an average number which is less than the specified minimum average roll property, will be recorded as a failure. If two conformance samples fail, all rolls within the sampled 100,000 square feet or lot will be rejected for use on the project unless the manufacturer would like to have additional testing performed at no cost to the OWNER. If only one (1) conformance test fails, the roll that yielded the failure will be rejected and a subsequent conformance sampled from the same 100,000 square feet or lot will be tested. All rolls within the sampled 100,000 square feet or lot will be rejected for use on the project if the subsequent conformance test fails. Only the roll which yielded a failure will be rejected from use on the project if the subsequent conformance test passes.

2.04 GEOTEXTILE INSPECTION

A. Material Inspection

The CONTRACTOR shall visually inspect all geotextile rolls for imperfections, faulty areas and possible damage prior to installation. All defective rolls shall be marked and repaired in accordance with approved methods.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Placement

Geotextile(s) shall be installed as shown on the Construction Drawings, approved installation drawings, and as specified herein or in accordance with the approved installation procedures. No geotextile roll shall be installed without approval of the CQA ENGINEER. Geotextile rolls shall be placed in such a manner as to minimize field sewing.

Geotextile shall be cut only with an approved geotextile cutter.

All changes to approved installation drawings and procedures shall be approved by the CQA ENGINEER prior to implementation.

The CONTRACTOR shall exercise extreme care during geotextile installation to prevent damage to the prepared supporting subgrade surface or to other installed geosynthetics. The CONTRACTOR shall exercise care to prevent the entrapment of rocks, clods of earth or other matter which could damage the geotextile or other geosynthetic, clog the geotextile or hamper seaming. Any geotextile surface showing damage to penetration by foreign objects or distress shall be replaced or repaired.

No foot traffic shall be allowed on the geotextile except with approved smooth - sole shoes. No vehicular traffic shall be allowed on the geotextile. The CONTRACTOR shall not use the geotextile as a work area or storage area for tools and supplies.

The CQA ENGINEER shall have the authority to order the immediate stoppage of work as a result of improper installation procedures or for any reason which may result in defective and improper installation.

Cleanup within the work area shall be an ongoing responsibility of the CONTRACTOR. Particular care shall be taken to ensure that no trash, tools or other materials are trapped beneath the geotextile.

B. Repairs

Geotextile repairs shall be made with patches of the same geotextile material, using approved sewing systems, equipment and techniques. The patch size shall be 24" larger in all directions that the area to be repaired. All corners shall be rounded. All stitches shall be located no closer than 1 inch from the edge of the patch.

C. Joining Methods

Thread used to sew panels of geotextiles together shall be UV stabilized polypropylene. The tread color shall contrast with the geotextile color to assist in inspection of the seam.

Geotextile seams shall be prayer or flat seams for non-woven geotextiles. All seams shall be formed by mating the edges of the geotextile panels, and sewn together with continuous stitches located a minimum of 3 inches from the mated edges. A two - thread, type 401k double - locked stitch shall be used for all sewing work. Sewing procedures shall conform to the latest procedures recommended by the geotextile manufacturer. Thermal welding can also be performed on geotextiles with mass per unit area greater than 7.9 ounces per square yard. For both forms of seaming the CONTRACTOR shall demonstrate that the seam efficiency meets requirements found in Table 1.

D. Cover

All geotextile should be covered within 14 days. If the geotextile will be left exposed for more than 14 days, the manufacturer, prior to shipping, shall provide field U.V. test data and written recommendations for the maximum time of U.V. exposure. Geotextiles which will be left exposed for more than 14 days shall be routinely sampled and tested for tensile strengths every 4 weeks. Samples should be taken from the exposed geotextile and these areas properly repaired. If within the time frame of recommended exposure the tensile strength of the geotextile falls below 80% of the original values, the manufacturer shall replace the detective material assuming all cost for removal of the detective material and installation of the replacement material.

E. Socks

Geotextile fabric socks for wrapping pipe shall be constructed with the fabric specified in this section. The sock shall be constructed by forming a cylinder and stitching the seam in accordance with the joining methods specified in this section. The sock diameter shall be sufficient size to slip easily over the pipe and connecting sleeve.

-- END OF SECTION --

SECTION 02930

GRASSING

PART 1 GENERAL

1.01 WORK INCLUDED

Provide seedbed preparation, liming, fertilizing, seeding, and mulching of all newly graded finish earth surfaces, unless indicated otherwise, and all areas inside or outside the limits of construction that are disturbed by the Contractor's operation. Areas shall be hydroseeded, except small areas that are inaccessible to the hydroseeding equipment, which shall be drilled seedbed.

1.02 SUBMITTALS

A. Contractor shall furnish Certificates of Conformance from manufacturers or agencies.

1. Seed
2. Fertilizer
3. Lime
4. Soil Testing Recommendation - County Extension Service

B. Manufacturer's Literature

Including physical characteristics, application and installation instructions, and recommendations:

1. Hydraulic Mulch Material
2. Erosion Control Material

1.03 DELIVERY

A. Fertilizer and Lime

Deliver materials to the site in the original, unopened containers bearing the manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. In lieu of containers, furnish fertilizer and lime in bulk with a certificate indicating the above information accompanying each delivery.

B. Seed

Deliver seed to the site in original sealed packages bearing the producer's guaranteed analysis for percentages of mixtures, purity, germination, weedseed content, and inert material. Label in conformance with USDA Federal Seed Act 53 Stat. Rules and Regulations and applicable state seed laws. Wet, moldy, or otherwise damaged seed will be rejected.

1.04 STORAGE AND HANDLING

Store lime, fertilizer, and seed in dry locations away from contaminants. Protect seed from drying out. When handling materials, do not drop or dump from vehicles.

1.05 MEASUREMENT AND PAYMENT

Not applicable.

PART 2 PRODUCTS

2.01 SEED

Permanent seeding shall be in accordance with the North Carolina Erosion and Sediment Control Planning and Design Manual and following schedule:

SPECIES	RATES / ACRE (lbs./acre)	PLANTING DATES
Tall Fescue	100	Aug 20 - Oct 25 Feb 1 - April 15
Kobe Lespedeza	10	Aug 20 - Oct 25 Feb 1 - April 15
Sericea Lespedeza	30	Aug 20 – Oct 25 Feb 1 - April 15

Temporary seeding shall be used for spoil piles standing less than six (6) months. Long-term spoil piles shall be permanently seeded.

Mulch shall be applied to seeded areas within 24 hours after temporary and permanent seeding operations. Mulch shall be essentially free of noxious weeds and applied at a rate of approximately 92 lbs/1,000 square feet (4,000 lbs/acre).

On areas where ground surface exceeds approximately five (5%) slopes, the mulch shall be tacked using a sufficient amount of asphalt or similar binding material to hold mulch in place.

Seedbed Preparation

1. Work lime and fertilizer into the soil where conventional equipment can be used. Use disk or similar equipment to prepare to depth of 3-4 inches. Use ripper if necessary.

2. Lime and fertilizer may be applied with seed mixture when a hydroseeding used and where mulch will be applied. Seedbed preparation may not be necessary where hydroseeding equipment is used.

3. Slopes that are too steep for conventional equipment (2:1 or steeper) should be seeded with hydroseeding equipment.

Where hydroseeding equipment is not available for use on steep slopes, scarify the soil surface with a chain harrow, pick chain, grader blades with chisels, hand tools, or other equipment that will pit the soil or make trenches approximately 1-2 inches deep, 6-12 inches apart across the slope in which the seed can lodge and germinate.

2.02 LIME

ASTM C 602, commercial agricultural limestone containing a minimum of 94 percent of total carbonates, 52 percent calcium, and 42 percent magnesium. Provide the following ASTM E 11 gradation: minimum 100 percent passing the No. 20 sieve and 75 percent passing the No. 100 sieve. Application rates shall be as recommended by the North Carolina Department of Agriculture through standard soil testing procedures.

2.03 FERTILIZER

Commercial grade, free flowing, uniform in composition and bearing the manufacturer's guaranteed statement of analysis. Analysis of fertilizer and application rates shall be as recommended by the North Carolina Department of Agriculture through soil testing procedures, and in accordance with this schedule:

(Continued on next page)

FERTILIZER REQUIREMENTS				
TYPE OF SPECIES	**YEAR**	**ANALYSIS OR EQUIVALENT N-P-K**	**RATE**	**N TOP DRESSING RATE**
1. Cool season grasses	First	6-12-12	1,500 lbs/ac	50-100 lbs/ac ½/
2. Cool season grasses and legumes	First	6-12-12	1,500 lbs/ac	0-50 lbs/ac 1/
3. Ground covers	First	10-10-10	1,300 lbs/ac 3/	- -
4. Temporary cover crops seeded alone	First	10-10-10	500 lbs/ac	30 lbs/ac 4/
5. Warm season grasses	First	6-12-12	1,500 lbs/ac	50-100 lbs/ac 2/5/

1/ Apply in spring following seeding
2/ Apply in split applications when high rates are used
3/ Apply in three (3) split applications
4/ Apply to grass species only
5/ Apply when plants grow to a height of 2 to 4 inches

2.04 MULCH

Free from noxious weeds, mold, or other deleterious material. Provide wood cellulose fiber when hydroseeding.

A. Straw

Stalks from oats, wheat, rye, barley, or rice. Furnish air-dry condition and of proper consistency for placing with commercial mulch-blowing equipment.

B. Wood Cellulose Fiber

Processed to contain no growth or germination-inhibiting factors and dyed an appropriate color to facilitate visual metering of materials application. Composition on air-dry weight basis: 9-15 percent moisture, pH range 3.5 to 5.0.

2.05 WATER

Suitable quality for irrigation.

PART 3 EXECUTION

3.01 SEED BED PREPARATION

Areas required to be seeded shall have been brought to the required subgrade. New areas to be seeded shall be thoroughly tilled to a minimum depth of four (4) inches by scarifying, disk harrowing, or other approved methods. Remove debris and stones larger than one inch remaining on the surface after tillage.

A. Fertilizer and Lime

Apply fertilizer and lime at the rates recommended by North Carolina Department of Agriculture.

B. Drill Seeding For New Seeding

Incorporated fertilizer and lime into the soil to a minimum depth of four (4) inches. Application may be performed as part of the tillage operations.

C. Hydroseeding

Apply liquid fertilizer in amounts recommended by the North Carolina Department of Agriculture. Apply lime manually.

3.02 SEEDING

A. Seeding Conditions

Immediately before seeding, restore soil to the proper grade. Do not seed when the ground is muddy or in any unsatisfactory condition for seeding.

B. Seeding Method

Apply seed within 24 hours after seedbed preparation. Sow seed with approved sowing equipment using one or a combination of the following methods. Sow one-half the seed in one direction and sow remainder at tight angles to the first sowing.

C. Drill Seeding

Use cultipacker seeders or grass seed drills. Drill seed uniformly to maximum depth of ¼" clay soils and ½" in sandy soils. Cover seed by spike-tooth harrow, cultipacker, or other approved devices.

D. Hydroseeding

Mix seed, fertilizer, and wood cellulose fiber in required amount of water to produce a homogenous slurry. After seed, water, and fertilizer have been thoroughly mixed, add 1,500 pounds of wood cellulose fiber per acre (dry weight) and apply the slurry. Seed shall not remain in water containing fertilizer for more than one (1) hour prior to application and shall be agitated during application.

3.03 PROTECTION OF SEEDED AREAS

Immediately after seeding, protect the area against traffic and other use by erecting barricades, as required, and placing approved signs at appropriate intervals until final acceptance.

3.04 RESTORATION

Restore to original condition existing lawn areas which have been damaged during seeding operations. Clean paving when work in adjacent areas is complete.

3.05 TURF

A. Duration

Turf establishment period will be in effect until final acceptance.

B. Maintenance

During turf establishment period, mow the seeded area to an average height of two (2") inches whenever the average height of grass becomes four (4") inches. Remove excess clippings, eradicate weeds, apply water and/or fertilizer, overseed, and perform other operations necessary to promote turf growth.

3.06 FINAL ACCEPTANCE

A. Final Inspection and Acceptance

At the end of the turf establishment period, final inspection will be made upon written request at least 10 days prior to the anticipated date. Final acceptance will be based upon a satisfactory stand of turf, defined as 95 percent ground cover of the established species.

B. Replanting

In areas which do not have a satisfactory stand of turf, replant as directed.

--END OF SECTION--

V. FACILITY PLAN

FACILITY PLAN

PREPARED BY ESP ASSOCIATES, P.A.

CHARLOTTE MOTOR SPEEDWAY LANDFILL V
PHASE 3 PERMIT TO CONSTRUCT
CITY OF CONCORD, NORTH CAROLINA

FOR

REPUBLIC SERVICES OF SOUTH CAROLINA, LLC

MAY 2009

FACILITY PLAN

BFI WASTE SYSTEMS OF NORTH AMERICA, INC. CMS LANDFILL V – LATERAL EXPANSION PHASE 2 EXPANSION (CELLS 2F, 2G & 2H) AND PHASES 3, 4 & 5

This Facility Plan has been prepared in accordance with the State of North Carolina, Department of Environment and Natural Resources, Division of Waste Management, Rule.1619 of the North Carolina Administrative Code (NCAC), Title 15A, Chapter 13, Subchapter 13B.

This Plan has been prepared on behalf of:

BFI Waste Systems of North America, Inc.
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FACILITY PLAN
BFI WASTE SYSTEMS OF NORTH AMERICA, INC.
CMS LANDFILL V – LATERAL EXPANSION, PHASE 2 EXPANSION (CELLS 2F, 2G & 2H) AND PHASES 3, 4 & 5

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FACILITY PLAN
BFI WASTE SYSTEMS OF NORTH AMERICA, INC.
CMS LANDFILL V – LATERAL EXPANSION
PHASE 2 (CELLS 2F, 2G & 2H) AND PHASES 3, 4 & 5

Introduction

CMS Landfill V is an operating municipal solid waste landfill (Permit No. 13-04) located on property owned by BFI Waste Systems of North America, Inc. (BFI) and located within the city limits of Concord, North Carolina. This facility plan addresses the comprehensive site development proposed for the BFI – CMS Landfill. Specifically, the plan describes the lateral expansion (s) of the existing facility to include the continuation of Phase 2 (Cells 2F, 2G and 2H), Phase 3, Phase 4 and Phase 5. These expansion areas are shown on the Site Development Plans in Appendix 1. The progression of phase permitting and cell construction is shown on the phasing plans located in Appendix 2. As part of this application, a Permit to Construct is requested for the initial Phase 2 expansion including Cells 2F, 2G and 2H. The proposed grades are based on groundwater and bedrock information supplied by ENSR Consulting and Engineering (NC), Inc. in the Design Hydrogeologic Study dated December 2003. Phases 3, 4 and 5 base grades were developed using the groundwater information taken from the "Groundwater Potentiometric Surface Contour Map, January 2003", Figure 4 in the Design Hydrogeologic Study dated December 2003.

Section 1.0 – Site Development

1.1 Facility Description

The proposed CMS Landfill V, Lateral Expansion includes a continuation of Phase 2 (Cells 2F, 2G and 2H), Phase 3, Phase 4 and Phase 5. These expansion areas are located on property owned by BFI Waste Systems of North America, Inc. within the City Limits of Concord, North Carolina. A property boundary survey was performed by ESP Associates, P.A. for the proposed lateral expansion dated June 11, 2003. A copy of this survey sealed by a Registered Land Surveyor is included in Appendix 1. In general, the site is bordered on the south and west by the Rocky River and by Pitts School Road to the east.

CMS Landfill V is an active Subtitle D Municipal Solid Waste Landfill constructed and operating in accordance with NCDENR – Division of Waste Management Permit 13-04 last issued August 22, 2002. Existing operations consist of Cells 1A & 1B, 2A through 2E and 2L. In addition, the Facility currently operates the following solid waste related activities within the Facility Boundary:

- Municipal Solid Waste Disposal (Cells 1A, 1B, 2A-2E, 2L)
- Leachate Storage Lagoon
- Leachate Pre-Treatment Facility
- Solidification of Non-Hazardous Liquid Wastes
- Gas Recovery Facility (Owned by a third party)

- Solid Waste Hauling Operations
- Equipment & Truck Maintenance Facilities
- Scales & Scale House
- Administration Offices
- All Weather Access / Haul Roads

These operations/facilities are shown on the Site Development Plans included in Appendix 1. The conceptual Cell and Phase layouts are shown on the Site Development Plans in Appendix 1.

1.2 Landfill Construction

Development of the phase 2 Expansion, Phase 3, Phase 4 and Phase 5 are depicted in the Construction Plan – Base Grades included in Appendix 1 showing limits of grading, erosion & sedimentation control devices, access roads and leachate transmission pipelines. Each phase has been designed not to exceed a disposal capacity in excess of 5 years. Borrow material will be excavated from the North Borrow Area located north of US Highway 29 (Plan included in Appendix 1). The final configuration of the proposed expansion is shown on the Construction Plan – Final Contours included in Appendix 1.

1.3 Landfill Operation

The initial Phase of Construction includes the continuation of Phase 2, specifically Cells 2F, 2G and 2H. These Cells have been designed to contain "split sumps" (two sumps per Cell) due to the groundwater surface maps (provided by ENSR Consulting & Engineering (NC), Inc.) depicting higher groundwater levels bisecting the proposed footprint from north to south. Therefore, each Cell shall promote leachate collection to the east and west utilizing a minimum post-settlement floor slope of two (2) percent. Phases 3, 4 and 5 may contain a similar design based upon the current Facility wide hydrogeologic characterization. However, the final design of these Phases will be dependent upon the future design hydrogeologic studies. Therefore, the proposed base grades for the future Phases may be adjusted based on the results of further studies.

Once the facility receives a permit to operate a Cell (2F, 2G or 2H), operations will begin on the east side of the Cell thereby activating the east sump for leachate collection. During operations on the east side, the west sump may still be treated as clean stormwater and not enter the leachate collection system. Once the first waste lift is across the east side of the Cell, the west side will be activated for leachate collection and waste placement.

Waste shall be placed in approximately 30-foot maximum lifts placed in 2 to 3-foot increments by spreading across the Cell floor or previous lift prior to compaction. The initial "fluff" lift shall be a minimum 8-foot thick lift when placed across the Cell floor. This process shall continue until proposed final grades are achieved.

Section 2.0 – Waste Stream

2.1 Types of Waste

As defined by the State of North Carolina 15A NCAC 13B .1602, CMS Landfill V will accept waste types defined as Commercial Solid Waste, Household Waste, Construction & Demolition Debris and Industrial Solid Waste.

Currently, non-hazardous liquid waste are accepted at the facility and directed to the Solidification Facility. This is a Division of Waste Management permitted Demonstration Project (last modified December 30, 1999) activity requiring the solidification of non-hazardous liquid waste using reagents prior to disposal in the landfill. The Paint Filter Test (EPA Method 9095) is the passing criteria for solidification of liquid waste prior to disposal.

The CMS Landfill V Facility also accepts petroleum contaminated soils for disposal or use as daily cover as a Division of Waste Management permitted Pilot Demonstration activity (February 5, 2004). The Facility accepts soils that do not exceed a petroleum based concentration of 3,000 parts per million (ppm).

Automobile shredder fluff is also accepted at this facility and used as a reagent for solidification operations and / or mixed with soil for daily cover. This is a Division of Waste Management permitted activity for the Facility as a Demonstration Project (February 5, 2004).

2.2 Disposal Rates

Currently, CMS Landfill V receives approximately 4,000 tons of waste per day for disposal. In accordance with the most recent Franchise Agreement with the City of Concord (Copy Included in Appendix 3), CMS Landfill V may accept an average of 120,000 tons per month and a maximum monthly tonnage not to exceed 140,000 tons.

Therefore, in accordance with the Franchise Agreement, anticipated waste flows at the facility over the remaining life of the Facility are as follows:

Year	Average Tons per Day	Average Tons per Month
2005	4,400	105,600
2006	4,400	105,600
2007	4,400	105,600
2008	4,400	105,600
2009	4,400	105,600
2010	4,400	105,600
2011	4,400	105,600
2012	4,400	105,600
2013	4,400	105,600

Year	Average Tons per Day	Average Tons per Month
2014	4,400	105,600
2015	4,400	105,600
2016	4,400	105,600
2017	4,400	105,600
2018	4,400	105,600

The waste amounts listed above are estimates and may vary based on future disposal contracts.

2.3 Service Area

In accordance with the Franchise Agreement with the City of Concord (Appendix 3), CMS Landfill V shall serve the populations and geographic territories of the City of Concord, Cabarrus County, the State of North Carolina and other areas within a seventy-five (75) mile radius of the BFI – CMS Landfill.

2.4 Waste Segregation

The general waste stream for CMS Landfill V consists of Commercial Solid Waste, Household Waste, Construction & Demolition Debris and Industrial Solid Waste as defined in Section 2.1. Waste shall enter the facility at the scalehouse to be weighed and routed to the appropriate disposal area. Municipal Solid Waste, Industrial Waste and Construction & Demolition Debris shall be directed to the working face of landfill operations for disposal.

Currently, non-hazardous liquid wastes are accepted at the facility and directed to the Solidification Facility. This is a Division of Waste Management permitted Demonstration Project (last modified December 30, 1999) activity requiring the solidification of non-hazardous liquid waste using reagents prior to disposal in the landfill. The Paint Filter Test (EPA Method 9095) is the passing criteria for solidification of liquid waste prior to disposal.

The CMS Landfill V Facility also accepts petroleum contaminated soils for disposal or use as daily cover. This activity is a Division of Waste Management permitted Pilot Demonstration activity (February 5, 2004). The Facility accepts soils that do not exceed a petroleum based concentration of 3,000 parts per million (ppm). Additionally, this Facility accepts automobile shredder fluff (ASR) to mix with soil for use as daily cover. This is also a NCDENR – Division of Waste Management Demonstration Project (February 5, 2004).

Additionally, BFI maintains a waste screening program at the facility for detection and prevention of unauthorized waste (hazardous, free liquids) for disposal. This program consists of performing random inspections of incoming waste. These inspections are performed on a daily basis for the various haulers entering the facility. A designated screening inspector shall perform the random inspection near the working face of the

landfill within the containment limits. Details concerning the screening process and recordation are included in the Facility's Operations Plan.

The facility operator shall notify the Division of Waste Management within 24 hours of attempting to dispose of waste products not approved for disposal at the facility. No hazardous, liquid or infectious waste shall be accepted and disposed of in the landfill.

2.5 Equipment

Equipment used to operate and maintain the CMS Landfill V Facility is owned / leased and operated by BFI Waste Systems of North America, Inc. The equipment is maintained on site by Facility personnel (outside vendors when necessary) and replaced as needed. A list of typical operations equipment to be maintained on-site for landfill operations follows. This list of equipment may vary from time to time based on the size and type of waste stream received at the Facility.

Equipment Type	Quantity
Bull Dozers	2
Waste Compactors	2
Trackhoes	2
Articulating Dump Trucks	4
Motor Grader	1
Water Trucks	2
All Purpose Tractor	1

Fuels, oils and lubricants are maintained on-site for the operation and maintenance of equipment. A Spill Prevention Control and Countermeasure plan is in place in accordance with 40 CFR Part 112 for storage of these materials.

Section 3.0 – Landfill Capacity

3.1 Data & Assumptions

Landfill capacity volumes have been generated utilizing proposed top of operational / protective cover grading plans and proposed final contours plan. The Civil Design package within AutoCadd Release 2000 is used to generate surfaces and compute available volumes for each individual Cell. The plans used to generate capacities are the Phasing Plans included at the end of this report. In order to arrive at an anticipated time capacity is reached, we have assumed operations begin January 1, 2005 in accordance with the disposal rates listed in Section 2.2 of this Facility Plan. We have also assumed, based on CMS Landfill V operating data, the in-place density of solid waste is 0.8 tons per cubic yard including daily cover soils.

3.2 Operating Capacity

The AutoCadd Generated capacities for each Cell are listed Below:

	AC	Gross Airspace (CY)	Final Cover (CY)	Net Airspace (CY)
Phase 2 Exp.				
Cell 2F	14.2	2,028,000	80,182	1,826,138
Cell 2G	14.0	2,450,000	79,053	2,223,947
Cell 2H	13.5	1,972,000	76,230	1,777,450
Phase 3	60.6	8,275,000	342,195	7,932,805
Phase 4	6.8	3,275,000	169,400	3,105,600
Phase 5	19.0	3,836,000	112,930	3,723,070

Based on the available airspace listed above and the waste volumes listed in Section 2.2, anticipated operating capacity of each Cell / Phase operating 285 days per year is listed below:

	Years
Phase 2 Exp.	**3.7**
Cell 2F	1.2
Cell 2G	1.4
Cell 2H	1.1
Phase 3	**5.0**
Phase 4	**1.9**
Phase 5	**2.2**

Therefore, based on current waste stream under contract, the anticipated remaining operating capacity for CMS Landfill V would be on the order of 12.8 years disposing of approximately 15.2 million tons. Based on the uncertainty of municipalities and private haulers awarding contracts, the remaining operating capacity may extend up to 30 years.

3.3 Required Soils

Calculations to determine the quantities of various soils needed were performed using the plans previously described and the details contained in the Engineering Plans. A summary of the different soil types needed for construction, operation and closure of each Cell is listed below.

Phase 2 Expansion

Cell 2F

Construction

Excavation from Construction	42,000 CY
Structural Fill Required	113,000 CY
Compacted Soil Liner (1 X 10^{-7} cm/sec), or	45,818 CY

Cell 2F (Cont'd)

Compacted Soil Liner (1 X 10^{-5} cm/sec)	34,364 CY
Protective Cover Soils	45,818 CY
Operation	
Daily Cover Soils	121,680 CY
Closure	
Barrier Soil Liner (1 X 10^{-5} cm/sec)	23,692 CY
Protective Cover / Vegetation layer	39,422 CY

Cell 2G

Construction	
Excavation from Construction	68,000 CY
Structural Fill Required	78,000 CY
Compacted Soil Liner (1 X 10^{-7} cm/sec), or	45,173 CY
Compacted Soil Liner (1 X 10^{-5} cm/sec)	33,880 CY
Protective Cover Soils	45,173 CY
Operation	
Daily Cover Soils	147,000 CY
Closure	
Barrier Soil Liner (1 X 10^{-5} cm/sec)	18,949 CY
Protective Cover / Vegetation layer	36,736 CY

Cell 2H

Construction	
Excavation from Construction	38,000 CY
Structural Fill Required	78,000 CY
Compacted Soil Liner (1 X 10^{-7} cm/sec), or	43,560 CY
Compacted Soil Liner (1 X 10^{-5} cm/sec)	32,670 CY
Protective Cover Soils	43,560 CY
Operation	
Daily Cover Soils	118,320 CY
Closure	
Barrier Soil Liner (1 X 10^{-5} cm/sec)	9,535 CY
Protective Cover / Vegetation layer	32,791 CY

Phase 3

Construction	
Excavation from Construction	139,680 CY
Structural Fill Required	479,000 CY
Compacted Soil Liner (1 X 10^{-7} cm/sec), or	195,537 CY
Compacted Soil Liner (1 X 10^{-5} cm/sec)	146,653 CY
Protective Cover Soils	195,537 CY
Operation	
Daily Cover Soils	496,500 CY
Closure	

Phase 3 (Cont'd)

Barrier Soil Liner (1 X 10^{-5} cm/sec)	55,999 CY
Protective Cover / Vegetation layer	167,101 CY

Phase 4

Construction	
Excavation from Construction	40,000 CY
Structural Fill Required	43,000 CY
Compacted Soil Liner (1 X 10^{-7} cm/sec), or	21,940 CY
Compacted Soil Liner (1 X 10^{-5} cm/sec)	16,450 CY
Protective Cover Soils	21,940 CY
Operation	
Daily Cover Soils	186,300 CY
Closure	
Barrier Soil Liner (1 X 10^{-5} cm/sec)	62,291 CY
Protective Cover / Vegetation layer	86,176 CY

Phase 5

Construction	
Excavation from Construction	175,500 CY
Structural Fill Required	52,000 CY
Compacted Soil Liner (1 X 10^{-7} cm/sec), or	61,310 CY
Compacted Soil Liner (1 X 10^{-5} cm/sec)	45,980 CY
Protective Cover Soils	61,310 CY
Operation	
Daily Cover Soils	222,780 CY
Closure	
Barrier Soil Liner (1 X 10^{-5} cm/sec)	95,009 CY
Protective Cover / Vegetation layer	128,333 CY

Totals

Construction	
Excavation from Construction	503,180 CY
Structural Fill Required	843,000 CY
Compacted Soil Liner (1 X 10^{-7} cm/sec), or	413,338 CY
Compacted Soil Liner (1 X 10^{-5} cm/sec)	309,997 CY
Protective Cover Soils	413,338 CY
Operation	
Daily Cover Soils	1,292,580 CY
Closure	
Barrier Soil Liner (1 X 10^{-5} cm/sec)	265,474 CY
Protective Cover / Vegetation layer	490,558 CY

3.4 Borrow Sources

BFI Waste Systems of North America, Inc. operates two borrow areas for the CMS Landfill V Facility. The north borrow area is located on the North side of US Highway 29 and bordered on the east by the Rocky River. This borrow source has been used for the CMS Landfill V Facility since 1991. Based on the most recent grading plan (prepared by Eagle Engineering) for the north borrow area and 2002 topographic information, approximately 2.7 million cubic yards of soil remain for borrow activities. This site is accessed from the landfill by Lowe's Motor Speedway access roads made available to the facility by reserved easement for hauling borrow materials.

The south borrow area is located to the south of Cell 2D and is located on the south side of the Rocky River. This borrow area is accessed by on-site haul roads and an Army Corp of Engineers permitted river crossing.

Low permeable soils will be excavated from the north borrow area and the potentially expanded south borrow area. Protective, daily and final cover soils will be excavated from the north borrow area. Additional soils may be obtained from area quarries on an as needed basis.

Section 4.0 – Containment and Environmental Controls

4.1 Leachate and Methane Gas Migration

Composite Liner System

CMS Landfill V, Phase 2 Expansion, Phase 3, Phase 4 and Phase 5 will contain a composite liner system to prevent the flow or percolation of leachate and methane gases into the natural subsurface soils and aquifer surrounding the landfill footprint. This composite liner section shall consist of one of the following two options:

Option 1

- A minimum 24-inch thick compacted soil liner with a permeability less than or equal to 1.0×10^{-7} cm/sec overlain by a minimum 60-mil thick high density polyethylene liner.

Option 2

- A minimum 18-inch thick compacted soil liner with a permeability less than or equal to 1.0×10^{-5} cm/sec, overlain by a geosynthetic clay liner with a permeablility no greater than 5.0×10^{-9} cm/sec, overlain by a minimum 60-mil thick high density polyethylene liner.

In both cases, soil liner materials may be amended with bentonite to achieve the required permeability.

Leachate Collection & Removal System

A leachate collection system will be constructed above the composite liner system in each Cell. The leachate collection system will consist of a geocomposite drainage media that rests on the 60-mil high density polyethylene liner to collect and transport leachate along the Cell floor. A network of leachate collection pipes surrounded by #57 washed stone will be placed at various locations along the Cell floor to intersect flow of leachate along the top of protective cover and the geocomposite. The leachate collection pipes will tie-in to a leachate header line that will transport the collected leachate to the sump area for each Cell. At each sump area, a stainless steel pump will rest on the Cell floor housed in a high density polyethylene side-wall riser pipe to remove leachate from within the Cell and transport into the leachate transmission system. A high density polyethylene transmission pipe along with a series of manholes and lift stations shall transport leachate from each Cell to the on-site Pre-treatment Facility Storage Lagoon.

The leachate collection and removal system is designed so that no more than 12-inches of hydraulic head will act on the liner system during normal operating conditions.

Final Closure Composite Liner System

A composite liner system consisting of an 18-inch thick compacted soil liner with a permeability not exceeding 1.0×10^{-5} cm/sec and minimum 40-mil thick linear low density polyethylene liner will be installed above the waste mass for each Cell. This cap composite liner system will serve to prevent the infiltration of rainfall into the waste mass. The cap composite liner system will also serve to prevent the horizontal migration of methane gas from the waste mass. The compacted soil liner component will not be placed on the side slopes beneath the 40-mil liner. A 12-inch thick foundation soil layer will be placed on the side slopes consisting of clean structural fill soils beneath the 40-mil liner.

Gas Recovery Facility

An existing gas recovery facility (owned by a third party) is on-site operating by creating a vacuum through a network of collection pipes and gas extraction wells throughout areas of the landfill that have achieved final waste grades or will not receive waste for a substantial time period. This gas recovery system reduces the concentration and quantity of gases within the landfill to further deter the migration of gases off-site.

Detection and Monitoring

Groundwater monitoring wells and methane monitoring wells are strategically placed based on the Design Hydrogeologic Study (prepared by ENSR Consulting and Engineering (NC), Inc., December 2003) around the perimeter of the landfill for the detection of leachate and methane gas migration. Groundwater monitoring wells are sampled semi-annually for analytical testing and the methane monitoring wells are monitored quarterly for the presence of methane. The concentration of methane gases shall not exceed 25 percent of the lower explosive limit (LEL) at site structures or exceed the LEL at the Facility boundary. The LEL for methane gases is 5 percent in a known volume of air.

4.2 Nuisance and Vector Control

Potential nuisances involved with landfill operations include dust, odor, litter, sedimentation and fires. Dust is kept to a minimum by utilizing the two on-site water trucks to wet the access and haul roads on-site. Odor is controlled with the application of daily cover over disposed waste and the on-site gas recovery facility. Litter is controlled with the use of "litter fences" that may be moved around the working face of the landfill based on the prevailing wind direction. Constant policing and "good housekeeping" practices are carried out by landfill personnel to reduce potential litter. Sedimentation is controlled by erosion and sedimentation control devices in place around the landfill footprint designed to collect the runoff from a 25-year, 24-hour storm event. Open fires are not permitted at the landfill. In the event a small fire should occur, the fire will be smothered with nearby soils, use of on-site water trucks or local fire department. If a fire occurs that may not be extinguished with soil or water trucks, the City of Concord Fire Department shall be called by dialing 911.

Potential vectors that may be drawn to landfilling operations are primarily rodents and birds that are categorized as "scavengers". To deter the presence of these vectors, waste is covered daily with soil or alternative cover to limit the accessibility of a food source.

4.3 Stormwater Control

An erosion and sedimentation control plan has been designed for the construction, operation and closure of the Phase 2 Expansion and Phase 3. Plans for Phases 4 and 5 will be developed at a later date once base grades and footprints may be firmly established. Based on a 25-year, 24-hour storm for this area, stormwater runoff conveyances and devices were designed for the peak flow condition (construction, operations or closure). Stabilized channels will intercept stormwater runoff and direct flow to sediment basins. The sediment basins will allow sediment to settle to the floor of the basin, then allowing controlled discharge of stormwater to receiving waters.

During landfilling operations, the waste and daily cover shall be sloped to promote drainage away from the landfill. The subsequent runoff shall be intercepted by the erosion and sedimentation control devices and routed through the sediment basins.

Section 5.0 – Leachate Management

5.1 Collection Systems

A leachate collection system will be constructed above the composite liner system in each Cell. The leachate collection system will consist of a geocomposite drainage media that rests on the 60-mil high density polyethylene liner to collect and transport leachate along the Cell floor. A network of leachate collection pipes surrounded by #57 washed stone will be placed at various locations along the Cell floor to intersect flow of leachate along the top of protective cover and the geocomposite. The leachate collection pipes will tie-in to a leachate header line that will transport the collected leachate to the sump area for each Cell. At each sump area, a stainless steel pump will rest on the Cell floor housed in a high density polyethylene side-wall riser pipe to remove leachate from within

the Cell and transport into the leachate transmission system. A high density polyethylene transmission pipe along with a series of manholes and lift stations shall transport leachate from each Cell to the on-site Pre-treatment Facility Storage Lagoon.

The leachate collection and removal system is designed so that no more than 12-inches of hydraulic head will act on the liner system during normal operating conditions.

5.2 Leachate Transmission

Leachate shall be collected in the topographically low area (sump area) of each Cell. A submersible pump within a sidewall riser will be located at each Cell's sump area. The submersible pump shall transmit leachate from within a landfill Cell to the leachate force main system. The leachate force main system transfers leachate from the landfill Cells to the leachate surface impoundment located near the entrance to the site. Several lift stations are positioned along the leachate force main system for transmission through topographically high and low areas.

5.3 Leachate Storage Facility

The on-site leachate storage lagoon has served the Facility since operations began in the early 1990's. The lagoon has a total storage capacity of approximately 2.9 million gallons or 390,000 cubic feet. The storage lagoon was constructed with a composite liner system and maintains a grout filled geosynthetic (fabric form) above the liner section to protect the integrity of the liner. Two floating aerators are positioned at the ends of the lagoon to introduce oxygen into the leachate and begin the treatment process by reducing BOD and COD levels.

5.4 Leachate Pre-Treatment Facility

The Leachate Pre-Treatment Facility is located adjacent to the storage lagoon. The pre-treatment facility pumps water from the lagoon through a series of automatic monitoring systems to continually monitor discharge water quality. Based on historical data at the Facility, the aeration process occurring in the leachate storage lagoon has been sufficient treatment of leachate to meet the discharge requirements of the Rocky River Waste Water Plant. Additional treatment available in the Pre-Treatment Facility includes:

- 1,300 gallon pH adjustment Tank
- 2,035 gallon flocculation tank
- 1,034 gallon clarifier
- 1,900 gallon surge tank

Following necessary treatment, the water is discharged to the Rocky River Waste Water Plant operated by the Water & Sewer Authority of Cabarrus County. A copy of the "Industrial User Pretreatment Permit No. 1024" is included in Appendix 4 of this Plan.

5.5 Normal Operating Conditions

During the design of Cells 2F, 2G and 2H, the "HELP" model was used to generate leachate quantities for various stages of operation throughout this Phase. Based on the

results of "HELP" model analysis, the peak leachate generation rate will occur when Cell 2F has reached final waste elevations and the western side of Cell 2G is activated for operations. The resulting peak leachate generation rate is 19,698 gallons per day. Based on averaging the various scenarios applied to the "HELP" model analysis, average leachate generation rates should be on the order of 13,280 gallons per day.

In order to evaluate historically high leachate generation rates, actual discharged amounts from 2003 are analyzed since 2003 was recorded as the "fifth wettest" year on record for this region. Beginning December 1, 2002 and ending December 31, 2003, CMS Landfill V discharged a total of 6,387,747 gallons of pretreated leachate to the Rocky River Waste Water Treatment Plant. This volume equates to an average daily discharge rate of 16,130 gallons.

5.6 Discharge Limits

A copy of the "Industrial User Pretreatment Permit No. 1024" issued to BFI Waste Systems of North America, Inc. by the Water & Sewer Authority of Cabarrus County is included in Appendix 4 of this Plan. The effluent limitations are listed on page 5 of the permit and requires monthly sampling and reporting (semi-annually for priority pollutants). The permit allows discharge from the pretreatment facility at an average rate of 150,000 gallons per day (0.15 MGD).

5.7 Contingency Plan

Based on the 2003 data for the "fifth wettest" year on record, the average daily discharge rate of pretreated leachate was 16,130 gallons per day. This amount is only 10.8 percent of the allowable discharge to Rocky River Waste Water Treatment Plant. Additionally, using the 2003 average flow rate, the leachate lagoon has a capacity of 2.9 million gallons to accommodate 180 days of this flow without discharging. In consideration of these items, a contingency plan is "built-in" to the design of the facility and discharge permit.

APPENDIX

APPENDIX 1 **FACILITY PLANS & BOUNDARY SURVEY**

- Property Boundary Survey
- Site Development Plan – Landfill Units & Leachate Facilities
- Site Development Plan – All Facilities
- Construction Plan – Base Grades
- Construction Plan – Final Contours
- North Borrow Area Plan

APPENDIX 2 **PHASING PLANS**

- Cell 2F Phasing Plan
- Cell 2G Phasing Plan
- Cell 2H Phasing Plan
- Phase 3 Phasing Plan
- Phase 4 Phasing Plan
- Phase 5 Phasing Plan

APPENDIX 3 **FRANCHISE AGREEMENT**

APPENDIX 4 **INDUSTRIAL USER PRETREATMENT PERMIT**

APPENDIX 1

FACILITY PLANS & BOUNDARY SURVEY

Property Boundary Survey
Site Development Plan – Landfill Units & Leachate Facilities
Site Development Plan – All Facilities
Construction Plan – Base Grades
Construction Plan – Final Grades
North Borrow Area Plan

PROPERTY BOUNDARY SURVEY

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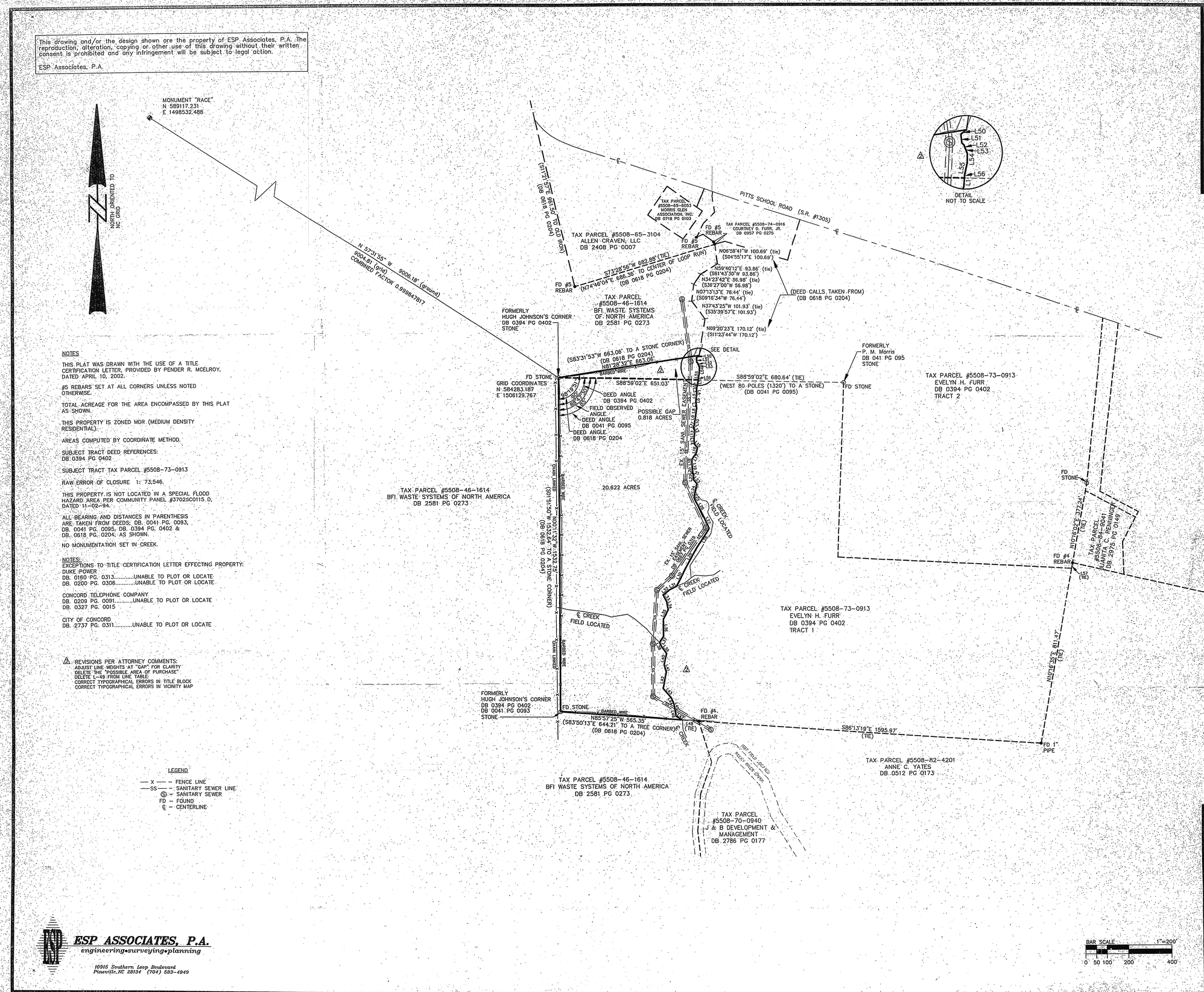
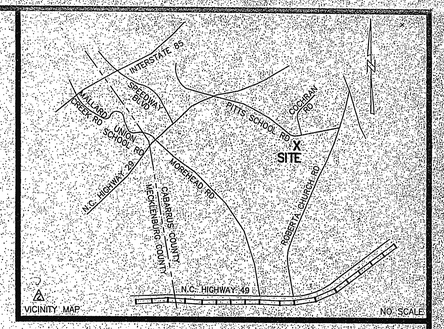




NOTES

THIS PLAT WAS DRAWN WITH THE USE OF A TITLE CERTIFICATION LETTER, PROVIDED BY PENDER R. MCELROY, DATED APRIL 10, 2002.

#5 REBARS SET AT ALL CORNERS UNLESS NOTED OTHERWISE.

TOTAL ACREAGE FOR THE AREA ENCOMPASSED BY THIS PLAT AS SHOWN.

THIS PROPERTY IS ZONED MDR (MEDIUM DENSITY RESIDENTIAL).

AREAS COMPUTED BY COORDINATE METHOD.

SUBJECT TRACT DEED REFERENCES:
DB 0394 PG 0402

SUBJECT TRACT TAX PARCEL #5508-73-0913

RAW ERROR OF CLOSURE 1: 73,546.

THIS PROPERTY IS NOT LOCATED IN A SPECIAL FLOOD HAZARD AREA PER COMMUNITY PANEL #37025C0115 D, DATED 11-02-94.

ALL BEARING AND DISTANCES IN PARENTHESIS ARE TAKEN FROM DEEDS; DB. 0041 PG. 0093, DB. 0041 PG. 0095, DB. 0394 PG. 0402 & DB. 0618 PG. 0204, AS SHOWN.

NO MONUMENTATION SET IN CREEK.

NOTES:
EXCEPTIONS TO TITLE CERTIFICATION LETTER EFFECTING PROPERTY:
DUKE POWER
DB. 0160 PG. 0313.....UNABLE TO PLOT OR LOCATE
DB. 0200 PG. 0306.....UNABLE TO PLOT OR LOCATE

CONCORD TELEPHONE COMPANY
DB. 0209 PG. 0091.....UNABLE TO PLOT OR LOCATE
DB. 0327 PG. 0015

CITY OF CONCORD
DB. 2737 PG. 0311.....UNABLE TO PLOT OR LOCATE

△2 REVISIONS PER ATTORNEY COMMENTS:
ADJUST LINE WEIGHTS AT "GAP" FOR CLARITY
DELETE THE "POSSIBLE AREA OF PURCHASE"
DELETE L-49 FROM LINE TABLE
CORRECT TYPOGRAPHICAL ERRORS IN TITLE BLOCK
CORRECT TYPOGRAPHICAL ERRORS IN VICINITY MAP

LEGEND
— X — — FENCE LINE
— SS — — SANITARY SEWER LINE
Ⓢ – SANITARY SEWER
FD – FOUND
℄ – CENTERLINE

△2 LINE TABLE

LINE	LENGTH	BEARING
L1	20.56'	S04°30'22"W
L2	15.62'	S21°48'07"W
L3	16.88'	S03°39'26"E
L4	15.30'	S03°27'18"E
L5	18.67'	S10°44'26"W
L6	14.84'	S04°27'34"W
L7	27.10'	S06°02'26"E
L8	32.80'	S06°47'38"W
L9	30.00'	S08°53'07"W
L10	17.73'	S06°53'03"W
L11	13.05'	S27°45'32"W
L12	17.50'	S28°26'19"E
L13	30.86'	S07°12'17"W
L14	29.19'	S02°19'19"E
L15	21.41'	S39°27'17"E
L16	27.46'	S12°13'10"W
L17	33.51'	S34°21'47"W
L18	21.87'	S06°00'31"W
L19	23.59'	S05°37'02"E
L20	19.20'	S09°05'37"W
L21	8.79'	S68°06'13"E
L22	24.45'	S06°28'41"W
L23	26.32'	S38°15'19"E
L24	56.67'	S11°14'41"W
L25	23.14'	S12°37'09"E
L26	25.06'	S25°36'25"E
L27	70.70'	S25°27'17"E
L28	102.93'	S32°59'52"W
L29	107.84'	S29°16'21"W
L30	95.60'	S27°05'24"W
L31	33.93'	S84°09'41"W
L32	40.08'	S53°17'54"W
L33	35.19'	S27°48'21"E
L34	36.87'	S10°48'48"E
L35	48.85'	S28°51'52"W
L36	77.74'	S06°28'10"E
L37	32.68'	S33°20'43"W
L38	19.56'	S26°17'29"E
L39	39.83'	S35°35'20"E
L40	52.58'	S12°44'01"W
L41	54.38'	S16°11'56"E
L42	27.44'	S10°32'51"W
L43	57.64'	S41°22'19"E
L44	31.11'	S21°38'25"E
L45	28.02'	S11°27'09"E
L46	27.97'	S09°23'49"E
L47	28.20'	S56°40'28"E
L48	80.83'	S85°57'25"E
L50	16.16'	S52°43'36"W
L51	20.03'	S06°25'43"E
L52	7.00'	S44°34'01"E
L53	20.65'	S22°33'46"E
L54	21.23'	S01°41'11"W
L55	28.21'	S11°56'15"W
L56	7.21'	S04°30'22"W
L57	25.56'	N10°16'35"E

NORTH CAROLINA PROFESSIONAL SEAL L-3846 LAND SURVEYOR DAVID A. WEINICH

I, David A. Weinich, N. C. P. L. S. certify that this map, drawn from an actual field survey under my direction, meets and exceeds the Minimum Standards set forth in the Manual of Practice for Land Surveying in North Carolina. Title References regarding the adjoining properties are subject to information provided by local County Government. Subject tract title research for retracement of Boundary Lines only, and not intended to certify title.

David A. Weinich
L-3846

NO.	DATE	REVISION	BY
2	4/25/02	ATTORNEY COMMENTS (SEE NOTES)	FPC
1	4/23/02	REVISE LINE TABLE BEARINGS	WCC

REVISED ALTA/ACSM BOUNDARY ADJUSTMENT BETWEEN BFI WASTE SYSTEMS & EVELYN H. FURR
LOCATED IN TOWNSHIP No. 2
CABARRUS COUNTY
NORTH CAROLINA

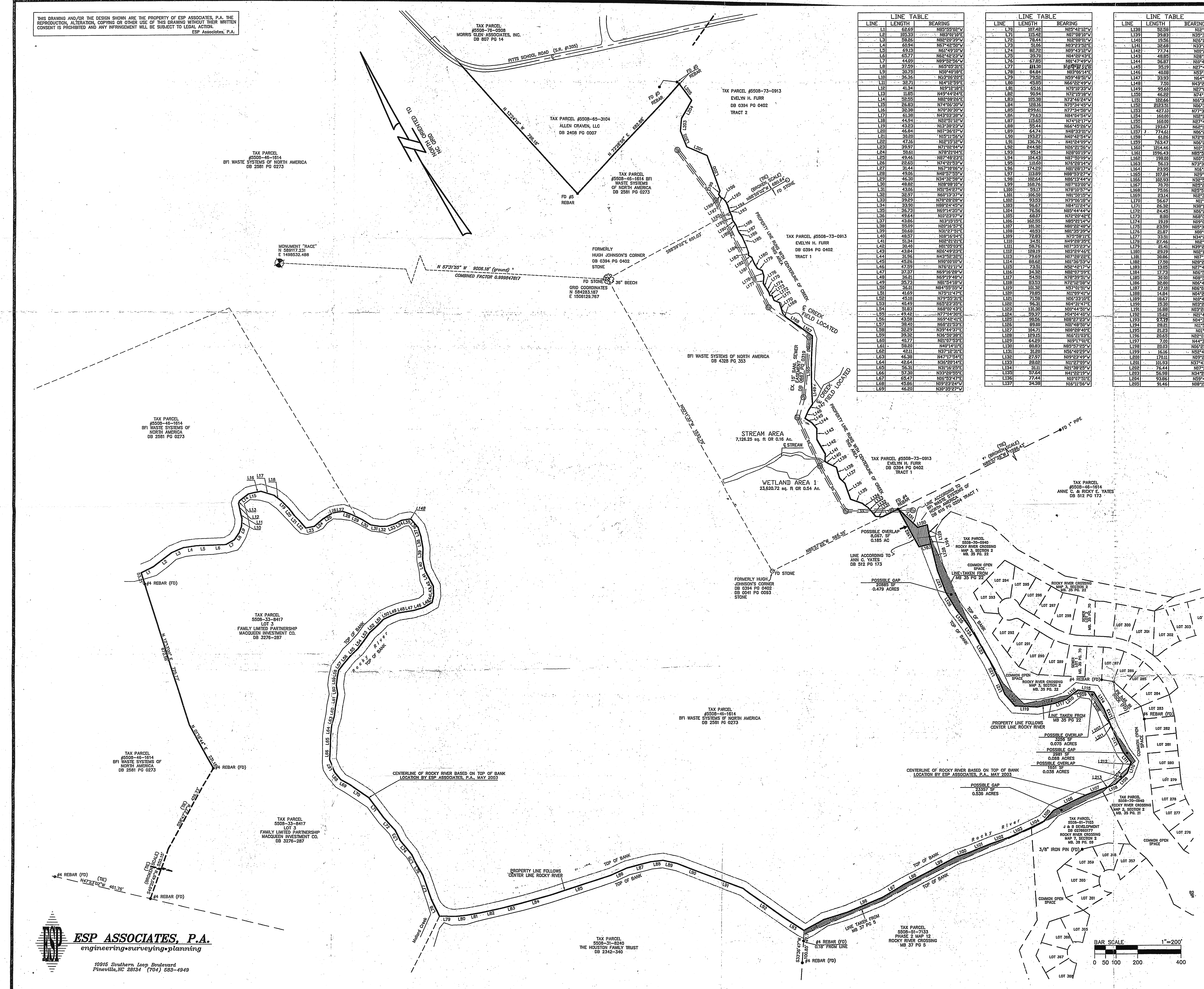
PROJECT NO. 0G23
SCALE 1"=200'
DATE 4/19/02
DRAWN BY FPC/WCC
CHECKED BY DAW
DRAWING NO. 0G23-ALTA.dwg

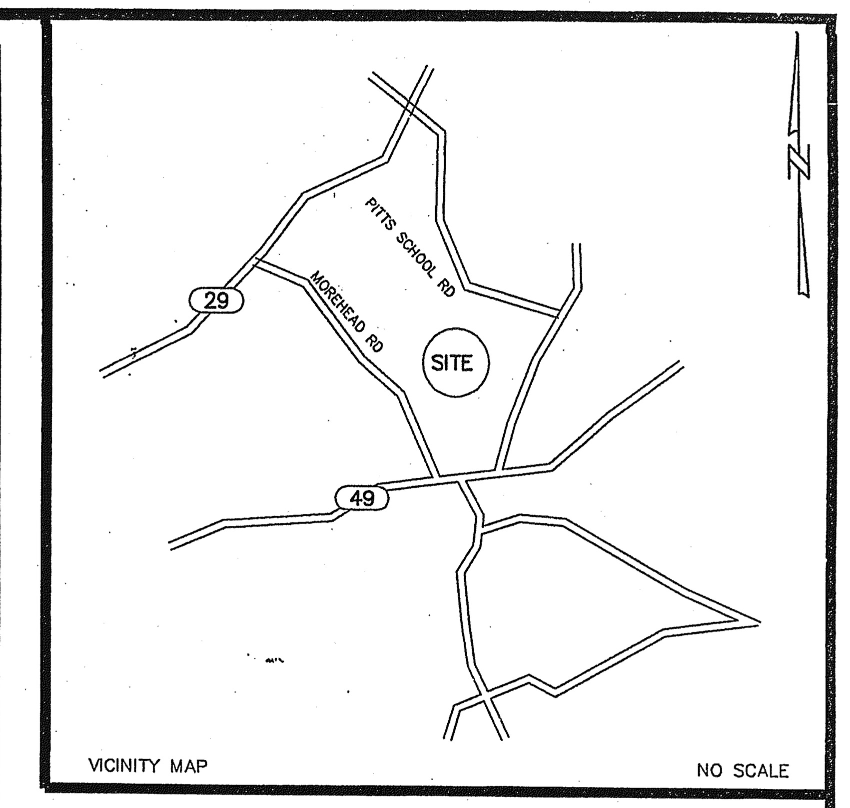
BFI WASTE SYSTEMS OF NORTH AMERICA, INC.
5105 MOREHEAD RD
CONCORD, NORTH CAROLINA 28027
704-782-2004

△2 SHT ___ OF ___

ESP ASSOCIATES, P.A.
engineering•surveying•planning
10915 Southern Loop Boulevard
Pineville,NC 28134 (704) 583-4949

THIS DRAWING AND/OR THE DESIGN SHOWN ARE THE PROPERTY OF ESP ASSOCIATES, P.A. THE REPRODUCTION, ALTERATION, COPYING OR OTHER USE OF THIS DRAWING WITHOUT THEIR WRITTEN CONSENT IS PROHIBITED AND ANY INFRINGEMENT WILL BE SUBJECT TO LEGAL ACTION.
ESP Associates, P.A.





LINE	LENGTH	BEARING
L1	62.69	N85°55'02"W
L2	105.33	N83°01'10"E
L3	58.26	N82°20'39"W
L4	60.94	N67°42'50"W
L5	69.13	N61°49'10"W
L6	65.77	N62°42'23"W
L7	44.09	N89°52'56"W
L8	37.59	N65°05'31"E
L9	30.75	N50°40'18"E
L10	36.36	N33°06'20"E
L11	32.71	N14°12'59"E
L12	41.34	N19°12'18"E
L13	11.85	N49°44'24"E
L14	52.55	N82°08'26"E
L15	26.83	N74°06'30"W
L16	32.38	N70°30'30"W
L17	61.38	N43°03'38"W
L18	44.94	N22°51'12"W
L19	43.23	N13°38'23"W
L20	46.84	N07°36'07"W
L21	30.20	N15°11'56"W
L22	47.16	N12°15'12"W
L23	39.97	N71°02'04"W
L24	50.61	N78°21'04"E
L25	49.46	N87°48'23"E
L26	22.65	N74°21'53"W
L27	31.44	N67°10'06"W
L28	49.06	N40°57'55"W
L29	46.30	N34°32'58"W
L30	48.82	N28°08'10"W
L31	43.06	N51°54'27"W
L32	32.97	N60°13'37"W
L33	39.29	N78°28'28"W
L34	33.90	N88°24'45"W
L35	36.73	N69°14'35"W
L36	49.64	N10°23'07"W
L37	43.86	N13°15'15"E
L38	55.09	N20°16'57"E
L39	50.68	N31°27'51"E
L40	48.57	N18°16'04"E
L41	51.34	N02°21'21"E
L42	30.40	N01°05'03"E
L43	43.84	N26°49'23"E
L44	31.96	N43°52'32"E
L45	45.26	N90°00'00"W
L46	47.59	N76°21'11"W
L47	37.37	N69°16'28"W
L48	36.21	N69°19'48"W
L49	35.73	N81°54'18"W
L50	36.01	N84°55'55"W
L51	41.69	N75°11'47"E
L52	45.18	N79°55'31"E
L53	40.49	N65°23'35"E
L54	51.83	N68°00'43"E
L55	49.42	N77°04'30"E
L56	43.58	N69°42'41"E
L57	38.40	N68°21'53"E
L58	32.29	N39°44'37"E
L59	39.32	N36°50'38"E
L60	40.77	N21°07'53"E
L61	58.20	N40°14'11"E
L62	42.11	N37°12'31"E
L63	46.38	N47°17'54"E
L64	42.64	N36°20'14"E
L65	56.31	N31°16'25"E
L66	57.30	N33°28'55"E
L67	65.47	N06°53'47"E
L68	45.86	N09°23'24"W
L69	46.20	N30°35'27"W

LINE	LENGTH	BEARING
L70	107.42	N25°42'12"W
L71	115.42	N07°08'10"W
L72	78.44	N12°08'01"W
L73	51.06	N03°23'52"E
L74	82.72	N09°43'12"W
L75	39.70	N04°20'43"E
L76	67.85	N01°47'49"W
L77	111.30	N10°31'51"E
L78	84.84	N03°06'14"E
L79	79.52	N59°48'51"W
L80	45.85	N66°22'49"W
L81	65.16	N70°10'33"W
L82	90.94	N72°15'18"W
L83	105.38	N73°46'24"W
L84	128.16	N75°34'45"W
L85	299.61	N77°34'58"W
L86	79.63	N84°04'54"W
L87	115.65	N74°12'17"W
L88	55.44	N66°45'26"W
L89	64.74	N48°33'01"W
L90	193.27	N40°42'54"W
L91	136.76	N41°24'09"W
L92	244.92	N26°21'56"W
L93	95.14	N28°00'19"W
L94	104.43	N87°50'09"W
L95	110.60	N76°28'14"W
L96	174.29	N81°28'17"W
L97	113.89	N88°53'27"W
L98	102.64	N86°13'44"W
L99	168.76	N87°03'00"W
L100	59.17	N78°10'57"W
L101	106.50	N81°50'15"W
L102	93.53	N79°06'18"W
L103	96.67	N84°11'24"W
L104	76.56	N85°44'44"W
L105	68.07	N72°20'42"E
L106	162.55	N85°21'14"W
L107	101.32	N80°22'40"W
L108	40.53	N81°35'39"W
L109	72.83	N75°58'11"E
L110	34.51	N49°28'35"E
L111	58.76	N07°35'23"W
L112	128.19	N03°29'46"E
L113	79.69	N07°28'22"E
L114	88.62	N01°36'53"W
L115	73.51	N52°42'17"W
L116	34.32	N82°07'59"E
L117	54.50	N78°39'51"W
L118	83.53	N72°12'58"W
L119	101.32	N57°01'51"W
L120	70.85	N11°09'41"W
L121	71.58	N06°33'10"E
L122	96.31	N04°31'47"E
L123	131.30	N00°44'50"W
L124	59.37	N04°04'40"W
L125	90.56	N08°27'23"W
L126	89.00	N01°48'50"W
L127	104.71	N08°28'40"E
L128	129.15	N16°21'03"E
L129	64.29	N19°17'01"E
L130	80.83	N85°57'25"W
L131	31.20	N56°40'29"W
L132	27.97	N09°23'49"W
L133	28.02	N11°27'09"W
L134	31.11	N21°38'25"W
L135	57.64	N41°22'19"W
L136	77.44	N10°07'51"E
L137	34.38	N16°11'56"W

LINE	LENGTH	BEARING
L138	52.58	N12°44'01"E
L139	39.83	N35°35'20"W
L140	19.56	N26°17'29"W
L141	32.68	N33°20'43"E
L142	77.74	N00°28'10"W
L143	48.85	N28°51'52"E
L144	36.87	N10°48'48"W
L145	35.19	N27°48'21"W
L146	40.08	N53°17'54"E
L147	33.93	N64°09'41"E
L148	7.50	N43°23'45"W
L149	95.60	N27°05'24"E
L150	46.22	N74°11'23"W
L151	122.66	N16°38'49"W
L152	2123.51	N06°32'36"E
L153	427.10	N77°32'24"W
L154	160.00	N02°18'24"W
L155	160.00	N27°42'36"E
L156	193.67	N62°17'24"W
L157	774.61	N06°20'36"E
L158	61.26	N72°02'24"W
L159	763.47	N06°20'36"E
L160	1214.46	N10°32'36"E
L161	1596.43	N85°57'24"W
L162	198.00	N00°38'36"E
L163	56.13	N73°38'57"W
L164	23.95	N16°21'03"E
L165	107.84	N29°16'21"E
L166	102.93	N32°59'52"E
L167	70.70	N25°27'17"W
L168	75.06	N25°56'25"W
L169	23.14	N12°37'00"W
L170	56.67	N11°14'41"E
L171	26.32	N38°15'19"W
L172	24.45	N06°28'41"E
L173	8.80	N68°06'13"W
L174	19.19	N09°05'37"E
L175	23.59	N05°37'02"W
L176	21.87	N00°00'31"E
L177	33.51	N34°21'47"E
L178	27.46	N12°13'10"E
L179	21.41	N39°27'17"W
L180	29.19	N02°19'19"W
L181	30.86	N07°12'17"E
L182	17.50	N28°26'19"W
L183	13.05	N27°45'32"E
L184	17.73	N06°53'03"E
L185	30.00	N08°53'07"E
L186	32.80	N06°47'38"E
L187	27.10	N06°02'26"W
L188	14.84	N04°27'34"E
L189	18.67	N10°44'26"E
L190	15.30	N03°27'18"W
L191	16.88	N03°28'26"W
L192	15.62	N21°48'07"E
L193	27.17	N04°30'22"E
L194	28.21	N11°56'15"E
L195	21.23	N01°14'11"E
L196	20.65	N22°03'46"W
L197	7.00	N44°34'01"W
L198	20.03	N06°25'43"W
L199	16.16	N52°43'36"E
L200	170.11	N09°20'23"E
L201	101.93	N37°43'25"W
L202	76.44	N07°13'13"E
L203	56.98	N34°23'42"E
L204	93.86	N59°40'12"E
L205	91.46	N08°15'52"W

LINE	LENGTH	BEARING
L207	25.56	N05°00'33"W
L208	158.87	N05°00'33"W
L209	72.50	N70°53'55"W
L210	34.60	N82°07'59"E
L211	12.47	S07°28'22"W
L212	20.68	S49°28'35"W
L213	8.58	N81°35'39"W
L214	141.17	N75°59'58"E

LEGEND:

R/W = RIGHT-OF-WAY
(TYP) = TYPICAL
C.O.S. = COMMON OPEN SPACE
(100.00') = NUMBER IN PARENTHESIS IS THE TOTAL DISTANCE
——— = SURVEYED LINE
— — — = LINE NOT SURVEYED, TAKEN FROM DEEDS
(S) = SANITARY SEWER MANHOLE
—SS— = SANITARY SEWER LINE
FD = FOUND

NOTES:

AREA COMPUTATION BY COORDINATE METHOD.

THIS PLAT IS OF A SURVEY OF AN EXISTING PARCEL OR PARCELS OF LAND.

SUBJECT TRACT DEED REFERENCE:
DEED BOOK 2581, PAGE 0273, CABARRUS COUNTY, NC

SUBJECT TRACT TAX PARCEL # 550846 1614
SUBJECT TRACT TAX MAP # 550801

DATE OF SURVEY: 06/11/2003

RAW ERROR OF CLOSURE 1 : 17,115.21

A PORTION OF THIS PROPERTY IS INSIDE THE 500-YEAR FLOODPLAIN (ZONE "X"), A PORTION OF THIS PROPERTY IS INSIDE THE 500-YEAR FLOODPLAIN (ZONE "X"), AND A PORTION OF THIS PROPERTY IS INSIDE THE 100-YEAR FLOODPLAIN (ZONE "AE"), PER F.I.R.M. MAP COMMUNITY PANEL No. 37025C 0115 D, DATE: NOV.2, 1994. (LINE BEST-FIT FROM CABARRUS COUNTY GIS – FLOODPLAIN INFORMATION, NOT FIELD LOCATED)

THIS PROPERTY ZONED "I-2" (HEAVY INDUSTRIAL DISTRICT)

THIS PROPERTY MAY BE SUBJECT TO ANY EASEMENTS AND/OR RIGHTS-OF-WAY.

#5 REBAR SET AT ALL CORNERS UNLESS NOTED OTHERWISE.

NORTH CAROLINA PROFESSIONAL SEAL L-3846 LAND SURVEYOR DAVID A. WEIRICH

I David A. Weirich, N. C. P. L. S. certify that this map, drawn from an actual field survey under my direction, meets and/or exceeds the Minimum Standards set forth in the manual of Practice for Land Surveying in North Carolina. Title References regarding the adjoining properties are subject to information provided by local County Government. Subject tract title research for retracement of Boundary Lines only, and not intended to certify title.

David A. Weirich
L-3846

NO.	DATE	REVISION	BY

SURVEY FOR BFI
SHOWING SOUTHERN & EASTERN
PROPERTY LINE ALONG ROCKY RIVER

LOCATED IN TOWNSHIP No. 2
CABARRUS COUNTY
NORTH CAROLINA

PROJECT NO QC23 Boundary
SCALE 1"=200'
DATE
DRAWN BY LKJ
CHECKED BY DAW
DRAWING NO QC23 Boundary

BFI WASTE SYSTEMS NORTH AMERICA

5105 MORHEAD ROAD

CONCORD, NORTH CAROLINA 28027
(704) 782-2004

SHEET 1 OF ONE (1) SHEET

ESP ASSOCIATES, P.A.
engineering•surveying•planning
10915 Southern Loop Boulevard
Pineville, NC 28134 (704) 583-4949

SITE DEVELOPMENT PLAN
LANDFILL UNITS & LEACHATE FACILITIES

NOTES:

PROPOSED LEACHATE FORCE MAIN INFORMATION PROVIDED BY ALMES & ASSOCIATES, INC.

EXISTING TOPOGRAPHY SUPPLIED BY CHAS. H. SELLS, INC. DATED APRIL 12, 2003

FLOODPLAIN INFORMATION OBTAINED FROM F.E.M.A. F.I.R.M. MAP DATED NOV. 2, 1994

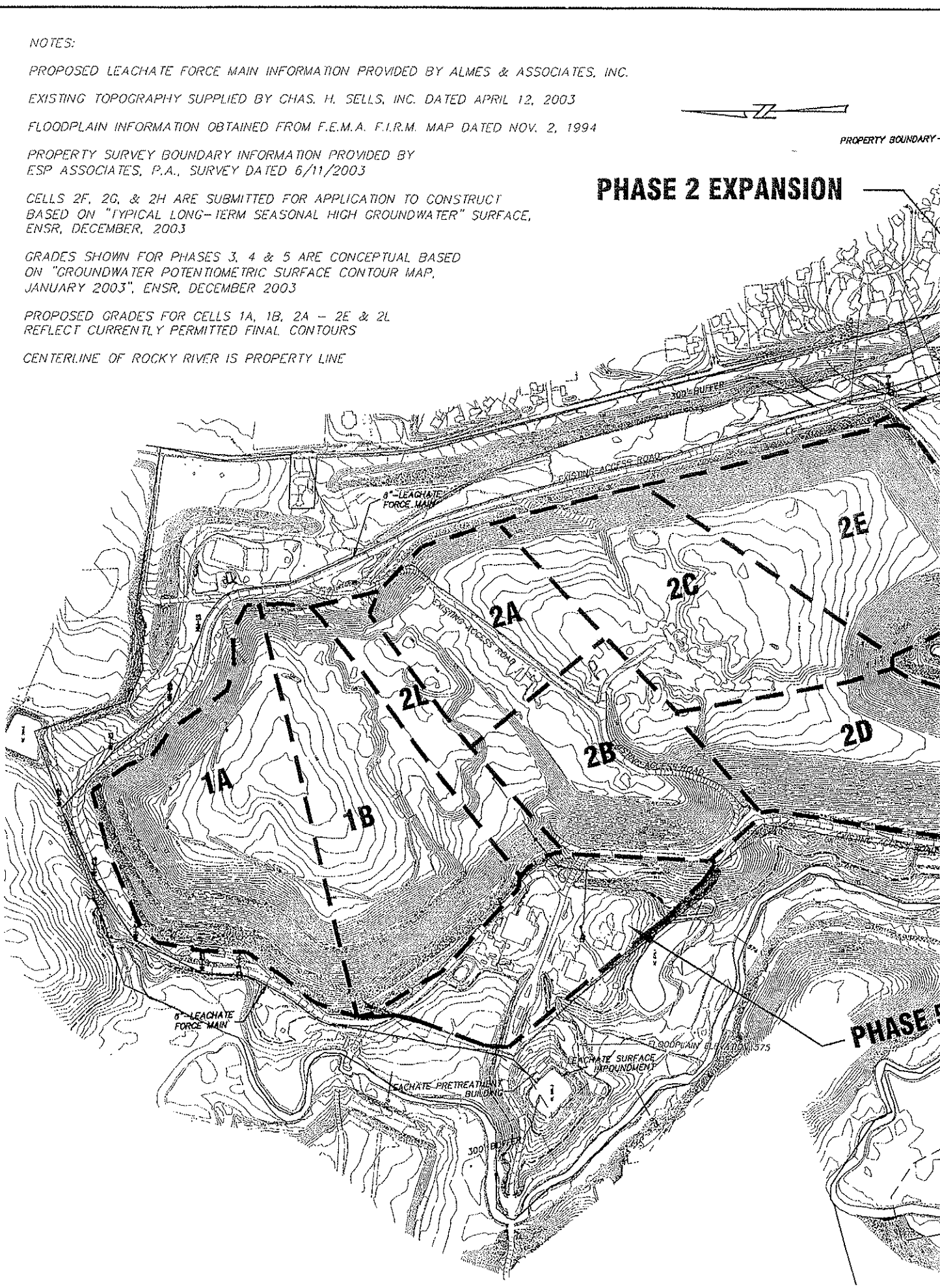
PROPERTY SURVEY BOUNDARY INFORMATION PROVIDED BY ESP ASSOCIATES, P.A., SURVEY DATED 6/11/2003

CELLS 2F, 2G, & 2H ARE SUBMITTED FOR APPLICATION TO CONSTRUCT BASED ON "TYPICAL LONG-TERM SEASONAL HIGH GROUNDWATER" SURFACE, ENSR, DECEMBER, 2003

GRADES SHOWN FOR PHASES 3, 4 & 5 ARE CONCEPTUAL BASED ON "GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR MAP, JANUARY 2003", ENSR, DECEMBER 2003

PROPOSED GRADES FOR CELLS 1A, 1B, 2A – 2E & 2L REFLECT CURRENTLY PERMITTED FINAL CONTOURS

CENTERLINE OF ROCKY RIVER IS PROPERTY LINE



SITE DEVELOPMENT PLAN
ALL FACILITIES

NOTES:

PROPOSED LEACHATE FORCE MAIN INFORMATION PROVIDED BY ALMES & ASSOCIATES, INC.

EXISTING TOPOGRAPHY SUPPLIED BY CHAS. H. SELLS, INC. DATED APRIL 12, 2003

FLOODPLAIN INFORMATION OBTAINED FROM F.E.M.A. F.I.R.M. MAP DATED NOV. 2, 1994

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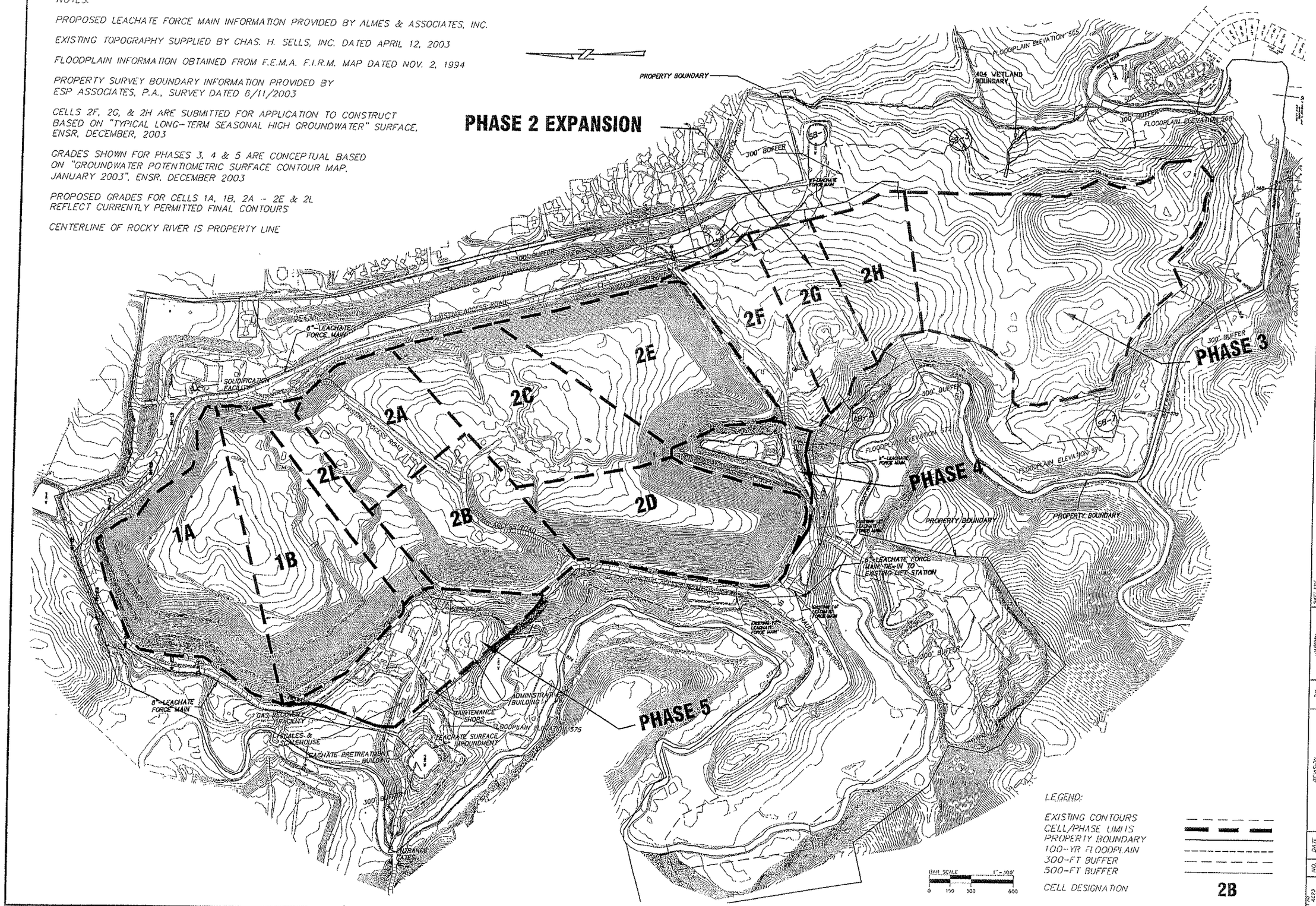
GRADES SHOWN FOR PHASES 3, 4 & 5 ARE CONCEPTUAL BASED ON "GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR MAP, JANUARY 2003", ENSR, DECEMBER 2003

PROPOSED GRADES FOR CELLS 1A, 1B, 2A - 2E & 2L REFLECT CURRENTLY PERMITTED FINAL CONTOURS

CENTERLINE OF ROCKY RIVER IS PROPERTY LINE



LEGEND:

EXISTING CONTOURS
CELL/PHASE LIMITS
PROPERTY BOUNDARY
100-YR FLOODPLAIN
300-FT BUFFER
500-FT BUFFER

CELL DESIGNATION 2B

ESP Associates, P.A.
engineering • surveying • planning
P.O. Box 7030 • Charlotte, NC 28241
10915 Southern Loop Boulevard
Pineville, NC 28134
(704) 583-9193 • FAX (704) 583-9150
www.espassociates.com

BFI WASTE SYSTEMS OF NORTH AMERICA, INC.
P.O. BOX 219
PINEVILLE, N.C. 28134

SITE DEVELOPMENT PLAN
ALL FACILITIES

CMS LANDFILL V

CONCORD, N.C. CABARRUS CO., N.C.

NORTH CAROLINA PROFESSIONAL SEAL 20204 ENGINEER

NO.	DATE	REVISION	BY

PROJECT NO. 4023
SCALE 1"=300'
DATE 4/21/04
DRAWN BY
DESIGNED BY
DWG. FC-2

CONSTRUCTION PLAN
BASE GRADES

NOTES:

PROPOSED LEACHATE FORCE MAIN INFORMATION PROVIDED BY ALMES & ASSOCIATES, INC.

EXISTING TOPOGRAPHY SUPPLIED BY CHAS. H. SELLS, INC. DATED APRIL 12, 2003

FLOODPLAIN INFORMATION OBTAINED FROM F.E.M.A. F.I.R.M. MAP DATED NOV. 2, 1994

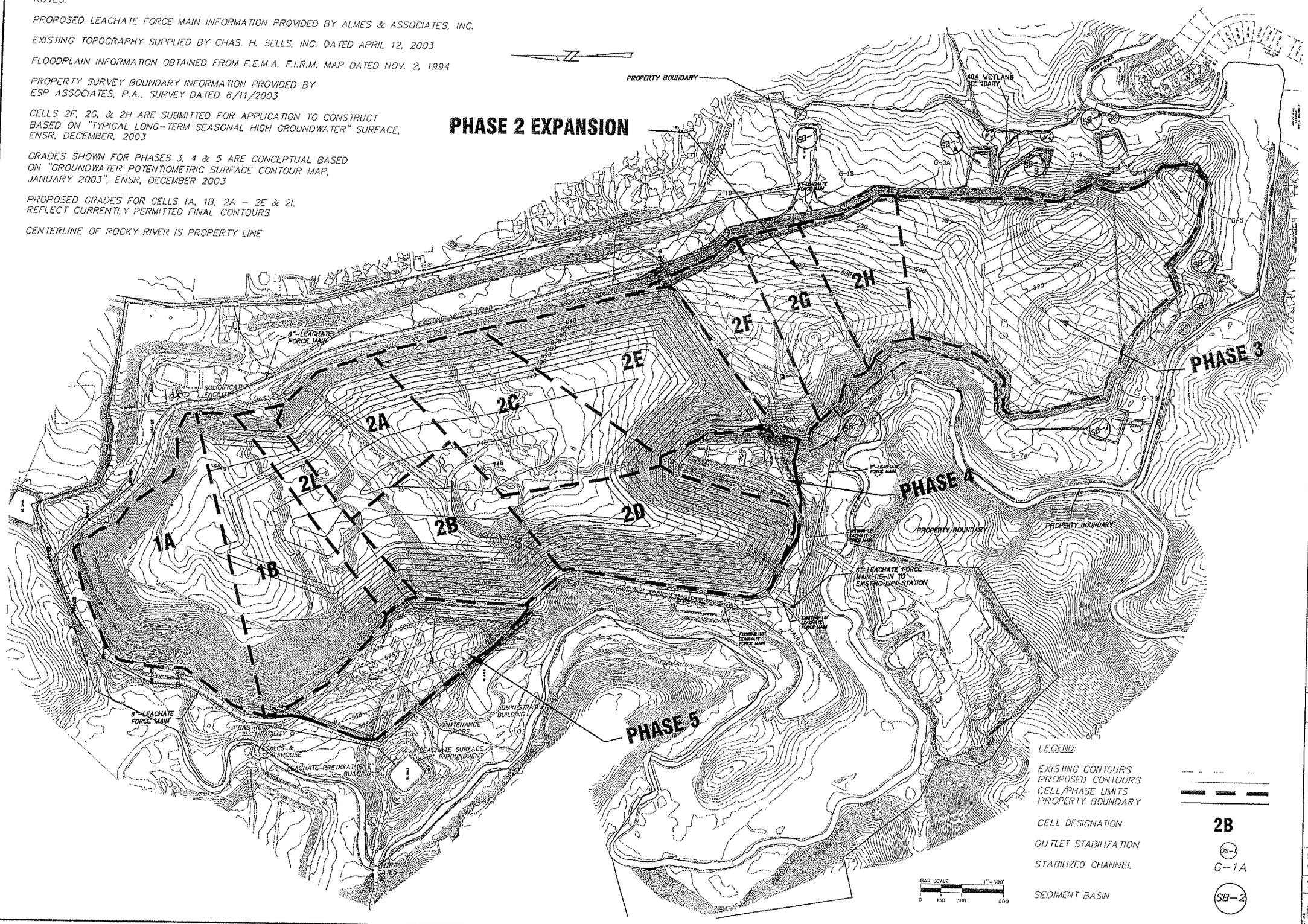
PROPERTY SURVEY BOUNDARY INFORMATION PROVIDED BY ESP ASSOCIATES, P.A., SURVEY DATED 6/11/2003

CELLS 2F, 2G, & 2H ARE SUBMITTED FOR APPLICATION TO CONSTRUCT BASED ON "TYPICAL LONG-TERM SEASONAL HIGH GROUNDWATER" SURFACE, ENSR, DECEMBER, 2003

GRADES SHOWN FOR PHASES 3, 4 & 5 ARE CONCEPTUAL BASED ON "GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR MAP, JANUARY 2003", ENSR, DECEMBER 2003

PROPOSED GRADES FOR CELLS 1A, 1B, 2A – 2E & 2L REFLECT CURRENTLY PERMITTED FINAL CONTOURS

CENTERLINE OF ROCKY RIVER IS PROPERTY LINE



LEGEND:

EXISTING CONTOURS	
PROPOSED CONTOURS	
CELL/PHASE LIMITS	
PROPERTY BOUNDARY	
CELL DESIGNATION	2B
OUTLET STABILIZATION	DS-1
STABILIZED CHANNEL	G-1A
SEDIMENT BASIN	SB-2

ESP Associates, P.A.
engineering • surveying • planning
P.O. Box 7030 • Charlotte, NC 28241
10915 Southern Loop Boulevard
Pineville, NC 28134
(704) 563-4949 • Fax (704) 563-4950
www.espassociates.com

BFI WASTE SYSTEMS OF NORTH AMERICA, INC.
P.O. BOX 219
PINEVILLE, N.C. 28134

FACILITY CONSTRUCTION PLAN
BASE GRADES

CMS LANDFILL V

CONCORD, N.C.

CABARRUS CO., N.C.

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 020770 CLAIRE W. HASIELA

NO.	DATE	REVISION	BY

PROJECT NO. RC23
SCALE 1"=300'
DATE 4/21/04
DRAWN BY MAG
CHECKED BY JHW
FC-3

CONSTRUCTION PLAN
FINAL GRADES

NOTES:

PROPOSED LEACHATE FORCE MAIN INFORMATION PROVIDED BY ALMES & ASSOCIATES, INC.

EXISTING TOPOGRAPHY SUPPLIED BY CHAS. H. SELLS, INC. DATED APRIL 12, 2003

FLOODPLAIN INFORMATION OBTAINED FROM F.E.M.A. F.I.R.M. MAP DATED NOV. 2, 1994

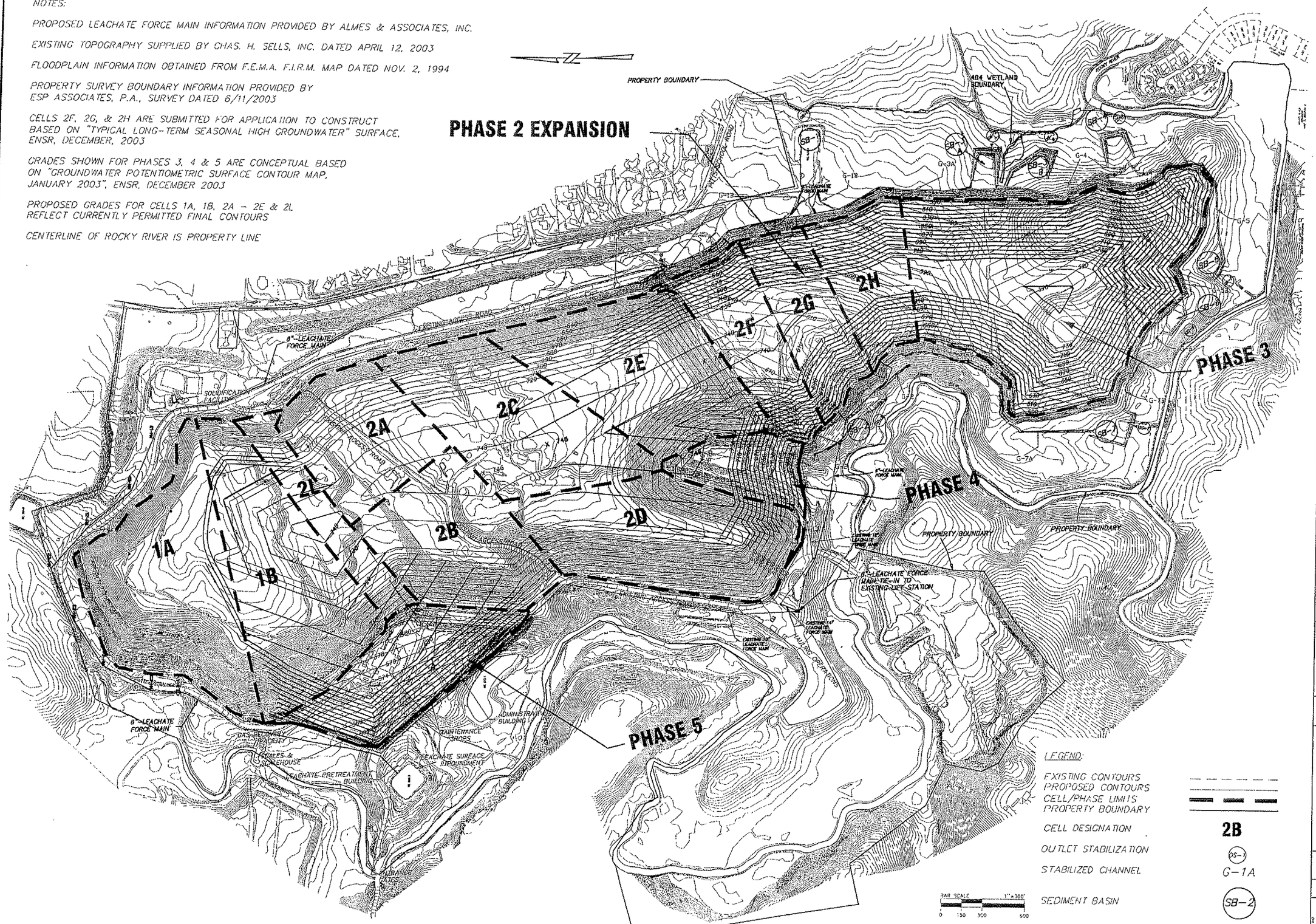
PROPERTY SURVEY BOUNDARY INFORMATION PROVIDED BY ESP ASSOCIATES, P.A., SURVEY DATED 6/11/2003

CELLS 2F, 2G, & 2H ARE SUBMITTED FOR APPLICATION TO CONSTRUCT BASED ON "TYPICAL LONG-TERM SEASONAL HIGH GROUNDWATER" SURFACE, ENSR, DECEMBER, 2003

GRADES SHOWN FOR PHASES 3, 4 & 5 ARE CONCEPTUAL BASED ON "GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR MAP, JANUARY 2003", ENSR, DECEMBER 2003

PROPOSED GRADES FOR CELLS 1A, 1B, 2A – 2E & 2L REFLECT CURRENTLY PERMITTED FINAL CONTOURS

CENTERLINE OF ROCKY RIVER IS PROPERTY LINE



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10015 Monroe Road
Charlotte, NC 28270
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BFI WASTE SYSTEMS OF NORTH AMERICA, INC.
P.O. BOX 219
PINEVILLE, N.C. 28134

SHEET TITLE: FACILITY CONSTRUCTION PLAN FINAL CONTOURS

PROJECT: CMS LANDFILL V
CONCORD, N.C.
CABARRUS CO., N.C.

NORTH CAROLINA PROFESSIONAL SEAL 15202 ENGINEER

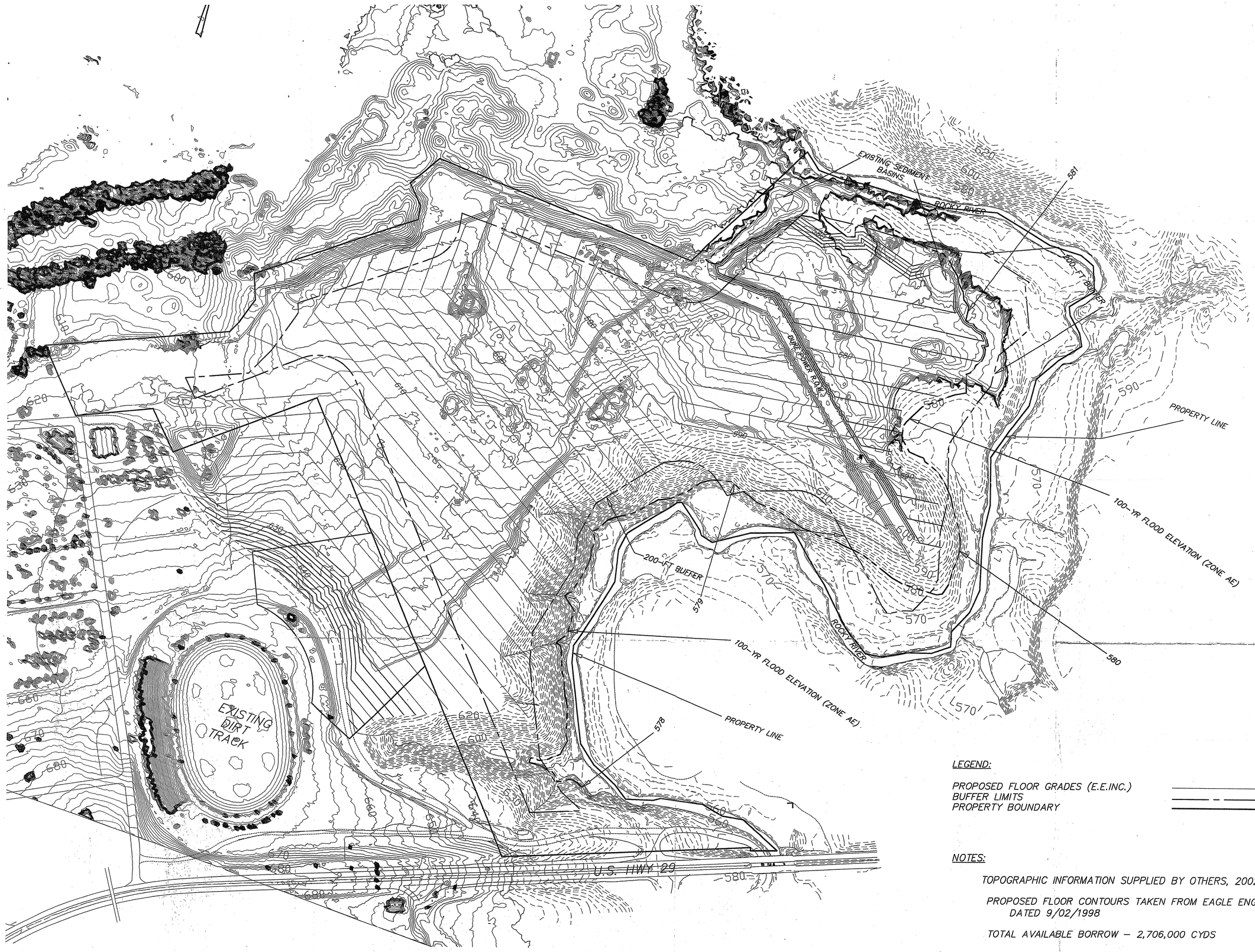
REVISION	BY

NO.	DATE

PROJECT NO. 1623
SCALE 1" = 300'
DATE 5/21/04
DRAWN BY MAC
CHECKED BY

FC-4

NORTH BORROW AREA
GRADING PLAN



LEGEND:

PROPOSED FLOOR GRADES (E.E.INC.)
BUFFER LIMITS
PROPERTY BOUNDARY

NOTES:

TOPOGRAPHIC INFORMATION SUPPLIED BY OTHERS, 2002

PROPOSED FLOOR CONTOURS TAKEN FROM EAGLE ENGINEERS, INC. DATED 9/02/1998

TOTAL AVAILABLE BORROW – 2,706,000 CYDS

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10915 Stonehom Loop Boulevard
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(704) 583-4949 • Fax: (704) 583-4950
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CLIENT: BFI
5105 MOREHEAD ROAD
CONCORD, NC 28027

SHEET TITLE: PROPOSED GRADING PLAN MOREHEAD FARMS BORROW AREA

PROJECT: CMS LANDFILL
CONCORD, NC

NO.	DATE	REVISION	BY

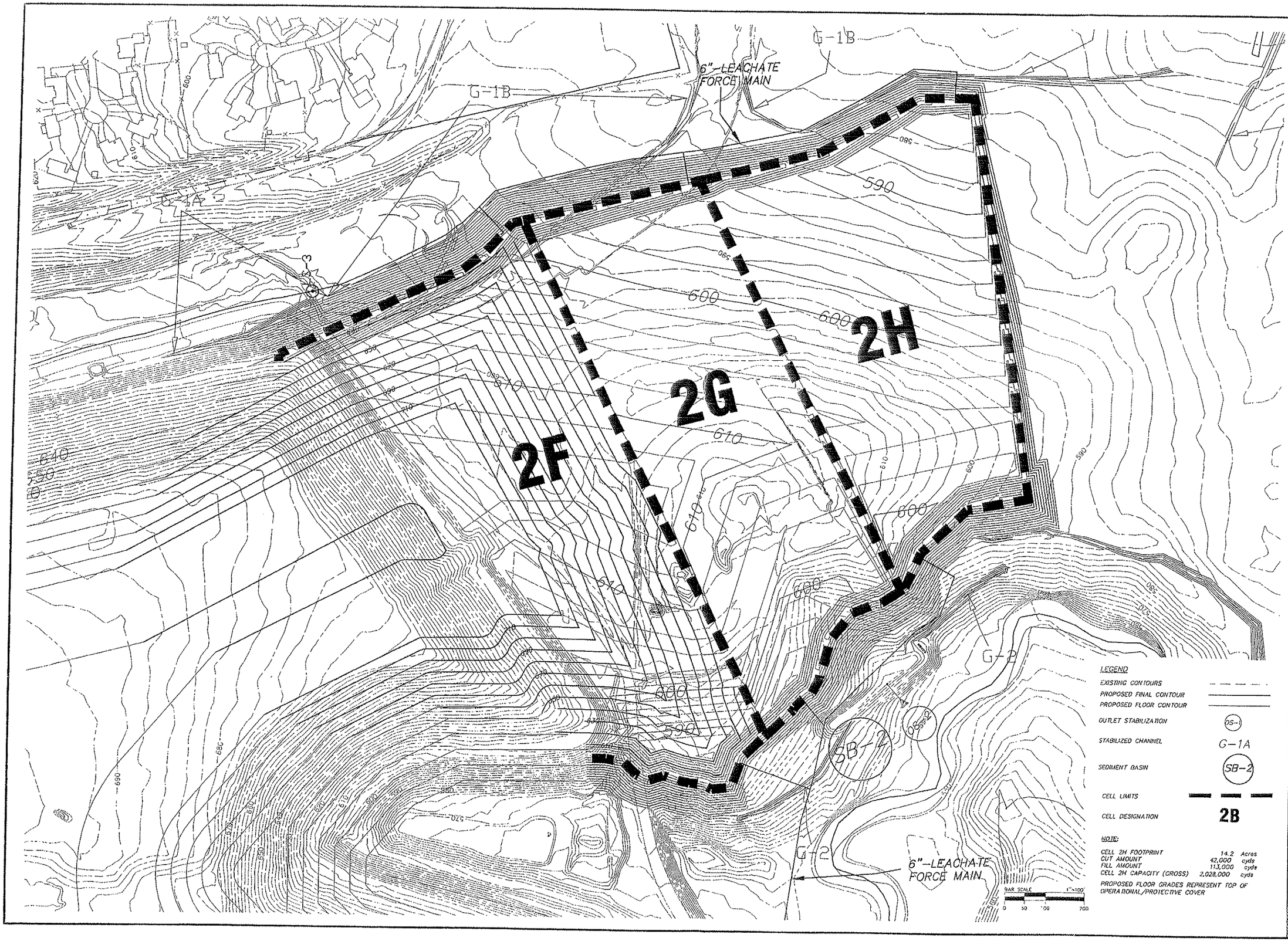
PROJECT NO. RC23
SCALE 1"=200'
DATE 3/19/2004
DRAWN BY MAG
CHECKED BY DWW
1 OF 1 SHT

APPENDIX 2

PHASING PLANS

Cell 2F Phasing Plan
Cell 2G Phasing Plan
Cell 2H Phasing Plan
Phase 3 Phasing Plan
Phase 4 Phasing Plan
Phase 5 Phasing Plan

CELL 2F PHASING PLAN



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10915 Southern Loop Boulevard
Pineville, NC 28134
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www.espassociates.com

BFI WASTE SYSTEMS OF NORTH AMERICA, INC
P.O. BOX 219
PINEVILLE, NC 28134

SHEET TITLE: PHASING PLAN – PHASE 2 CELL 2F

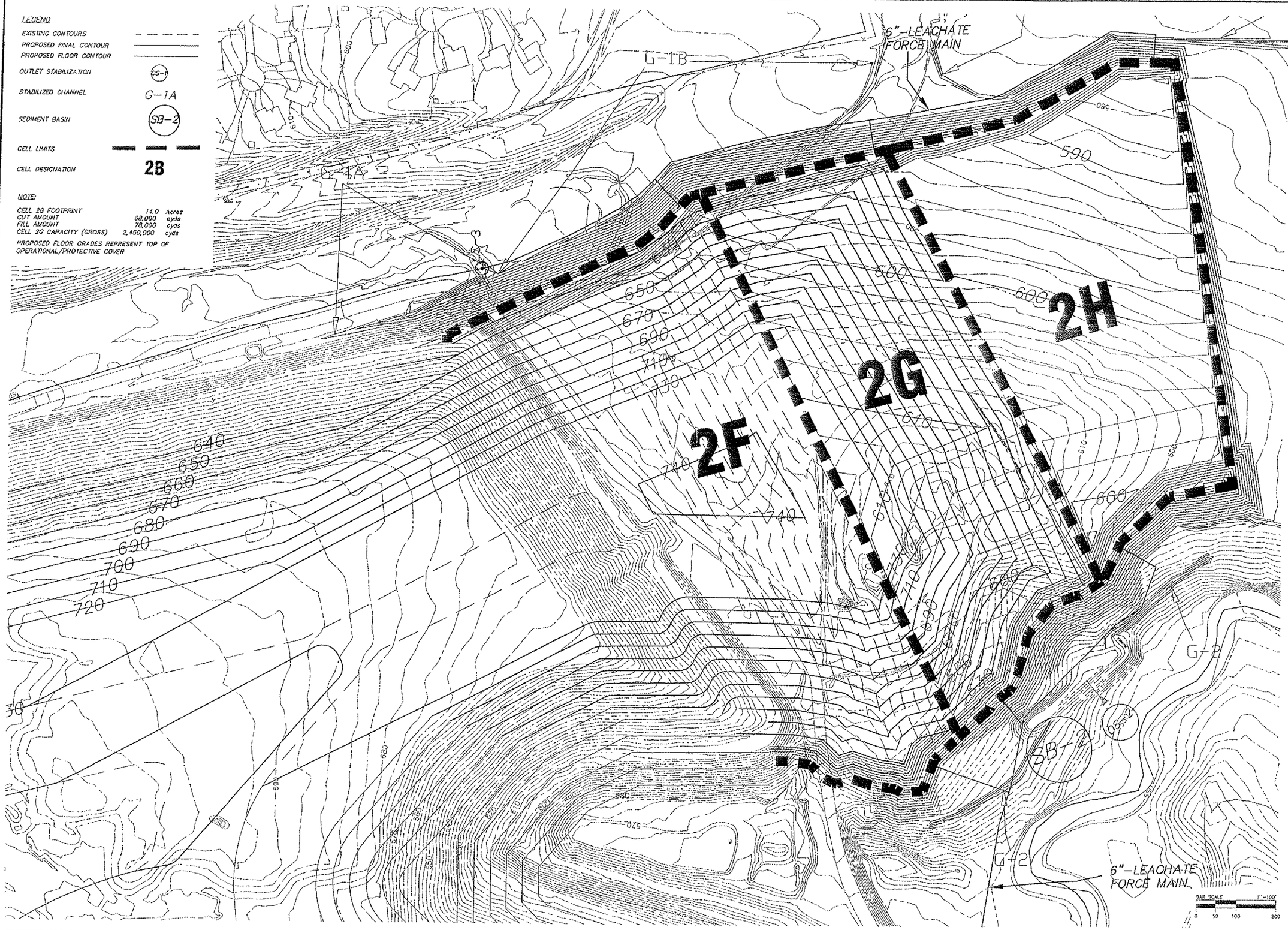
PROJECT: CMS LANDFILL V

CONCORD, NC CABARRUS CO. NC

NO.	DATE	REVISION	BY

PROJECT NO. R023
SCALE 1"=100'
DATE 4/20/04
DRAWN BY MAC
CHECKED BY DWN
FC-5

CELL 2G PHASING PLAN



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BFI WASTE SYSTEMS OF NORTH AMERICA, INC
P.O. BOX 219
PINEVILLE, NC 28134

PHASING PLAN – PHASE 2
CELL 2G

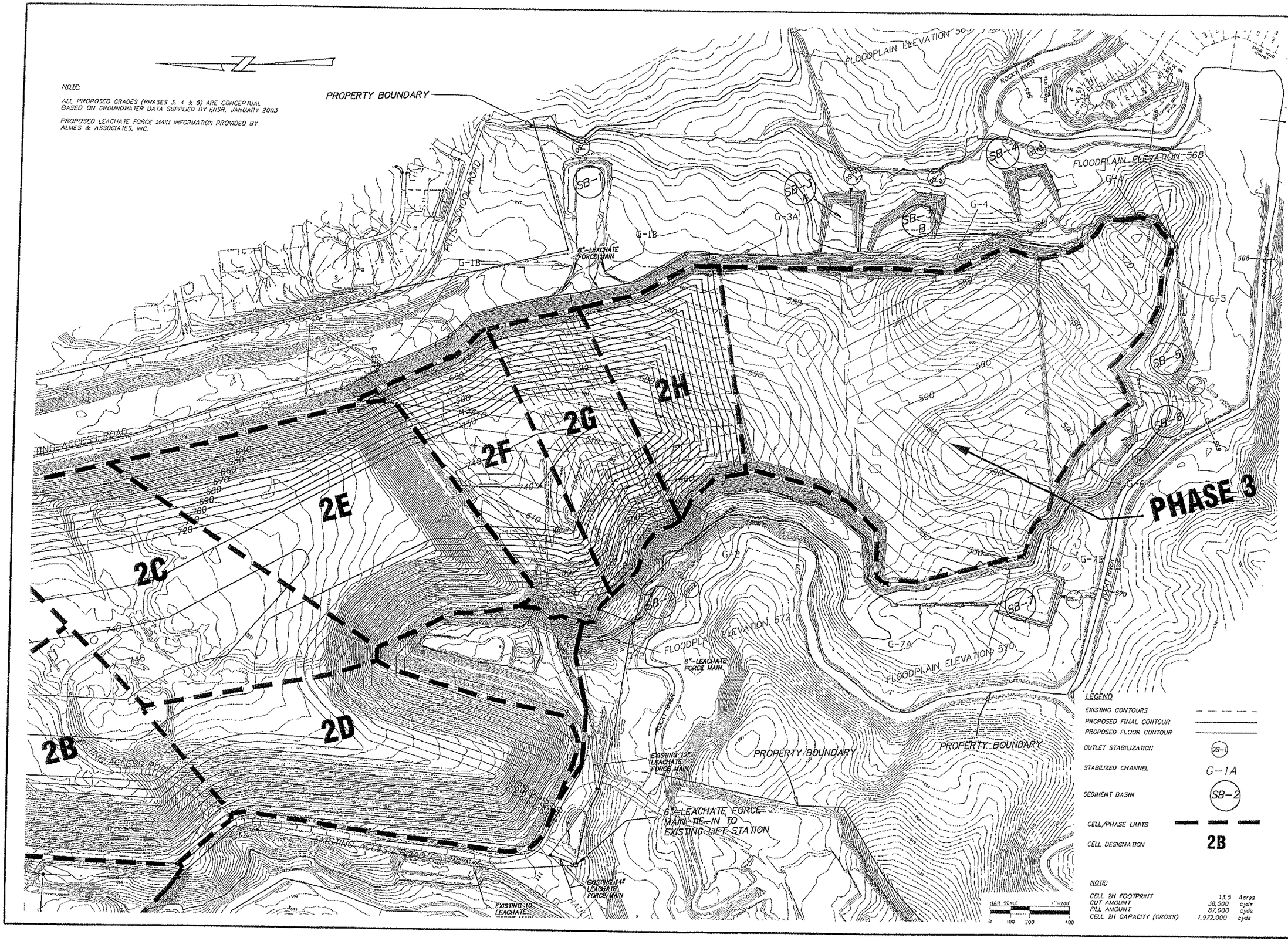
CMS LANDFILL V

CONCORD, NC CABARRUS CO. NC

NO.	DATE	REVISION	BY

PROJECT NO. R023
SCALE 1"=100'
DATE 4/20/04
DRAWN BY MAG
CHECKED BY DWH
FC-6

CELL 2H PHASING PLAN



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BFI WASTE SYSTEMS OF NORTH AMERICA, INC.
P.O. BOX 219
PINEVILLE, N.C.

PHASING PLAN – PHASE 2
CELL 2H

CMS LANDFILL V

CONCORD, N.C. CABARRUS CO., N.C.

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 20770 WASIELA

NO.	DATE	REVISION	BY

PROJECT NO. RC23
SCALE 1"=200'
DATE 6/20/04
DRAWN BY MAC
CHECKED BY DWG
FC-7

PHASE 3 PHASING PLAN

NOTE:

ALL PROPOSED GRADES (PHASES 3, 4 & 5) ARE CONCEPTUAL BASED ON GROUNDWATER DATA SUPPLIED BY ENSR, JANUARY 2003

PROPOSED LEACHATE FORCE MAIN INFORMATION PROVIDED BY ALMES & ASSOCIATES, INC.

PROPERTY BOUNDARY

FLOODPLAIN ELEVATION

ROCKY RIVER

FLOODPLAIN ELEVATION 568

PITTS SCHOOL ROAD

8"-LEACHATE FORCE MAIN

G-1A

G-1B

G-2

G-3A

G-7A

SB-1

SB-2

SB-3

SB-4

SB-5

SB-6

SB-7

SB-8

2B

2C

2D

2E

2F

2G

2H

PHASE 3

PHASE 4

FLOODPLAIN ELEVATION 572

FLOODPLAIN ELEVATION 570

EXISTING ACCESS ROAD

EXISTING 12" LEACHATE FORCE MAIN

6"-LEACHATE FORCE MAIN TIE-IN TO EXISTING LIFT STATION

EXISTING 14" LEACHATE FORCE MAIN

EXISTING 10" LEACHATE FORCE MAIN

MAP SCALE 1"=200'

0 100 200 400

LEGEND

EXISTING CONTOURS	
PROPOSED FINAL CONTOUR	
PROPOSED FLOOR CONTOUR	
OUTLET STABILIZATION	OS-1
STABILIZED CHANNEL	G-1A
SEDIMENT BASIN	SB-2
CELL/PHASE LIMITS	
CELL DESIGNATION	2B

NOTE:

PHASE 3 FOOTPRINT	60.6 Acres
TOTAL CUT AMOUNT	139,680 cyds
TOTAL FILL AMOUNT	479,000 cyds
TOTAL PHASE 3 CAPACITY (GROSS)	8,275,000 cyds

ESP Associates, P.A.
Engineering • Surveying • Planning
P.O. Box 7030 • Charlotte, NC 28241
10915 Sonoma Lake Boulevard
Pineville, NC 28134
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www.espassociates.com

BFI WASTE SYSTEMS OF NORTH AMERICA, INC.
P.O. BOX 219
PINEVILLE, N.C.

PHASING PLAN
PHASE 3

CMS LANDFILL V

CABARRUS CO., N.C.

CONCORD, N.C.

NORTH CAROLINA PROFESSIONAL SEAL 9770 DAVID W. HOOTS

NO.	DATE	REVISION	BY

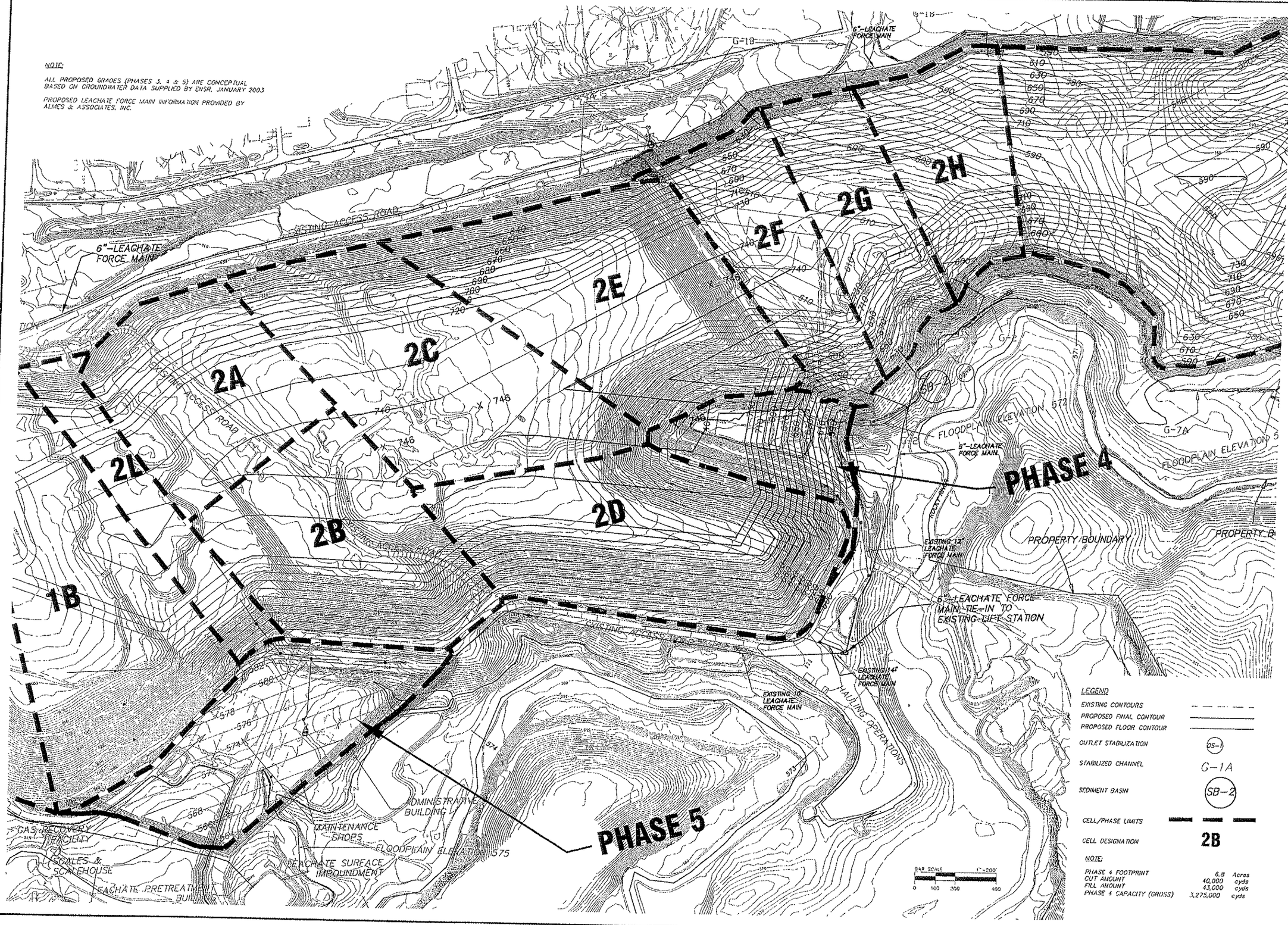
PROJECT NO. R023
SCALE 1"=200'
DATE 10/02/2003
DRAWN BY S.K.G.
CHECKED BY DWH
FC-8

PHASE 4 PHASING PLAN

NOTE:

ALL PROPOSED GRADES (PHASES 3, 4 & 5) ARE CONCEPTUAL BASED ON GROUNDWATER DATA SUPPLIED BY ENSR, JANUARY 2003

PROPOSED LEACHATE FORCE MAIN INFORMATION PROVIDED BY ALMCS & ASSOCIATES, INC.



LEGEND

EXISTING CONTOURS	
PROPOSED FINAL CONTOUR	
PROPOSED FLOOR CONTOUR	
OUTLET STABILIZATION	OS-1
STABILIZED CHANNEL	G-1A
SEDIMENT BASIN	SB-2
CELL/PHASE LIMITS	
CELL DESIGNATION	2B

NOTE:

PHASE 4 FOOTPRINT	6.8	Acres
CUT AMOUNT	40,000	cyds
FILL AMOUNT	43,000	cyds
PHASE 4 CAPACITY (GROSS)	3,275,000	cyds

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Pineville, NC 28134
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www.espassociates.com

BFI WASTE SYSTEMS OF NORTH AMERICA, INC.
P.O. BOX 219
PINEVILLE, N.C.

PHASING PLAN PHASE 4

CMS LANDFILL V

CABARRUS CO., N.C.

CONCORD, N.C.

NORTH CAROLINA PROFESSIONAL SEAL 19970 ENGINEER GARY W. MIG

NO.	DATE	REVISION	BY

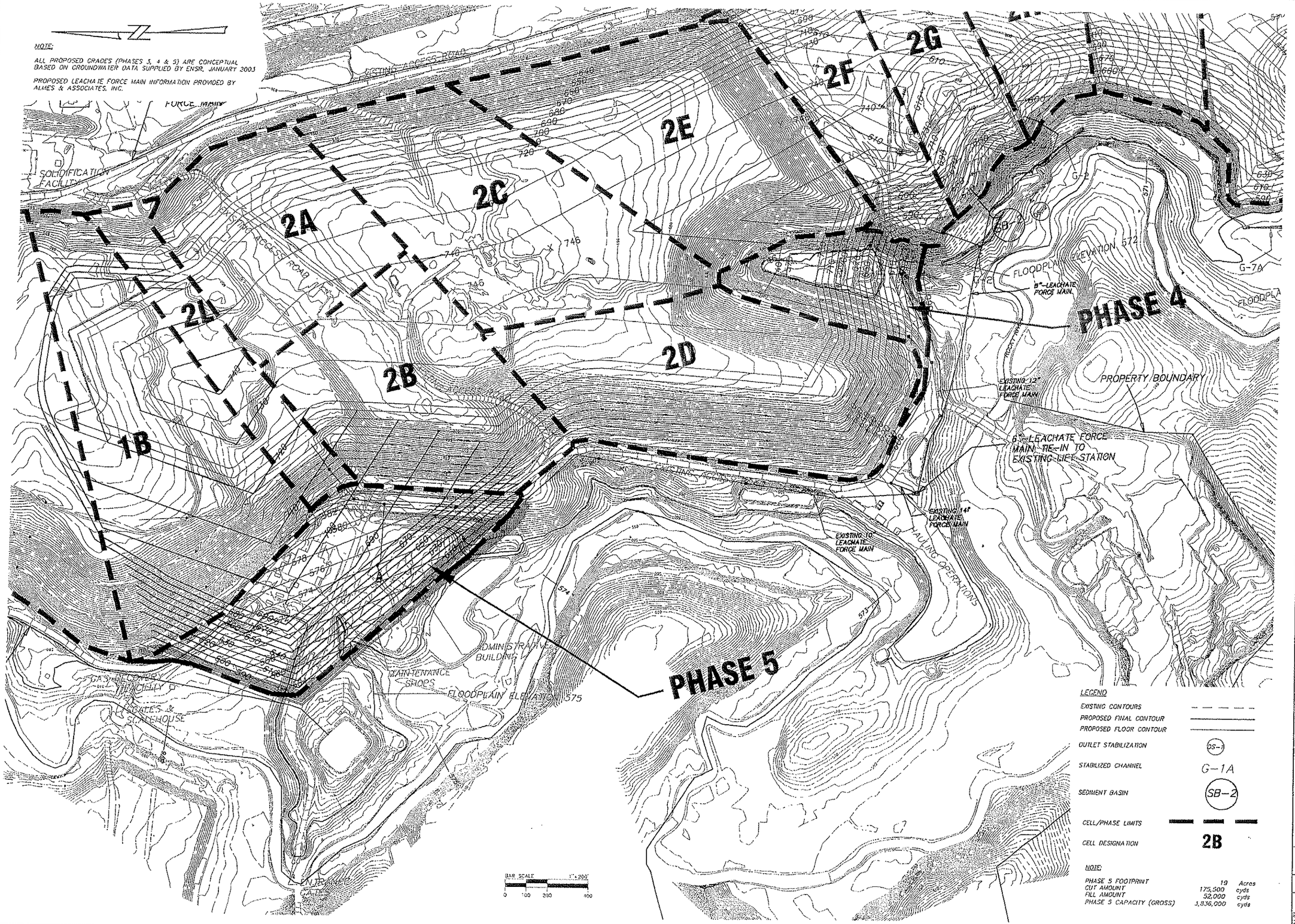
PROJECT NO. 4223
SCALE 1"=200'
DATE 4/21/03
DRAWN BY MIG
CHECKED BY
DWG. FC-9

PHASE 5 PHASING PLAN

NOTE:

ALL PROPOSED GRADES (PHASES 3, 4 & 5) ARE CONCEPTUAL BASED ON GROUNDWATER DATA SUPPLIED BY ENSR, JANUARY 2003

PROPOSED LEACHATE FORCE MAIN INFORMATION PROVIDED BY ALMES & ASSOCIATES, INC.



LEGEND

EXISTING CONTOURS	
PROPOSED FINAL CONTOUR	
PROPOSED FLOOR CONTOUR	
OUTLET STABILIZATION	OS-1
STABILIZED CHANNEL	G-1A
SEDIMENT BASIN	SB-2
CELL/PHASE LIMITS	
CELL DESIGNATION	2B

NOTE:

PHASE 5 FOOTPRINT	19	Acres
CUT AMOUNT	175,500	cyds
FILL AMOUNT	52,000	cyds
PHASE 5 CAPACITY (GROSS)	3,836,000	cyds

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10915 Stonehaven Lane Boulevard
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www.espassociates.com

BFI WASTE SYSTEMS OF NORTH AMERICA, INC.
P.O. BOX 219
PINEVILLE, N.C.

PHASING PLAN
PHASE 5

CMS LANDFILL V

CABARRUS CO., N.C.

CONCORD, N.C.

NORTH CAROLINA PROFESSIONAL SEAL 8870 ENGINEER WILLIAM A. GRAVES

NO.	DATE	REVISION	BY

PROJECT NO. 8023
SCALE 1"=200'
DATE 7/30/04
DRAWN BY MAG
CHECKED BY WAG

FC-10

APPENDIX 3

FRANCHISE AGREEMENT WITH CITY OF CONCORD, NORTH CAROLINA

CERTIFICATE OF RECORDING OFFICER

I, Jill B. Chunn, the duly appointed and acting Deputy City Clerk for the City of Concord, North Carolina, do hereby certify and acknowledge that the attached Ordinance No. 03-10, titled "An Ordinance Renewing a Nonexclusive Franchise to BFI Waste Systems of North America, Inc." is accurate copy of the original ordinance on file and of record in the Office of the City Clerk.

WITNESS MY HAND AND SEAL of the City of Concord, North Carolina this 26th day of March, 2002.

Jill B. Chunn

Jill B. Chunn, Deputy City Clerk

(SEAL)

AN ORDINANCE RENEWING A NONEXCLUSIVE FRANCHISE TO BFI WASTE SYSTEMS OF NORTH AMERICA, INC.

Whereas, the disposal of municipal solid waste is a statutory responsibility and a fiscal concern of the City of Concord; and

Whereas, the City of Concord disposes of its municipal solid waste at the sanitary landfill operated by BFI Waste Systems of North America, Inc., known as BFI-CMS Landfill (formerly known as CMS Development Corporation Landfill V), located in the City of Concord; and

Whereas, BFI Waste Systems of North America, Inc. is currently operating its BFI-CMS Landfill pursuant to permits and authorizations granted by the State of North Carolina; and

Whereas, under its Solid Waste Management Plan dated January 31, 1992, the City of Concord has confirmed its plan to rely upon the BFI-CMS Landfill for the disposal of municipal solid waste generated within the City; and

Whereas, the City now agrees to renew a franchise to BFI Waste Systems of North America, Inc. for the operation of the BFI-CMS Landfill consistent with the City's Solid Waste Management Plan;

Now, therefore, the City Council of Concord, North Carolina, pursuant to G.S. 160A-76, and G.S. 130A-294 et. seq., hereby renews a franchise to BFI Waste Systems of North America, Inc. to operate a sanitary landfill within the City of Concord, North Carolina, pursuant to the following terms:

(1) The franchise is for the operation of a sanitary landfill intended to receive ordinary household waste, commercial solid waste, industrial solid waste and special waste, including asbestos, ash and industrial processed waste, and such other non-hazardous waste as approved by the State of North Carolina.

(2) The geographic territory intended to be served by the sanitary landfill is the City of Concord, Cabarrus County, and the State of North Carolina and other areas within a seventy-five (75) mile radius of the BFI-CMS Landfill; the population intended to be served is the population of the City of Concord, Cabarrus County, and the State of North Carolina and other areas within a seventy-five (75) mile radius of the BFI-CMS Landfill.

(3) The duration of this franchise is thirty (30) years from the date of its adoption. It is estimated that the BFI-CMS Landfill will be able to accept for disposal municipal solid waste until the year 2033.

(4) This franchise is a non-exclusive franchise for the operation of a sanitary landfill by BFI Waste Systems of North America, Inc. within the geographic boundary line of property currently owned or under option by BFI Waste Systems of North America, Inc. located in Concord, North Carolina and described on Exhibit A (the "Site"); this franchise does not grant to BFI Waste Systems of North America, Inc. the exclusive right to operate a sanitary landfill within the city limits of Concord, and it does not grant to BFI Waste Systems of North America, Inc. a franchise to operate a sanitary landfill in any location outside the Site.

(5) In granting this franchise, it is estimated that BFI Waste Systems of North America, Inc. currently receives an average of approximately 90,000 tons of municipal solid waste per month at the BFI-CMS Landfill. The parties recognize that the volume of waste to be accepted at the Landfill may vary over the course of this franchise. Pursuant to this franchise, the franchisee may accept up to an average of approximately 120,000 tons of municipal solid waste

per month at the BFI-CMS Landfill with the maximum monthly volume not to exceed 140,000 tons per month, and subject to such permits as may be required by and issued by the N.C. Division of Solid Waste Management for additional cells within the BFI-CMS Landfill or other use of the BFI-CMS Landfill.

(6) The franchisee, BFI Waste Systems of America, Inc., is required to continue accepting for disposal municipal solid waste generated within the City of Concord, North Carolina, pursuant to the terms of the Contract for Disposal of Solid Waste by and between the City of Concord, North Carolina, and CMS Development Corp. and Browning-Ferris Industries of South Atlantic, Inc. (the predecessors to BFI Waste Systems of North America, Inc. by merger), dated August 1, 1990, as the Contract may be amended from time to time, including the amendment of even date herewith, by agreement between the City and BFI Waste Systems of North America, Inc. Further, the franchisee, BFI Waste Systems of America, Inc., or its successors in interest hereby agrees to provide airspace for the disposal of all residential municipal solid waste generated within the City of Concord, North Carolina for thirty (30) years from the date of the granting of this franchise. If the BFI-CMS Landfill should reach capacity before the conclusion of the thirty (30) year term of this franchise so that BFI could not continue to accept the monthly volume of waste at the BFI-CMS Landfill anticipated by this franchise and still provide airspace at the BFI-CMS Landfill for the disposal of all residential municipal solid waste generated with the City of Concord, North Carolina for the thirty (30) year term of this franchise, franchisee agrees to erect a transfer station on the Site and, if necessary, transport all residential municipal solid waste generated within the City of Concord, North Carolina to another location for disposal pursuant to law. The erection of said transfer station and the transportation and disposal of all residential municipal solid waste generated within the City of Concord, North Carolina for the said period of thirty (30) years shall be at the sole expense of the franchisee. The City agrees to cooperate with the franchisee in providing any required approvals and assist in obtaining all required authorizations for the siting of a transfer station.

The commercial waste disposal rates and the recycling program at no cost to the City shall continue under the same terms and conditions as set forth in previous franchises and/or agreements between the parties as amended.

(7) Host fees will be paid and managed as follows:

(a) With the exception of residential waste generated within the City of Concord, BFI will pay to the City a host fee of $.40 per ton of Waste deposited in the Landfill beginning on the day that the State of North Carolina issues to BFI a permit for the construction of the next phase of the Landfill. Beginning on the day that BFI begins to place Waste in the initial cell covered by said permit, BFI will increase the host fee to $.75 per ton of Waste deposited in the Landfill. BFI guarantees that the non-escrowed portion of the host fees paid will be at least $38,200.00 a month for a period of fifteen (15) years from the time BFI begins to pay host fees.

(b) Once the host fee is $.75 per ton of Waste deposited in the Landfill, the City will place $.25 of each $.75 in an interest bearing account. This account will be maintained throughout the life of the franchise. At the expiration of this franchise, if BFI has met its obligation to provide to the City disposal for all residential waste generated during the term of the franchise, then all principal and interest contained in the account will be paid to BFI (or its successor). If BFI defaults on its obligation to provide to the City disposal for all residential waste generated during the term of this franchise, then the principal and interest contained in the account will be paid to the City.

(c) Host fees shall be paid monthly, beginning twenty-one (21) days after the last day of the calendar month during which the State of North Carolina issues to BFI a permit for the construction of the next phase of the Landfill and continuing every twenty-one (21) days after the end of each calendar

month during which Waste has been accepted for disposal at the Landfill or at such other intervals as may be agreed to by the parties in writing. BFI will provide to the City a copy of its annual report to the State at the time the report is submitted to the State and, at the City's request, will make its daily log and supporting documents available for review at reasonable times and intervals.

(8) Nothing in this franchise shall authorize BFI Waste Systems of North America, Inc. to modify the BFI-CMS Landfill in a manner which would cause the City of Concord to incur any additional capital expenditures in the provision or delivery of services to the BFI-CMS Landfill such as water, sewer, utilities or roads as a result of such modification, unless BFI Waste Systems of North America, Inc. agrees to pay all additional costs associated with delivering those services.

(9) The City of Concord and BFI anticipate that the language of this franchise will satisfy the State of North Carolina sufficiently to permit the expansion described herein by BFI. In the event that the language of this franchise does not satisfy the requirements of the State of North Carolina, the franchise may be amended to conform to the requirements of the State of North Carolina or this franchise may be declared null and void at the option of the BFI.

(10) This franchise shall become effective upon the execution of a franchise agreement by BFI outlining the operation of the expanded landfill to the satisfaction of the Legal Department.

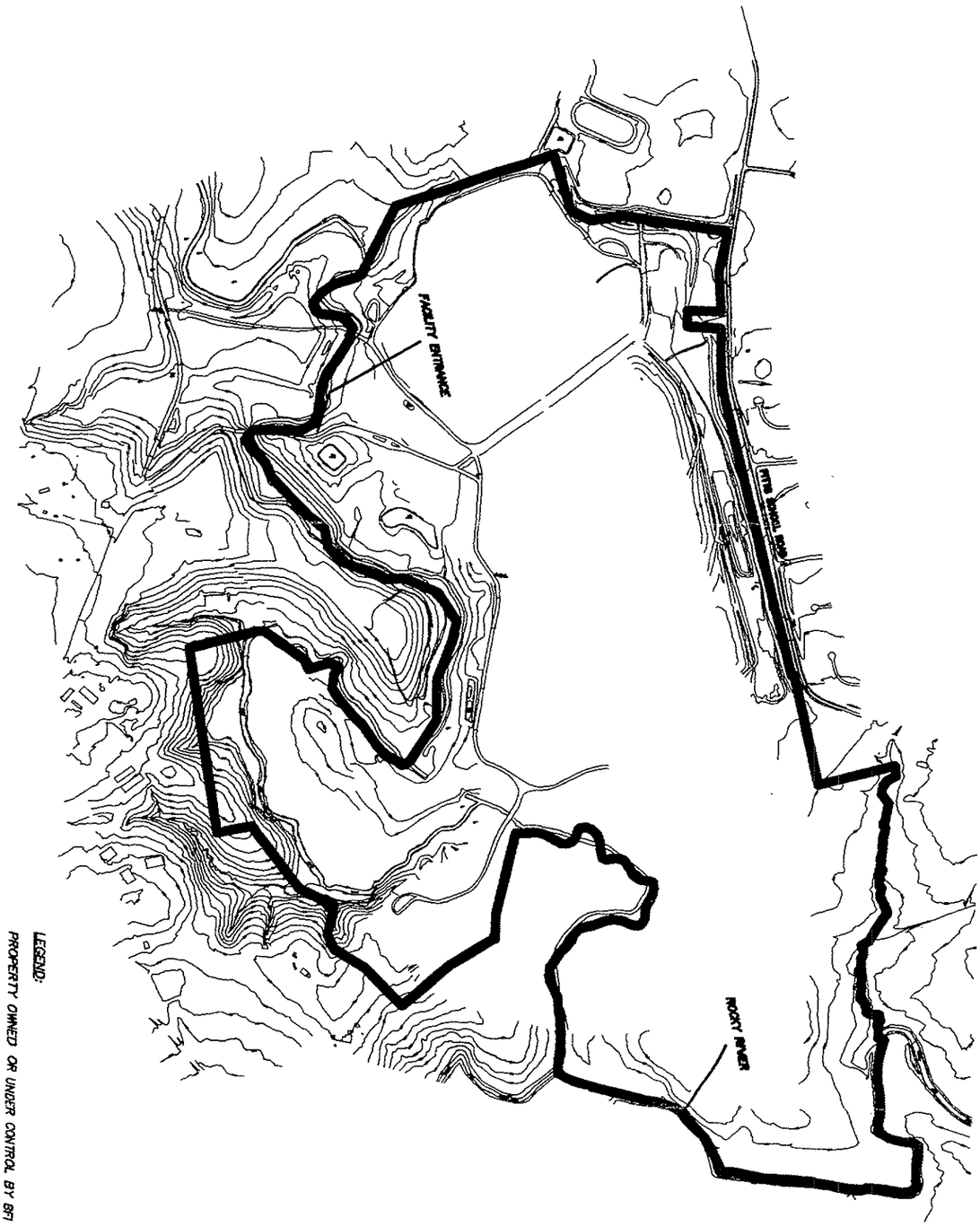
Adopted on first reading this 9th day of January, 2003.

Adopted on second reading this 13th day of February, 2003.

CITY COUNCIL
CITY OF CONCORD
NORTH CAROLINA

J. Scott Padgett, Mayor

ATTEST: Vickie C. Weant
Vickie C. Weant, City Clerk



LEGEND:

PROPERTY OWNED OR UNDER CONTROL BY BFI

PROJECT NO. RC23	SHEET TITLE	FRANCHISE ORDINANCE EXHIBIT "A" BFI – CMS LANDFILL V
SCALE N.T.S		
DATE 2/13/0		
DRAWN BY MAG	PROJECT	BFI WASTE SYSTEMS OF N.A.
CHECKED BY DWW		
1 OF 1 SHT		

QH19FRANCH

CONCORD, NC

ESP ASSOCIATES, P.A.
engineeringsurveyingplanning
P.O. Box 7030, Charlotte, NC 28241
10916 Southern Loop Boulevard
Pineville, NC 28134 (704) 583-4949

APPENDIX 4

INDUSTRIAL USER PRETREATMENT PERMIT NO. 1024
ISSUED TO BFI WASTE SYSTEMS OF NORTH AMERICA, Inc.
ISSUED BY WATER & SEWER AUTHORITY OF CABARRUS COUNTY, NORTH CAROLINA

November 29, 1999

WSACC

WATER & SEWER AUTHORITY OF CABARRUS CO.

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Tricia Phillips
District Manager, Environment, Safety & Health
BFI Waste Systems of North America
5105 Morehead Road
Harrisburg, N.C. 28075

SUBJECT: INDUSTRIAL USER PRETREATMENT PERMIT NO. 1024

Dear Ms. Phillips:

Please find the enclosed industrial user pretreatment permit (IUP) no. 1024 issued in response to your Industrial User Wastewater Survey and Permit Application which was received by the Water and Sewer Authority of Cabarrus County (WSACC) on July 1, 1999. This permit is issued pursuant to the requirements of North Carolina General Statute 143.215.1 and WSACC's Sewer Use Ordinance.

Please review the IUP and all the conditions contained therein. If no comments or objections are filed by you or the State with the Executive Director within thirty (30) days following receipt of this letter, the IUP becomes final and binding.

If you have any questions concerning BFI Waste System's IUP, please contact Beverly Metcalf, Industrial Pretreatment Coordinator, at 788-4164, ext. 12.

Sincerely,

Jay R. Shive
Facilities Operations Director

JRS:BKM:tmg

cc: John C. Murdock, III
Mark Fowler

Enclosure

232 Davidson Hwy
P.O. Box 128
Concord NC
28026-0128
Ph 704.786.1783
Fx 704.786.6205

WATER AND SEWER AUTHORITY
OF CABARRUS COUNTY
Concord, North Carolina

PERMIT

Industrial User Pretreatment Permit(IUP)
To Discharge Wastewater Under the
Industrial Pretreatment Program

Permit No. 1024 40 CFR 403

In Compliance with the Water & Sewer Authority of Cabarrus County (WSACC) Sewer Use Ordinance, North Carolina General Statute 143-215.1, other lawful standards and regulations promulgated and adopted by the North Carolina Environmental Management Commission, and WSACC, the following industry,

BFI WASTE SYSTEMS OF NORTH AMERICA, INC.
5105 MOREHEAD ROAD
HARRISBURG, N.C. 28075

is hereby authorized to discharge wastewater from a facility located at the above listed address into the sanitary sewer collection system and the wastewater treatment facility of WSACC listed below:

Rocky River Regional Wastewater Treatment Plant
NPDES No. NC0036269
6400 Breezy Lane
Concord, N.C. 28025

in accordance with effluent limitations, monitoring requirements, and other conditions set forth in Parts I, II, and III of this industrial user pretreatment permit (IUP). All such discharges shall be made at discharge locations approved in advance by WSACC.

This permit shall become effective January 1, 2000.

This permit and the authorization to discharge shall expire at midnight on December 31, 2004.

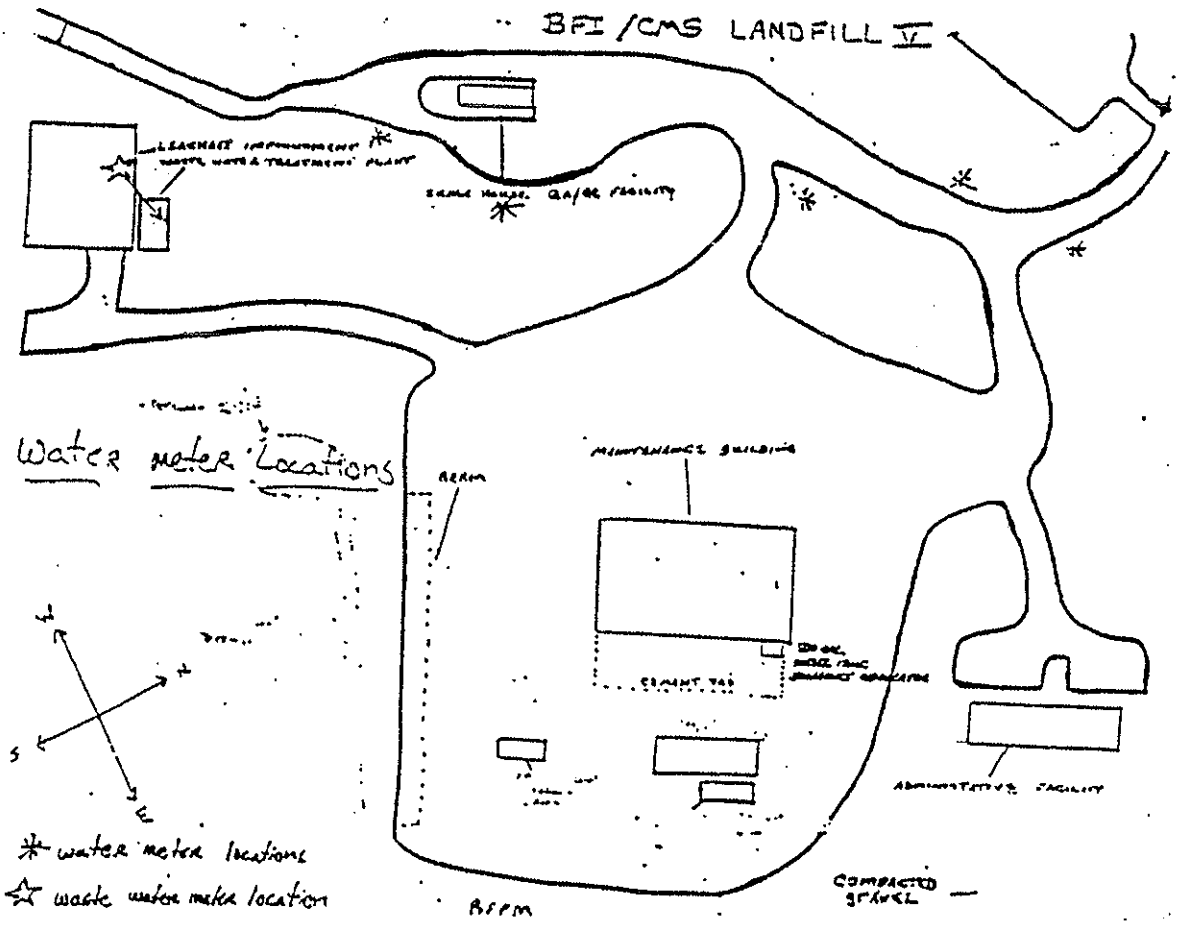
Signed this 24 day of November, 1999

Jay R. Shive
Facilities Operations Director

C. Description of Discharge

Pipe	Description
Pipe 01	Pretreated leachate from the landfill for municipal solid waste and wastewater from the electrical generating plant.
Pipe 02	Domestic sewage

* Pipe 02: Discharge at Pipe 02 of pollutants at levels above those associated with typical domestic sewage is prohibited. The discharge from this pipe may be monitored periodically and unannounced by WSACC to assess compliance. Should a requirement to use Pipe 02 for the discharge of process wastewater arise, a permit application must be submitted to WSACC and a new permit issued prior to any such discharge.


BFI/CMS LANDFILL V
Water meter Locations
BERM
MAINTENANCE BUILDING
CEMENT PAD
ADMINISTRATIVE FACILITY
COMPACTED GRAVEL
BERM
N
S
E
* water meter locations
☆ waste water meter location

E. Effluent Limits and Monitoring Requirements

Effective January 1, 2000 and lasting until midnight on December 31, 2004, the Permittee is authorized to discharge wastewater from pipe 01. This discharge shall be limited and monitored as specified below. Parameters and prohibitions not limited in this permit shall be regulated and limited in compliance with WSACC Sewer Use Ordinance and applicable federal categorical regulation.

	Effluent Limitation (lbs/day)		Monitoring Frequency		
Limited Parameter	Daily Maximum	Maximum Monthly Avg.	Sample Type	WSACC	BFI
FLOW		0.150 MGD	Continuous		Continuous
BOD	1385	923	Composite	Monthly	
COD	2273	1516	Composite	Monthly	
TSS	270	180	Composite	Monthly	
NH_3	38	25	Composite	Monthly	
CADMIUM	0.022	0.015	Composite	Monthly	
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NICKEL	0.11	0.07	Composite	Monthly	
ZINC	0.54	0.36	Composite	Monthly	
*pH			Grab	Monthly	
**PRIORITY POLLUTANT SCAN			Composite		Biannually

* Permittee's discharge pH shall not be less than 5.0 standard units nor greater than 10.0 standard units and shall be monitored as required by WSACC.

** A priority pollutant scan shall be conducted by the Permittee biannually, which means one sample per six months. WSACC may modify the frequency of the priority pollutant scan based upon the results.

F. Definitions and Limit Page notes:

In addition to the definitions in WSACC Sewer Use Ordinance, the following definitions apply:

1. Maximum Monthly Average:

The maximum monthly average discharge is the arithmetic mean of all the samples collected during a calendar month.

2. Daily Maximum:

The daily maximum discharge means the total discharge from all production periods during a 24 hour calendar day.

3. Continuous:

Continuous for the purpose of flow monitoring is defined as the measure of discharge flow from the facility which is documented in the form of permanent flow records and occurs without interruption.

4. DENR:

DENR means the Department of Environment and Natural Resources, State of North Carolina.

5. Composite Sample:

A 24 hour flow proportional composite sample which consists of a series of aliquots of equal volume collected from a representative point in the discharge stream over a 24 hour period with the time intervals between aliquots determined by a preset number of gallons passing through Pipe 01. Flow measurement between aliquot intervals shall be determined by the primary measuring device and wastewater meter, and the preset gallon interval between aliquot collection fixed at no greater than 1/24 of the expected total daily flow through Pipe 01.The volume of each aliquot shall be in direct proportion to the rate of flow during the time of collection.

6. Grab Sample:

A grab sample is defined as a single sample collected instantaneously at a representative point in the discharge stream.

7. Monthly Monitoring Frequency:

The monthly monitoring frequency shall mean composite or grab samples collected over four (4) consecutive discharge days per month at the designated monitoring site.

8. Biannually Monitoring Frequency:

The biannually monitoring frequency shall mean a composite sample collected from one discharge day per six months at the designated monitoring site. For the purposes of this IUP, the biannual periods of the year shall be January - June and July - December.

G. Flow Measurement and Monitoring Point:

1) The Permittee shall provide and operate monitoring facilities for the inspection, sampling and flow measurement of the Permittee's process wastewater discharges.

2) The approved wastewater meter shall be calibrated, at a minimum, once every six months by the manufacturer's authorized service representative.

3) The Permittee is responsible for the periodic maintenance and calibration of the meter and primary measuring device to assure accuracy. The Permittee shall, upon request of WSACC, furnish maintenance and calibration records.

4) There shall be interface capability with an Isco model sampler (contact closure); the Permittee shall purchase the interface line. WSACC shall take precedence; therefore, a splitter cable, purchased by the Permittee, will enable both WSACC and the Permittee to monitor at the same time and insure no interruption occurs in the Permittee's self-monitoring event.

5) The wastewater meter must have a non-resettable mechanical totalizer that reads in cubic feet or gallons.

6) If the wastewater meter is being used for billing or compliance, it must have permanent flow records (i.e. strip chart recordings) that include at minimum the following basic information: date, time, totalizer reading (with units), interval flow (with units), maximum flow rate (with units), primary measuring device type, and if there is a graph, a scale with units on both axis. Any interruption in such records is a violation of this permit and may result in a fine of at least $100.00 each day the interruption is allowed to continue.

7) Flow monitoring equipment and the sampling point shall be located in an area accessible to WSACC personnel without prior notification. WSACC must be supplied with any keys and/or other tools necessary to perform the aforementioned.

8) There shall be no by-pass capability of the wastewater metering devices and monitoring point(s). The Permittee is required, within thirty days after receipt of this permit, to deliver to WSACC certification that all process wastewaters discharged into WSACC's POTW, flow through pipe 01 as specified in Part I, C. of this permit.

9) The wastewater meter shall have a back-up power source (battery or generator) to insure uninterrupted measurement of the discharge flow in the event of a power failure. The back-up source shall provide power to the wastewater meter's sensor and permanent flow records for a minimum of 12 hours.

10) The Permittee shall maintain permanent flow records and maintenance and calibration records for a minimum of three years.

11) The daily wastewater meter readings shall be recorded in a binder which is to be located in the immediate area of the wastewater meter. A copy of these readings shall be submitted to WSACC by the second day of the following month.

PART II: GENERAL CONDITIONS

1. Representative Sampling:

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge. All samples shall be taken at the specified monitoring points, before the effluent joins or is diluted by any other wastestream. Monitoring points shall not be changed without notification to, and approval by, the permit issuing authority.

2. Reporting:

a. Monitoring results obtained by the Permittee from shall be summarized and reported on the Industrial Monitoring Report form or an approved form, postmarked no later than the last day of the month following the month in which the samples were taken. The chain of custody forms shall accompany all reports. If no discharge occurs during the reporting period, "no discharge" shall be reported. Copies of these and all other reports required herein shall be submitted to WSACC at the following address:

Attention: Industrial Pretreatment Coordinator
Water & Sewer Authority of Cabarrus County
6400 Breezy Lane
Concord, N.C. 28025

b. If the monitoring performed by the Permittee indicates a violation, the Permittee shall notify WSACC within 24 hours of becoming aware of the violation. The Permittee shall also repeat the sampling and analysis and submit the results of the repeat analysis to WSACC within thirty (30) days after becoming aware of the violation.

3. Test procedures:

Test procedures for the analysis of pollutants shall be performed in accordance with the techniques prescribed in 40 CFR 136 and amendments thereto (unless specified otherwise in the monitoring conditions of this permit) by a North Carolina Division of Environmental Management Certified Laboratory that is certified in the analysis of the pollutant in wastewater.

4. Additional Monitoring by Permittee:

If the Permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be submitted to WSACC. WSACC may require more frequent monitoring or the monitoring of other pollutants not required in this permit by written notification to the Permittee.

5. Recording Results:

For each measurement or sample taken pursuant to the requirements of this permit, the Permittee and/or WSACC shall record the following information:

a. laboratory reports shall include the following information:
   1. exact place, time, date of sampling;
   2. dates the analyses were performed;
   3. person(s) who performed the analyses;
   4. analytical techniques or methods used; and
   5. results of all required analyses.

b. chain of custodies shall contain the following information:
   1. sampling location(s);
   2. date(s) and time(s) sample taken;
   3. sample type: composite (time, flow, hand) or grab;
   4. container type;
   5. type of preservative used, if any;
   6. sample iced upon receipt;
   7. parameters to be run from that particular bottle;
   8. individual(s) who performed the sampling and/or field measurements; and
   9. samples relinquished/received by who and when (date & time)

6. Duty to Comply:

The Permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of WSACC Sewer Use Ordinance and is grounds for possible enforcement action, including, but not limited to, $10,000.00 Civil Penalty per occurrence.

7. Duty to Mitigate - Prevention of Adverse Impact:

The Permittee shall take all reasonable steps to prevent or minimize any discharge in violation of this permit which has the potential of adversely affecting human health, the sewer system, wastewater treatment plant, receiving waters, or environment, including such accelerated or additional monitoring necessary to determine the nature and impact of the non- complying discharge or installation of necessary pretreatment methods or devices which will insure compliance.

8. Facilities Operation, Bypass:

The Permittee shall at all times maintain in good working order and operate as efficiently as possible, all control facilities or systems installed or used by the Permittee to achieve compliance with the terms and conditions of this permit. Bypass of treatment facilities is prohibited except when approved in advance by WSACC. Bypass approval shall be given only when such bypass is in compliance with 40 CFR 403.17.

9. Removed Substances:

Solids, sludges, filter backwash or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in an approved manner such as to prevent any pollutants from such materials from entering the sewer system. The Permittee is responsible for assuring its compliance with any requirements regarding the generation, treatment, storage, and/or disposal of "hazardous waste" as defined under the Federal Resource Conservation and Recovery Act.

10. Upset Conditions:

An "upset" means an exceptional incident in which there is an unintentional and temporary noncompliance with the effluent limitations of this permit because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed or inadequate treatment facilities, lack of preventative maintenance, or careless or improper operations.

An upset may constitute an affirmative defense for action brought for the noncompliance. The Permittee has the burden of proof to provide evidence and demonstrate that none of the specifically listed above were responsible for the noncompliance.

11. Right of Entry:

The Permittee shall allow the staff of DENR, EPA, or WSACC and their authorized representatives, upon the presentation of credentials:

a. To enter upon the Permittee's premises where a real or potential discharge is located or in which records are required to be kept under the terms and conditions of this permit; and

b. At reasonable times to have access to and copy of records required to be kept under the terms and conditions of this permit; to inspect any monitoring method required in this permit; and to sample any discharge of pollutants.

12. Availability of Records and Reports:

The Permittee shall retain records of all monitoring information, including all calibration and maintenance records as well as copies of reports and information used to complete the application for this permit for at least three years or longer if requested in writing by WSACC. All records that pertain to matters that are subject to any type of enforcement action shall be retained and preserved by the Permittee until all enforcement activities have concluded and all periods of limitation with respect to any and all appeals have expired.

Except for data determined to be confidential under WSACC's Sewer Use Ordinance, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of WSACC. As required by the Sewer Use Ordinance, effluent data shall not be considered confidential.

13. Duty to Provide Information:

The Permittee shall furnish to WSACC, within a reasonable time, any information which WSACC or DENR may request to determine whether cause exists for modifying, revoking and reissuing, or terminating the permit or to determine compliance with this permit. The Permittee shall also furnish, upon request, copies of records required to be kept by this permit.

14. Signatory Requirements:

All reports or information submitted pursuant to the requirements of this permit must be signed and certified by a ranking official or duly authorized agent of the Permittee.

15. Toxic Pollutants:

If a toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 307(a) of the Federal Clean Water Act for a toxic pollutant which is present in the discharge and such standard or prohibition is more stringent than any limitation for such pollutant in this permit, this permit may be revised or modified in accordance with the toxic effluent standard or prohibition and the Permittee so notified.

16. Civil and Criminal Liability:

Nothing in this permit shall be construed to relieve the Permittee from civil or criminal penalties for noncompliance.

17. Federal, State and/or Local Laws:

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the Permittee from any responsibilities, liabilities or penalties established pursuant to any applicable Federal and/or State laws or regulations or WSACC's Sewer Use Ordinance.

18. Penalties:

The Sewer Use Ordinance of WSACC provides that any person who violates a permit condition is subject to a civil penalty not to exceed $10,000 dollars per day of such violation for as long as the violation(s) continues.

Under state law, (NCGS 143-215.6B), under certain circumstances it is a crime to violate terms, conditions, or requirements of pretreatment permits. It is a crime to knowingly make any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance. These crimes are enforced at the prosecutorial discretion of the local District Attorney.

19. Need to Halt or Reduce not a Defense:

It shall not be a defense for a Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity to maintain compliance with the conditions of the permit.

20. Transferability:

This permit shall not be reassigned or transferred or sold to a new owner, new user, different premises, or a new or changed operation without approval of WSACC.

21. Property Rights:

This permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations.

22. Severability:

The provisions of this permit are severable and, if any provision of this permit or the application of any provision of this permit to any circumstance is held invalid, the application of such provision to other circumstances and the remainder of this permit shall not be affected thereby.

23. Permit Modification, Revocation, Termination:

This permit may be modified, revoked and reissued or terminated with cause in accordance to the requirements of WSACC Sewer Use Ordinance and North Carolina General Statutes or implementing regulations.

24. Reapplication for Permit Renewal:

The Permittee is responsible for filing an application for reissuance of this permit at least 180 days prior to its expiration date.

25. Dilution Prohibition:

The Permittee shall not increase the use of potable or process water or in any other way attempt to dilute the discharge as a partial or complete substitute for adequate treatment to achieve compliance with the limitations contained in this permit.

26. Notification of Production Changes:

The Permittee shall give notice to WSACC 90 days prior to any facility expansion, production increase or decrease, or process modification which has the potential to result in new or substantially increased or decreased discharges or a change in the nature of the discharge. This shall also apply to any substantial changes in the relative proportions or dilution flow and regulated flow, whether increases or decreases. The Permittee shall not proceed with that facility expansion, production increase or process modification until WSACC has given permission.

27. Construction:

No construction of pretreatment facilities or additions thereto shall begin until Final Plans and Specifications have been submitted to WSACC and written approval and an Authorization to Construct have been issued

28. Categorical Standard Reopener:

This permit shall be modified, or alternatively, revoked and reissued to comply with any applicable effluent standard or limitation issued or approved under Sections 302(b)(2)(C) and (D), 304(b)(2), and 307(a)(2) of the Clean Water Act, if the effluent standard or limitation so issued or approved:

a. Contains different conditions or is otherwise more stringent than any effluent limitation in this permit; or
b. Controls any pollutant not limited in this permit.

The permit as modified or reissued under this paragraph shall also contain any other requirements of the Act then applicable.

29. General Prohibitive Standards:

The Permittee shall comply with the general prohibitive discharge standards in 40 CFR 403.5 (a) and (b) of the Federal pretreatment regulations.

30. Accidental Discharges and Slug Loads:

The Permittee shall provide protection from accidental and slug discharges of prohibited materials and other substances regulated by this permit. The Permittee shall develop a written slug/spill control plan and submit it to WSACC within 120 days of receipt of this permit for approval by WSACC. The plan shall include, but is not limited to: description of discharge practices; description of stored chemicals; procedures for immediately notifying WSACC of slug discharges that would cause a violation of 40 CFR 403.5(b), with procedures for notification within 5 days; and if necessary, procedures to prevent adverse impact from accidental spills, including inspection and maintenance of storage areas, handling and transfer of materials, loading and unloading operations, control of plant site run-off, worker training, building of containment structures or equipment, measures for containing toxic organic pollutants (including solvents), and/or measures and equipment for emergency response. A copy of this plan shall be submitted and received by WSACC by the implementation date.

The Permittee shall notify by telephone WSACC immediately of all discharges that could cause problems to the POTW including any slug loadings as defined by 40 CFR 403.5(b). If the Permittee experiences such a discharge, they shall contact WSACC immediately at (704) 788-4164 upon the first awareness of the commencement of the discharge. Should the Permittee be unable to speak with WSACC personnel upon calling the specified number, a message or the phone number where the Permittee can be reached may be left on WSACC's pager by calling (704) 789-6530. Notification shall include location of the discharge, type of waste, concentration and volume if known and corrective actions taken by the Permittee. The Permittee thereof shall file a written follow-up report within five (5) days, unless waived by WSACC. The report shall describe the cause of the discharge and measures taken to prevent similar future occurrences. Such written notification shall not relieve the Permittee from any liability, which may be incurred as a result of the discharge.

31. Excessive Scum and Foam:

Any materials which may cause excessive amounts of scum and/or foam that may interfere with the operation of the treatment plant or cause undue labor in connection with its operation, cause a violation of the NPDES permit, or cause toxicity is prohibited.

32. Biodegradable Substances:

All substances shall be biodegradable to the extent that it does not cause interference with or pass through of the treatment plant or noncompliance with the POTW permit in accordance with the design criteria of the treatment plant.

33. Concentration Limitation:

The Permittee shall not discharge any concentration of pollutant which has an adverse impact on the wastewater treatment plant facilities or operation.

34. Industrial Surcharges and Schedule of Payments:

a. Industrial sewer surcharges will be assessed and billed monthly in accordance with the limitations in and provisions adopted pursuant to Section 3.3 of WSACC Code (Sewer Use Ordinance) or as amended and shall be due as specified on the bill. The effluent limitations set forth in this pretreatment permit do not void any appropriate user charges (surcharges) adopted in accordance with Section 3.3.

b. Failure to pay all surcharges, fees, fines, and late fees in a timely manner may cause WSACC to initiate action to revoke the industrial user pretreatment permit.

c. Any discharge by the Permittee after revocation of the permit will be subject to a fine of $10,000 per day for as long as the discharge continues without a valid permit.

PART III. SPECIAL CONDITIONS

1. Completion of Wastewater Survey and Permit Application:

The Permittee was responsible for filing complete and accurate information for issuance of this renewed permit. Said information consisted of a wastewater survey and permit application dated 6/22/99. Should the Permittee determine that said information was incomplete and/or inaccurate in any manner, the Permittee shall notify WSACC immediately in writing. Such notice shall identify the information, which was incomplete and/or inaccurate and shall include the new complete and accurate information as well as an explanation of the impact of the new complete and accurate information on the existing permit.

2. Communication:

The Permittee is responsible for communicating all requirements and conditions of this permit to all applicable persons.

3. Alkyl Phenol Ethoxylates (APEs):

The discharge of compounds containing alkyl phenol ethoxylates (APEs) shall be prohibited, due to the inhibiting and toxic effect of APEs on the biological treatment at the wastewater treatment plant. Linear alcohol ethoxylates, a more readily biodegradable surfactant, may be substituted for APEs.

4. Permit Reopener:

The permit shall be reopened and modified or, alternatively, revoked and reissued to comply with any applicable effluent standard or limitation for the control of any pollutant shown through headworks analysis to contribute to interference, inhibition, pass through and/or toxicity at the POTW. Similarly, permit modification or reissuance shall be made for any pollutant that is otherwise limited by or appears on the POTW's NPDES discharge permit and/or is limited by 503 sludge regulations. The permit as modified or reissued under this paragraph may also contain any other requirements of State or Federal pretreatment regulations then applicable.

- and if necessary, procedures to prevent adverse impact from accidental spills, including inspection and maintenance of storage areas, handling and transfer of materials, loading and unloading operations, control of plant site run-off, worker training, building of containment structures or equipment, measures for containing toxic organic pollutants (including solvents), and/or measures and equipment for emergency response.

9. Sludge Management Plan:

Ninety (90) days after the effective date of this permit and prior to the disposal of any sludge generated from the pretreatment system, the Permittee shall submit a sludge management plan to WSACC.

10. Priority Pollutants:

Priority pollutants shall mean those substances as defined in CFR 40 Part 122, Appendix D. Once a priority pollutant database is established, WSACC will determine whether organic limitations are needed.

11. Solid Waste Permit:

The Permittee shall comply with all of the terms and conditions in the Solid Waste Permit issued by the North Carolina Department of Environment, Health and Natural Resources, Division of Solid Waste Management.

12. Permit Limitation Exceedance Response Plan:

This plan will describe the actions taken by BFI Waste Systems of North America (BFI) to respond to a situation where effluent from the BFI pretreatment plant fails to meet permit limitations over a period of time.

ACTION 1: Upon notification of a concern by WSACC, or upon BFI's detection of an elevated parameter, BFI will resample leachate on two consecutive days and have analyzed for the parameter(s) of concern. Analytical turnaround time is generally in the 7-14 day range for organic compounds, 2-3 days for metals and 5-7 days for BOD. The resampling is done to attempt to verify if the excursion was a laboratory error, an anomaly or if there is a trend of noncompliance with a pretreatment standard.

ACTION 2: If the duplicate analytical data indicates an excursion, BFI will schedule a meeting with representatives of WSACC within 48 hours to discuss the results and possible alternatives. Some possible interim alternatives include:

a. batch treat and test pond contents prior to release

b. tank truck to alternate facility

c. recycle leachate to landfill on temporary basis

d. increase aeration

f. add or change polymers

g. adjust retention time

ACTION 3: Determine corrective action. If additional treatment processes are deemed necessary (e.g. carbon adsorption canisters, sand filtration), select vendor, perform pilot testing as necessary and install equipment. At this time a schedule of compliance will be developed and submitted to WSACC.

ACTION 4: Implement and monitor for compliance.

APPENDIX 4

INDUSTRIAL USER PRETREATMENT PERMIT NO. 1024
ISSUED TO BFI WASTE SYSTEMS OF NORTH AMERICA, Inc.
ISSUED BY WATER & SEWER AUTHORITY OF CABARRUS COUNTY, NORTH CAROLINA

November 29, 1999

WSACC

WATER & SEWER AUTHORITY OF CABARRUS CO.

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Tricia Phillips
District Manager, Environment, Safety & Health
BFI Waste Systems of North America
5105 Morehead Road
Harrisburg, N.C. 28075

SUBJECT: INDUSTRIAL USER PRETREATMENT PERMIT NO. 1024

Dear Ms. Phillips:

Please find the enclosed industrial user pretreatment permit (IUP) no. 1024 issued in response to your Industrial User Wastewater Survey and Permit Application which was received by the Water and Sewer Authority of Cabarrus County (WSACC) on July 1, 1999. This permit is issued pursuant to the requirements of North Carolina General Statute 143.215.1 and WSACC's Sewer Use Ordinance.

Please review the IUP and all the conditions contained therein. If no comments or objections are filed by you or the State with the Executive Director within thirty (30) days following receipt of this letter, the IUP becomes final and binding.

If you have any questions concerning BFI Waste System's IUP, please contact Beverly Metcalf, Industrial Pretreatment Coordinator, at 788-4164, ext. 12.

Sincerely,

Jay R. Shive
Facilities Operations Director

JRS:BKM:tmg

cc: John C. Murdock, III
Mark Fowler

Enclosure

232 Davidson Hwy
P.O. Box 428
Concord NC
28026-0428
Ph 704.786.1783
Fx 704.786.5205

WATER AND SEWER AUTHORITY
OF CABARRUS COUNTY
Concord, North Carolina

PERMIT

Industrial User Pretreatment Permit(IUP)
To Discharge Wastewater Under the
Industrial Pretreatment Program

Permit No. 1024 40 CFR 403

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Signed this 24 day of November, 1999

Jay R. Shive
Facilities Operations Director

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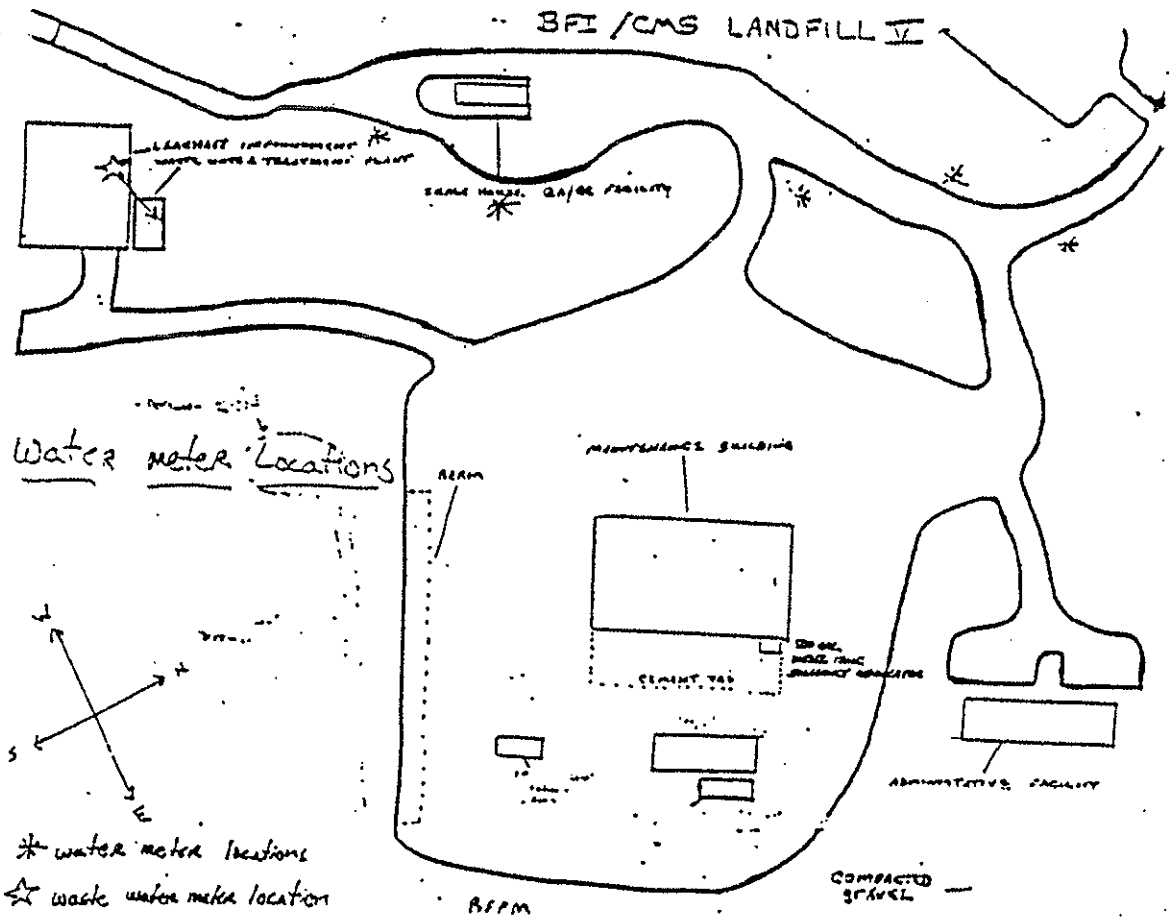
BFI/CMS LANDFILL V
Water meter Locations
MAINTENANCE BUILDING
BERM
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**PRIORITY POLLUTANT SCAN			Composite		Biannually

* Permittee's discharge pH shall not be less than 5.0 standard units nor greater than 10.0 standard units and shall be monitored as required by WSACC.

** A priority pollutant scan shall be conducted by the Permittee biannually, which means one sample per six months. WSACC may modify the frequency of the priority pollutant scan based upon the results.

F. Definitions and Limit Page notes:

In addition to the definitions in WSACC Sewer Use Ordinance, the following definitions apply:

1. Maximum Monthly Average:

The maximum monthly average discharge is the arithmetic mean of all the samples collected during a calendar month.

2. Daily Maximum:

The daily maximum discharge means the total discharge from all production periods during a 24 hour calendar day.

3. Continuous:

Continuous for the purpose of flow monitoring is defined as the measure of discharge flow from the facility which is documented in the form of permanent flow records and occurs without interruption.

4. DENR:

DENR means the Department of Environment and Natural Resources, State of North Carolina.

5. Composite Sample:

A 24 hour flow proportional composite sample which consists of a series of aliquots of equal volume collected from a representative point in the discharge stream over a 24 hour period with the time intervals between aliquots determined by a preset number of gallons passing through Pipe 01. Flow measurement between aliquot intervals shall be determined by the primary measuring device and wastewater meter, and the preset gallon interval between aliquot collection fixed at no greater than 1/24 of the expected total daily flow through Pipe 01.The volume of each aliquot shall be in direct proportion to the rate of flow during the time of collection.

6. Grab Sample:

A grab sample is defined as a single sample collected instantaneously at a representative point in the discharge stream.

7. Monthly Monitoring Frequency:

The monthly monitoring frequency shall mean composite or grab samples collected over four (4) consecutive discharge days per month at the designated monitoring site.

8. Biannually Monitoring Frequency:

The biannually monitoring frequency shall mean a composite sample collected from one discharge day per six months at the designated monitoring site. For the purposes of this IUP, the biannual periods of the year shall be January - June and July - December.

G. Flow Measurement and Monitoring Point:

1) The Permittee shall provide and operate monitoring facilities for the inspection, sampling and flow measurement of the Permittee's process wastewater discharges.

2) The approved wastewater meter shall be calibrated, at a minimum, once every six months by the manufacturer's authorized service representative.

3) The Permittee is responsible for the periodic maintenance and calibration of the meter and primary measuring device to assure accuracy. The Permittee shall, upon request of WSACC, furnish maintenance and calibration records.

4) There shall be interface capability with an Isco model sampler (contact closure); the Permittee shall purchase the interface line. WSACC shall take precedence; therefore, a splitter cable, purchased by the Permittee, will enable both WSACC and the Permittee to monitor at the same time and insure no interruption occurs in the Permittee's self-monitoring event.

5) The wastewater meter must have a non-resettable mechanical totalizer that reads in cubic feet or gallons.

6) If the wastewater meter is being used for billing or compliance, it must have permanent flow records (i.e. strip chart recordings) that include at minimum the following basic information: date, time, totalizer reading (with units), interval flow (with units), maximum flow rate (with units), primary measuring device type, and if there is a graph, a scale with units on both axis. Any interruption in such records is a violation of this permit and may result in a fine of at least $100.00 each day the interruption is allowed to continue.

7) Flow monitoring equipment and the sampling point shall be located in an area accessible to WSACC personnel without prior notification. WSACC must be supplied with any keys and/or other tools necessary to perform the aforementioned.

8) There shall be no by-pass capability of the wastewater metering devices and monitoring point(s). The Permittee is required, within thirty days after receipt of this permit, to deliver to WSACC certification that all process wastewaters discharged into WSACC's POTW, flow through pipe 01 as specified in Part I, C. of this permit.

9) The wastewater meter shall have a back-up power source (battery or generator) to insure uninterrupted measurement of the discharge flow in the event of a power failure. The back-up source shall provide power to the wastewater meter's sensor and permanent flow records for a minimum of 12 hours.

10) The Permittee shall maintain permanent flow records and maintenance and calibration records for a minimum of three years.

11) The daily wastewater meter readings shall be recorded in a binder which is to be located in the immediate area of the wastewater meter. A copy of these readings shall be submitted to WSACC by the second day of the following month.

PART II: GENERAL CONDITIONS

1. Representative Sampling:

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge. All samples shall be taken at the specified monitoring points, before the effluent joins or is diluted by any other wastestream. Monitoring points shall not be changed without notification to, and approval by, the permit issuing authority.

2. Reporting:

a. Monitoring results obtained by the Permittee from shall be summarized and reported on the Industrial Monitoring Report form or an approved form, postmarked no later than the last day of the month following the month in which the samples were taken. The chain of custody forms shall accompany all reports. If no discharge occurs during the reporting period, "no discharge" shall be reported. Copies of these and all other reports required herein shall be submitted to WSACC at the following address:

Attention: Industrial Pretreatment Coordinator
Water & Sewer Authority of Cabarrus County
6400 Breezy Lane
Concord, N.C. 28025

b. If the monitoring performed by the Permittee indicates a violation, the Permittee shall notify WSACC within 24 hours of becoming aware of the violation. The Permittee shall also repeat the sampling and analysis and submit the results of the repeat analysis to WSACC within thirty (30) days after becoming aware of the violation.

3. Test procedures:

Test procedures for the analysis of pollutants shall be performed in accordance with the techniques prescribed in 40 CFR 136 and amendments thereto (unless specified otherwise in the monitoring conditions of this permit) by a North Carolina Division of Environmental Management Certified Laboratory that is certified in the analysis of the pollutant in wastewater.

4. Additional Monitoring by Permittee:

If the Permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be submitted to WSACC. WSACC may require more frequent monitoring or the monitoring of other pollutants not required in this permit by written notification to the Permittee.

5. Recording Results:

For each measurement or sample taken pursuant to the requirements of this permit, the Permittee and/or WSACC shall record the following information:

a. laboratory reports shall include the following information:
   1. exact place, time, date of sampling;
   2. dates the analyses were performed;
   3. person(s) who performed the analyses;
   4. analytical techniques or methods used; and
   5. results of all required analyses.

b. chain of custodies shall contain the following information:
   1. sampling location(s);
   2. date(s) and time(s) sample taken;
   3. sample type: composite (time, flow, hand) or grab;
   4. container type;
   5. type of preservative used, if any;
   6. sample iced upon receipt;
   7. parameters to be run from that particular bottle;
   8. individual(s) who performed the sampling and/or field measurements; and
   9. samples relinquished/received by who and when (date & time)

6. Duty to Comply:

The Permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of WSACC Sewer Use Ordinance and is grounds for possible enforcement action, including, but not limited to, $10,000.00 Civil Penalty per occurrence.

7. Duty to Mitigate - Prevention of Adverse Impact:

The Permittee shall take all reasonable steps to prevent or minimize any discharge in violation of this permit which has the potential of adversely affecting human health, the sewer system, wastewater treatment plant, receiving waters, or environment, including such accelerated or additional monitoring necessary to determine the nature and impact of the non- complying discharge or installation of necessary pretreatment methods or devices which will insure compliance.

8. Facilities Operation, Bypass:

The Permittee shall at all times maintain in good working order and operate as efficiently as possible, all control facilities or systems installed or used by the Permittee to achieve compliance with the terms and conditions of this permit. Bypass of treatment facilities is prohibited except when approved in advance by WSACC. Bypass approval shall be given only when such bypass is in compliance with 40 CFR 403.17.

9. Removed Substances:

Solids, sludges, filter backwash or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in an approved manner such as to prevent any pollutants from such materials from entering the sewer system. The Permittee is responsible for assuring its compliance with any requirements regarding the generation, treatment, storage, and/or disposal of "hazardous waste" as defined under the Federal Resource Conservation and Recovery Act.

10. Upset Conditions:

An "upset" means an exceptional incident in which there is an unintentional and temporary noncompliance with the effluent limitations of this permit because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed or inadequate treatment facilities, lack of preventative maintenance, or careless or improper operations.

An upset may constitute an affirmative defense for action brought for the noncompliance. The Permittee has the burden of proof to provide evidence and demonstrate that none of the specifically listed above were responsible for the noncompliance.

11. Right of Entry:

The Permittee shall allow the staff of DENR, EPA, or WSACC and their authorized representatives, upon the presentation of credentials:

a. To enter upon the Permittee's premises where a real or potential discharge is located or in which records are required to be kept under the terms and conditions of this permit; and

b. At reasonable times to have access to and copy of records required to be kept under the terms and conditions of this permit; to inspect any monitoring method required in this permit; and to sample any discharge of pollutants.

12. Availability of Records and Reports:

The Permittee shall retain records of all monitoring information, including all calibration and maintenance records as well as copies of reports and information used to complete the application for this permit for at least three years or longer if requested in writing by WSACC. All records that pertain to matters that are subject to any type of enforcement action shall be retained and preserved by the Permittee until all enforcement activities have concluded and all periods of limitation with respect to any and all appeals have expired.

Except for data determined to be confidential under WSACC's Sewer Use Ordinance, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of WSACC. As required by the Sewer Use Ordinance, effluent data shall not be considered confidential.

13. Duty to Provide Information:

The Permittee shall furnish to WSACC, within a reasonable time, any information which WSACC or DENR may request to determine whether cause exists for modifying, revoking and reissuing, or terminating the permit or to determine compliance with this permit. The Permittee shall also furnish, upon request, copies of records required to be kept by this permit.

14. Signatory Requirements:

All reports or information submitted pursuant to the requirements of this permit must be signed and certified by a ranking official or duly authorized agent of the Permittee.

15. Toxic Pollutants:

If a toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 307(a) of the Federal Clean Water Act for a toxic pollutant which is present in the discharge and such standard or prohibition is more stringent than any limitation for such pollutant in this permit, this permit may be revised or modified in accordance with the toxic effluent standard or prohibition and the Permittee so notified.

16. Civil and Criminal Liability:

Nothing in this permit shall be construed to relieve the Permittee from civil or criminal penalties for noncompliance.

17. Federal, State and/or Local Laws:

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the Permittee from any responsibilities, liabilities or penalties established pursuant to any applicable Federal and/or State laws or regulations or WSACC's Sewer Use Ordinance.

18. Penalties:

The Sewer Use Ordinance of WSACC provides that any person who violates a permit condition is subject to a civil penalty not to exceed $10,000 dollars per day of such violation for as long as the violation(s) continues.

Under state law, (NCGS 143-215.6B), under certain circumstances it is a crime to violate terms, conditions, or requirements of pretreatment permits. It is a crime to knowingly make any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance. These crimes are enforced at the prosecutorial discretion of the local District Attorney.

19. Need to Halt or Reduce not a Defense:

It shall not be a defense for a Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity to maintain compliance with the conditions of the permit.

20. Transferability:

This permit shall not be reassigned or transferred or sold to a new owner, new user, different premises, or a new or changed operation without approval of WSACC.

21. Property Rights:

This permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations.

22. Severability:

The provisions of this permit are severable and, if any provision of this permit or the application of any provision of this permit to any circumstance is held invalid, the application of such provision to other circumstances and the remainder of this permit shall not be affected thereby.

23. Permit Modification, Revocation, Termination:

This permit may be modified, revoked and reissued or terminated with cause in accordance to the requirements of WSACC Sewer Use Ordinance and North Carolina General Statutes or implementing regulations.

24. Reapplication for Permit Renewal:

The Permittee is responsible for filing an application for reissuance of this permit at least 180 days prior to its expiration date.

25. Dilution Prohibition:

The Permittee shall not increase the use of potable or process water or in any other way attempt to dilute the discharge as a partial or complete substitute for adequate treatment to achieve compliance with the limitations contained in this permit.

26. Notification of Production Changes:

The Permittee shall give notice to WSACC 90 days prior to any facility expansion, production increase or decrease, or process modification which has the potential to result in new or substantially increased or decreased discharges or a change in the nature of the discharge. This shall also apply to any substantial changes in the relative proportions or dilution flow and regulated flow, whether increases or decreases. The Permittee shall not proceed with that facility expansion, production increase or process modification until WSACC has given permission.

27. Construction:

No construction of pretreatment facilities or additions thereto shall begin until Final Plans and Specifications have been submitted to WSACC and written approval and an Authorization to Construct have been issued

28. Categorical Standard Reopener:

This permit shall be modified, or alternatively, revoked and reissued to comply with any applicable effluent standard or limitation issued or approved under Sections 302(b)(2)(C) and (D), 304(b)(2), and 307(a)(2) of the Clean Water Act, if the effluent standard or limitation so issued or approved:

a. Contains different conditions or is otherwise more stringent than any effluent limitation in this permit; or
b. Controls any pollutant not limited in this permit.

The permit as modified or reissued under this paragraph shall also contain any other requirements of the Act then applicable.

29. General Prohibitive Standards:

The Permittee shall comply with the general prohibitive discharge standards in 40 CFR 403.5 (a) and (b) of the Federal pretreatment regulations.

30. Accidental Discharges and Slug Loads:

The Permittee shall provide protection from accidental and slug discharges of prohibited materials and other substances regulated by this permit. The Permittee shall develop a written slug/spill control plan and submit it to WSACC within 120 days of receipt of this permit for approval by WSACC. The plan shall include, but is not limited to: description of discharge practices; description of stored chemicals; procedures for immediately notifying WSACC of slug discharges that would cause a violation of 40 CFR 403.5(b), with procedures for notification within 5 days; and if necessary, procedures to prevent adverse impact from accidental spills, including inspection and maintenance of storage areas, handling and transfer of materials, loading and unloading operations, control of plant site run-off, worker training, building of containment structures or equipment, measures for containing toxic organic pollutants (including solvents), and/or measures and equipment for emergency response. A copy of this plan shall be submitted and received by WSACC by the implementation date.

The Permittee shall notify by telephone WSACC immediately of all discharges that could cause problems to the POTW including any slug loadings as defined by 40 CFR 403.5(b). If the Permittee experiences such a discharge, they shall contact WSACC immediately at (704) 788-4164 upon the first awareness of the commencement of the discharge. Should the Permittee be unable to speak with WSACC personnel upon calling the specified number, a message or the phone number where the Permittee can be reached may be left on WSACC's pager by calling (704) 789-6530. Notification shall include location of the discharge, type of waste, concentration and volume if known and corrective actions taken by the Permittee. The Permittee thereof shall file a written follow-up report within five (5) days, unless waived by WSACC. The report shall describe the cause of the discharge and measures taken to prevent similar future occurrences. Such written notification shall not relieve the Permittee from any liability, which may be incurred as a result of the discharge.

31. Excessive Scum and Foam:

Any materials which may cause excessive amounts of scum and/or foam that may interfere with the operation of the treatment plant or cause undue labor in connection with its operation, cause a violation of the NPDES permit, or cause toxicity is prohibited.

32. Biodegradable Substances:

All substances shall be biodegradable to the extent that it does not cause interference with or pass through of the treatment plant or noncompliance with the POTW permit in accordance with the design criteria of the treatment plant.

33. Concentration Limitation:

The Permittee shall not discharge any concentration of pollutant which has an adverse impact on the wastewater treatment plant facilities or operation.

34. Industrial Surcharges and Schedule of Payments:

a. Industrial sewer surcharges will be assessed and billed monthly in accordance with the limitations in and provisions adopted pursuant to Section 3.3 of WSACC Code (Sewer Use Ordinance) or as amended and shall be due as specified on the bill. The effluent limitations set forth in this pretreatment permit do not void any appropriate user charges (surcharges) adopted in accordance with Section 3.3.

b. Failure to pay all surcharges, fees, fines, and late fees in a timely manner may cause WSACC to initiate action to revoke the industrial user pretreatment permit.

c. Any discharge by the Permittee after revocation of the permit will be subject to a fine of $10,000 per day for as long as the discharge continues without a valid permit.

PART III. SPECIAL CONDITIONS

1. Completion of Wastewater Survey and Permit Application:

The Permittee was responsible for filing complete and accurate information for issuance of this renewed permit. Said information consisted of a wastewater survey and permit application dated 6/22/99. Should the Permittee determine that said information was incomplete and/or inaccurate in any manner, the Permittee shall notify WSACC immediately in writing. Such notice shall identify the information, which was incomplete and/or inaccurate and shall include the new complete and accurate information as well as an explanation of the impact of the new complete and accurate information on the existing permit.

2. Communication:

The Permittee is responsible for communicating all requirements and conditions of this permit to all applicable persons.

3. Alkyl Phenol Ethoxylates (APEs):

The discharge of compounds containing alkyl phenol ethoxylates (APEs) shall be prohibited, due to the inhibiting and toxic effect of APEs on the biological treatment at the wastewater treatment plant. Linear alcohol ethoxylates, a more readily biodegradable surfactant, may be substituted for APEs.

4. Permit Reopener:

The permit shall be reopened and modified or, alternatively, revoked and reissued to comply with any applicable effluent standard or limitation for the control of any pollutant shown through headworks analysis to contribute to interference, inhibition, pass through and/or toxicity at the POTW. Similarly, permit modification or reissuance shall be made for any pollutant that is otherwise limited by or appears on the POTW's NPDES discharge permit and/or is limited by 503 sludge regulations. The permit as modified or reissued under this paragraph may also contain any other requirements of State or Federal pretreatment regulations then applicable.

- and if necessary, procedures to prevent adverse impact from accidental spills, including inspection and maintenance of storage areas, handling and transfer of materials, loading and unloading operations, control of plant site run-off, worker training, building of containment structures or equipment, measures for containing toxic organic pollutants (including solvents), and/or measures and equipment for emergency response.

9. Sludge Management Plan:

Ninety (90) days after the effective date of this permit and prior to the disposal of any sludge generated from the pretreatment system, the Permittee shall submit a sludge management plan to WSACC.

10. Priority Pollutants:

Priority pollutants shall mean those substances as defined in CFR 40 Part 122, Appendix D. Once a priority pollutant database is established, WSACC will determine whether organic limitations are needed.

11. Solid Waste Permit:

The Permittee shall comply with all of the terms and conditions in the Solid Waste Permit issued by the North Carolina Department of Environment, Health and Natural Resources, Division of Solid Waste Management.

12. Permit Limitation Exceedance Response Plan:

This plan will describe the actions taken by BFI Waste Systems of North America (BFI) to respond to a situation where effluent from the BFI pretreatment plant fails to meet permit limitations over a period of time.

ACTION 1: Upon notification of a concern by WSACC, or upon BFI's detection of an elevated parameter, BFI will resample leachate on two consecutive days and have analyzed for the parameter(s) of concern. Analytical turnaround time is generally in the 7-14 day range for organic compounds, 2-3 days for metals and 5-7 days for BOD. The resampling is done to attempt to verify if the excursion was a laboratory error, an anomaly or if there is a trend of noncompliance with a pretreatment standard.

ACTION 2: If the duplicate analytical data indicates an excursion, BFI will schedule a meeting with representatives of WSACC within 48 hours to discuss the results and possible alternatives. Some possible interim alternatives include:

a. batch treat and test pond contents prior to release

b. tank truck to alternate facility

c. recycle leachate to landfill on temporary basis

d. increase aeration

f. add or change polymers

g. adjust retention time

ACTION 3: Determine corrective action. If additional treatment processes are deemed necessary (e.g. carbon adsorption canisters, sand filtration), select vendor, perform pilot testing as necessary and install equipment. At this time a schedule of compliance will be developed and submitted to WSACC.

ACTION 4: Implement and monitor for compliance.

VI. OPERATION PLAN

OPERATION PLAN

CHARLOTTE MOTOR SPEEDWAY LANDFILL V
PHASE 3 PERMIT TO CONSTRUCT
CITY OF CONCORD, NORTH CAROLINA

FOR

REPUBLIC SERVICES OF SOUTH CAROLINA, LLC

MAY 2009

NORTH CAROLINA PROFESSIONAL SEAL 16146 ENGINEER WILLIAM F. HODGES 4/30/09

NORTH CAROLINA PROFESSIONAL SEAL 32249 ENGINEER K. MATTHEW CHEEK 4/30/09

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OPERATION PLAN

CHARLOTTE MOTOR SPEEDWAY LANDFILL V - PHASE 3

FOR

REPUBLIC SERVICES OF SOUTH CAROLINA, LLC
CITY OF CONCORD, NORTH CAROLINA

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1.0 LANDFILL OPERATIONS AND MAINTENANCE

Charlotte Motor Speedway Landfill V is owned and operated by Republic Services of South Carolina, LLC. Operation and maintenance of the facility is the responsibility of the Facility Manager. The Operational Manager is responsible for operation and maintenance of the landfill. The facility is located on property owned by Republic Services of South Carolina, LLC within the City Limits of Concord, North Carolina.

In accordance with Rule .1625 of the North Carolina Division of Waste Management Rules, an Operation Plan is required along with drawings to describe the existing site conditions, progression of operations, leachate and storm water controls, special waste areas, buffer zones and borrow areas. The Engineering Plans are included in Section X. of this document and include:

Site Development Plan - shows existing conditions, existing structures and buffer zones.

Phasing Plans for Phase 3 (Cells No. 2I, 2J, 2K and 2M) - shows the progression of Cell development and operations.

Phase 3 Leachate and Storm Water Controls Including Details.

1.1 Landfill Cell Sequencing

The initial Phase of construction and landfill development includes the continuation of Phase 2, specifically Cells No. 2I, 2J, 2K and 2M. Following the Phase 3 Development, Phase 4 and Phase 5 shall be developed in order. Phasing plans depicting the development of the Cells in Phase 3 are included in Section X. and show the progression of landfilling operations.

Once the facility receives a permit to operate each Cell in Phase 3 (2I, 2J, 2K and 2M), operations will begin on the east side of the Cell thereby activating the east sump for leachate collection. During operations on the east side, the western sump may still be treated as clean storm water and not enter the leachate collection system. Once the first waste lift is across the east side of the Cell, the west side will be activated for leachate collection and waste placement.

Perimeter berms shall be constructed along the proposed cell limits. In areas where further landfill development is proposed, a temporary berm will be constructed to contain leachate within the cell limits but allow for an efficient "tie-in" to future cells. Details of the perimeter and temporary berms are shown in the Engineering Plans.

1.2 Storm Water Management

An erosion and sedimentation control plan has been designed for the construction, operation and closure of Phase 3. Plans for Phases 4 and 5 will be developed at a later date once base grades and footprints have been firmly established. Based on a 25-year,

24-hour storm for this area, storm water runoff conveyances and devices were designed for the peak: flow condition (construction, operations or closure). Stabilized channels will intercept storm water runoff and direct flow to sediment basins. The sediment basins will allow sediment to settle to the floor of the basin, then allowing controlled discharge of storm water to receiving waters.

During landfilling operations, the waste and daily cover shall be sloped to promote drainage away from the landfill. The subsequent runoff shall be intercepted by the erosion and sedimentation control devices and routed through the sediment basins.

Proposed grading for Phases 4 and 5 has not been finalized due to on-going water level measurements throughout the Phase footprints. Storm water segregation within Cell footprints may be necessary within these Phases if final base grades warrant.

During landfilling operations, the waste and daily cover shall be sloped to promote drainage away from the landfill. The subsequent runoff shall be intercepted by the erosion and sedimentation control devices and routed through the sediment basins.

1.3 Leachate Management

A leachate collection system will be constructed above the composite liner system in each Cell. The leachate collection system will consist of a geocomposite drainage media that rests on the 60-mil high density polyethylene liner to collect and transport leachate along the Cell floor. A leachate header line will transport the collected leachate to the sump area for each Cell. At each sump area, a stainless steel pump will rest on the Cell floor housed in a high density polyethylene side-slope riser pipe to remove leachate from within the Cell and transport into the leachate transmission system. A high density polyethylene transmission pipe along with a series of manholes and lift stations shall transport leachate from each Cell to the on-site Pre-treatment Facility Storage Lagoon.

The leachate collection and removal system is designed so that no more than 12-inches of hydraulic head will act on the liner system during normal operating conditions. Cleanouts will be installed at the ends of the header pipes to provide necessary flushing of the system for maintenance as needed.

During the design of Cells No. 2I, 2J, 2K and 2M, the "HELP" model was used to generate leachate quantities for various stages of operation throughout this Phase. The results of this modeling can be found in Section VII. Design Calculations of this report.

In order to evaluate historically high leachate generation rates, actual discharged amounts from 2003 are analyzed since 2003 was recorded still, even five years later as the "fifth wettest" year on record for this region. Beginning December 1, 2002 and ending December 31, 2003, Charlotte Motor Speedway Landfill V discharged a total of 6,387,747 gallons of pretreated leachate to the Rocky River Waste Water Treatment Plant. This volume equates to an average daily discharge rate of 16,130 gallons.

1.4 Placement of Waste and Cover Requirements

Waste placement shall proceed beginning with Cell No. 2I and proceed further into Cells No. 2J, 2K and 2M. Following filling of the Phase 3 area, operations will continue into Phase 4 followed by Phases 5. Initial waste placement in the Phase 3 Cells will begin in Cell No. 2I. Waste shall be placed so that standing water is not created behind the fill areas.

Barrels and drums shall not be disposed of unless they are verified to be empty and perforated sufficiently to ensure that no free liquids or hazardous waste is included within. This does not include household waste in small containers of original packaging.

Charlotte Motor Speedway Landfill V maintains a waste screening program at the facility for detection and prevention of unauthorized waste (hazardous, free liquids) for disposal. This program consists of performing random inspections of incoming waste. These inspections are performed on a daily basis for the various haulers entering the facility. A designated screening inspector shall perform the random inspection near the working face of the landfill within the containment limits.

The load chosen for inspection shall be directed to unload at a relatively flat area near the working face. The screening inspector shall sort through the unloaded waste using a loader, backhoe or similar available equipment to spread the load in a thin lift across the designated inspection area. Hand raking and shoveling may be necessary in order to spread the load sufficiently. Once the waste is spread thin enough to observe the entire load, the inspector shall record the contents of the load and complete the "Detailed Screening Report and Waste Screening Checklist for recordation.

If free liquid or hazardous wastes are not observed, the waste will be disposed of at the nearby working face following inspection. If hazardous waste is identified, the inspector shall immediately notify the Site Manager and the Charlotte Motor Speedway Landfill V hazardous materials emergency response team shall be notified. If non-hazardous liquid waste is observed, it shall be contained within the inspection area and either solidified using absorbent or containerized. The solidified or containerized waste shall be disposed of at an appropriate facility. If hazardous waste is encountered, the hazardous materials response team shall determine appropriate handling, containerizing, transporting and disposal at an approved facility for hazardous waste.

Records of inspections shall be kept in a separate screening or inspections file and maintained at the facility at all times. Sample forms for performing and documentation of inspections are attached with this Facility Plan. Facility personnel performing the inspections shall be adequately trained for identification of hazardous and liquid waste through programs offered by the Solid Waste Association of North America (SWANA) or North Carolina Department of Environment and Natural Resources (NCDENR).

The facility operator shall notify the Solid Waste Section within 24 hours of attempting to dispose of waste products not approved for disposal at the facility. No hazardous, liquid

or infectious waste shall be accepted and disposed of in the landfill. A copy of the Waste Screening Form is included in Appendix 5 of this plan for reference.

1.5 Waste Acceptance and Disposal

As defined by the State of North Carolina 15A NCAC 13B.1602, Charlotte Motor Speedway Landfill V will accept waste types defined as Commercial Solid Waste, Household Waste, Construction & Demolition Debris and Industrial Solid Waste. Generally, waste acceptance criteria shall remain as in place for current and on-going operations.

Currently, non-hazardous liquid wastes are accepted at the facility and directed to the Solidification Facility. This is a Solid Waste Section permitted Demonstration Project (last modified December 30, 1999) activity requiring the solidification of non-hazardous liquid waste using reagents prior to disposal in the landfill. The Paint Filter Test (EPA Method 9095) is the passing criteria for solidification of liquid waste prior to disposal. A copy of the Operations Plan for Solidification Facility is included in Appendix 2 of this Plan.

The Charlotte Motor Speedway Landfill V Facility also accepts petroleum contaminated soils for disposal or use as daily cover. This is a Solid Waste Section permitted Pilot Demonstration activity (February 5, 2004) at the Facility accepting soils that do not exceed a petroleum based concentration of 3,000 parts per million (ppm). A copy of the Operations Plan for Petroleum Contaminated Soils for Use as Alternate Daily Cover is included in Appendix 1 of this Plan.

Automobile shredder fluff is also accepted at this facility and used as a reagent for solidification operations and mixed with soil for daily cover. This is a Solid Waste Section permitted activity for the Facility as a Demonstration Project (February 5, 2004). A copy of the Solid Waste Section approval is included in Appendix 3 of this Plan.

The landfill owner or operator shall notify the Solid Waste Section within 24 hours of attempted disposal of any waste the landfill is not permitted to receive, including waste from beyond the approved service area. No hazardous, liquid or infectious waste shall be accepted at the facility for disposal. Waste prohibited for disposal include those hazardous wastes defined in 15A NCAC 13A (including hazardous waste from conditionally exempt small quantity generators), polychlorinated biphenyls as defined in 40 CFR 761, septic waste, waste oil or any waste that is determined to contain "free liquids" as defined by EPA Method 9095 (Paint Filter Liquids Test), S.W. 846 except as noted below.

Bulk or non-containerized liquid waste shall not be disposed of in the landfill unless the waste is a household waste other than septic waste or waste oil or the waste is leachate or gas condensate from the landfill facility. Containers holding liquid waste may not be disposed of in the landfill unless the container is a small container similar in size to that normally found in household waste, the container is designed to hold liquids for use other than storage or the waste is a household waste.

Management and disposal of asbestos shall be in accordance with 40 CFR 61. Asbestos shall be disposed of at the landfill at the bottom of the working face, separate from other waste, and immediately covered with soil.

Non-regulated medical waste may be disposed of within general solid waste disposal guidelines. All sharps that are either broken or intact shall be placed in a sealed, puncture proof container prior to disposal.

Spoiled foods, animal carcasses, abattoir waste, hatchery waste and other animal waste delivered to the disposal site shall be covered with soil immediately.

Wastewater treatment plant sludges may be disposed with general solid waste upon passing a Paint Filter Test (EPA Method 9095) and tested with a Toxicity Characteristic Leaching Procedure.

Barrels and drums shall not be disposed of unless they are verified to be empty and perforated sufficiently to ensure that no free liquids or hazardous waste is included within. This does not include household waste in small containers of original packaging.

Republic maintains a waste screening program at the facility for detection and prevention of unauthorized waste (hazardous, free liquids) for disposal. This program consists of performing random inspections of incoming waste. These inspections are performed on a daily basis for the various haulers entering the facility. A designated screening inspector shall perform the random inspection near the working face of the landfill within the containment limits.

The load chosen for inspection shall be directed to unload at a relatively flat area near the working face. The screening inspector shall sort through the unloaded waste using a loader, backhoe or similar available equipment to spread the load in a thin lift across the designated inspection area. Hand raking and shoveling may be necessary in order to spread the load sufficiently. Once the waste is spread thin enough to observe the entire load, the inspector shall record the contents of the load and complete the "Detailed Screening Report and Waste Screening Checklist for recordation.

If free liquid or hazardous wastes are not observed, the waste will be disposed of at the nearby working face following inspection. If hazardous waste is identified, the inspector shall immediately notify the site manager and the Republic hazardous materials emergency response team shall be notified. If non-hazardous liquid waste is observed, it shall be contained within the inspection area and either solidified using absorbent or containerized. The solidified or containerized waste shall be disposed of at an appropriate facility. If hazardous waste is encountered, the hazardous materials response team shall determine appropriate handling, containerizing, transporting and disposal at an approved facility for hazardous waste.

Records of inspections shall be kept in a separate screening or inspections file and maintained at the facility at all times. Sample forms for performing and documentation of

inspections are attached with this Facility Plan. Facility personnel performing the inspections shall be adequately trained for identification of hazardous and liquid waste through programs offered by the Solid Waste Association of North America (SWANA) or North Carolina Department of Environment and Natural Resources (NCDENR).

The facility operator shall notify the Solid Waste Section within 24 hours of attempting to dispose of waste products not approved for disposal at the facility. No hazardous, liquid or infectious waste shall be accepted and disposed of in the landfill.

A copy of the Waste Screening Form is included in Appendix 5 of this plan for reference.

1.6 Facility Personnel Training

Personnel at the Charlotte Motor Speedway Landfill V Facility shall be trained to perform their position related tasks effectively. Individuals shall be trained in the following categories dependent upon their job description:

a) Operation and Maintenance of the Leachate Surface Impoundment and Pretreatment Facility
b) Leachate flow volumes, sampling and recordation
c) Operation and Maintenance of the Scales
d) Recordation of Waste Loading (Qualitative and Quantitative)
e) Identification of Hazardous Waste
f) Identification of Liquid Waste
g) File Management and Record Keeping
h) Control of Accidental Fires

The facility and operations managers shall be familiar with all aspects of training for landfill operations and maintenance.

1.7 Inspection Procedures

The Charlotte Motor Speedway Landfill V Facility conducts daily random inspections for commercial waste haulers. The inspection procedure is carried out as follows:

a) Selecting a commercial hauler based on a random number or pre-determined date and time for inspection
b) Directing the hauler to the specified inspection location at the landfill
c) Unloading of the waste in the inspection area
d) Visual inspection of the load for hazardous, liquid or other non-permitted waste
e) Flagging or segregating suspect materials
f) Determination if load is acceptable for disposal
g) Acceptance or rejection of the load
h) Recordation of Inspection

This waste screening process is described in detail in Section 1.5 of this Plan. A sample Waste Screening Form is included in Appendix 5 for reference.

1.8 Record Keeping

The Charlotte Motor Speedway Landfill V Facility maintains an on-site Operating Record in accordance with the NCDENR- Solid Waste Section Rule .1626 that includes the following:

- Waste inspection records
- Waste determination records
- Personnel Training records
- Waste screening program
- Waste amounts received along with source
- Methane gas monitoring results
- Methane gas remediation plans (if required)
- Groundwater Monitoring
- Approved Groundwater Monitoring Plan
- Groundwater monitoring analytical Results
- Notice of Statistically Significant changes in constituents (if required)
- Report of Explanation for change in Statistically Significant changes if change is not due to the Landfill Facility
- Notice of Appendix II Constituents detected (if required)
- Report of each sampling event
- Permit modification to document selection of corrective action (if required)
- Report justifying alternative corrective measures (if required)
- Report documenting completion of corrective measures (if required)
- Closure and Post-Closure Monitoring Plan and Results
- Closure Cost Estimate and Financial Assurance Documentation
- Asbestos Disposal Recordation in accordance with 40 CFR 61
- Operations Plan
- Leachate Management Plan

Files containing the previously listed items shall be kept in the operating record for the active life of the landfill and the post-closure care period. All information contained in the operating record must be furnished to the Solid Waste Section upon request or made available for inspection. Additional records to be maintained on-site for the Facility include:

- Solid Waste Facility Permits
- EPA Generator I.D. / Permits
- NPDES Storm Water Permit, Monitoring and Sampling
- Industrial User Pretreatment Discharge Permit

- Erosion & Sedimentation Control Plan, Permit and Inspections
- Division of Waste Management Inspections
- Applications for Permits and Operations Plans
- SPCC Plan and Updates
- Special Waste Acceptance Records

2.0 FACILITY OPERATIONS AND MAINTENANCE

This Section of the Operations Plan addresses the operational and maintenance requirements that are not specific to a specific landfill Phase or Cell. These requirements apply to the operations within the Facility boundary.

2.1 Erosion and Sedimentation Control

Each phase of landfill development requiring the disturbance or clearing of natural lands requires an erosion and sedimentation control plan designed for the 25-year, 24-hour storm event. The erosion and sedimentation control governing authority for Charlotte Motor Speedway landfill V is Cabarrus County. The erosion and sedimentation control plan serves to stabilize disturbed areas and contain runoff sediments on-site.

For the development of the Phase 3 area, the erosion and sedimentation control plan will utilize two existing sediment basins, SB-1 and SB-2, and require construction of three new sediment basins, SB-3, SB-4, and SB-5. Stabilized channels and downdrain piping will convey storm water runoff to these sediment basins to contain runoff sediments on-site.

Following each significant rainfall event, all sediment and erosion control devices should be inspected for integrity. All devices should be inspected for erosion damage and repaired immediately. Once the sediment levels in the basins have reached one third of the basin storage capacity, the accumulated sediments will be removed from the basin and may be applied as daily cover in the landfill. Any trash or debris found in the basins will be removed and transported to the landfill for disposal.

The stabilized channels shall be inspected after each significant rainfall event for any erosion damage or substantial sediment accumulation. The channels shall be repaired to function as shown on the approved erosion and sedimentation control plan.

Embankment slopes shall be periodically inspected for erosion damage. Provisions for stabilized vegetation on embankment slopes shall be made within 21 working days following completion of any phase of landfill development. If vegetation growth is not adequate after the first growing season, apply additional fertilizer prior to the next growing season. Vegetation should be mowed at least twice a year. If erosion damage occurs within a stabilized area, the damaged area shall be filled with soil to original grade, seeded and mulched. If needed, a manufactured erosion mat shall be installed to temporarily stabilize the area until vegetation is stabilized.

The landfill shall not cause a discharge of pollutants into waters of the United States, including wetlands, that violates any requirement of the Clean Water Act, including but not limited to, NPDES requirements pursuant to Section 402. The landfill shall not cause a discharge of a non-point source pollutant to the waters of the United States, including wetlands, that violates any requirement of a local government or state-wide water quality management plan that has been approved in accordance with Sections 208 or 319 of the Clean Water Act.

2.2 Access and Safety Requirements

The Charlotte Motor Speedway Landfill V facility maintains controlled access with a chain-link fence surrounding the site starting at the Rocky River on the northwest corner, traversing east and then south along the inside of the landscaped berm along Pitts School Road until reaching the Rocky River in the southeast portion of the site. The Rocky River serves as a natural security boundary along the southern and eastern sides of the site. A locking gate is located at the entrance to the site near the scalehouse and a second locking gate is located at the northeast comer of the site for emergency access. Landfill personnel are located at the scales near the entrance to the facility between all hours of operation and public access to assure compliance with Facility operations.

Access roads into and around the site consist of all weather construction and are maintained in good condition. Speed limits are posted along access roads to promote driver safety.

Personnel and public entering the landfill are required to wear hard hats and high visibility safety vests in and around the active areas.

The Facility prohibits the removal of solid waste from the landfill without the approval of the facility or operations manager. Solid waste will not be removed from the working face.

With the exception of asbestos contained in fiber drums, barrels and drums shall not be disposed of in the landfill unless they are verified as empty and perforated sufficiently so as not to contain hazardous or liquid waste.

2.3 Dust, Litter, Odors and Vectors

Potential nuisances involved with landfill operations include dust, odor and litter. Dust is kept to a minimum by utilizing the two on-site water trucks to wet the access and haul roads on-site. Wind blown dust may also be minimized by seeding areas that will remain inactive to promote vegetation. Odor is controlled with the application of daily cover over disposed waste and the on-site gas recovery facility. If odor becomes a concern, masking agents may be used or cover applied more vigorously.

Litter is controlled with the use of "litter fences" that may be moved around the working face of the landfill based on the prevailing wind direction. Constant policing and "good housekeeping" practices are carried out by landfill personnel to reduce potential litter.

Potential vectors that may be drawn to landfilling operations are primarily rodents, insects and birds that are categorized as "scavengers". To deter the presence of these vectors, waste is covered daily with soil or alternative cover to limit the accessibility of a food source. Standing water shall not be allowed in the landfill disposal footprint that may promote insect population.

2.4 Landfill Signage

Facility signs are posted along the access road leading to the scalehouse. The existing signs display information for:

Facility Name and Owner
Hours of Operation
Permit Number
Emergency Contact
No hazardous or non-permitted waste may be accepted without written approval from the North Carolina Division of Waste Management
Additional Facility Specific Information

Directional, informational and traffic signs are posted along access roads to efficiently direct haulers and visitors to the working face of the landfill or other appropriate facilities at a safe speed.

2.5 Fire Control

Open burning of solid waste is prohibited at Charlotte Motor Speedway Landfill V. Heavy equipment and readily available soils are in place to control accidental small fires along with two on-site water trucks. Any fire that occurs at the Landfill shall be reported to the Solid Waste Section within 24 hours of occurrence and the Landfill operations or facility manager shall submit a written notice of fire to the Solid Waste Section within 15 days.

In the event a large fire occurs at the landfill facility, the City of Concord Fire Department shall be contacted by dialing 911. "Hot" loads that are delivered to the landfill shall be directed away from the landfill area, dumped, and the fire department notified. The load shall be sprayed with water until extinguished and combustion is not a threat. The load will then be transported to the landfill for disposal.

2.6 Explosive Gases Control

A methane gas monitoring program is in place at the Charlotte Motor Speedway Landfill V Facility. This program was implemented in accordance with the North Carolina Solid Waste Section Rule .1626 (4). The program consists of quarterly air quality sampling within facility structures and within permanent methane gas monitoring probes. The purpose of the program is to protect the health and safety of personnel and public at the facility and detect methane gas migration off-site. The following describes the monitoring

program, devices implemented, sampling frequency, sampling procedures, recordation and reporting.

2.6.1 Permanent Methane Monitoring Probes

Permanent methane monitoring probes are installed between the landfill footprint and the facility boundary and structures to detect the horizontal migration of methane gases from the landfill. The methane monitoring probes are placed approximately 800 feet apart along the perimeter of the landfill and at varying distances from the landfill depending on location of facility boundary and nearby structures. A copy of the Methane Monitoring Probe Location Plan illustrating proposed methane probes in the Phase 3 area will be submitted to the Section with the Design Hydrogeologic Report. The plan will show locations of existing and proposed wells through proposed Cell No. 2M. Additional locations will be determined following design of Phases 4 and 5.

2.6.2 Methane Monitoring Probe Construction

The methane monitoring probes extend to depths that are a minimum of five (5) feet below the depth of the liner system of the nearest landfill Cell. Encountering groundwater should be avoided if possible while establishing probe depths. The probes will be constructed of Schedule 40 PVC casing attached to a 10-foot section of 0.01-inch machine slotted PVC screen. The screen section shall be surrounded with No. 78M stone (Pea Gravel) to fill the eight-inch annulus of the borehole. The Pea Gravel shall extend a minimum of two feet above the machine slotted screen. A minimum 2-foot thick bentonite seal shall be installed above the Pea Gravel section. The bentonite seal shall be hydrated prior to filling the remaining annulus space with Portland cement to the ground surface. A 4-inch by 4-inch locking protective steel casing will be installed over the PVC casing stick-up. A minimum 2-foot by 2-foot concrete pad will be installed around the protective casing sloped to drain rainwater away from the probe. The probes shall be installed by a North Carolina Certified Well Driller.

2.6.3 Methane Monitoring Procedures and Frequency

The methane monitoring program shall be performed by Charlotte Motor Speedway Landfill V personnel properly trained to use an explosimeter (gas meter). Methane monitoring probes and facility structures will be monitored quarterly for concentrations of methane gas using an explosimeter. The following testing procedures shall be used each quarter:

<u>Methane Monitoring Probe Testing Procedure</u>

1. Calibrate the explosimeter in accordance with the manufacturer's recommendations for methane calibration. Calibration shall be performed in area known to be free of methane gas.

2. Aspirate to purge the explosimeter 4 to 5 times prior to each reading in an area
known to be free of methane gas.
3. Open the cover of the methane monitoring probe.
4. Insert the explosimeter into the PVC casing approximately 1 to 2 feet below the
top of the PVC casing.
5. Aspirate the explosimeter 5 to 7 times immediately before gas is evacuated from the probe.
6. Record the percent methane (volume by air) and percent of lower explosive limit (LEL).

Methane Monitoring for Facility Structures

1. Calibrate the explosimeter in accordance with the manufacturer's recommendations for methane calibration. Calibration shall be performed in areas known to be free of methane gas.
2. Aspirate to purge the explosimeter 4 to 5 times prior to each reading in an area known to be free of methane gas.
3. For Structures Built Upon Concrete Slabs: Place the explosimeter tube near penetrations through interior walls such as floor drains, electrical outlets, switches or any cracks in concrete slab or around the base of the walls if none of the previously mentioned items are present. Aspirate the explosimeter 5 to 7 times at each location. Record the percent methane (volume by air) and percent of lower explosive limit (LEL). Purge the explosimeter prior to performing another reading.
4. For Structures with a Crawl Space: Perform testing as described in item 3 above with the addition of performing testing at the opening and vents of the crawl space. Insert the explosimeter 2 to 3 feet into the crawl space area and aspirate 5 to 7 times at each location. Record the percent methane (volume by air) and percent of lower explosive limit (LEL). Purge the explosimeter prior to performing another reading.

Permanent methane monitors may be installed within structures to monitor the presence of methane gases.

2.6.4 Reporting Requirements and Response Plan

The results of the quarterly methane monitoring shall be recorded for each probe and facility structure and placed in the operating record. Regulations require that explosive gases be controlled such that concentrations of gases are less than 25 percent of the Lower Explosive Limit (LEL) for methane in structures and below the LEL at the facility boundary. If monitoring results exceed either of these requirements, the following procedures shall be followed:

1. Immediately report methane levels to the Landfill Manager.
2. Evacuate and restrict access to facility structures or exterior areas that have recorded the non-compliance methane levels.
3. Prohibit use of equipment and materials that may cause sparks or an open flame.
4. Turn off the main electrical supply switch or breaker at the structure containing high methane levels.
5. The Landfill Manager shall direct qualified and properly equipped response teams (or subcontracted response) to locate the methane source for capping or isolation.
6. Do not allow re-entry or normal operations until the methane levels are acceptable.

Within seven days of detecting non-compliance methane levels, the recorded methane gas levels shall be placed in the operating record along with the actions taken to protect onsite personnel and public health. Within 60 days of detecting non-compliance methane levels, a remediation plan for the methane gas release shall be implemented to avoid reoccurrence. This plan shall also be placed in the operating record and the Solid Waste Section shall be notified of the implementation of remediation plan. The Solid Waste Section may grant an extension of time if warranted.

2.7 Gas to Energy Facility

A methane gas collection / gas to energy facility is located on-site and operated by Fortistar Methane Group. This facility operates by creating a vacuum through a network of collection pipes and gas extraction wells throughout areas of the landfill that have achieved final waste grades or will not receive waste for a substantial time period. This gas recovery system reduces the concentration and quantity of gases within the landfill to further deter the migration of gases off-site. The collected gases are used as fuels to operate an electricity-generating turbine to supply power to the City of Concord.

The installation of gas extraction wells and piping network is an on-going operation as areas of the landfill achieve final grade. A copy of the LFG (landfill gas) Master Plan will be submitted to the Section prior to expanding the existing system. This plan will include a compilation of as-built drawings created following each phase of gas extraction construction through June 12, 2003. The limits of gas extraction shall expand as final grades are achieved for Phase 2, Phase 3, Phase 4 and Phase 5. Future expansion of the gas extraction system shall be performed in accordance with the approved NSPS GCCS Design Plan.

2.8 Leachate Management System

A leachate collection system will be constructed above the composite liner system in each Cell. The collection system for each Cell is connected to a main transmission pipeline consisting of manholes and lift stations that transport leachate from the landfill to the on-site leachate storage lagoon. A leachate pretreatment facility is located adjacent

to the lagoon to treat leachate to acceptable levels in accordance with the facilities Industrial User Pretreatment Discharge Permit. Leachate shall be sampled semi-annually concurrently with groundwater sampling and analyzed for Appendix I constituents, pH, BOD, COD, TDS, phosphate nitrate and sulfate. This sampling and analysis is in addition to the requirements of the Industrial User Pretreatment Discharge Permit located in the Facility Plan.

2.8.1 Leachate Management System Design and Maintenance

The leachate collection system within landfill cells will consist of a geocomposite drainage media that rests on a 60-mil high density polyethylene liner to collect and transport leachate along the Cell floor. A leachate header line will transport the collected leachate to the sump area for each Cell. At each sump area, a stainless steel pump will rest on the Cell floor housed in a high density polyethylene side-wall riser pipe to remove leachate from within the Cell and transport into the leachate transmission system. A high density polyethylene transmission pipe along with a series of manholes and lift stations shall transport leachate from each Cell to the on-site Pre-treatment Facility Storage Lagoon.

The on-site leachate storage lagoon has served the Facility since operations began in the early 1990's. The lagoon has a total storage capacity of approximately 2.9 million gallons or 390,000 cubic feet. The storage lagoon was constructed with a composite liner system and maintains a grout filled geosynthetic (fabric form) above the liner section to protect the integrity of the liner. Two floating aerators are positioned at the ends of the lagoon to introduce oxygen into the leachate and begin the treatment process by reducing BOD and COD levels.

The Leachate Pre-Treatment Facility is located adjacent to the storage lagoon. The pretreatment facility pumps water from the lagoon through a series of automatic monitoring systems to continually monitor discharge water quality. Based on historical data at the Facility, the aeration process occurring in the leachate storage lagoon has been sufficient treatment of leachate to meet the discharge requirements of the Rocky River Waste Water Plant. Additional treatment available in the Pre-Treatment Facility includes:

1,300 gallon pH adjustment Tank
2,035 gallon flocculation tank
1,034 gallon clarifier
1,900 gallon surge tank

Following necessary treatment, the water is discharged to the Rocky River Waste Water Plant operated by the Water & Sewer Authority of Cabarrus County. A copy of the "Industrial User Pretreatment Permit No. 1024" is included in Appendix 4 of the Facility Plan.

Periodic maintenance of the system requires inspection of all the associated pumps, valves, fittings and control panels to ensure that the leachate management

system components are in "good working condition". Manholes and lift stations should be inspected for accumulated sediment and cleaned as warranted. If required, the leachate transmission piping may be flushed with water to remove accumulated sediments. The same is true for the leachate collection system within individual landfill Cells. The systems contain cleanouts at the ends of header lines that may be "back-flushed" with water to maintain the efficiency of the system.

Any components that are found to not be in "good working condition" shall be replaced or repaired immediately.

2.8.2 Sampling, Record Keeping & Reporting

A copy of the "Industrial User Pretreatment Permit No. 1024" issued to Charlotte Motor Speedway Landfill V by the Water & Sewer Authority of Cabarrus County is included in Appendix 4 of the Facility Plan. The effluent limitations are listed on Page 5 of the permit and requires monthly sampling and reporting (semi-annually for priority pollutants). The permit allows discharge from the pretreatment facility at an average rate of 150,000 gallons per day (0.15 MGD).

Additionally, leachate shall be sampled semi-annually concurrently with groundwater sampling and analyzed for Appendix I constituents, pH, BOD, COD, TDS, phosphate nitrate and sulfate. Documentation of sampling and corresponding analytical results shall be placed in the operating record.

The facility will also record the amounts of leachate generated based on levels recorded in the storage lagoon and also record the amounts of pretreated leachate discharged to the Rocky River Waste Water Treatment Plant. Documentation of this recordation shall be placed in the operations record.

APPENDIX

Appendix 1	Operations Plan for Petroleum Hydrocarbon Contaminated Soils for Use as Alternate Daily Cover
Appendix 2	Operations Plan for Solidification Facility
Appendix 3	Approval to Continue to Use Automobile Shredder Fluff as Alternate Daily Cover
Appendix 4	Approval for Alternative Daily Cover Request – Posi-Shell as an Alternative Daily Cover
Appendix 5	Waste Screening Form

APPENDIX 1

OPERATIONS PLAN FOR PETROLEUM HYDROCARBON CONTAMINATED SOILS FOR USE AS ALTERNATE DAILY COVER

APPLICATION FOR
PILOT DEMONSTRATION PROJECT

PETROLEUM HYDROCARBON CONTAMINATED SOILS
FOR USE AS ALTERNATE DAILY COVER (ADC)
CMS LANDFILL V

Concord, North Carolina

Prepared for:

BFI Waste Systems of North America, Inc.

Prepared by:

ESP Associates, P.A.

Charlotte, North Carolina

February 2002

2-8-02

ESP Associates, P.A.
engineering • surveying • planning

February 8, 2002

State of North Carolina
Department of Environment & Natural Resources
Division of Waste Management
1646 Mail Service Center
Raleigh, NC 27699-1646

ATTENTION: Ms. Sheri Coghill

Reference: **APPLICATION FOR PILOT DEMONSTRATION PROJECT PETROLEUM HYDROCARBON CONTAMINATED SOILS FOR DAILY COVER - CMS LANDFILL V**
Concord, North Carolina
ESP Job No. PJ04

Ms. Coghill:

On behalf of BFI Waste Systems of North America, Inc. (BFI), ESP Associates, P.A. (ESP) is submitting herewith an application for a pilot demonstration project to apply petroleum hydrocarbon contaminated soils as an alternate daily cover during landfill operations at CMS Landfill V. This proposed demonstration is based on the enclosed operations plan.

If you should have any questions or require additional information following review of the attached operations plan, please contact me at (704) 504-1015.

Sincerely,

ESP Associates, P.A.

NORTH CAROLINA PROFESSIONAL SEAL 20770 ENGINEER DAVID W. WASIELA

David W. Wasiela, P.E.
Project Engineer
NC Registration No. 20770

2-8-02

Cc: Mr. Rich Nolan – BFI
Mr. John Marston – BFI
DWW/mb

P.O. Box 7030, Charlotte, NC 28241, (704) 583-4949 Fax (704) 583-4950
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I. INTRODUCTION

The CMS Landfill V facility in Concord, North Carolina is a regional solid waste disposal facility. The landfill disposes of municipal solid wastes from communities and industries throughout North Carolina. Currently, on-site soils are utilized for daily and intermediate cover of the waste. In order to conserve these soils and to beneficially reuse petroleum contaminated soils with relatively low levels of Total Petroleum Hydrocarbons (TPH), an alternative daily and intermediate cover system will be utilized. This alternative system will utilize petroleum hydrocarbon contaminated soils in place of native on-site soils.

The previously permitted contaminated soils bioremediation pad was closed in October 2000 for construction of Cell 2E (Refer to ESP report dated October 24, 2000). While the bioremediation pad was in operation, treated soils were hauled to the active working face and used for daily cover.

II. ACCEPTABLE ALTERNATIVE COVER SOILS

Petroleum contaminated soils are generated at cleanup sites, spill sites, and in conjunction with underground fuel tank removals. The sources of this soil material vary significantly in their levels of total petroleum hydrocarbons (TPH). For the alternative cover material, only those petroleum contaminated soils with TPH concentrations not exceeding the following limits will be acceptable:

- 3,000 ppm TPH by EPA method 5030 for soils impacted with low boiling point petroleum hydrocarbons; such as gasoline, aviation fuel, and gasohol.
- 3,000 ppm TPH by EPA method 3550 for soils impacted with high boiling point petroleum hydrocarbons; such as kerosene, diesel, and mineral spirits.
- 3,000 ppm TPH by EPA method 9071 for soils impacted with heavy fuels, oils, and grease; such as #4, #5, and #6 fuel oils.

- 3,000 ppm of total BTEX by EPA method 8020. (If a soil is impacted with more than one type petroleum product, then more than one method may be used to characterize TPH levels.)

Only contaminated soils generated from within the facility's permitted service area will be accepted at the landfill. The facility shall not accept any soils contaminated with hazardous waste, chlorinated solvents, organic acids, tars or asphalt. The generator or contractor will sample all potential alternative cover materials to determine if the material is acceptable for use as an alternative daily cover (ADC). These results will be reviewed by the Landfill Operator and acceptability determined. Material which does not meet the aforementioned acceptance criteria shall not be accepted and utilized as an ADC.

III. STORAGE OF THE ALTERNATIVE COVER MATERIAL

Alternative cover soils with any level of petroleum contamination shall be stockpiled or stored within the limits of the lined cells of the facility. Petroleum hydrocarbon contaminated soils may not be stored at the facility for more than 45 days. Stockpiling of petroleum contaminated soils outside the limits of the lined cell is prohibited. Stockpiles shall be located away from traffic and operations areas. Stockpiles shall be covered by a tarp or maintained at an appropriate moisture content to prevent blowing of dust from the stockpiles. Earthen berms may be constructed around the stockpiles to prevent runoff from leaving the lined landfill footprint.

Soils being transported to the facility or awaiting transfer to the lined cell must be covered to prevent run-off due to precipitation.

IV. USAGE OF THE ALTERNATIVE COVER MATERIAL

The amount of Petroleum Contaminated soils accepted at the facility and used as ADC shall not exceed 10 percent of the permitted facility average monthly waste stream.

Historically, the CMS Landfill V Facility requires daily cover amounts of approximately 10 to 15 percent of the waste stream. Petroleum Contaminated Soils can be used as Alternative Daily Cover only in areas or on intermediate slopes of the MSWLF cell which are in the confines of the base liner system. These soils will not be used on exterior side slopes of the MSWLF cell.

The Landfill Operator shall use special care to assure there is no operational difficulty caused by the usage of this material. In order to accomplish this, all personnel handling the material, either in the cell or being transported to the site, shall be trained in proper handling of the alternative daily cover.

V. FACILITY MONITORING

In order to assess the impact of petroleum contaminated soils usage as alternative daily cover, the following sampling and analysis will be performed during the demonstration:

1. Leachate - Liquids collected in the lined landfill shall be analyzed on a monthly basis for TPH and BTEX. Samples will be collected at the manhole nearest to the cell receiving alternative daily cover.
2. Stormwater - Stormwater in the sediment basins hydraulically downgradient of alternative cover soil use shall be analyzed on a monthly basis for TPH and BTEX.
3. Air Quality - Once per quarter, a hand held photo ionization detector will be used to monitor the air quality in the area where alternative daily cover soils are stockpiled or placed. The detector will be "set-up" for detection of Benzene to detect the presence of airborne volatiles. The detection "action level" will be 10 ppm at which point placement of alternative daily cover will terminate until monitoring indicates that the air quality is within acceptable limits (less than 10 ppm Benzene). If the "action

level" is met or exceeded, the landfill manager will be contacted immediately and all work shall cease.

Prior to use of any of the proposed contaminated soils as cover material, a baseline sampling of the leachate and affected sediment basin(s) will be performed for comparison to on-going monitoring.

VI. RECORD KEEPING

Records shall be maintained by the Landfill Operator on the following:

1. Manifests of incoming petroleum contaminated soils.
2. Waste profile forms for incoming petroleum contaminated soils with TPH on all materials (provided by generator).
3. Results of leachate analysis for TPH.
4. Results of stormwater analysis for TPH
5. Total amount of Petroleum Contaminated Soil received
6. Total amount of Waste received
7. Total amount of Petroleum Contaminated Soil used as ADC

VII. TRAINING

All employees handling petroleum contaminated soils shall be trained in:

1. Methods to utilize the petroleum contaminated soils as alternative daily cover.
2. Methods to store petroleum contaminated soils in the lined cells.
3. Methods to contain petroleum contaminated soils.
4. Record keeping
5. Health and safety concerns

VIII. REGULATORY AUTHORITY

The regulatory authority which permitted the landfill facility is:

NC Department of Environment & Natural Resources
1646 Mail Service Center
Raleigh, NC 27699-1646
Phone No. (919) 733-0692

IX. FACILITY OPERATOR

The facility operator is:

BFI Waste Systems of North America, Inc.
CMS Landfill V
5105 Morehead Road
Harrisburg, NC 28025

APPENDIX 2

SOLIDIFICATION FACILITY OPERATIONS PLAN

ESP ASSOCIATES, P.A.
engineering • surveying • planning

December 15, 1999

State of North Carolina
Department of Environment and
Natural Resources
Division of Waste Management
401 Oberlin Road
Raleigh, North Carolina 27605

ATTENTION: Ms. Sheri Coghill

Reference: **REVISED OPERATIONS PLAN**
CMS LANDFILL V, SOLIDIFICATION FACILITY
Concord, North Carolina
ESP Job No. E3-NL03

Ms. Coghill:

On behalf of Charlotte Motor Speedway Landfill V, ESP Associates, P.A. (ESP) is submitting this request for modification for the referenced project. In summary, we request to receive any "non-hazardous" liquid waste for solidification and to also be allowed to use any "non-hazardous" special waste as solidifying reagents. For the purpose of this letter, "non-hazardous" is defined by the Division's "Procedure and Criteria for Waste Determination". A revised Operations Plan for the facility is attached with this letter.

Following the redesign and relocation of the solidification facility at CMS Landfill V, the new solidification pit is now surrounded by a composite liner system consisting of 60-mil high density polyethylene (HDPE) liner underlain by a geosynthetic clay liner. Above the HDPE, a double layer of 12 ounce non-woven geotextile is in place to "cushion" the approximately 12 inches of #57 washed stone placed above. The 20ft X 20ft reinforced concrete solidification box measuring 8 feet in depth is located above the #57 washed stone and also contains an interior lined with 3/8-inch thick steel plating. An HDPE sidewall riser and pump is located between the liner system and the concrete box in order to remove accumulated liquids from above the liner system and then solidify with reagents. The relocation and redesign was submitted by ESP to the Division on August 29, 1997 and subsequent approval from the Division is dated September 3, 1997.

Corporate Office
10915 Southern Loop Boulevard, Pineville, NC 28134
(704) 583-4949 Fax (704) 583-4950

Raleigh Office
961 Trinity Rd., Ste. 200, Raleigh, NC 27607
(919) 858-9200 Fax (919) 858-9300

Geotechnical Engineering Office
372 Crompton Street, Charlotte, NC 28273
(704) 504-1015 Fax (704) 504-0917

Operations will continue to use the "Solidification Demonstration Project Log" forms as previously submitted to the Division for previous trial periods. Operations will continue to "Log" and "Track" the generator of the "non-hazardous" liquid waste, note the waste type and quantity, note the reagent used for solidification and list the results of paint filter testing prior to disposal.

It is our opinion that this modification is necessary to ensure appropriate compliance with the Division's intent for this Pilot Demonstration Project. If you should have any questions or require additional information concerning this letter, please contact me.

Sincerely,

ESP Associates, P.A.

NORTH CAROLINA PROFESSIONAL SEAL 20770 ENGINEER DAVID W. WASIELA

12-15-99

David W. Wasiela, P.E.
Registered Engineer
N.C. Registration No. 20770

Cc: Brian Card – Allied Waste Industries
Rich Nolan – Allied Waste Industries
Harold Watson - BFI

CMS LANDFILL V
SOLIDIFICATION FACILITY

OPERATIONS PLAN

Revised December 1999
ESP Associates, P.A.

CMS LANDFILL V
SOLIDIFICATION FACILITY
OPERATIONS PLAN

Background Information

The CMS Landfill V Solidification Facility was originally permitted January 19, 1996 by the Division of Waste Management as a "Pilot Demonstration Project" to be conducted in accordance with operational procedures outlined in a submittal dated July 14, 1995. Following approval, "6 month trial period" reports have been submitted to the Division for review describing waste type, quantity solidified and agents used to solidify the waste. The Division has approved the continuation of the operations on a "Pilot Demonstration" basis.

The CMS Landfill V Solidification Facility was redesigned and relocated in September 1997. The new solidification pit is surrounded by a composite liner system consisting of 60-mil high density polyethylene (HDPE) liner underlain by a geosynthetic clay liner. Above the HDPE, a double layer of 12 ounce non-woven geotextile is in place to "cushion" the approximately 12 inches of #57 washed stone placed above. The 20ft X 20ft reinforced concrete solidification box measuring 8 feet in depth is located above the #57 washed stone and also contains an interior lined with 3/8-inch thick steel plating. An HDPE sidewall riser and pump is located between the liner system and the concrete box in order to remove accumulated liquids from above the liner system and then solidify with reagents. The relocation and redesign was submitted by ESP to the Division on August 29, 1997 and subsequent approval from the Division is dated September 3, 1997. A copy of the redesign and relocation is attached at the end of the Operations Plan.

Facility Operations

The Solidification Facility at CMS Landfill V is intended to serve area municipalities and industry that produce "non-hazardous" liquid waste and sludges. "Non-hazardous" is defined by the Division of Waste Management's "Procedure and Criteria for Waste Determination". Therefore, appropriate testing of waste including TCLP testing must be performed prior to transporting of waste from the source to the facility to verify "non-hazardous" status. Results of testing will be maintained on-site and will be accessible to the Division for review upon request.

Agents used to solidify the liquid waste will consist of any "non-hazardous" special waste. The "non-hazardous" special waste shall also be governed by the Division's "Procedure and Criteria for Waste Determination" and be subjected to the same testing described for the liquid waste. Additionally, available information for both the liquid waste and solidifying agents will be reviewed to avoid the potential of a chemical reaction. All testing results will be maintained on-site and made accessible to the Division for review upon request.

The "non-hazardous" liquid waste shall be delivered to the facility in either tanker trucks or drums. When waste is transported by tanker truck, the waste shall be discharged into the steel plate lined concrete solidification box. Solidifying agents will be added to the waste within 24 hours of receipt. Solidifying agents will be blended with the liquid waste using heavy equipment

until the mixture is capable of passing the "Paint Filter Liquids Test" (EPA Method 9095A). A copy of the "Paint Filter Liquids Test" is included at the end of the Operations Plan. The solidification process will continue until passing test results are achieved and thereby ending the "solidification process". Following solidification, the waste shall be removed from the concrete box using a backhoe or trackhoe and transported to the MSW landfill working face for disposal using articulating dump trucks or roll-off containers. When waste is delivered within drums, the drums will be "off-loaded" to the area designated as the staging area near the solidification pit. Drums of "non-hazardous" liquid waste will not be stored beyond 24-hours prior to undergoing solidification. Results of "Paint Filter Testing" will be maintained on-site and made available to the Division for review upon request.

Reporting

The solidification process shall be documented by completing and updating a "Solidification Demonstration Project Log". The log shall include the following information:

1. Date waste is received
2. The generator/source of waste
3. Waste/material type
4. Internal tracking number (where applicable)
5. Manifest number
6. Quantity of waste received
7. Solidifying agent used
8. Result of "Paint Filter Test"

The logs will also note any complications monitored during the process and include suggested remedies.

In accordance with the "Pilot Demonstration Project", reports will be sent to the Division at a minimum frequency of every 6-months for review and comment. These reports will contain copies of the Solidification Demonstration Project Logs and summarize the operations within the 6-month period. The reports are to be submitted to:

State of North Carolina
Department of Environment and Natural Resources
Division of Waste Management
Post Office Box 27687
Raleigh, North Carolina 27611

Attention: Ms. Sheri Coghill

METHOD 9095A

PAINT FILTER LIQUIDS TEST

PAINT FILTER LIQUIDS TEST

1.0 SCOPE AND APPLICATION

1.1 This method is used to determine the presence of free liquids in a representative sample of waste.

1.2 The method is used to determine compliance with 40 CFR 264.314 and 265.314.

2.0 SUMMARY OF METHOD

2.1 A predetermined amount of material is placed in a paint filter. If any portion of the material passes through and drops from the filter within the 5-min test period, the material is deemed to contain free liquids.

3.0 INTERFERENCES

3.1 Filter media were observed to separate from the filter cone on exposure to alkaline materials. This development causes no problem if the sample is not disturbed.

3.2 Temperature can affect the test results if the test is performed below the freezing point of any liquid in the sample. Tests must be performed above the freezing point and can, but are not required to, exceed room temperature of 25° C.

4.0 APPARATUS AND MATERIALS

4.1 Conical paint filter: Mesh number 60 +/- 5% (fine meshed size). Available at local paint stores such as Sherwin-Williams and Glidden.

4.2 Glass funnel: If the paint filter, with the waste, cannot sustain its weight on the ring stand, then a fluted glass funnel or glass funnel with a mouth large enough to allow at least 1 in. of the filter mesh to protrude should be used to support the filter. The funnel should be fluted or have a large open mouth in order to support the paint filter yet not interfere with the movement, to the graduated cylinder, of the liquid that passes through the filter mesh.

4.3 Ring stand and ring, or tripod.

4.4 Graduated cylinder or beaker: 100-mL.

5.0 REAGENTS

5.1 None.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

6.1 All samples must be collected according to the directions in Chapter Nine of this manual.

6.2 A 100-mL or 100-g representative sample is required for the test. If it is not possible to obtain a sample of 100 mL or 100 g that is sufficiently representative of the waste, the analyst may use larger size samples in multiples of 100 mL or 100 g, i.e., 200, 300, 400 mL or g. However, when larger samples are used, analysts shall divide the sample into 100-mL or 100-g portions and test each portion separately. If any portion contains free liquids, the entire sample is considered to have free liquids. If the sample is measured volumetrically, then it should lack major air spaces or voids.

7.0 PROCEDURE

7.1 Assemble test apparatus as shown in Figure 1.

7.2 Place sample in the filter. A funnel may be used to provide support for the paint filter. If the sample is of such light bulk density that it overflow the filter, then the sides of the filter can be extended upward by taping filter paper to the inside of the filter and above the mesh. Settling the sample into the paint filter may be facilitated by lightly tapping the side of the filter as it is being filled.

7.3 In order to assure uniformity and standardization of the test, material such as sorbent pads or pillows which do not conform to the shape of the paint filter, should be cut into small pieces and poured into the filter. Sample size reduction may be accomplished by cutting the sorbent material with scissors, shears, knife, or other such device so as to preserve as much of the original integrity of the sorbent fabric as possible. Sorbents enclosed in a fabric should be mixed with the resultant fabric pieces. The particles to be tested should be reduced smaller than 1 cm (i.e., should be capable of passing through a 9.5 mm (0.375 inch) standard sieve). Grinding sorbent materials should be avoided as this may destroy the integrity of the sorbent and produce many "fine particles" which would normally not be present.

7.4 For brittle materials larger than 1 cm that do not conform to the filter, light crushing to reduce oversize particles is acceptable if it is not practical to cut the material. Materials such as clay, silica gel, and some polymers may fall into this category.

7.5 Allow sample to drain for 5 min into the graduated cylinder.

7.6 If any portion of the test material collects in the graduated cylinder in the 5-min period, then the material is deemed to contain free liquids for purposes of 40 CFR 264.314 and 265.314.

8.0 QUALITY CONTROL

8.1 Duplicate samples should be analyzed on a routine basis.

9.0 METHOD PERFORMANCE

9.1 No data provided.

10.0 REFERENCES

10.1 None provided.

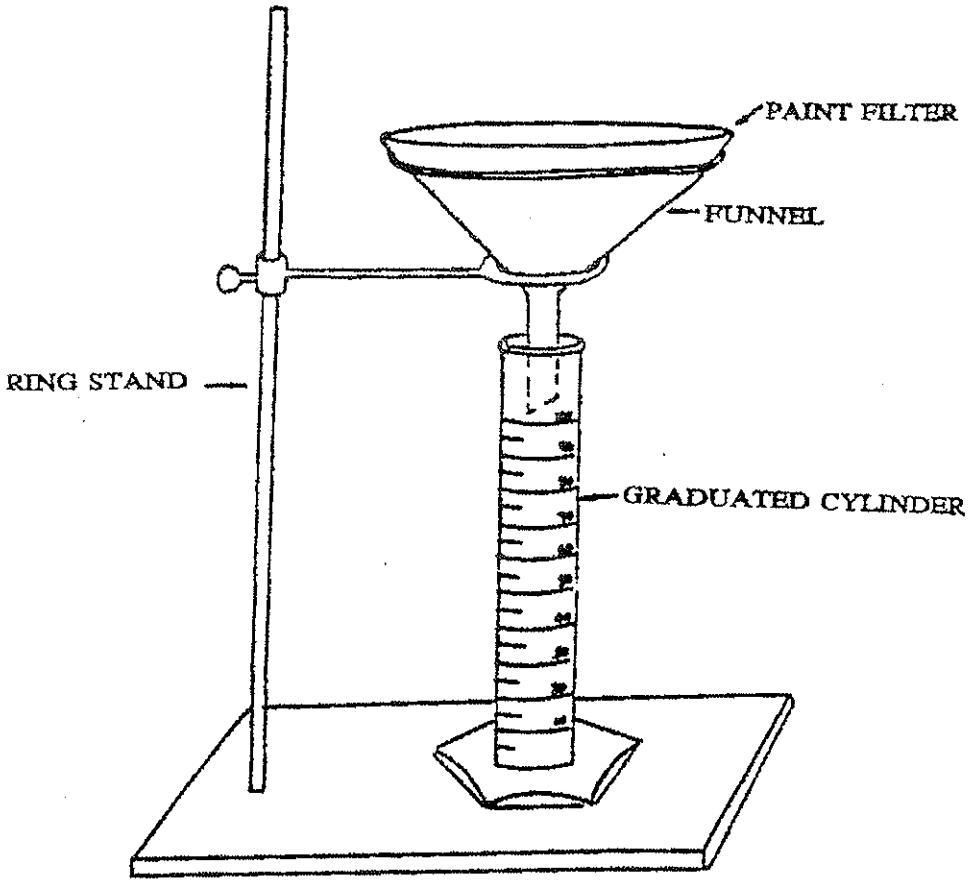
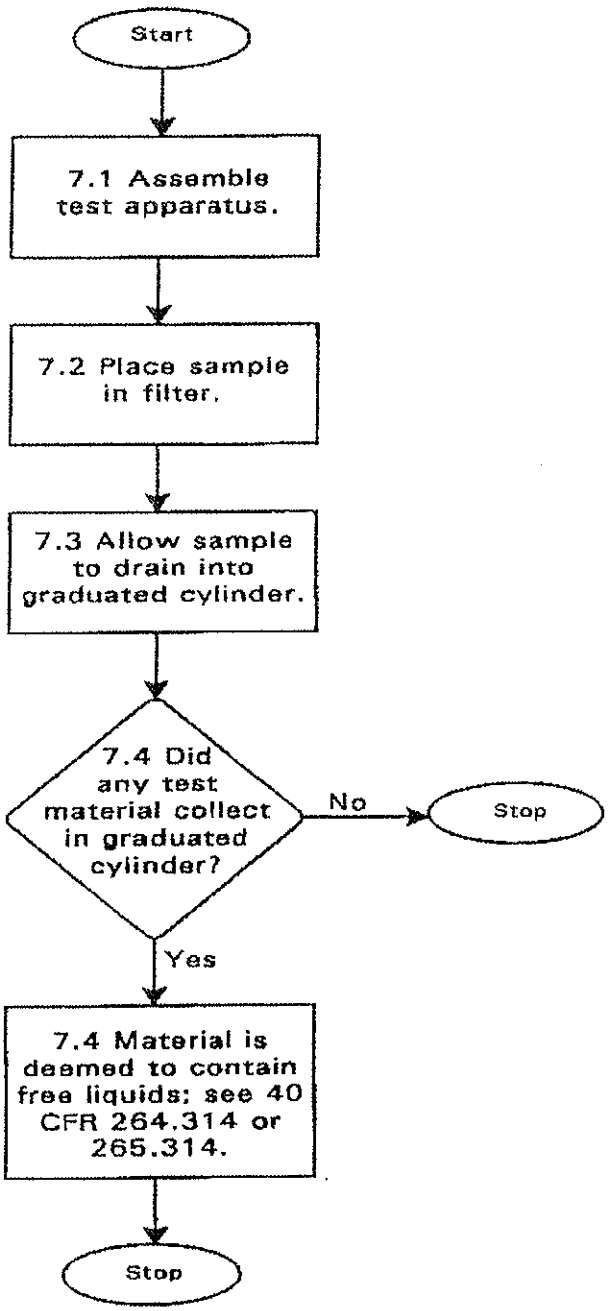


Figure 1. Paint filter test apparatus.

METHOD 9095A
PAINT FILTER LIQUIDS TEST



RELOCATION & REDESIGN
AS SUBMITTED TO THE DIVISION
AUGUST 29, 1997

ESP ASSOCIATES, P.A.
engineering • surveying • planning

August 29, 1997

State of North Carolina
Department of Environment, Health and
Natural Resources
Division of Waste Management
Post Office Box 27687
Raleigh, North Carolina 27611-7687

ATTENTION: Ms. Sherri Coghill

Reference: **Sludge Solidification Facility**
BFI/CMS Landfill V
Relocation & Redesign

Ms. Coghill:

As a follow up to our meeting with Ms. Coghill of the Division of Waste Management on July 30, 1997 we are submitting with this letter a revised relocation for the sludge solidification facility at the referenced project. The information previously submitted for redesign of the facility in our letter dated May 14, 1997, is attached with this letter for reference.

In summary, the proposed relocation of the sludge solidification facility is east of the east end of Cell 1A. The new location is between two permitted 500-foot buffer zones created for private residences with wells located up and side gradient hydrologically. The new location will still provide in excess of a 500-foot buffer from the private residences with wells and in excess of 300 feet from property boundaries. The new proposed location is shown on the attached site plan.

Charlotte Office: 10915 Southern Loop Boulevard, Pineville, NC 28134
(704) 583-4949 Fax (704) 583-4950
Raleigh Office: 1150 S.E. Maynard Road, Suite 240, Cary, NC 27511
(919) 467-9613 Fax (919) 467-9614

Also attached with this letter is a cross section and plan view of the proposed solidification facility. Design improvements include a minimum 2-foot-thick low permeable soil liner, a minimum 40 mil thick linear low density polyethylene liner (LLDPE), leakage collection system and splash pad. Leakage collected from the roll-off containers will be pumped into sludges to be solidified when operations commence again. An approximately 26 ft X 30 ft concrete pad is proposed on the east side of the containers for temporarily storing sludges that arrive in 55 gallon drums.

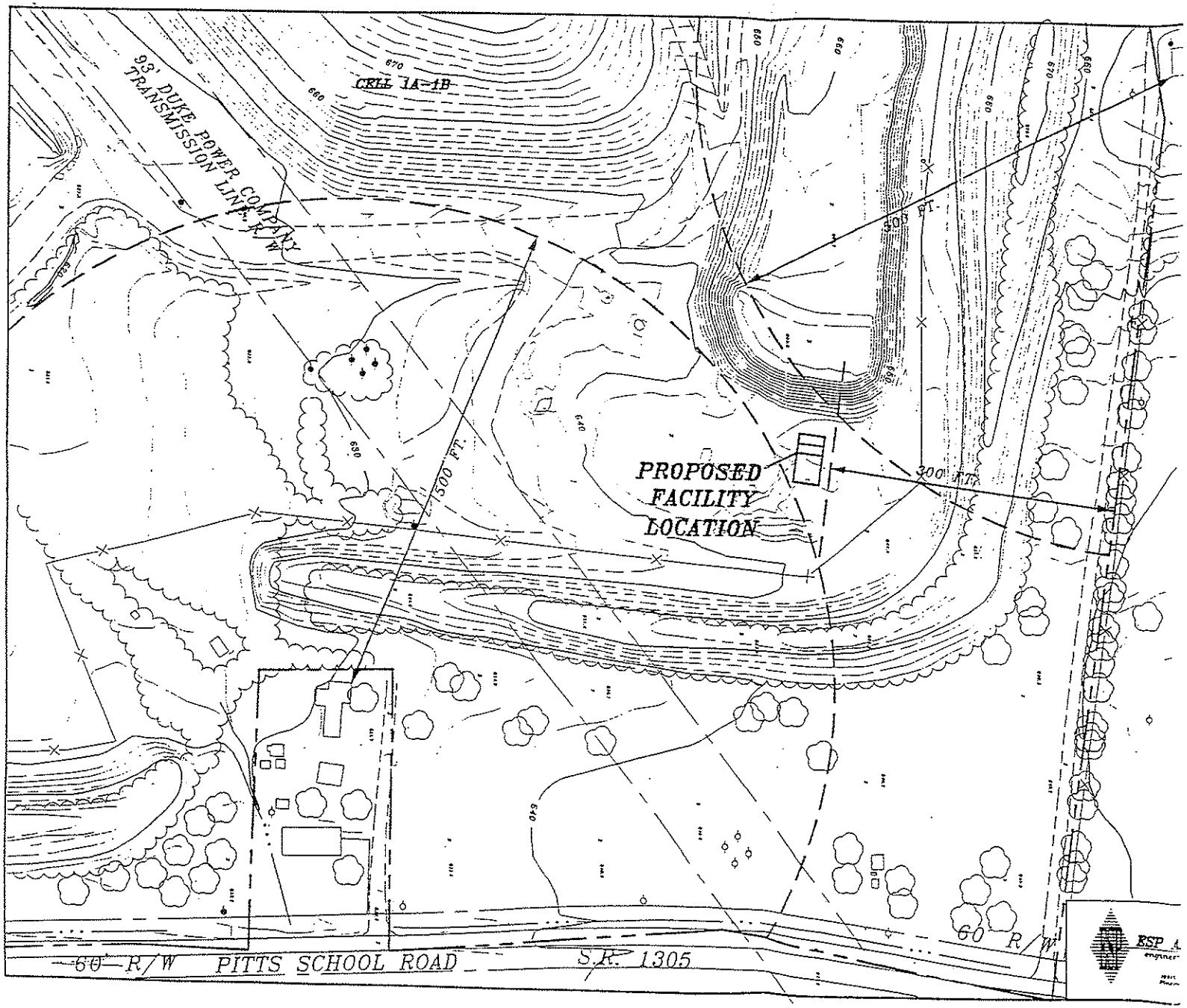
We request the Division to comment on the relocation and redesign in order to finalize facility plans. If you should have any questions or require additional information concerning this project, please contact us.

Sincerely,
ESP Associates, P.A.

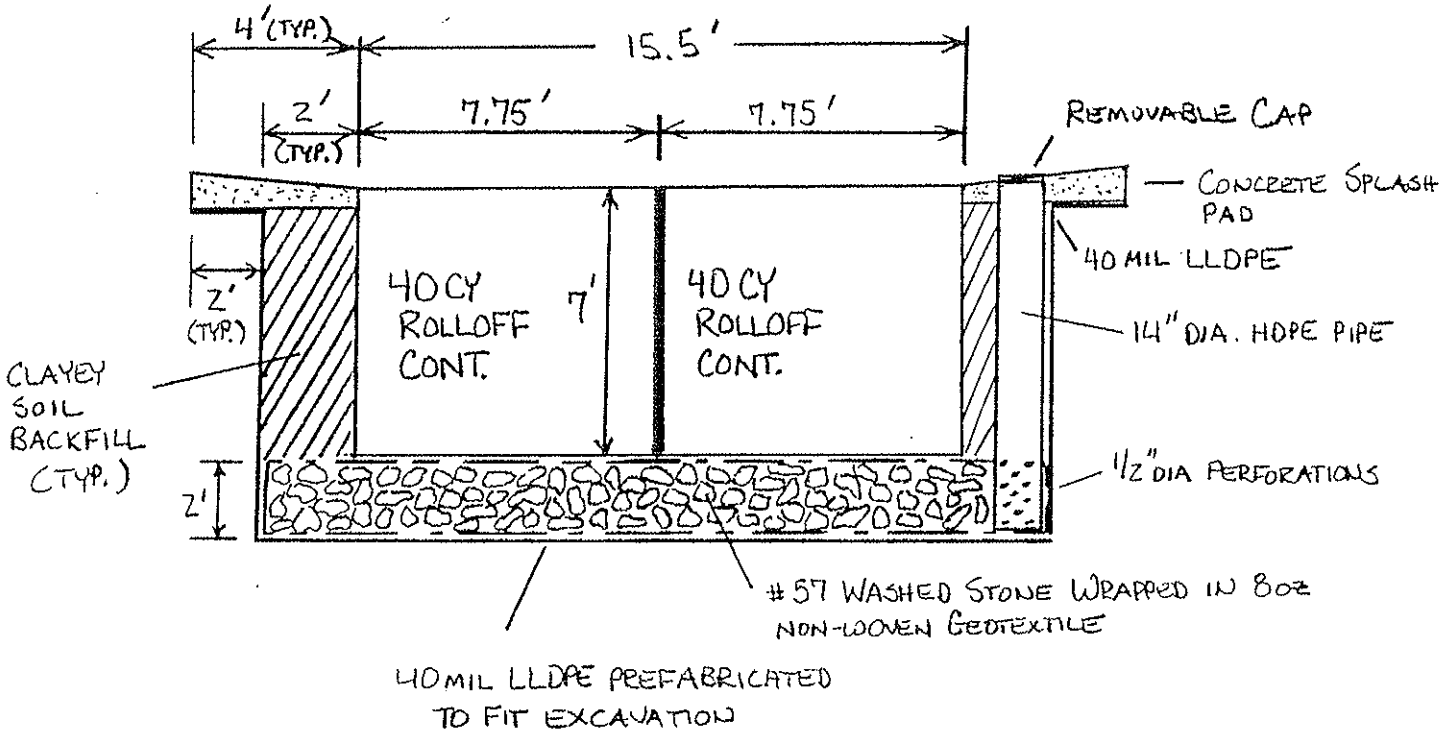
David W. Wasiela, P.E.
Project Engineer

P. Greg Garrett, P.E.
Project Engineer

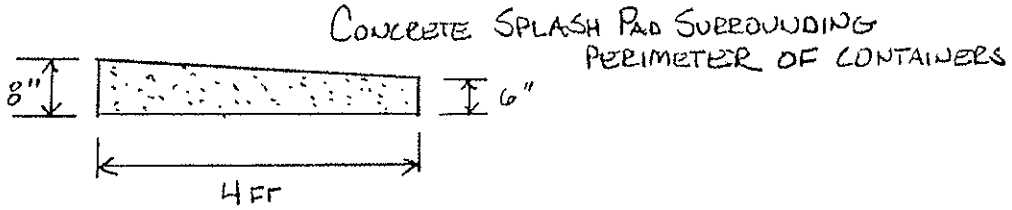
cc: John Barnard, P.E. - Browning-Ferris Industries
David Conrad, P.E. - Browning-Ferris Industries
David Cradduck - Browning-Ferris Industries



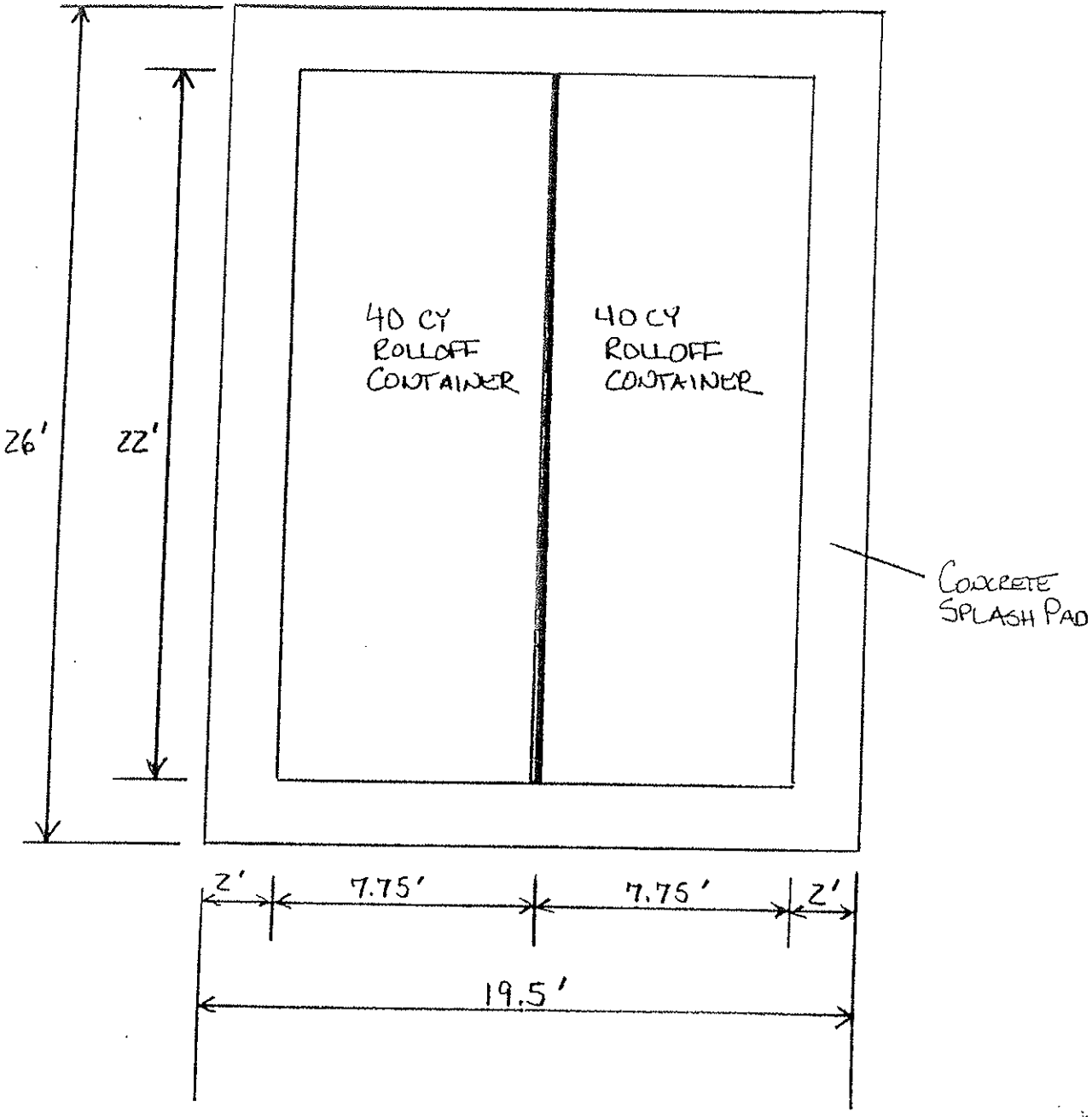
93' DUKE POWER COMPANY
TRANSMISSION LINE R/W
CELL 1A-1B
670
660
630
640
500 FT.
300 FT.
PROPOSED
FACILITY
LOCATION
60' R/W
PITTS SCHOOL ROAD
S.R. 1305
60' R/W
ESP



* NOTE: MINIMUM 2FT THICK LOW PERMEABLE SOIL LINER IS LOCATED BENEATH THE 40-MIL LLDPE



CROSS SECTION OF PROPOSED REDESIGN



PLAN VIEW OF PROPOSED REDESIGN

APPENDIX 3

APPROVAL TO CONTINUE USE OF AUTOMOBILE SHREDDER FLUFF AS ALTERNATE DAILY COVER

NCDENR

North Carolina Department of Environment and Natural Resources

Dexter R. Matthews, Director

Division of Waste Management

Michael F. Easley, Governor
William G. Ross Jr., Secretary

February 5, 2004

Mike Gurley
BFI - CMS Landfill
5105 Morehead Road
Concord, NC 28027

RE: Continuance - Alternate Daily Cover Demonstration
BFI - CMS Landfill
Permit No. 13-04

Dear Mr. Gurley:

The Solid Waste Section hereby allows CMS to continue the demonstration of the use of automobile shredder fluff (ASR) mixed with soils as an alternate daily cover at the referenced facility for an additional 120-day period. The demonstration shall be conducted in accordance with the operational guidelines described in the request of September 26, 2002. At the conclusion of the demonstration period (120 days from the date of this letter), BFI shall submit a report documenting the amount of ASR used, the effectiveness ASR/soil mix as a substitute for daily soil cover, and analysis results for leachate and stormwater.

If you have any questions or comments, please contact Sherri Coghill at (919) 733-0692, ext. 259.

Sincerely,

James C. Coffey

James C. Coffey, Chief
Solid Waste Section

cc: Brent Rockett, DWM
Tim Jewett, DWM
Teresa Bradford, DWM

1646 Mail Service Center, Raleigh, North Carolina 27699-1646
Phone 919-733-4996 \ FAX 919-715-3605 \ Internet http://wastenotnc.org
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BFI CMS LANDFILL FAX:704-707-2177 MAR 17 2004 16:12 P.02

APPENDIX 4

APPROVAL FOR ALTERNATIVE DAILY COVER REQUEST
POSI-SHELL AS AN ALTERNATIVE DAILY COVER

North Carolina
Department of Environment and Natural Resources

Div n of Waste Management

Michael F. Easley, Governor
William G. Ross Jr., Secretary
Dexter R. Matthews, Director

NCDENR

February 4, 2004

Mr. Timothy Schotsch, General Manager
BFI – Charlotte Area Landfills
5105 Morehead Road
Concord, North Carolina 28027

Re: Alternative Daily Cover Request
BFI-CMS Landfill V
Permit No. 13-04

Dear Mr. Schotsch:

The Solid Waste Section has received your request for the use of Posi-Shell ® as an alternative daily cover at the BFI-CMS Landfill. Based on the information included in the request, a demonstration period of 90 days has been approved to evaluate and ensure compliance with 15A North Carolina Administrative Code 13B .1626(2)(b). 15A NCAC 13B .1626(2)(b) requires an owner/operator to demonstrate that the alternative cover aterial and thickness control disease vectors, fires, odors, blowing litter and scavenging without presenting a eat to human health and the environment.

You will need to fully document the use of Posi-Shell® during the demonstration period with photos, journals and other pertinent information regarding compliance with 15A NCAC 13B .1626(2)(b). The effectiveness must be documented thoroughly throughout the test period. At the end of the test period, all substantiating information will need to be submitted to the Solid Waste Section.

The Solid Waste Section will periodically inspect the referenced facility during the 90-day trial period to ensure that the alternative daily cover meets the requirements stated above. At the end of the 90-day period, if the Solid Waste Section determines that the demonstration period was successful, approval for permanent use of the alternative daily cover will be granted.

If you have any questions, please contact me at (704) 663-1699, extension 212.

Sincerely,

Teresa N. Bradford

Teresa N. Bradford
Waste Management Specialist
Solid Waste Section

cc: Brent Rockett, SWS
Mark Poindexter, SWS
Jim Barber, SWS
Sherri Coghill, SWS

919 North Main Street, Mooresville, North Carolina 28115
Phone: 704-663-1699 \ FAX: 704-663-6040 \ Internet: www.enr.state.nc.us
AN EQUAL OPPORTUNITY \ AFFIRMATIVE ACTION EMPLOYER – 50% RECYCLED / 10% POST CONSUMER PAPER

APPENDIX 5

WASTE SCREENING FORM

INSPECTION FORM

Company Name: _____

Type Load: _____

Date: _____ Time: _____

Checker Signature: _____

Truck No. _____ Can No. _____

As required by law your commercial waste load is to be inspected according to our random inspection plan. Any unauthorized waste that is found must be picked-up by your company within 24 hours. You will be directed where to dump your load (the spotter will direct you to the designated area). It is not necessary for you to wait until the inspection is complete.

Inspector's Signature: _____

Date: _____ Time: _____

Driver's Signature: _____

RANDOM INSPECTION REPORT

Inspection Date: _____

Inspection Time: _____ (a.m./p.m.)

Inspector's Name: _____

Inspector's Signature: _____

Transporter's Name: _____

Address: _____

Phone No: _____

Vehicle Type: _____

Driver's Name: _____

Driver's License No.: _____

License Plate No. _____

Source of Waste _____
As Stated By Driver _____

Inspector's Observations: _____
(continue on back, _____
if necessary) _____
_____
_____

Waste Load Approved? Yes _____ / No _____
If no, was the waste rejected? Yes _____ No _____
If no, Notification Form Completed? Yes _____ No _____
(Hazardous and PCB wastes only)

Waste Discrepancy Report Completed? Yes _____ No _____
(Hazardous/PCB and unauthorized wastes)

Permit No.	Date	Document ID No.
13-04	**June 23, 2009**	**7794**

RECEIVED
June 17, 2009
Solid Waste Section
Asheville Regional Office

RECEIVED
May 22, 2009
Division of Air Quality
Mooresville Regional Office

PERMIT APPLICATION

FOR

PHASE 3 PERMIT TO CONSTRUCT

CHARLOTTE MOTOR SPEEDWAY
LANDFILL V
CITY OF CONCORD, NORTH CAROLINA

FOR

REPUBLIC SERVICES OF SOUTH CAROLINA, LLC

MAY 2009

VOLUME 2 OF 2

NORTH CAROLINA PROFESSIONAL SEAL 16146 ENGINEER WILLIAM F. HODGES 4/30/09

NORTH CAROLINA PROFESSIONAL SEAL 32249 ENGINEER K. MATTHEW CHEEK 4/30/09

HODGES, HARBIN, NEWBERRY & TRIBBLE, INC.
CONSULTING ENGINEERS
484 MULBERRY STREET
SUITE 265
MACON, GEORGIA 31201

TEL: (478) 743-7175 NC Corp. License No. C-0813 **FAX: (478) 743-1703**

PERMIT APPLICATION
FOR
CHARLOTTE MOTOR SPEEDWAY LANDFILL V
PHASE 3 PERMIT TO CONSTRUCT

MAY 2009

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DESIGN CALCULATIONS

FOR

CHARLOTTE MOTOR SPEEDWAY LANDFILL V
PHASE 3 PERMIT TO CONSTRUCT
CITY OF CONCORD, NORTH CAROLINA

FOR

REPUBLIC SERVICES OF SOUTH CAROLINA, LLC

MAY 2009

NORTH CAROLINA PROFESSIONAL SEAL 16146 ENGINEER WILLIAM F. HODGES 4/30/09

NORTH CAROLINA PROFESSIONAL SEAL 32249 ENGINEER K. MATTHEW CHEEK 4/30/09

HODGES, HARBIN, NEWBERRY & TRIBBLE, INC.
CONSULTING ENGINEERS
484 MULBERRY STREET
SUITE 265
MACON, GEORGIA 31201

TEL: (478) 743-7175 NC Corp. License No. C-0813 **FAX: (478) 743-1703**

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1. STORM WATER MANAGEMENT CALCULATIONS

a. General

The Charlotte Motor Speedway MSW Landfill V (MSWLF) is an existing municipal solid waste landfill located in Cabarrus County, North Carolina. Phases 1 and 2 of the landfill footprint are currently constructed. Phase 3 development of the landfill will disturb approximately 70 acres. Of this disturbed area approximately 54.25 acres will represent the actual footprint of the waste disposal cells and approximately 15.7 acres will represent areas for access road, buildings, support facilities, basins, and outside slopes along cut and fill areas around the landfill. Efforts have been made in the design of this facility to minimize the total disturbed area. Disturbed areas will be stabilized using erosion control measures. Storm water which comes from off-site and undisturbed areas on-site will be diverted around the MSWLF (Run-on control). Precipitation runoff from the MSWLF will be transported by landfill sideslope drainage berms and downdrains, to one of three detention basins (run-off control). These basins are designed to protect water quality by reducing the storm water runoff rate and removing total suspended solids (TSS) from storm water runoff. These basins, as well as a timely application of various erosion and sedimentation practices, will minimize the time that soils are exposed, control storm water runoff, protect soils from erosive forces, protect surrounding property and preserve water quality. Below is a detailed description of the storm water, erosion and sedimentation control techniques to be used at the MSWLF to protect the site and surrounding property.

The best way to control sediment is to minimize erosion at its source. One way to minimize erosion is to control storm water through the use of storm water management structures in areas of concentrated water flows. In the design of a landfill closure, storm water must be controlled, collected and transported from the top of the landfill to the point where it exits the property. Storm water which falls onto the top of a landfill or along its side slopes, will be collected by a series of side slope diversion berms and side slope downdrain pipes. Side slope diversion berms are vegetated earthen structures constructed across the landfill side slope. These are spaced every 20 vertical feet (approx.) on the landfill side slope. The side slope diversion berms are constructed a minimum of 2' high and at a minimum 1% slope along the storm water pathway. The purpose of the side slope diversion berm is to reduce the slope length that storm water runoff will travel as sheet flow, and move the storm water to a side slope downdrain pipe.

All landfill side slopes and berms will be grassed. Berms will be lined with a temporary liner, such as Excelsior Matting or other materials for temporary protection prior to permanent vegetation being established. The side slope downdrain pipes will be used to transport runoff from points on the landfill to the base of landfill sideslopes. These pipes will be a minimum of 18" diameter corrugated HDPE pipe and will be sized to carry the runoff collected behind each berm while not exceeding 65% of the capacity of the pipe diameter. The downdrain pipes will discharge directly into a detention basin. A rip-rap apron or other energy dissipating device will be placed at the outlet of each downdrain system to reduce the velocity of the concentrated pipe flow and prevent erosion at the outlet as it enters the basin.

A perimeter drainage berm will be constructed around the waste footprint to collect all of the storm water runoff from the outer waste limits around the landfill to the top of the landfill. This berm will be a minimum of 2' deep and have 1.5H:1V side slopes. All drainage berms will be grassed. If velocities exceed 2 feet per second (i.e. scour velocity), temporary and/or permanent protective measures will be used to prevent scouring. These measures include temporary liners which are used to protect the berms until the grass has time to grow and mature, and permanent liners, such as stone rip-rap, concrete or special geotextile materials. These liners are discussed further in Section (e) of this chapter.

The storm water runoff has now been taken from areas on the landfill, along grassed diversion berms, through the downdrain pipe systems to the perimeter drainage berm system. The perimeter drainage berm system transports the storm water by gravity to a downdrain pipe which discharges directly into one of three detention basins. The storm water is transported into the detention basins through downdrain pipes. The inlets and pipes are sized to handle the 25 year - 24 hour storm event. Temporary drop inlet protections in the forms of sediment traps and silt fences are used around the drop inlet as necessary to collect sediment from upstream berms. These protections help keep sediment out of the downdrain pipe system. The outlet of each downdrain pipe entering the detention basins is also protected from soil scouring with a stone rip-rap apron.

The sediment basins are to be used for final trapping and settlement of sediment. Sediment Basin No. 1 and 2 were previously approved by the NCDENR. Sediment Basins No. 3, 4 and 5 have been designed in accordance with the NCDENR Erosion and Sediment Control Planning and Design Manual. Design specifications for each basin are included in this document.

Based on the topography of the site and the design of the landfill, there are areas that will be disturbed and the storm water runoff from these areas may not be diverted to one of the three sediment basins. These areas include some outside cut and fill slopes on the landfill and the sediment basins. In order to control storm water runoff and control erosion and sedimentation, all of these areas will be protected by the installation of silt fencing as well as being mulched and vegetated. Mulch or other stabilizing material helps to reduce runoff and erosion, conserve soil moisture, and prevent soil compaction and crusting. Each of these areas will be stabilized by using temporary and permanent grassing along with slope protective materials, such as Excelsior Matting, permanent erosion control pre-seeded blankets, channel liners, other types of erosion control blankets and mats, EarthGuard or a sprayed-on synthetic polyacrylamide polyamine (PAM), if required. (The PAM chemically binds to the fine clay particles and prevents the particles from going into solution.) In addition to the use of mulch, grassing and slope protective materials, all areas downhill of a disturbed area will be protected with silt fencing. Silt fencing will capture sediment and prevent it from leaving the site and entering any drainage ways.

Erosion and sedimentation control measures will be inspected routinely and after any significant rainfall events. Any damage observed will be repaired. Cleanout of sediment control structures will occur regularly to maintain the effectiveness of the structures. Sediment removed from these structures will be used as cover soils for the landfill waste. Silt fencing and drop inlet protection will remain in place until sediment contributing areas are stabilized.

The site manager of the MSWLF will be responsible for the facility storm water, erosion and sedimentation control program. The address and telephone number of the manager is listed below:

Mr. Brad Green
Republic Services of South Carolina, LLC
CMS Landfill General Manager
Charlotte Motor Speedway Landfill V
5105 Morehead Road
Concord, NC 28027
Phone: (704) 782-2004

b. Design Assumptions

The following assumptions are used to size all downdrains, side slope berms, and storm piping.

1) It is assumed that the surface of the landfill is 50% impervious. This fairly represents the observed amount of runoff from many closed landfills in the southeastern United States.

2) Downdrains are designed to flow approximately 65% full during the 25 year - 24 hour storm event. All proposed downdrain pipes are a minimum of 18" diameter.

3) Downdrain calculations are based on corrugated plastic pipe.

4) Storm drainage flows were calculated using HYDRAFLOW and the SCS Method.

5) The Curve Number CN = 74

6) Side slope drainage berms shall be 24" deep minimum and designed with a minimum of 1% slope.

7) Manning's "n" for 18" and 24" corrugated plastic downdrain pipe is: 0.020

8) Manning's "n" for concrete pipe is 0.013.

9) Manning "n" for corrugated metal pipe is 0.023.

10) See "Erosion Control Plan" sheet in the Phase 3 Engineering Plans for Drainage Structure Locations.

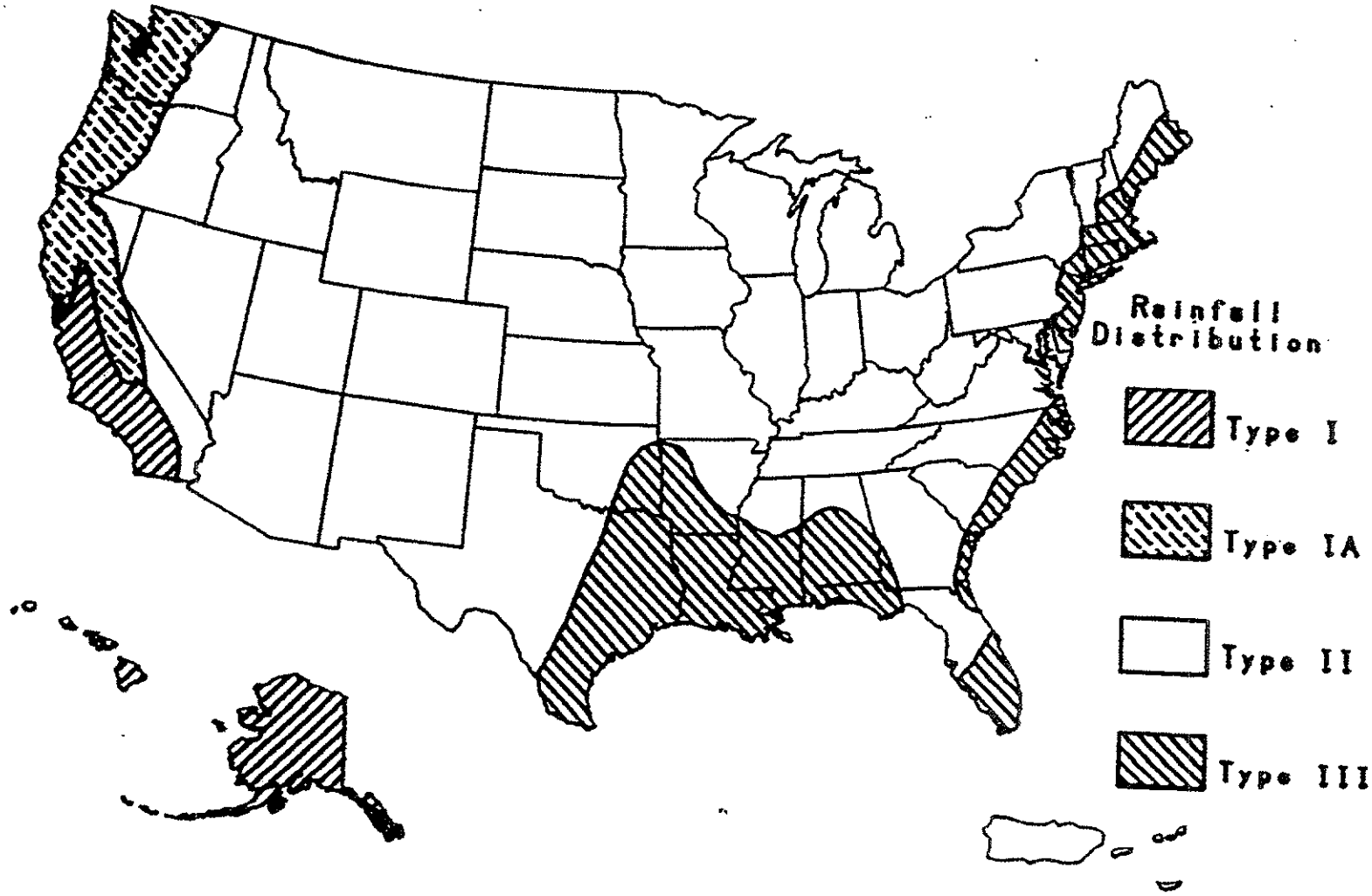


Figure B-2.—Approximate geographic boundaries for SCS rainfall distributions.

Technical Release 55 (TR-55) presents simplified procedures for estimating runoff and peak discharges in small watersheds. In selecting the appropriate procedure, consider the scope and complexity of the problem, the available data, and the acceptable level of error. While this TR gives special emphasis to urban and urbanizing watersheds, the procedures apply to any small watershed in which certain limitations are met. The following excerpt presents the portion of TR-55 for determining peak discharge. New rainfall data from NOAA is presented in tabular form.

SCS runoff curve number method

The SCS Runoff Curve Number (CN) method is described in detail in NEH-4 (SCS 1985). The SCS runoff equation is:

Equation 8.03a

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S}$$

where:

Q = runoff (in)
P = rainfall (in)
S = potential maximum retention after runoff begins (in) and
I_a = initial abstraction (in)

Initial abstraction (I_a) is all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration. Ia is highly variable but generally is correlated with soil and cover parameters. Through studies of many small agricultural watersheds, Ia was found to be approximated by the following empirical equation:

Equation 8.03b

$$I_a = 0.2S$$

By removing Ia as an independent parameter, this approximation allows use of a combination of S and P to produce a unique runoff amount. Substituting equation 8.03b into equation 8.03a gives:

Equation 8.03c

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)}$$

S is related to the soil and cover conditions of the watershed through the CN. CN has a range of 0 to 100, and S is related to CN by:

Equation 8.03d

$$S = \frac{1000}{CN} - 10$$

Figure 8.03a and Table 8.03d solve equations 8.03c and 8.03d for a range of CN's and rainfall.

Factors considered in determining runoff curve numbers

The major factors that determine CN are the hydrologic soil group (HSG), cover type, treatment, hydrologic condition, and antecedent runoff condition (ARC). Another factor considered is whether impervious areas outlet directly to the drainage system (connected) or whether the flow spreads over pervious areas before entering the drainage system (unconnected). Figure 8.03b is provided to aid in selecting the appropriate figure or table for determining curve numbers.

CN's in Tables 8.03e-8.03g represent average antecedent runoff condition for urban, cultivated agricultural, other agricultural, and arid and semiarid rangeland uses. Table 8.03c assumes impervious areas are directly connected. The following sections explain how to determine CN's and how to modify them for urban conditions.

Hydrologic soil groups

Infiltration rates of soils vary widely and are affected by subsurface permeability as well as surface intake rates. Soils are classified into four HSG's (A, B, C, and D) according to their minimum infiltration rate, which is obtained for bare soil after prolonged wetting. The soils in the area of interest may be identified from a soil survey report, which can be obtained from local SCS offices or soil and water conservation district offices.

Most urban areas are only partially covered by impervious surfaces: the soil remains an important factor in runoff estimates. Urbanization has a greater effect on runoff in watersheds with soils having high infiltration rates (sands and gravels) than in watersheds predominantly of silts and clays, which generally have low infiltration rates.

Any disturbance of a soil profile can significantly change its infiltration characteristics. With urbanization, native soil profiles may be mixed or removed or fill material from other areas may be introduced.

Table 8.03e Runoff curve numbers of urban areas[1]

Cover Description: Cover type and hydrologic condition	Average percent impervious area[2]	Curve number for hydrologic soil group: A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [4]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

1. Average runoff condition, and Ia = 0.2S.
2. The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using Figure 8.03c or 8.03d.
3. CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.
4. Composite CN's to use for the design of temporary measures during grading and construction should be computed using Figure 8.03c or 8.03d based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

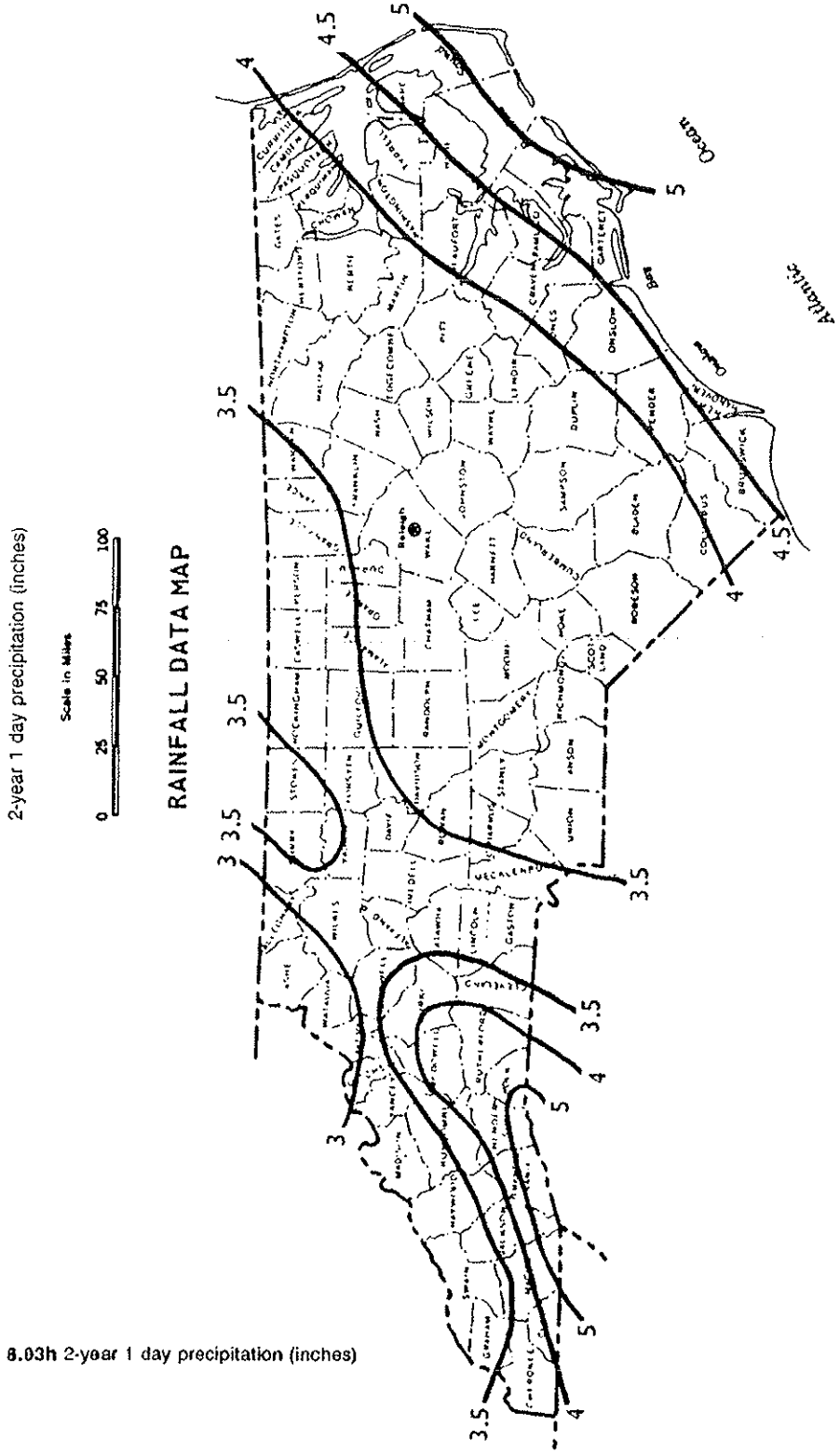


Figure 8.03h 2-year 1 day precipitation (inches)

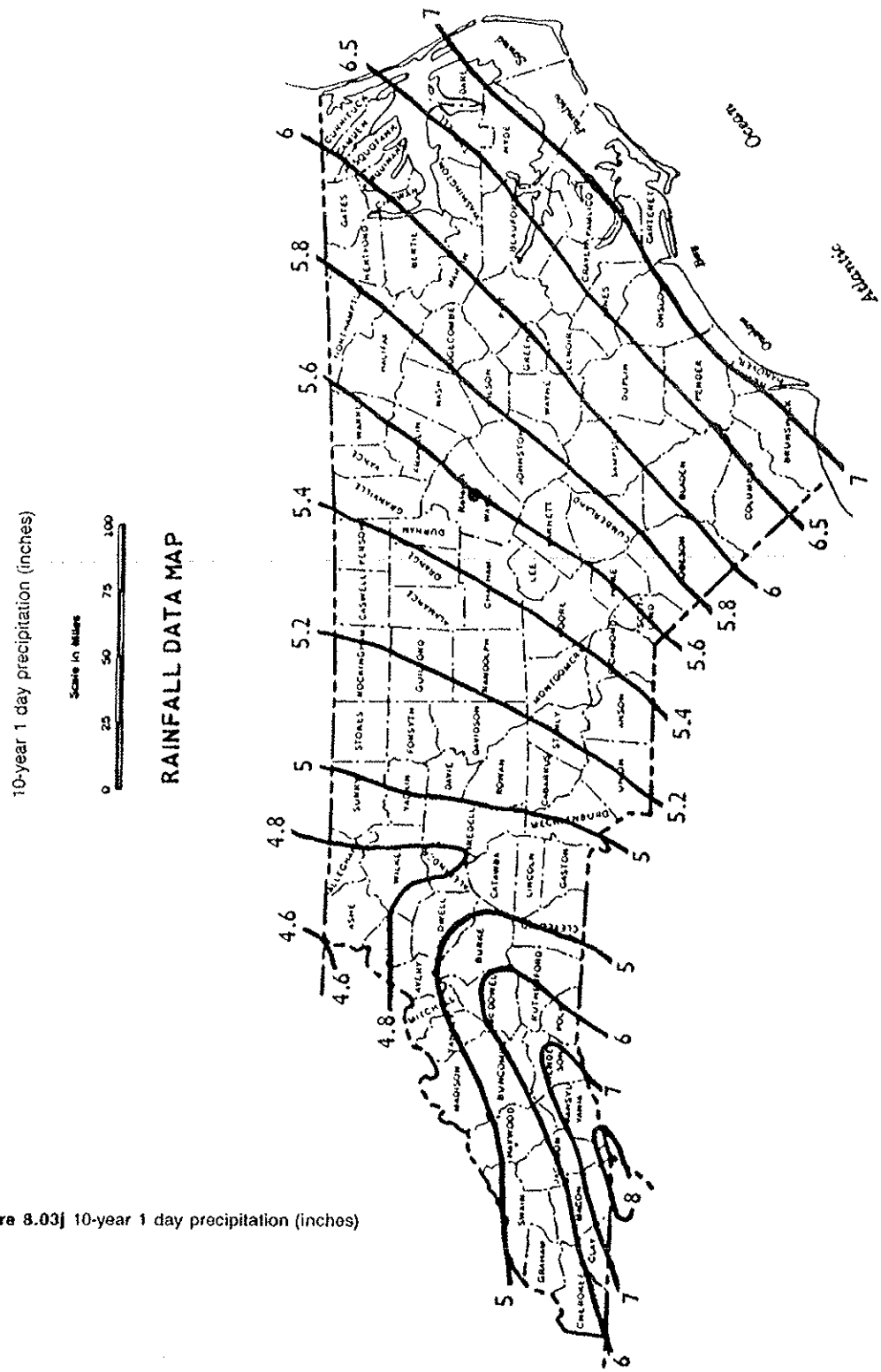


Figure 8.03j 10-year 1 day precipitation (inches)

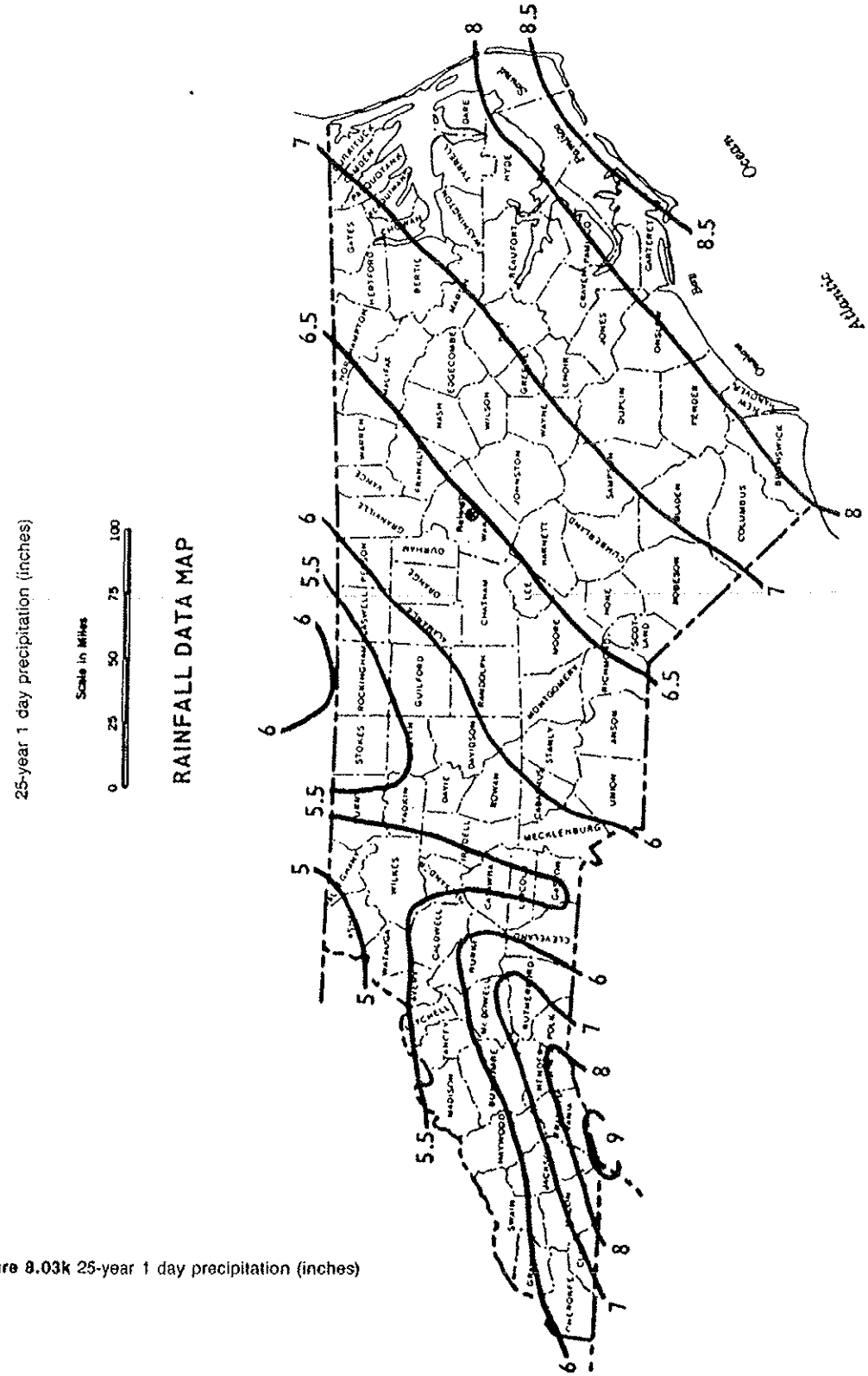


Figure 8.03k 25-year 1 day precipitation (inches)

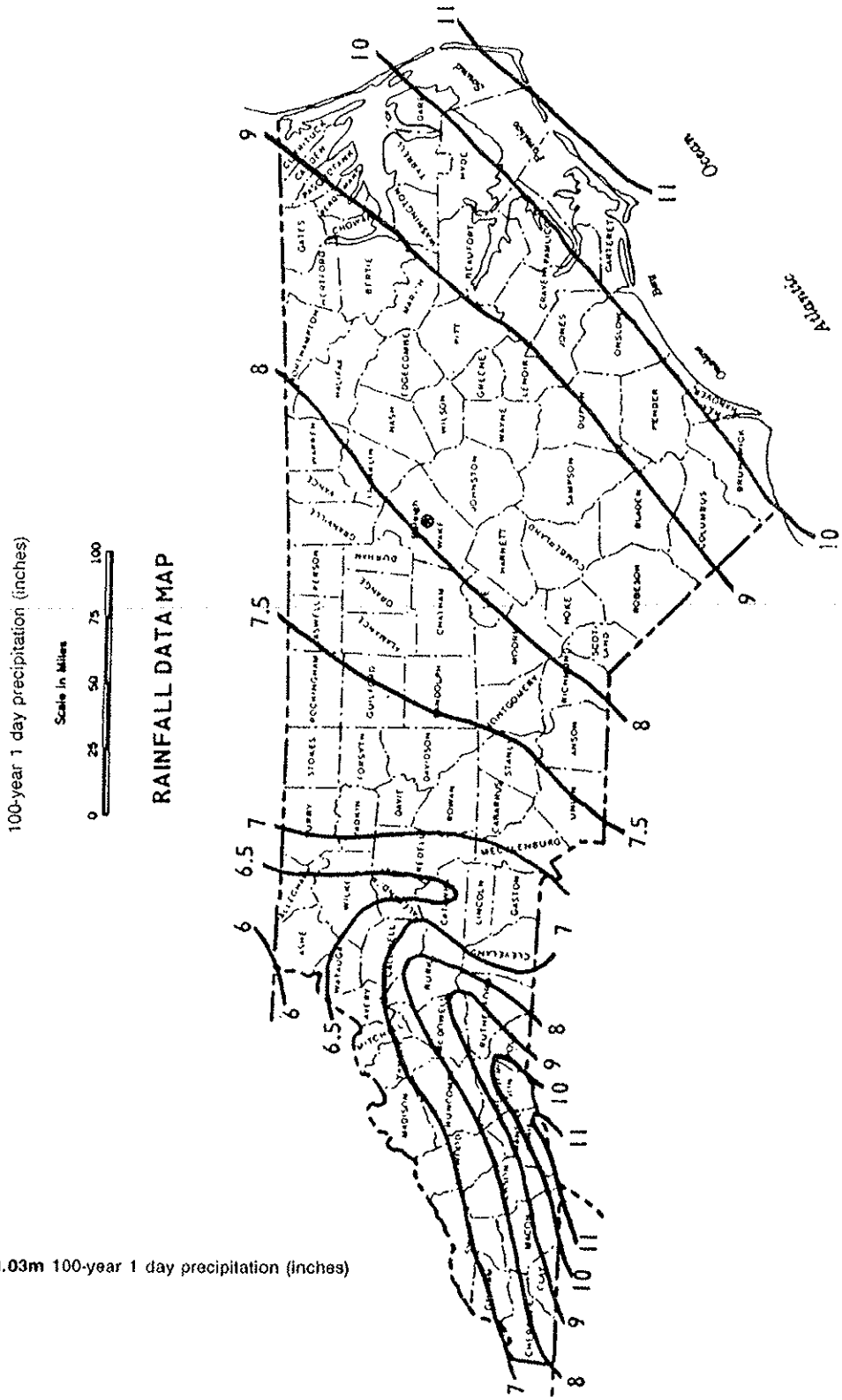


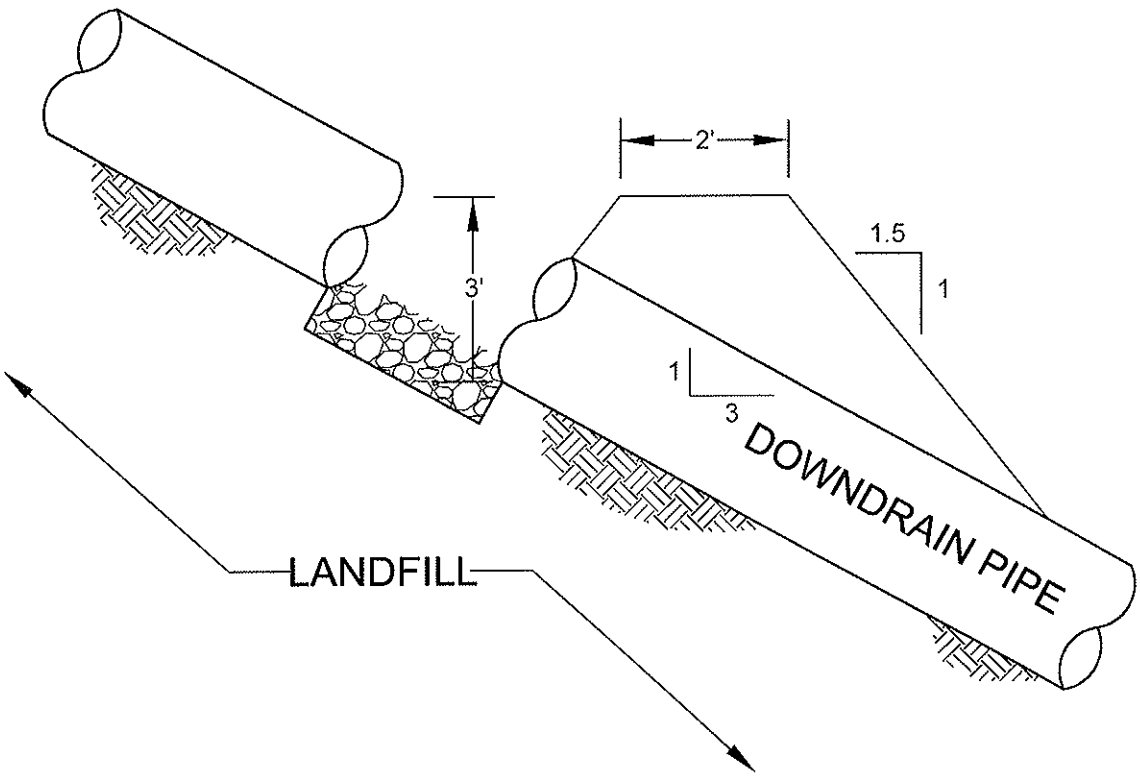
Figure 8.03m 100-year 1 day precipitation (inches)

c. Landfill Side Slope Drainage Berm

The following sketch shows a selected cross section for the side slope drainage berm. Using Manning's Equation with the flowmaster computer program, it is determined that the berm will carry 30.59 cfs at a depth of 2.25 feet. The maximum flow carried in any one berm, except the berm flowing into Downdrain 17, is only 28.12 cfs. Therefore, the berm design is sufficient with a minimum safety factor of 1.09 for flow. The berm flowing into Downdrain 17 has been designed to carry 68.37 cfs at a depth of 3.00 ft. The maximum flow carried in the berm is 54.85 cfs which is sufficient. The factor of safety for flow is 1.25.

These calculations assume good maintenance of the site to prevent clogging of the inlets.

SIDE SLOPE DRAINAGE BERM



DRAINAGE BERM DESIGN

Q MAXIMUM FOR DRAINAGE BERM @ 0.39% SLOPE AND DEPTH OF FLOW ≤ 2.25 FEET = 30.59 CFS

Q MAXIMUM FOR DRAINAGE BERMS AT CHARLOTTE MOTOR SPEEDWAY LANDFILL V PHASE 3 = 28.12 CFS

Qmax for 36" Berm
Worksheet for Triangular Channel

Project Description	
Project File	s:\engineering\charlotte motor speedway design calcs\design calcs\24in qma.fm2
Worksheet	Qmax for 36" Berm
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.035	
Channel Slope	0.003900	ft/ft
Depth	2.25	ft
Left Side Slope	1.500000	H : V
Right Side Slope	3.000000	H : V

Results		
Discharge	30.59	cfs
Flow Area	11.39	ft^2
Wetted Perimeter	11.17	ft
Top Width	10.13	ft
Critical Depth	1.63	ft
Critical Slope	0.021790	ft/ft
Velocity	2.69	ft/s
Velocity Head	0.11	ft
Specific Energy	2.36	ft
Froude Number	0.45	
Flow is subcritical.		

Qmax for 45' Berm
Worksheet for Triangular Channel

Project Description	
Project File	s:\engineering\charlotte motor speedway design calcs\24in qma.fm2
Worksheet	Qmax for 45" Berm
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.035	
Channel Slope	0.004200	ft/ft
Depth	3.00	ft
Left Side Slope	1.500000	H : V
Right Side Slope	3.000000	H : V

Results		
Discharge	68.37	cfs
Flow Area	20.25	ft^2
Wetted Perimeter	14.90	ft
Top Width	13.50	ft
Critical Depth	2.25	ft
Critical Slope	0.019574	ft/ft
Velocity	3.38	ft/s
Velocity Head	0.18	ft
Specific Energy	3.18	ft
Froude Number	0.49	
Flow is subcritical.		

d. Downdrain Calculations

Table 1 summarizes the sizing of each downdrain that appears on the Final Drainage Plan. These tables list the total peak discharge to be handled by each downdrain, the percentage of full flow capacity, and the size of each downdrain.

All proposed downdrains are sized to be a minimum of 18" diameter to minimize clogging. The size of the downdrain is verified to ensure that the maximum flow is less than or equal to 65% of the capacity of the pipe. The maximum depth of flow for any single downdrain is 64.24% of the diameter. If the calculated flow requires greater than a 24" diameter downdrain, then additional downdrain pipes are installed.

TABLE NO.1 - DOWNDRAIN CALCULATIONS

DOWN DRAIN NO.	PEAK DISCHARGE (cfs)	SIZE OF DOWNDRAIN (in)	% FULL
1	5.93	18	26
2	16.54	18	45
3	21.18	18	52
4	26.26	18	60
5	31.17	24	42
6	36.16	24	46
7	41.28	24	49
8	46.32	24	53
9	8.21	18	31
10	12.25	18	38
11	16.48	18	45
12	20.72	18	52
13	24.95	18	58
14	29.30	18	64
15	33.38	24	44
16	37.77	24	47
17	89.61	2-24	52
18	3.67	18	21
19	7.84	18	30
20	12.33	18	38
21	17.17	18	46
22	22.46	18	54
23	27.87	18	62
24	33.38	24	44
25	39.01	24	48
26	45.08	24	52
27	50.73	24	56
28	3.79	18	21
29	5.51	18	25
30	5.69	18	26
31	10.00	18	34
32	12.86	18	39
33	16.14	18	45
34	19.97	18	50
35	24.11	18	57
36	28.47	18	63
37	30.81	24	42
38	58.33	24	61
39	3.51	18	20
40	7.22	18	29
41	11.36	18	37
42	15.42	18	43
43	19.95	18	50
44	24.56	18	57
45	4.13	18	22
46	7.64	18	30

DOWN DRAIN NO.	PEAK DISCHARGE (cfs)	SIZE OF DOWNDRAIN (in)	% FULL
47	11.51	18	37
48	15.37	18	43
49	19.51	18	50
50	23.69	18	56
51	28.16	18	63
52	32.74	24	43
53	37.2	24	46
54	41	24	49
55	4.54	18	23
56	9.2	18	33
57	14.8	18	42
58	20.84	18	52
59	27.31	18	61
60	34.19	24	44
61	44.04	24	51
62	54.44	24	58
63	56.77	24	60

e. Outlet Protection Calculations

PIPE NO. 300

Q_{100} = 108 cfs La = 28 ft.

D_o = 48 in. d^{50} = 12 in.

Quantity of Rip Rap = $\frac{6(D_o) + La}{2}$ La/9

= 81 S.Y. 12" Rip Rap

L = 28'	W1 = 12'	W2 = 40'

PIPE NO. 400

Q_{25} = 80 cfs La = 22 ft.

D_o = 42 in. d^{50} = 12 in.

Quantity of Rip Rap = $\frac{6(D_o) + La}{2}$ La/9

= 53 S.Y. 12" Rip Rap

L = 22'	W1 = 10.5'	W2 = 32.5'

PIPE NO. 500

Q_{100} = 72 cfs

La = 26 ft.

D_o = 48 in.

d^{50} = 12 in.

Quantity of Rip Rap = $\frac{6(D_o) + La}{2}$ La/9

= 72 S.Y. 12" Rip Rap

L = 26'	W1 = 12'	W2 = 38'

Note: For outlet protection to be placed at outlet of downdrain pipe(s) discharging directly into a ditch, the W1 and W2 dimensions of the rip-rap apron are equal to the total ditch width, including the entire sideslope length.

PIPE NO. DD 8

Q_{25} = 46.3 cfs La = 25 ft.

D_o = 24 in. d^{50} = 12 in.

$$\text{Quantity of Rip Rap} = \left[\frac{6(D_o) + La}{2}\right]\left[\frac{La}{9}\right]$$

= 52 S.Y. 12" Rip Rap

L = 25'	W1 = 6'	W2 = 31'

PIPE NO. DD 17

Q_{25} = 44.8 per pipe cfs La = 24 ft.

D_o = 2 - 24 in. d^{50} = 12 in.

$$\text{Quantity of Rip Rap} = \left[\frac{6(D_o) + La}{2}\right]\left[\frac{La}{9}\right]$$

= 53 S.Y. 12" Rip Rap

L = 24'	W1 = 8'	W2 = 32'

Note: For outlet protection to be placed at outlet of downdrain pipe(s) discharging directly into a ditch, the W1 and W2 dimensions of the rip-rap apron are equal to the total ditch width, including the entire sideslope length.

PIPE NO. DD 27

Q_{25} = 50.7 cfs La = 26 ft.

D_o = 24 in. d^{50} = 12 in.

$$\text{Quantity of Rip Rap} = \left[\frac{W_1 + W_2}{2}\right]\left[\frac{La}{9}\right]$$

= 49 S.Y. 12" Rip Rap

L = 26'	W1 = 17'	W2 = 17'

PIPE NO. DD 29

Q_{25} = 5.5 cfs La = 10 ft.

D_o = 18 in. d^{50} = 6 in.

$$\text{Quantity of Rip Rap} = \left[\frac{6(D_o) + La}{2}\right]\left[\frac{La}{9}\right]$$

= 26 S.Y. 6" Rip Rap

L = 10'	W1 = 4.5'	W2 = 14.5'

Note: For outlet protection to be placed at outlet of downdrain pipe(s) discharging directly into a ditch, the W1 and W2 dimensions of the rip-rap apron are equal to the total ditch width, including the entire sideslope length.

PIPE NO. DD 38

Q_{25} = 58.3 cfs La = 28 ft.

D_o = 24 in. d^{50} = 15 in.

$$\text{Quantity of Rip Rap} = \left[\frac{6(D_o) + La}{2}\right]\left[\frac{La}{9}\right]$$

= 62 S.Y. 15" Rip Rap

L = 28'	W1 = 6'	W2 = 34'

PIPE NO. DD 44

Q_{25} = 24.6 cfs La = 20 ft.

D_o = 18 in. d^{50} = 9 in.

$$\text{Quantity of Rip Rap} = \left[\frac{W_1 + W_2}{2}\right]\left[\frac{La}{9}\right]$$

= 30 S.Y. 9" Rip Rap

L = 20'	W1 = 13.5'	W2 = 13.5'

Note: For outlet protection to be placed at outlet of downdrain pipe(s) discharging directly into a ditch, the W1 and W2 dimensions of the rip-rap apron are equal to the total ditch width, including the entire sideslope length.

PIPE NO. DD 54

Q_{25} = 41.0 cfs La = 23 ft.

D_o = 24 in. d^{50} = 12 in.

$$\text{Quantity of Rip Rap} = \left[\frac{6(D_o) + La}{2}\right]\left[\frac{La}{9}\right]$$

= 45 S.Y. 12" Rip Rap

L = 23' W1 = 6' W2 = 29'

PIPE NO. DD 63

Q_{25} = 56.8 cfs La = 28 ft.

D_o = 24 in. d^{50} = 15 in.

$$\text{Quantity of Rip Rap} = \left[\frac{6(D_o) + La}{2}\right]\left[\frac{La}{9}\right]$$

= 62 S.Y. 15" Rip Rap

L = 28' W1 = 6' W2 = 34'

2. SEDIMENT BASIN NO. 3

a. Sediment Basin Design Criteria

Sediment Basin No. 3 at the Charlotte Motor Speedway Landfill V was designed utilizing the following design criteria.

- Minimum Length to Width Ratio = 2:1
- Minimum Surface Area @ 10 year storm = 0.01 acres min. per cfs of flow.
- Sediment Storage = 1,800 cubic feet of volume per acre of disturbed land measured at 3' depth elevation.
- Retain the 25 year, 24 hour storm event below the crest of the riser.
- Permanent Pool Depth = 3 feet
- Freeboard shall be a minimum of 1 foot above the maximum stage of the basin.
- Minimum dewatering time from top of riser = 24 hours

For Sediment Basin No. 3, the actual Phase 3 design criteria is compared to the NCDENR recommended criteria for sediment basins.

Sediment Basin No. 3

Criteria	NCDENR	Phase III Design
Length	2:1	2.5:1
Surface Area	.010 Acre/cfs	0.015 Acre/cfs
Volume at 3' Depth Elevation	1,800 C.F./Acre	5,797 C.F./Acre
Storm Retention	25 year	25 year
Permanent Pool Depth	3 feet	3 feet
Freeboard	1 foot	3.68 feet

b. Sediment Volumes and Surface Area Calculations

SEDIMENT VOLUME STORAGE REQUIREMENTS = 1,800 cu.ft. / acre

= 35.1 acres

= 1,800 x 35.1 acres

= 63,180 cf

From the Hydraflow Hydrographs Computer Program, this volume of sediment will occupy a depth of approximately 0.96 feet (interpolated from printout on next page). This sediment volume corresponds to elevation = 574.96 feet.

TOTAL VOLUME IN 3 FOOT PERMANENT POOL = 203,479 c.f.

AVAILABLE SEDIMENT STORAGE = 203,479 c.f. ÷ 35.1 ac = 5,797 c.f./ac

RECOMMENDED SURFACE AREA REQUIREMENTS = 0.01 ACRE PER CFS

Q_{10} = 108.98 cfs

Minimum Surface Area = 0.01 acres x Q_{100}

= 1.09 acres

= 47,480 s.f.

Actual Surface Area At Permanent Pool (El. 577.00) =
Sediment Basin 3 Area

= 73,536 s.f.

Actual Surface Area is greater than minimum surface area.

Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Thursday, Apr 30, 2009

Pond No. 1 - Sediment Pond No. 3

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 574.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	574.00	62,239	0	0
2.00	576.00	69,714	131,869	131,869
3.00	577.00	73,536	71,609	203,479
4.00	578.00	77,414	75,459	278,938
6.00	580.00	85,282	162,616	441,554
8.00	582.00	93,492	178,693	620,247
10.00	584.00	101,871	195,284	815,531

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 48.00	4.00	0.00	0.00
Span (in)	= 48.00	16.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 576.00	577.00	0.00	0.00
Length (ft)	= 78.00	0.00	0.00	0.00
Slope (%)	= 3.85	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 20.00	0.00	0.00	0.00
Crest El. (ft)	= 581.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	574.00	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
2.00	131,869	576.00	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
3.00	203,479	577.00	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
4.00	278,938	578.00	1.97 ic	1.95 ic	---	---	0.00	---	---	---	---	---	1.954
6.00	441,554	580.00	3.62 ic	3.60 ic	---	---	0.00	---	---	---	---	---	3.602
8.00	620,247	582.00	70.35 ic	3.49 ic	---	---	66.60	---	---	---	---	---	70.09
10.00	815,531	584.00	145.56 ic	0.98 ic	---	---	144.57 s	---	---	---	---	---	145.55

Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Thursday, Apr 30, 2009

Pond No. 3 - Sediment Pond No. 3 w/ Pool

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 577.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	577.00	73,536	0	0
1.00	578.00	77,414	75,459	75,459
3.00	580.00	85,282	162,616	238,075
5.00	582.00	93,492	178,693	416,769
7.00	584.00	101,871	195,284	612,052

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 48.00	4.00	0.00	0.00
Span (in)	= 48.00	16.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 576.00	577.00	0.00	0.00
Length (ft)	= 78.00	0.00	0.00	0.00
Slope (%)	= 3.85	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 20.00	0.00	0.00	0.00
Crest El. (ft)	= 581.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	577.00	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
1.00	75,459	578.00	8.47 ic	1.95 ic	---	---	0.00	---	---	---	---	---	1.954
3.00	238,075	580.00	8.47 ic	3.60 ic	---	---	0.00	---	---	---	---	---	3.602
5.00	416,769	582.00	70.35 ic	3.49 ic	---	---	66.60	---	---	---	---	---	70.09
7.00	612,052	584.00	145.56 ic	0.98 ic	---	---	144.56 s	---	---	---	---	---	145.54

Pond Report

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Pond No. 2 - Sediment Pond No. 3 Back to Back

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 581.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	581.00	89,331	0	0
1.00	582.00	93,492	91,394	91,394
3.00	584.00	101,871	195,284	286,678

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 48.00	0.00	0.00	0.00
Span (in)	= 48.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 576.00	0.00	0.00	0.00
Length (ft)	= 78.00	0.00	0.00	0.00
Slope (%)	= 3.85	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 20.00	0.00	0.00	0.00
Crest El. (ft)	= 581.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	581.00	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.00	91,394	582.00	104.79 ic	---	---	---	66.60	---	---	---	---	---	66.60
3.00	286,678	584.00	145.52 ic	---	---	---	145.51 s	---	---	---	---	---	145.51

c. Basin Dewatering

Total Basin Dewatering at Top of Riser

Retention time within the basin is an important factor in effective sediment retention. The perforated riser pipe method has been used for the proposed sediment basin.

The 5' x 5' square concrete overflow structure shall have one 4" (h) x 16" (w) dewatering orifice at elevation 577.00.

The calculation below has been performed to confirm that the dewatering (retention) time within the basin is >24 hours. This dewatering time will ensure the storm water is retained for an adequate length of time to allow the sediment to settle (minimum 24 hours).

$$T = \frac{(As)(2h)^{1/2}}{(Ao)(Cd)(20428)}$$

Where T = Dewatering Time (hr.)
As = Surface Area at Basin (ft^2)
h = Head of Water (ft)
Ao = Surface Area of Dewatering Orifice (ft^2)
Cd = Coefficient of Discharge for an Orifice (use 0.6)

T > 24 hours

Ao = 0.44 s.f. @ Elev. 577.00

As = 89,331 s.f. @ Elev. 581.00 (top of riser)

h = 581.00 – 577.00 = 4.00'

$$T = \frac{89{,}331\ (2 \times 4)^{1/2}}{(0.44)\ (0.6)\ (20{,}428)} = 46.9 \text{ hours}$$

(okay between 24 - 72 hours)

d. Reservoir Routing

Reservoir routing is determined by using the HydraFlow Computer Program.

Peak inflow rates (Q) are determined using the SCS Method and HydraFlow computer program. Peak inflow rates are calculated for the 2 year, 10 year, 25-year, and 100 year storm events and are summarized below.

Q_2 = 53.76 cfs
Q_{10} = 108.98 cfs
Q_{25} = 142.30 cfs
Q_{100} = 188.02 cfs

The bottom of the sediment basin has been set at 574.00. The permanent pool has been set at elevation 577.00. Dewatering of the sediment basin is accomplished by a 4" x 16" rectangular opening beginning at an invert elevation of 577.00.

For routing calculations, a 5' x 5' square riser with a 4" x 16" rectangular opening beginning at an invert elevation of 577.00 is used. The top of the riser is at an elevation of 581.00. The bottom of the sediment basin is elevation 574.00. The invert of the carrier pipe is 576.00. The top of the levee around the sediment basin is at an elevation of 584.00.

Based on the above information the reservoir routing calculations are performed and summarized below.

STORM YEAR	PEAK INFLOW CFS	PEAK OUTFLOW CFS	PEAK ELEV. FEET
2	53.76	2.15	578.17
10	108.98	3.27	579.50
25	142.30	3.80	580.32
100	188.02	8.29	581.14

Based on these routing calculations, the riser is large enough and the sediment basin has sufficient storage volume to retain the sediment from 35 disturbed acres plus the 25-year storm event from the entire drainage area below the crest of the riser (elev. 581.00).

Hydrograph Summary Report

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Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	2.254	1	723	6,211	------	------	------	Area to DD No. 1
2	SCS Runoff	4.165	1	727	14,223	------	------	------	Area to DD No. 2
3	Combine	6.209	1	725	20,434	1, 2	------	------	DD No. 2
4	SCS Runoff	1.829	1	723	5,041	------	------	------	Area to DD No. 3
5	Combine	7.965	1	724	25,475	3, 4	------	------	DD No. 3
6	SCS Runoff	1.943	1	723	5,356	------	------	------	Area to DD No. 4
7	Combine	9.869	1	724	30,832	5, 6	------	------	DD No. 4
8	SCS Runoff	1.878	1	723	5,176	------	------	------	Area to DD No. 5
9	Combine	11.72	1	723	36,008	7, 8	------	------	DD No. 5
10	SCS Runoff	1.911	1	723	5,266	------	------	------	Area to DD No. 6
11	Combine	13.63	1	723	41,274	9, 10	------	------	DD No. 6
12	SCS Runoff	1.960	1	723	5,401	------	------	------	Area to DD No. 7
13	Combine	15.59	1	723	46,675	11, 12	------	------	DD No. 7
14	SCS Runoff	1.927	1	723	5,311	------	------	------	Area to DD No. 8
15	Combine	17.51	1	723	51,986	13, 14	------	------	DD No. 8
16	SCS Runoff	3.177	1	720	7,246	------	------	------	Area to DD No. 9
17	SCS Runoff	1.559	1	720	3,556	------	------	------	Area to DD No 10
18	Combine	4.736	1	720	10,802	16, 17	------	------	DD No. 10
19	SCS Runoff	1.657	1	719	3,511	------	------	------	Area to DD No. 11
20	Combine	6.351	1	719	14,313	18, 19	------	------	DD No. 11
21	SCS Runoff	1.657	1	719	3,511	------	------	------	Area to DD No. 12
22	Combine	8.008	1	719	17,824	20, 21	------	------	DD No. 12
23	SCS Runoff	1.657	1	719	3,511	------	------	------	Area to DD No. 13
24	Combine	9.665	1	719	21,334	22, 23	------	------	DD No. 13
25	SCS Runoff	1.699	1	719	3,598	------	------	------	Area to DD No. 14
26	Combine	11.36	1	719	24,933	24, 25	------	------	DD No. 14
27	SCS Runoff	1.579	1	720	3,601	------	------	------	Area to DD No. 15
28	Combine	12.93	1	719	28,533	26, 27	------	------	DD No. 15
29	SCS Runoff	1.719	1	719	3,642	------	------	------	Area to DD No. 16
30	Combine	14.65	1	719	32,176	28, 29	------	------	DD No. 16
31	SCS Runoff	1.512	1	747	9,505	------	------	------	Area to DD No. 17
32	SCS Runoff	1.383	1	725	4,227	------	------	------	Area to DD No. 18
33	SCS Runoff	1.650	1	722	4,253	------	------	------	Area to DD No. 19

Hydrograph Summary Report

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Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
34	Combine	2.963	1	723	8,481	32, 33	------	------	DD No. 19
35	SCS Runoff	1.855	1	720	4,231	------	------	------	Area to DD No. 20
36	Combine	4.691	1	721	12,711	34, 35	------	------	DD No. 20
37	SCS Runoff	2.009	1	719	4,257	------	------	------	Area to DD No. 21
38	Combine	6.559	1	720	16,968	36, 37	------	------	DD No. 21
39	SCS Runoff	2.092	1	719	4,432	------	------	------	Area to DD No. 22
40	Combine	8.567	1	720	21,400	38, 39	------	------	DD No. 22
41	SCS Runoff	2.092	1	720	4,771	------	------	------	Area to DD No. 23
42	Combine	10.66	1	720	26,171	40, 41	------	------	DD No. 23
43	SCS Runoff	2.165	1	721	5,314	------	------	------	Area to DD No. 24
44	Combine	12.81	1	720	31,486	42, 43	------	------	DD No. 24
45	SCS Runoff	2.202	1	721	5,406	------	------	------	Area to DD No. 25
46	Combine	15.00	1	720	36,892	44, 45	------	------	DD No. 25
47	SCS Runoff	2.333	1	721	5,727	------	------	------	Area to DD No. 26
48	Combine	17.31	1	720	42,618	46, 47	------	------	DD No. 26
49	SCS Runoff	2.237	1	723	6,166	------	------	------	Area to DD No. 27
50	Combine	19.40	1	720	48,784	48, 49	------	------	DD No. 27
51	Combine	34.26	1	720	90,465	30, 31, 50	------	------	DD No. 17
52	SCS Runoff	7.643	1	716	13,292	------	------	------	Area to Basin No. 3
53	Combine	53.76	1	720	155,742	15, 51, 52	------	------	Total Basin No. 3 Inflow
54	SCS Runoff	1.456	1	721	3,573	------	------	------	Area to DD No. 28
55	SCS Runoff	0.840	1	717	1,575	------	------	------	Area to DD No. 29
56	Combine	2.109	1	719	5,149	54, 55	------	------	DD No. 29
57	SCS Runoff	2.217	1	719	4,696	------	------	------	Area to DD No. 30
58	SCS Runoff	1.677	1	720	3,826	------	------	------	Area to DD No. 31
59	Combine	3.879	1	719	8,521	57, 58	------	------	DD No. 31
60	SCS Runoff	1.119	1	719	2,370	------	------	------	Area to DD No. 32
61	Combine	4.997	1	719	10,891	59, 60	------	------	DD No. 32
62	SCS Runoff	1.284	1	719	2,721	------	------	------	Area to DD No. 33
63	Combine	6.282	1	719	13,612	61, 62	------	------	DD No. 33
64	SCS Runoff	1.480	1	720	3,376	------	------	------	Area to DD No. 34
65	Combine	7.749	1	719	16,987	63, 64	------	------	DD No. 34
66	SCS Runoff	1.624	1	721	3,986	------	------	------	Area to DD No. 35

Hydrograph Summary Report

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Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
67	Combine	9.304	1	719	20,973	65, 66	------	------	DD No. 35
68	SCS Runoff	1.753	1	722	4,519	------	------	------	Area to DD No. 36
69	Combine	10.92	1	719	25,492	67, 68	------	------	DD No. 36
70	SCS Runoff	0.967	1	718	1,949	------	------	------	Area to DD No. 37
71	Combine	11.85	1	719	27,442	69, 70	------	------	DD No. 37
72	SCS Runoff	1.358	1	722	3,500	------	------	------	Area to DD No. 38
73	SCS Runoff	1.367	1	719	2,896	------	------	------	Area to DD No. 39
74	SCS Runoff	1.440	1	720	3,286	------	------	------	Area to DD No. 40
75	Combine	2.795	1	719	6,182	73, 74	------	------	DD No. 40
76	SCS Runoff	1.624	1	721	3,986	------	------	------	Area to DD No. 41
77	Combine	4.365	1	720	10,168	75, 76	------	------	DD No. 41
78	SCS Runoff	1.616	1	722	4,165	------	------	------	Area to DD No. 42
79	Combine	5.934	1	720	14,332	77, 78	------	------	DD No. 42
80	SCS Runoff	1.753	1	722	4,519	------	------	------	Area to DD No. 43
81	Combine	7.635	1	720	18,852	79, 80	------	------	DD No. 43
82	SCS Runoff	1.829	1	723	5,041	------	------	------	Area to DD No. 44
83	Combine	9.374	1	721	23,893	81, 82	------	------	DD No. 44
84	Combine	22.42	1	720	54,835	71, 72, 83	------	------	DD No. 38
85	SCS Runoff	8.032	1	716	13,967	------	------	------	Area to Basin No. 5
86	Combine	29.48	1	718	73,950	56, 84, 85	------	------	Total Basin No. 5 Inflow
87	Reservoir	2.147	1	931	149,274	53	578.17	89,611	Sediment Basin No. 3
88	Reservoir	21.48	1	732	155,738	53	581.47	42,885	Sed Basin No. 3 BTB
90	Reservoir	1.261	1	864	73,343	86	580.07	39,847	Sediment Basin No. 5
91	Reservoir	15.30	1	726	73,948	86	583.37	17,987	Sed Basin No. 5 BTB

Hydrograph Summary Report

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Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	4.549	1	722	12,244	------	------	------	Area to DD No. 1
2	SCS Runoff	8.490	1	726	28,039	------	------	------	Area to DD No. 2
3	Combine	12.63	1	724	40,283	1, 2	------	------	DD No. 2
4	SCS Runoff	3.692	1	722	9,937	------	------	------	Area to DD No. 3
5	Combine	16.21	1	724	50,221	3, 4	------	------	DD No. 3
6	SCS Runoff	3.922	1	722	10,559	------	------	------	Area to DD No. 4
7	Combine	20.07	1	723	60,779	5, 6	------	------	DD No. 4
8	SCS Runoff	3.791	1	722	10,204	------	------	------	Area to DD No. 5
9	Combine	23.85	1	723	70,983	7, 8	------	------	DD No. 5
10	SCS Runoff	3.856	1	722	10,381	------	------	------	Area to DD No. 6
11	Combine	27.68	1	723	81,364	9, 10	------	------	DD No. 6
12	SCS Runoff	3.955	1	722	10,647	------	------	------	Area to DD No. 7
13	Combine	31.62	1	723	92,011	11, 12	------	------	DD No. 7
14	SCS Runoff	3.889	1	722	10,470	------	------	------	Area to DD No. 8
15	Combine	35.49	1	723	102,481	13, 14	------	------	DD No. 8
16	SCS Runoff	6.314	1	719	14,285	------	------	------	Area to DD No. 9
17	SCS Runoff	3.098	1	719	7,009	------	------	------	Area to DD No 10
18	Combine	9.413	1	719	21,295	16, 17	------	------	DD No. 10
19	SCS Runoff	3.272	1	718	6,921	------	------	------	Area to DD No. 11
20	Combine	12.68	1	719	28,215	18, 19	------	------	DD No. 11
21	SCS Runoff	3.272	1	718	6,921	------	------	------	Area to DD No. 12
22	Combine	15.96	1	719	35,136	20, 21	------	------	DD No. 12
23	SCS Runoff	3.272	1	718	6,921	------	------	------	Area to DD No. 13
24	Combine	19.23	1	719	42,057	22, 23	------	------	DD No. 13
25	SCS Runoff	3.354	1	718	7,094	------	------	------	Area to DD No. 14
26	Combine	22.58	1	719	49,151	24, 25	------	------	DD No. 14
27	SCS Runoff	3.138	1	719	7,098	------	------	------	Area to DD No. 15
28	Combine	25.72	1	719	56,249	26, 27	------	------	DD No. 15
29	SCS Runoff	3.395	1	718	7,180	------	------	------	Area to DD No. 16
30	Combine	29.11	1	719	63,429	28, 29	------	------	DD No. 16
31	SCS Runoff	3.132	1	746	18,737	------	------	------	Area to DD No. 17
32	SCS Runoff	2.806	1	724	8,333	------	------	------	Area to DD No. 18
33	SCS Runoff	3.318	1	721	8,385	------	------	------	Area to DD No. 19

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Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
34	Combine	6.008	1	722	16,718	32, 33	------	------	DD No. 19
35	SCS Runoff	3.687	1	719	8,340	------	------	------	Area to DD No. 20
36	Combine	9.459	1	721	25,058	34, 35	------	------	DD No. 20
37	SCS Runoff	3.967	1	718	8,391	------	------	------	Area to DD No. 21
38	Combine	13.19	1	720	33,450	36, 37	------	------	DD No. 21
39	SCS Runoff	4.131	1	718	8,737	------	------	------	Area to DD No. 22
40	Combine	17.23	1	719	42,187	38, 39	------	------	DD No. 22
41	SCS Runoff	4.157	1	719	9,405	------	------	------	Area to DD No. 23
42	Combine	21.39	1	719	51,592	40, 41	------	------	DD No. 23
43	SCS Runoff	4.330	1	720	10,476	------	------	------	Area to DD No. 24
44	Combine	25.61	1	719	62,068	42, 43	------	------	DD No. 24
45	SCS Runoff	4.405	1	720	10,657	------	------	------	Area to DD No. 25
46	Combine	30.00	1	720	72,725	44, 45	------	------	DD No. 25
47	SCS Runoff	4.666	1	720	11,289	------	------	------	Area to DD No. 26
48	Combine	34.67	1	720	84,014	46, 47	------	------	DD No. 26
49	SCS Runoff	4.516	1	722	12,156	------	------	------	Area to DD No. 27
50	Combine	38.97	1	720	96,170	48, 49	------	------	DD No. 27
51	Combine	68.76	1	719	178,335	30, 31, 50	------	------	DD No. 17
52	SCS Runoff	14.89	1	716	26,202	------	------	------	Area to Basin No. 3
53	Combine	108.98	1	719	307,019	15, 51, 52	------	------	Total Basin No. 3 Inflow
54	SCS Runoff	2.912	1	720	7,044	------	------	------	Area to DD No. 28
55	SCS Runoff	1.646	1	717	3,105	------	------	------	Area to DD No. 29
56	Combine	4.233	1	718	10,150	54, 55	------	------	DD No. 29
57	SCS Runoff	4.376	1	718	9,256	------	------	------	Area to DD No. 30
58	SCS Runoff	3.334	1	719	7,542	------	------	------	Area to DD No. 31
59	Combine	7.710	1	719	16,798	57, 58	------	------	DD No. 31
60	SCS Runoff	2.209	1	718	4,671	------	------	------	Area to DD No. 32
61	Combine	9.918	1	719	21,470	59, 60	------	------	DD No. 32
62	SCS Runoff	2.536	1	718	5,364	------	------	------	Area to DD No. 33
63	Combine	12.45	1	719	26,833	61, 62	------	------	DD No. 33
64	SCS Runoff	2.941	1	719	6,655	------	------	------	Area to DD No. 34
65	Combine	15.40	1	719	33,488	63, 64	------	------	DD No. 34
66	SCS Runoff	3.248	1	720	7,857	------	------	------	Area to DD No. 35

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Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
67	Combine	18.56	1	719	41,345	65, 66	------	------	DD No. 35
68	SCS Runoff	3.525	1	721	8,909	------	------	------	Area to DD No. 36
69	Combine	21.89	1	719	50,254	67, 68	------	------	DD No. 36
70	SCS Runoff	1.907	1	718	3,843	------	------	------	Area to DD No. 37
71	Combine	23.70	1	719	54,097	69, 70	------	------	DD No. 37
72	SCS Runoff	2.730	1	721	6,900	------	------	------	Area to DD No. 38
73	SCS Runoff	2.699	1	718	5,710	------	------	------	Area to DD No. 39
74	SCS Runoff	2.863	1	719	6,477	------	------	------	Area to DD No. 40
75	Combine	5.562	1	719	12,187	73, 74	------	------	DD No. 40
76	SCS Runoff	3.248	1	720	7,857	------	------	------	Area to DD No. 41
77	Combine	8.728	1	719	20,044	75, 76	------	------	DD No. 41
78	SCS Runoff	3.249	1	721	8,210	------	------	------	Area to DD No. 42
79	Combine	11.86	1	720	28,254	77, 78	------	------	DD No. 42
80	SCS Runoff	3.525	1	721	8,909	------	------	------	Area to DD No. 43
81	Combine	15.33	1	720	37,163	79, 80	------	------	DD No. 43
82	SCS Runoff	3.692	1	722	9,937	------	------	------	Area to DD No. 44
83	Combine	18.85	1	720	47,100	81, 82	------	------	DD No. 44
84	Combine	44.83	1	720	108,097	71, 72, 83	------	------	DD No. 38
85	SCS Runoff	15.64	1	716	27,533	------	------	------	Area to Basin No. 5
86	Combine	59.28	1	718	145,780	56, 84, 85	------	------	Total Basin No. 5 Inflow
87	Reservoir	3.268	1	962	290,359	53	579.50	197,386	Sediment Basin No. 3
88	Reservoir	55.63	1	729	307,015	53	581.89	81,055	Sed Basin No. 3 BTB
90	Reservoir	1.975	1	899	143,513	86	581.35	87,847	Sediment Basin No. 5
91	Reservoir	37.42	1	724	145,777	86	583.68	32,739	Sed Basin No. 5 BTB

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Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	5.934	1	722	15,954	------	------	------	Area to DD No. 1
2	SCS Runoff	11.11	1	726	36,534	------	------	------	Area to DD No. 2
3	Combine	16.54	1	724	52,489	1, 2	------	------	DD No. 2
4	SCS Runoff	4.816	1	722	12,948	------	------	------	Area to DD No. 3
5	Combine	21.18	1	723	65,437	3, 4	------	------	DD No. 3
6	SCS Runoff	5.117	1	722	13,758	------	------	------	Area to DD No. 4
7	Combine	26.26	1	723	79,195	5, 6	------	------	DD No. 4
8	SCS Runoff	4.945	1	722	13,295	------	------	------	Area to DD No. 5
9	Combine	31.17	1	723	92,490	7, 8	------	------	DD No. 5
10	SCS Runoff	5.031	1	722	13,527	------	------	------	Area to DD No. 6
11	Combine	36.16	1	723	106,016	9, 10	------	------	DD No. 6
12	SCS Runoff	5.160	1	722	13,873	------	------	------	Area to DD No. 7
13	Combine	41.28	1	723	119,890	11, 12	------	------	DD No. 7
14	SCS Runoff	5.074	1	722	13,642	------	------	------	Area to DD No. 8
15	Combine	46.32	1	723	133,532	13, 14	------	------	DD No. 8
16	SCS Runoff	8.214	1	719	18,613	------	------	------	Area to DD No. 9
17	SCS Runoff	4.031	1	719	9,133	------	------	------	Area to DD No 10
18	Combine	12.25	1	719	27,747	16, 17	------	------	DD No. 10
19	SCS Runoff	4.251	1	718	9,018	------	------	------	Area to DD No. 11
20	Combine	16.48	1	719	36,764	18, 19	------	------	DD No. 11
21	SCS Runoff	4.251	1	718	9,018	------	------	------	Area to DD No. 12
22	Combine	20.72	1	719	45,782	20, 21	------	------	DD No. 12
23	SCS Runoff	4.251	1	718	9,018	------	------	------	Area to DD No. 13
24	Combine	24.95	1	719	54,800	22, 23	------	------	DD No. 13
25	SCS Runoff	4.357	1	718	9,243	------	------	------	Area to DD No. 14
26	Combine	29.30	1	719	64,043	24, 25	------	------	DD No. 14
27	SCS Runoff	4.082	1	719	9,249	------	------	------	Area to DD No. 15
28	Combine	33.38	1	719	73,292	26, 27	------	------	DD No. 15
29	SCS Runoff	4.410	1	718	9,356	------	------	------	Area to DD No. 16
30	Combine	37.77	1	719	82,648	28, 29	------	------	DD No. 16
31	SCS Runoff	4.117	1	746	24,414	------	------	------	Area to DD No. 17
32	SCS Runoff	3.667	1	724	10,858	------	------	------	Area to DD No. 18
33	SCS Runoff	4.323	1	721	10,925	------	------	------	Area to DD No. 19

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Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
34	Combine	7.844	1	722	21,784	32, 33	------	------	DD No. 19
35	SCS Runoff	4.796	1	719	10,867	------	------	------	Area to DD No. 20
36	Combine	12.33	1	721	32,651	34, 35	------	------	DD No. 20
37	SCS Runoff	5.154	1	718	10,934	------	------	------	Area to DD No. 21
38	Combine	17.17	1	720	43,585	36, 37	------	------	DD No. 21
39	SCS Runoff	5.367	1	718	11,385	------	------	------	Area to DD No. 22
40	Combine	22.46	1	719	54,970	38, 39	------	------	DD No. 22
41	SCS Runoff	5.408	1	719	12,255	------	------	------	Area to DD No. 23
42	Combine	27.87	1	719	67,224	40, 41	------	------	DD No. 23
43	SCS Runoff	5.641	1	720	13,650	------	------	------	Area to DD No. 24
44	Combine	33.38	1	719	80,875	42, 43	------	------	DD No. 24
45	SCS Runoff	5.738	1	720	13,886	------	------	------	Area to DD No. 25
46	Combine	39.01	1	720	94,761	44, 45	------	------	DD No. 25
47	SCS Runoff	6.078	1	720	14,709	------	------	------	Area to DD No. 26
48	Combine	45.08	1	720	109,470	46, 47	------	------	DD No. 26
49	SCS Runoff	5.891	1	722	15,839	------	------	------	Area to DD No. 27
50	Combine	50.73	1	720	125,309	48, 49	------	------	DD No. 27
51	Combine	89.61	1	719	232,370	30, 31, 50	------	------	DD No. 17
52	SCS Runoff	19.19	1	716	34,141	------	------	------	Area to Basin No. 3
53	Combine	142.30	1	719	400,044	15, 51, 52	------	------	Total Basin No. 3 Inflow
54	SCS Runoff	3.793	1	720	9,179	------	------	------	Area to DD No. 28
55	SCS Runoff	2.126	1	717	4,046	------	------	------	Area to DD No. 29
56	Combine	5.514	1	718	13,225	54, 55	------	------	DD No. 29
57	SCS Runoff	5.686	1	718	12,061	------	------	------	Area to DD No. 30
58	SCS Runoff	4.337	1	719	9,827	------	------	------	Area to DD No. 31
59	Combine	10.00	1	719	21,888	57, 58	------	------	DD No. 31
60	SCS Runoff	2.869	1	718	6,087	------	------	------	Area to DD No. 32
61	Combine	12.86	1	719	27,975	59, 60	------	------	DD No. 32
62	SCS Runoff	3.295	1	718	6,989	------	------	------	Area to DD No. 33
63	Combine	16.14	1	719	34,964	61, 62	------	------	DD No. 33
64	SCS Runoff	3.827	1	719	8,671	------	------	------	Area to DD No. 34
65	Combine	19.97	1	719	43,635	63, 64	------	------	DD No. 34
66	SCS Runoff	4.231	1	720	10,238	------	------	------	Area to DD No. 35

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Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
67	Combine	24.11	1	719	53,872	65, 66	------	------	DD No. 35
68	SCS Runoff	4.594	1	721	11,608	------	------	------	Area to DD No. 36
69	Combine	28.47	1	719	65,480	67, 68	------	------	DD No. 36
70	SCS Runoff	2.467	1	718	5,007	------	------	------	Area to DD No. 37
71	Combine	30.81	1	719	70,488	69, 70	------	------	DD No. 37
72	SCS Runoff	3.558	1	721	8,991	------	------	------	Area to DD No. 38
73	SCS Runoff	3.507	1	718	7,440	------	------	------	Area to DD No. 39
74	SCS Runoff	3.725	1	719	8,440	------	------	------	Area to DD No. 40
75	Combine	7.219	1	719	15,879	73, 74	------	------	DD No. 40
76	SCS Runoff	4.231	1	720	10,238	------	------	------	Area to DD No. 41
77	Combine	11.36	1	719	26,117	75, 76	------	------	DD No. 41
78	SCS Runoff	4.233	1	721	10,698	------	------	------	Area to DD No. 42
79	Combine	15.42	1	720	36,815	77, 78	------	------	DD No. 42
80	SCS Runoff	4.594	1	721	11,608	------	------	------	Area to DD No. 43
81	Combine	19.95	1	720	48,423	79, 80	------	------	DD No. 43
82	SCS Runoff	4.816	1	722	12,948	------	------	------	Area to DD No. 44
83	Combine	24.56	1	720	61,371	81, 82	------	------	DD No. 44
84	Combine	58.33	1	719	140,849	71, 72, 83	------	------	DD No. 38
85	SCS Runoff	20.16	1	716	35,876	------	------	------	Area to Basin No. 5
86	Combine	77.19	1	718	189,950	56, 84, 85	------	------	Total Basin No. 5 Inflow
87	Reservoir	3.800	1	988	367,646	53	580.32	266,722	Sediment Basin No. 3
88	Reservoir	78.03	1	728	400,039	53	582.11	102,053	Sed Basin No. 3 BTB
90	Reservoir	2.322	1	915	185,585	86	582.18	118,880	Sediment Basin No. 5
91	Reservoir	51.78	1	724	189,948	86	583.85	40,650	Sed Basin No. 5 BTB

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Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	7.834	1	722	21,124	------	------	------	Area to DD No. 1
2	SCS Runoff	14.72	1	726	48,373	------	------	------	Area to DD No. 2
3	Combine	21.91	1	724	69,497	1, 2	------	------	DD No. 2
4	SCS Runoff	6.358	1	722	17,144	------	------	------	Area to DD No. 3
5	Combine	28.06	1	723	86,642	3, 4	------	------	DD No. 3
6	SCS Runoff	6.756	1	722	18,216	------	------	------	Area to DD No. 4
7	Combine	34.75	1	723	104,858	5, 6	------	------	DD No. 4
8	SCS Runoff	6.529	1	722	17,604	------	------	------	Area to DD No. 5
9	Combine	41.21	1	723	122,461	7, 8	------	------	DD No. 5
10	SCS Runoff	6.642	1	722	17,910	------	------	------	Area to DD No. 6
11	Combine	47.79	1	723	140,371	9, 10	------	------	DD No. 6
12	SCS Runoff	6.812	1	722	18,369	------	------	------	Area to DD No. 7
13	Combine	54.54	1	723	158,740	11, 12	------	------	DD No. 7
14	SCS Runoff	6.699	1	722	18,063	------	------	------	Area to DD No. 8
15	Combine	61.17	1	723	176,802	13, 14	------	------	DD No. 8
16	SCS Runoff	10.81	1	719	24,645	------	------	------	Area to DD No. 9
17	SCS Runoff	5.307	1	719	12,093	------	------	------	Area to DD No 10
18	Combine	16.12	1	719	36,738	16, 17	------	------	DD No. 10
19	SCS Runoff	5.589	1	718	11,940	------	------	------	Area to DD No. 11
20	Combine	21.67	1	719	48,678	18, 19	------	------	DD No. 11
21	SCS Runoff	5.589	1	718	11,940	------	------	------	Area to DD No. 12
22	Combine	27.22	1	719	60,617	20, 21	------	------	DD No. 12
23	SCS Runoff	5.589	1	718	11,940	------	------	------	Area to DD No. 13
24	Combine	32.78	1	719	72,557	22, 23	------	------	DD No. 13
25	SCS Runoff	5.729	1	718	12,238	------	------	------	Area to DD No. 14
26	Combine	38.47	1	719	84,796	24, 25	------	------	DD No. 14
27	SCS Runoff	5.374	1	719	12,246	------	------	------	Area to DD No. 15
28	Combine	43.84	1	719	97,042	26, 27	------	------	DD No. 15
29	SCS Runoff	5.799	1	718	12,388	------	------	------	Area to DD No. 16
30	Combine	49.60	1	719	109,429	28, 29	------	------	DD No. 16
31	SCS Runoff	5.475	1	746	32,325	------	------	------	Area to DD No. 17
32	SCS Runoff	4.848	1	724	14,377	------	------	------	Area to DD No. 18
33	SCS Runoff	5.701	1	721	14,466	------	------	------	Area to DD No. 19

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Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
34	Combine	10.36	1	722	28,842	32, 33	------	------	DD No. 19
35	SCS Runoff	6.314	1	719	14,389	------	------	------	Area to DD No. 20
36	Combine	16.27	1	720	43,231	34, 35	------	------	DD No. 20
37	SCS Runoff	6.777	1	718	14,477	------	------	------	Area to DD No. 21
38	Combine	22.63	1	720	57,708	36, 37	------	------	DD No. 21
39	SCS Runoff	7.057	1	718	15,074	------	------	------	Area to DD No. 22
40	Combine	29.62	1	719	72,782	38, 39	------	------	DD No. 22
41	SCS Runoff	7.120	1	719	16,226	------	------	------	Area to DD No. 23
42	Combine	36.74	1	719	89,008	40, 41	------	------	DD No. 23
43	SCS Runoff	7.435	1	720	18,074	------	------	------	Area to DD No. 24
44	Combine	44.03	1	719	107,082	42, 43	------	------	DD No. 24
45	SCS Runoff	7.563	1	720	18,385	------	------	------	Area to DD No. 25
46	Combine	51.45	1	719	125,468	44, 45	------	------	DD No. 25
47	SCS Runoff	8.012	1	720	19,476	------	------	------	Area to DD No. 26
48	Combine	59.33	1	720	144,943	46, 47	------	------	DD No. 26
49	SCS Runoff	7.778	1	722	20,971	------	------	------	Area to DD No. 27
50	Combine	66.83	1	720	165,915	48, 49	------	------	DD No. 27
51	Combine	118.17	1	719	307,669	30, 31, 50	------	------	DD No. 17
52	SCS Runoff	25.13	1	715	45,205	------	------	------	Area to Basin No. 3
53	Combine	188.02	1	719	529,676	15, 51, 52	------	------	Total Basin No. 3 Inflow
54	SCS Runoff	5.000	1	720	12,153	------	------	------	Area to DD No. 28
55	SCS Runoff	2.780	1	717	5,358	------	------	------	Area to DD No. 29
56	Combine	7.269	1	718	17,511	54, 55	------	------	DD No. 29
57	SCS Runoff	7.476	1	718	15,969	------	------	------	Area to DD No. 30
58	SCS Runoff	5.710	1	719	13,011	------	------	------	Area to DD No. 31
59	Combine	13.13	1	719	28,981	57, 58	------	------	DD No. 31
60	SCS Runoff	3.773	1	718	8,059	------	------	------	Area to DD No. 32
61	Combine	16.88	1	719	37,040	59, 60	------	------	DD No. 32
62	SCS Runoff	4.332	1	718	9,253	------	------	------	Area to DD No. 33
63	Combine	21.18	1	719	46,294	61, 62	------	------	DD No. 33
64	SCS Runoff	5.038	1	719	11,481	------	------	------	Area to DD No. 34
65	Combine	26.22	1	719	57,774	63, 64	------	------	DD No. 34
66	SCS Runoff	5.576	1	720	13,555	------	------	------	Area to DD No. 35

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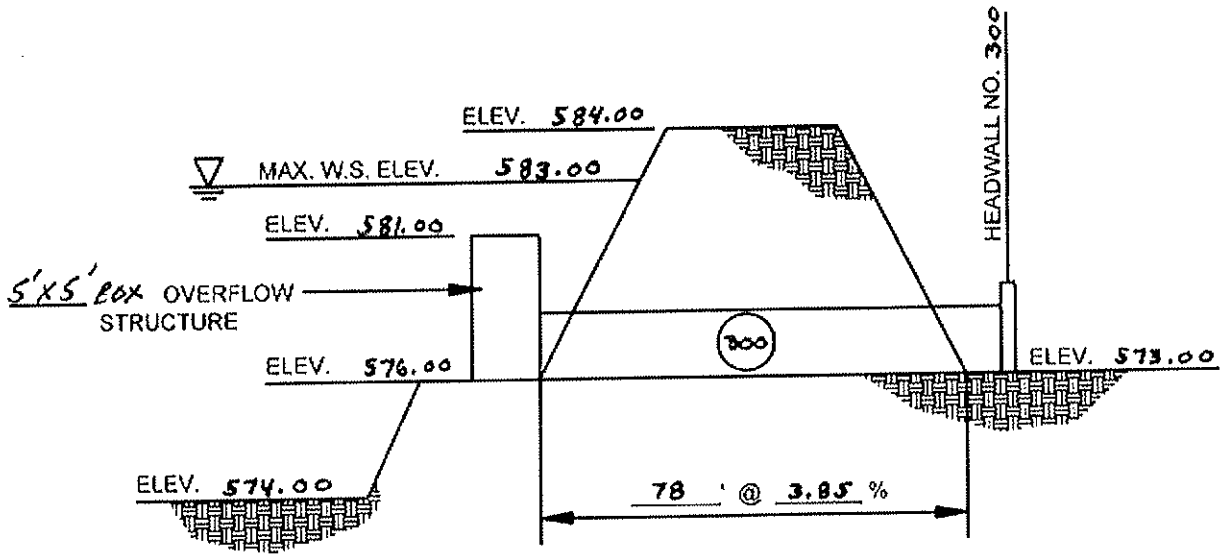
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
67	Combine	31.69	1	719	71,329	65, 66	------	------	DD No. 35
68	SCS Runoff	6.057	1	721	15,370	------	------	------	Area to DD No. 36
69	Combine	37.48	1	719	86,699	67, 68	------	------	DD No. 36
70	SCS Runoff	3.232	1	718	6,630	------	------	------	Area to DD No. 37
71	Combine	40.53	1	719	93,329	69, 70	------	------	DD No. 37
72	SCS Runoff	4.691	1	721	11,904	------	------	------	Area to DD No. 38
73	SCS Runoff	4.611	1	718	9,850	------	------	------	Area to DD No. 39
74	SCS Runoff	4.903	1	719	11,174	------	------	------	Area to DD No. 40
75	Combine	9.483	1	719	21,025	73, 74	------	------	DD No. 40
76	SCS Runoff	5.576	1	720	13,555	------	------	------	Area to DD No. 41
77	Combine	14.95	1	719	34,580	75, 76	------	------	DD No. 41
78	SCS Runoff	5.582	1	721	14,164	------	------	------	Area to DD No. 42
79	Combine	20.29	1	720	48,744	77, 78	------	------	DD No. 42
80	SCS Runoff	6.057	1	721	15,370	------	------	------	Area to DD No. 43
81	Combine	26.27	1	720	64,114	79, 80	------	------	DD No. 43
82	SCS Runoff	6.358	1	722	17,144	------	------	------	Area to DD No. 44
83	Combine	32.40	1	720	81,258	81, 82	------	------	DD No. 44
84	Combine	76.94	1	719	186,491	71, 72, 83	------	------	DD No. 38
85	SCS Runoff	26.40	1	715	47,501	------	------	------	Area to Basin No. 5
86	Combine	101.71	1	718	251,503	56, 84, 85	------	------	Total Basin No. 5 Inflow
87	Reservoir	8.292	1	843	473,451	53	581.14	339,503	Sediment Basin No. 3
88	Reservoir	107.63	1	727	529,672	53	582.40	129,995	Sed Basin No. 3 BTB
90	Reservoir	2.478	1	1887	222,048	86	582.60	181,599	Sediment Basin No. 5
91	Reservoir	71.71	1	723	251,501	86	584.05	50,663	Sed Basin No. 5 BTB

e. Riser Pipe and Carrier Pipe Design

OVERFLOW STRUCTURE NO. 3



DESIGN OF OVERFLOW STRUCTURE AS EMERGENCY SPILLWAY

FLOW (Q) WORST CASE = 100 YEAR STORM EVENT OCCURS WHEN THE WATER SURFACE ELEVATION AT THE TOP OF THE OVERFLOW STRUCTURE AND ALL DEWATERING HOLES ARE PLUGGED

FLOW (Q) MAXIMUM = 165 CFS

HEAD (H) MAXIMUM = MAXIMUM WATER SURFACE ELEVATION FOR WORST CASE FLOW MINUS THE ELEVATION AT THE CREST OF THE OVERFLOW STRUCTURE

= 583.00 - 581.00 = 2.00 FEET

BASED ON ABOVE HEAD, USE 5' x 5' Box OVERFLOW STRUCTURE

(SEE CHART ON NEXT PAGE)

WEIR FLOW (Q) OVER RISER CREST FOR CIRCULAR RISERS WITH TRASH RACK

$$Q = CLh^{3/2}$$

$$Q = 3.1 \times (\pi) \times (D/12) \times h^{3/2}$$

HEAD-h in feet	Riser Diameter (D_r) in inches: 12	18	24	30	36	48	54	60	HEAD-h in feet
				Flow In Cubic Feet Per Second					
0.1	0.3	0.5	0.6	0.8	0.9	1.2	1.4	1.5	0.1
0.2	0.9	1.3	1.7	2.2	2.6	3.5	3.9	4.4	0.2
0.3	1.6	2.4	3.2	4.0	4.8	6.4	7.2	8.0	0.3
0.4	2.5	3.7	4.9	6.2	7.4	9.9	11.1	12.3	0.4
0.6	4.5	6.8	9.1	11.3	13.6	18.1	20.4	22.6	0.6
0.8		10.5	13.9	17.4	20.9	27.9	31.4	34.8	0.8
1.0			19.5	24.3	29.2	39.0	43.8	48.7	1.0
1.2			25.6	32.0	38.4	51.2	57.6	64.0	1.2
1.4				40.3	48.4	64.5	72.6	80.7	1.4
1.6				49.3	59.1	78.8	88.7	98.6	1.6
1.8					70.6	94.1	105.8	117.6	1.8
2.0					82.6	110.2	124.0	137.7	2.0
2.2						127.1	143.0	158.9	2.2
2.4							162.9	181.0	2.4
2.6							183.7	204.1	2.6
2.8								228.1	2.8
3.0								253.0	3.0

5' x 5' Box ≈ 72" PIPE

$Q_{max} = 9.739 (6)(2)^{3/2}$

= 165 cfs

Table 6-22.2

Pipe, Riser, and Trash Rack Proportions

Eq. 6-10 $D_r \geq (1.50)(D_{ps})$

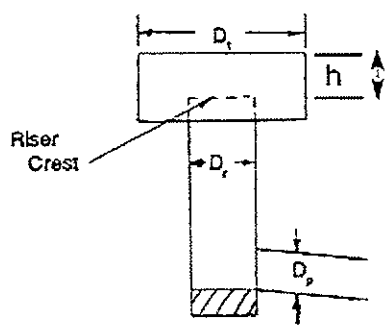
where D_r = diameter of riser

D_{ps} = diameter of principal spillway

Eq. 6-11 $D_t \geq (1.4)(D_r)$

where D_t = diameter of trash rack

D_r = diameter of riser



EXAMPLE: The peak runoff for a 2-year, 24-hour rain is 32 cfs. Select a pipe size for a head of 12 feet and length of 100 feet. From Table 6-15.1, 38.2 x 0.89 = 34 cfs discharge for a 24-inch diameter pipe.

Using Equation 6-10 $D_r \geq (1.5)(D_p)$

$D_r \geq (1.5)(24) \geq$ 36 inch diameter riser

Using Equation 6-11 $D_t \geq (1.4)(D_r)$

$D_t \geq (1.4)(36) \geq$ 50 inch diameter (Use 54 inch)

Determine h - From Table 6-15.2

Q = 34 cfs D_r = 36" h = 1.2'

NOTE: h = minimum distance between the crest of the riser and the crest of the emergency spillway.

CARRIER PIPE NO. 300

Q = 165 CFS WORST CASE

MAXIMUM HEADWATER = TOP OF LEEVE ELEVATION MINUS 1' FREEBOARD
= 584.00 - 1 = 583.00

HEAD (H) = MAXIMUM WATER ELEVATION ALLOWED MINUS THE CENTERLINE ELEVATION AT THE DOWNSTREAM END OF THE CARRIER PIPE
= 583.00 - 575.00 = 8

LENGTH (L) = 78

LENGTH FACTOR = .99 FOR LENGTHS OTHER THAN 70'

Q (AVAILABLE) = Q FROM TABLE TIMES LENGTH FACTOR
= 202 X .99 = 199.98

Q (AVAILABLE) MUST BE GREATER THAN Q WORST CASE

USE 48 " DIAMETER RCP CARRIER PIPE

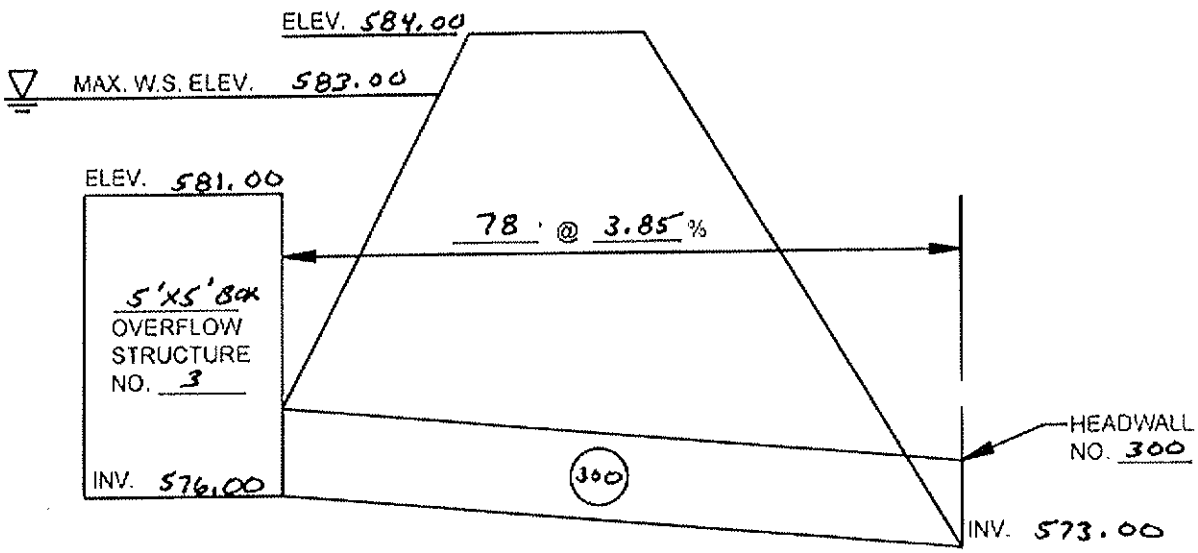


Table 6-25

PIPE FLOW CHART n = 0.025

FOR CORRUGATED METAL PIPE INLET $K_m = K_e + K_o = 1.0$ AND 70 FEET OF CORRUGATED METAL PIPE CONDUIT (full flow assumed)

Note correction factors for pipe lengths other than 70 feet

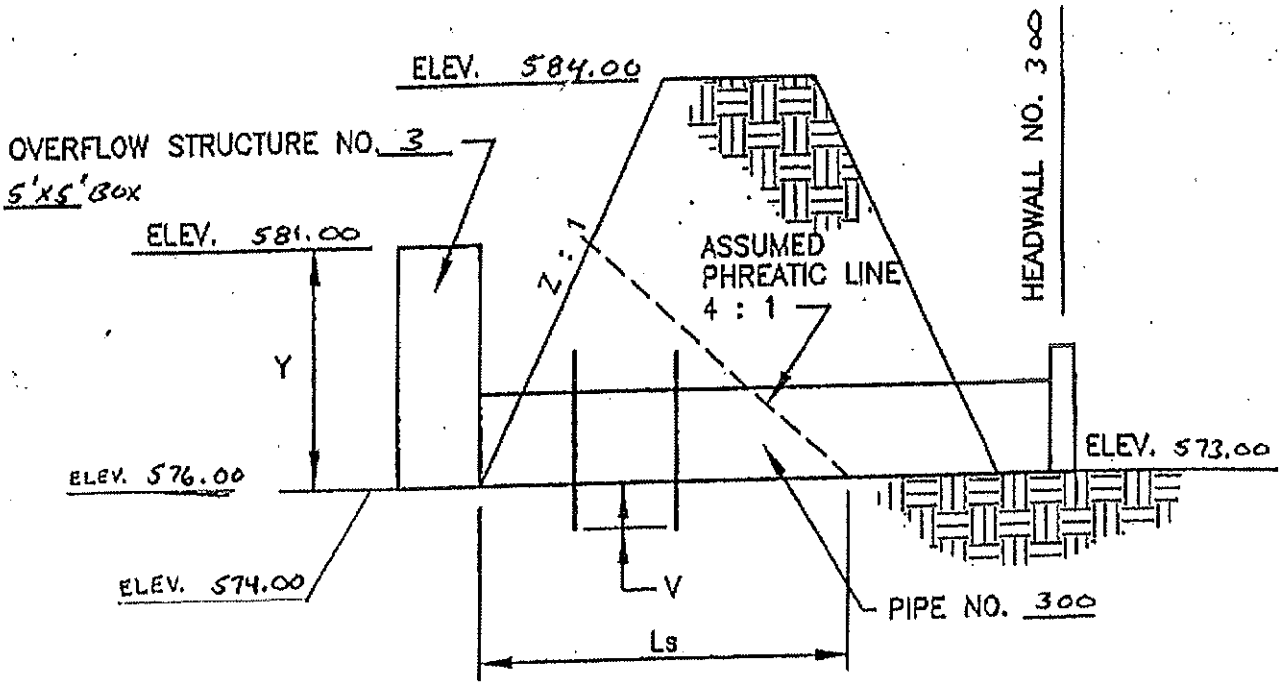
diameter of pipe in inches

H, in feet	12"	15"	18"	21"	24"	30"	36"	42"	48"	54"	60"	66"	72"	78"	84"	90"	96"	102"
1	3.22	5.44	8.29	11.8	15.9	26.0	38.6	53.8	71.4	91.5	114	139	167	197	229	264	302	342
2	4.55	7.69	11.7	16.7	22.5	36.8	54.6	76.0	101	129	161	197	236	278	324	374	427	483
3	5.57	9.42	14.4	20.4	27.5	45.0	66.9	93.1	124	159	198	241	289	341	397	458	523	592
4	6.43	10.9	16.6	23.5	31.8	52.0	77.3	108	143	183	228	278	334	394	459	529	604	683
5	7.19	12.2	18.5	26.3	35.5	58.1	86.4	120	160	205	255	311	373	440	513	591	675	764
6	7.88	13.3	20.3	28.8	38.9	67.7	94.6	132	175	224	280	341	409	482	562	647	739	837
7	8.51	14.4	21.9	31.1	42.0	68.8	102	142	189	242	302	368	441	521	607	699	798	904
8	9.10	15.4	23.5	33.3	44.9	73.5	109	152	202	259	323	394	472	557	685	748	854	966
9	9.65	16.3	24.9	35.3	47.7	78.0	116	161	214	275	342	418	500	590	688	793	905	1025
10	10.2	17.2	26.2	37.2	50.2	82.2	122	170	226	289	361	440	527	622	725	836	954	1080
11	10.7	18.0	27.5	39.0	52.7	86.2	128	178	237	304	379	462	553	653	761	877	1001	1133
12	11.1	18.9	28.7	40.8	55.0	90.1	134	186	247	317	395	482	578	682	794	916	1045	1184
13	11.6	19.6	29.9	42.4	57.3	93.7	139	194	257	330	411	502	601	710	827	953	1088	1232
14	12.0	20.4	31.0	44.1	59.4	97.3	145	201	267	342	427	521	624	738	858	989	1129	1278
15	12.5	21.1	32.1	45.6	61.5	101	150	208	277	354	442	539	646	762	888	1024	1169	1323
16	12.9	21.8	33.2	47.1	63.5	104	155	215	286	366	457	557	667	787	917	1057	1207	1367
17	13.3	22.4	34.2	48.5	65.5	107	159	222	294	377	471	574	688	812	946	1090	1244	1409
18	13.7	23.1	35.2	49.9	67.4	110	164	228	303	388	484	591	708	835	973	1121	1280	1450
19	14.0	23.8	36.1	51.3	69.2	113	168	234	311	399	497	607	727	858	1000	1152	1315	1489
20	14.4	24.3	37.1	52.6	71.0	116	173	240	319	409	510	623	746	880	1026	1182	1350	1528
21	14.7	24.9	38.0	53.9	72.8	119	177	246	327	419	523	638	764	902	1051	1211	1383	1566
22	15.1	25.5	38.9	55.2	74.5	122	181	252	335	429	535	653	782	923	1076	1240	1415	1603
23	15.4	26.1	39.8	56.5	76.2	125	186	258	342	439	547	668	800	944	1100	1268	1447	1639
24	15.8	26.7	40.6	57.7	77.8	127	189	263	350	448	559	682	817	964	1123	1295	1478	1674
25	16.1	27.2	41.5	58.9	79.4	130	193	269	357	458	571	696	834	984	1147	1322	1509	1708
26	16.4	27.7	42.3	60.0	81.0	133	197	274	364	467	582	710	850	1004	1169	1348	1539	1742
27	16.7	28.3	43.1	61.2	82.5	135	201	279	371	476	593	723	867	1023	1192	1373	1568	1775
28	17.0	28.8	43.9	62.3	84.1	138	204	285	378	484	604	737	883	1041	1214	1399	1597	1808
29	17.3	29.3	44.7	63.4	85.5	140	208	290	384	493	615	750	898	1060	1235	1423	1625	1840
30	17.6	29.8	45.4	64.5	87.0	142	212	294	391	501	625	763	913	1078	1256	1448	1653	1871
L, in feet	Correction Factors For Other Pipe Lengths																	
20	1.30	1.24	1.21	1.18	1.15	1.12	1.10	1.08	1.07	1.06	1.05	1.05	1.04	1.04	1.03	1.03	1.03	1.03
30	1.22	1.18	1.15	1.13	1.12	1.09	1.08	1.06	1.05	1.05	1.04	1.04	1.03	1.03	1.03	1.02	1.02	1.02
40	1.15	1.13	1.11	1.10	1.08	1.07	1.05	1.05	1.04	1.03	1.03	1.03	1.02	1.02	1.02	1.02	1.02	1.02
50	1.09	1.08	1.07	1.06	1.05	1.04	1.04	1.03	1.03	1.02	1.02	1.02	1.02	1.01	1.01	1.01	1.01	1.01
60	1.04	1.04	1.03	1.03	1.03	1.02	1.02	1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
70	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	.98	.97	.97	.97	.96	.98	.98	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99
90	.93	.94	.94	.95	.95	.96	.97	.97	.98	.98	.98	.98	.98	.99	.99	.99	.99	.99
100	.90	.91	.92	.93	.93	.95	.95	.96	.97	.97	.97	.98	.98	.98	.98	.98	.98	.99
120	.84	.86	.87	.89	.90	.91	.93	.94	.94	.95	.96	.96	.96	.97	.97	.97	.97	.98
140	.80	.82	.83	.85	.86	.88	.90	.91	.92	.93	.94	.94	.95	.95	.96	.96	.96	.97
160	.76	.78	.80	.82	.83	.86	.88	.89	.90	.91	.92	.93	.94	.94	.95	.95	.95	.96

Source: USDA - SCS

f. Anti-Seep Collar Design

ANTI – SEEP COLLAR DESIGN



Ls = LENGTH IN SATURATION ZONE

Y = OVERFLOW STRUCTURE HEIGHT = 5 FEET

Z = INSIDE SLOPE OF LEVEE = 3

PIPE SLOPE = 3.85 % = .0385 FEET/FEET

$$Ls = Y(Z + 4)\left(1 + \frac{\text{PIPE SLOPE}}{0.25 - \text{PIPE SLOPE}}\right)$$

Ls = 41.4 FEET

FROM ANTI – SEEP COLLAR DESIGN CHART ON THE NEXT PAGE :

V = COLLAR PROJECTION = 1.5 FEET

DIMENSIONS OF 12" THICK COLLAR = 8' x 8'

NUMBER OF REQUIRED COLLARS = 2

ANTI-SEEP COLLAR DESIGN

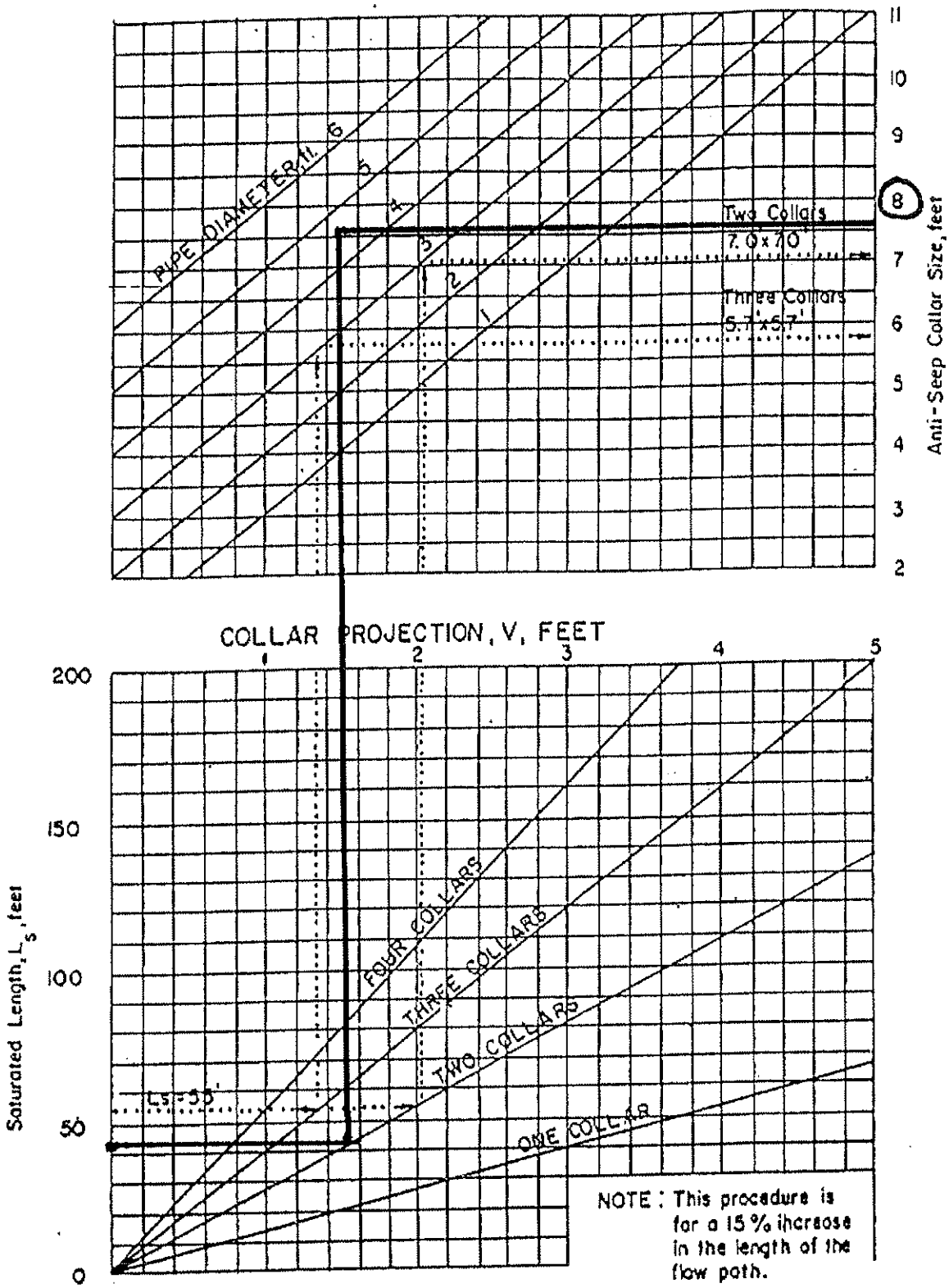


FIGURE A-13

g. Riser Base Foundation Design

OVERFLOW STRUCTURE BASE FOUNDATION DESIGN

A certain volume of concrete will be used to overcome the buoyancy of an empty overflow structure and carrier pipe that are below the assumed phreatic water surface. This volume is equal to:

Overflow Structure

$= (L_2)(w_2)(h)(62.4) - (w_2^2 - w_1^2)(h)(150-62.4)$

$L_1 = w_1 = 5'$ inside
$L_2 = w_2 = 6'$ outside

$= (6)(6)(5)(62.4) - (6^2 - 5^2)(5)(150-62.4)$

h = height = 5'

= 6,414 #

Carrier Pipe

$= 3.1416(R_2^2)(Ls)(62.4)-(3.1416)(R_2^2-r_2^2)(150-62.4)(Ls)$

$= 3.1416(2.42)(2.42)(41)(62.4)-3.1416\ (2.42^2-2^2)(87.6)(41)$

= 26,124 #

TOTAL WEIGHT

= 32,538 # x 1.5 (SAFETY FACTOR)

Ls = length in saturation zone = 41'
R_2 = outside radius = 29" = 2.42'
r_2 = inside radius = 24" = 2'

= 48,807 #

TOTAL REVISED VOLUME OF CONCRETE =
TOTAL WEIGHT / WEIGHT OF CONC. IN WATER

= 48,807 / 87.6 pcf (87.6 pcf = Wt. of conc. in submerged water)

= 557 C.F.

This volume of concrete will be made up from four areas.

1. Anti-Seep Collars
2. Overflow Structure Base
3. Carrier Pipe Encasement
4. Weight of Saturated Soil Directly Above Carrier Pipe

1. Anti-seep collars = area of square collar around carrier pipe x 12" thick x # of collars

= [(8' x 8') - (3.1416)(R_2^2) R_2 = outside radius of carrier pipe = 29" = 2.42'

x 1' x 2 r_2 = inside radius of carrier pipe = 24" = 2'

= 91 C.F.

2. Overflow Structure Base = Volume to handle riser bouyance x 1.5

= (6,414)(1.5)/87.6

= 110 C.F.

Use 10' x 10' x 2' = 200 C.F.

3. Carrier Pipe Encasement

Must extend 5' into dam. Distance from overflow structure to dam is equal to approximately 18'. Therefore, encasement length will be 23'.

Use 5' x 3.5' x 23' long

Carrier pipe encasement volume = 191 C.F.

4. Weight of Saturated Soil in Length of Saturation =

a. Weight of Soil = 100 lbs/C.F.

b. Weight of Saturated Soil = 100 lbs/C.F. – 62.4 lbs/C.F. = 37 lbs/C.F.

c. Volume of Soil in Length of Saturation over Carrier Pipe = 60 s.f. x 4.84 = 290 C.F.

d. 290 C.F. x 37 lbs/C.F. = 10,730 lbs

e. 10,730 lbs ÷ 87.6 lbs/C.F. = 122 C.F. (equivalent of submerged concrete)

TOTAL REQUIRED VOLUME = 557 C.F.

Actual Total Volume

Anti-Seep Collars	= 91 C.F.
Overflow Structure Base	= 200 C.F.
Carrier Pipe Encasement	= 191 C.F.
Weight of Saturated Soil	= 122 C.F.
TOTAL	= 604 C.F. => Okay (Factor of Safety = 1.08)

3. SEDIMENT BASIN NO. 4

a. Sediment Basin Design Criteria

Sediment Basin No. 4 at the Charlotte Motor Speedway Landfill V was designed utilizing the following design criteria.

- Minimum Length to Width Ratio = 2:1
- Minimum Surface Area @ 10 year storm = 0.01 acres min. per cfs of flow.
- Sediment Storage = 1,800 cubic feet of volume per acre of disturbed land measured at 3' depth elevation.
- Retain the 25 year, 24 hour storm event below the crest of the riser.
- Permanent Pool Depth = 3 feet
- Freeboard shall be a minimum of 1 foot above the maximum stage of the basin.
- Minimum dewatering time from top of riser = 24 hours

For Sediment Basin No. 4, the actual Phase 3 design criteria is compared to the NCDENR recommended criteria for sediment basins.

Sediment Basin No. 4

Criteria	NCDENR	Phase III Design
Length	2:1	2:1
Surface Area	.010 Acre/cfs	0.02 Acre/cfs
Volume at 3' Depth Elevation	1,800 C.F./Acre	6,694 C.F./Acre
Storm Retention	25 year	25 year
Permanent Pool Depth	3 feet	3 feet
Freeboard	1 foot	2.51 feet

b. Sediment Volumes and Surface Area Calculations

SEDIMENT VOLUME STORAGE REQUIREMENTS = 1,800 cu.ft. / acre

= 28.0 acres

= 1,800 x 28.0 acres

= 50,400 cf

From the Hydraflow Hydrographs Computer Program, this volume of sediment will occupy a depth of approximately 0.83 feet (interpolated from printout on next page). This sediment volume corresponds to elevation = 572.83 feet.

TOTAL VOLUME IN 3 FOOT PERMANENT POOL = 187,438 c.f.

AVAILABLE SEDIMENT STORAGE = 187,438 c.f. ÷ 28.0 ac = 6,694 c.f./ac

RECOMMENDED SURFACE AREA REQUIREMENTS = 0.01 ACRE PER CFS

Q_{10} = 76.68 cfs

Minimum Surface Area = 0.77 acres x Q_{100}

= 33,541 acres

= 47,480 s.f.

Actual Surface Area At Permanent Pool (El. 575.00) =
Sediment Basin No. 4 Area

= 68,411 s.f.

Actual Surface Area is greater than minimum surface area.

Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Thursday, Apr 30, 2009

Pond No. 1 - Sediment Pond No. 4

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 572.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	572.00	56,652	0	0
2.00	574.00	64,462	121,018	121,018
3.00	575.00	68,411	66,420	187,438
4.00	576.00	72,423	70,400	257,838
6.00	578.00	80,606	152,941	410,779
8.00	580.00	89,019	169,539	580,318

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .000	.000	.000	n/a
Orifice Coeff.	= 0.00	0.00	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 0.00	0.00	0.00	0.00
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	572.00	---	---	---	---	---	---	---	---	---	---	0.000
2.00	121,018	574.00	---	---	---	---	---	---	---	---	---	---	0.000
3.00	187,438	575.00	---	---	---	---	---	---	---	---	---	---	0.000
4.00	257,838	576.00	---	---	---	---	---	---	---	---	---	---	0.000
6.00	410,779	578.00	---	---	---	---	---	---	---	---	---	---	0.000
8.00	580,318	580.00	---	---	---	---	---	---	---	---	---	---	0.000

Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Thursday, Apr 30, 2009

Pond No. 2 - Sediment Pond No. 4 w/ Pool

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 575.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	575.00	68,411	0	0
1.00	576.00	72,423	70,400	70,400
3.00	578.00	80,606	152,941	223,341
5.00	580.00	89,019	169,538	392,880

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 42.00	4.00	0.00	0.00
Span (in)	= 42.00	18.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 572.00	575.00	0.00	0.00
Length (ft)	= 78.00	0.00	0.00	0.00
Slope (%)	= 1.28	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 20.00	0.00	0.00	0.00
Crest El. (ft)	= 577.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	575.00	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
1.00	70,400	576.00	51.79 oc	2.20 ic	---	---	0.00	---	---	---	---	---	2.198
3.00	223,341	578.00	51.79 oc	4.05 ic	---	---	23.55	---	---	---	---	---	27.60
5.00	392,880	580.00	114.04 ic	1.05 ic	---	---	112.98 s	---	---	---	---	---	114.03

Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Thursday, Apr 30, 2009

Pond No. 3 - Sediment Pond No. 4 BTB

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 577.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	577.50	78,546	0	0
0.50	578.00	80,606	39,783	39,783
2.50	580.00	89,019	169,539	209,321

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 42.00	0.00	0.00	0.00
Span (in)	= 42.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 572.00	0.00	0.00	0.00
Length (ft)	= 78.00	0.00	0.00	0.00
Slope (%)	= 1.28	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 20.00	0.00	0.00	0.00
Crest El. (ft)	= 577.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	577.50	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.50	39,783	578.00	89.70 ic	---	---	---	23.55	---	---	---	---	---	23.55
2.50	209,321	580.00	113.99 ic	---	---	---	113.98 s	---	---	---	---	---	113.98

c. Basin Dewatering

Total Basin Dewatering at Top of Riser

Retention time within the basin is an important factor in effective sediment retention. The perforated riser pipe method has been used for the proposed sediment basin.

The 5' x 5' square concrete overflow structure shall have one 4" (h) x 18" (w) dewatering orifice at elevation 575.00.

The calculation below has been performed to confirm that the dewatering (retention) time within the basin is >24 hours. This dewatering time will ensure the storm water is retained for an adequate length of time to allow the sediment to settle (minimum 24 hours).

$$T = \frac{(As)(2h)^{1/2}}{(Ao)(Cd)(20428)}$$

Where T	=	Dewatering Time (hr.)
As	=	Surface Area at Basin (ft^2)
h	=	Head of Water (ft)
Ao	=	Surface Area of Dewatering Orifice (ft^2)
Cd	=	Coefficient of Discharge for an Orifice (use 0.6)

T > 24 hours

Ao = 0.50 s.f. @ Elev. 575.00

As = 78,546 s.f. @ Elev. 577.00 (top of riser)

h = 577.50 – 575.00 = 2.50'

$$T = \frac{78{,}546\ (2 \times 2.5)^{1/2}}{(0.50)\ (0.6)\ (20{,}428)} = 28.7 \text{ hours}$$

(okay between 24 - 72 hours)

d. Reservoir Routing

Reservoir routing is determined by using the HydraFlow Computer Program.

Peak inflow rates (Q) are determined using the SCS Method and HydraFlow computer program. Peak inflow rates are calculated for the 2 year, 10 year, 25-year, and 100 year storm events and are summarized below.

Q_2 = 37.69 cfs
Q_{10} = 76.68 cfs
Q_{25} = 100.27 cfs
Q_{100} = 132.66 cfs

The bottom of the sediment basin has been set at 572.00. The permanent pool has been set at elevation 575.00. Dewatering of the sediment basin is accomplished by a 4" x 18" rectangular opening beginning at an invert elevation of 575.00.

For routing calculations, a 5' x 5' square riser with a 4" x 18" rectangular opening beginning at an invert elevation of 575.00 is used. The top of the riser is at an elevation of 577.50. The bottom of the sediment basin is elevation 572.00. The invert of the carrier pipe is 572.00. The top of the levee around the sediment basin is at an elevation of 580.00.

Based on the above information the reservoir routing calculations are performed and summarized below.

STORM YEAR	PEAK INFLOW CFS	PEAK OUTFLOW CFS	PEAK ELEV. FEET
2	37.69	2.05	575.89
10	76.68	3.17	576.90
25	100.27	4.62	577.49
100	132.66	17.95	577.85

Based on these routing calculations, the riser is large enough and the sediment basin has sufficient storage volume to retain the sediment from 28 disturbed acres plus the 25-year storm event from the entire drainage area below the crest of the riser (elev. 577.50).

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	1.586	1	721	3,894	------	------	------	Area to DD No. 45
2	SCS Runoff	1.409	1	719	2,984	------	------	------	Area to DD No. 46
3	Combine	2.929	1	719	6,878	1, 2	------	------	DD No. 46
4	SCS Runoff	1.512	1	719	3,204	------	------	------	Area to DD No. 47
5	Combine	4.441	1	719	10,082	3, 4	------	------	DD No. 47
6	SCS Runoff	1.512	1	719	3,204	------	------	------	Area to DD No. 48
7	Combine	5.953	1	719	13,285	5, 6	------	------	DD No. 48
8	SCS Runoff	1.598	1	720	3,646	------	------	------	Area to DD No. 49
9	Combine	7.537	1	719	16,931	7, 8	------	------	DD No. 49
10	SCS Runoff	1.642	1	721	4,032	------	------	------	Area to DD No. 50
11	Combine	9.111	1	719	20,962	9, 10	------	------	DD No. 50
12	SCS Runoff	1.754	1	721	4,306	------	------	------	Area to DD No. 51
13	Combine	10.80	1	720	25,269	11, 12	------	------	DD No. 51
14	SCS Runoff	1.839	1	722	4,741	------	------	------	Area to DD No. 52
15	Combine	12.59	1	720	30,010	13, 14	------	------	DD No. 52
16	SCS Runoff	1.829	1	723	5,041	------	------	------	Area to DD No. 53
17	Combine	14.29	1	720	35,051	15, 16	------	------	DD No. 53
18	SCS Runoff	2.725	1	738	13,953	------	------	------	Area to DD No. 54
19	Combine	15.50	1	720	49,003	17, 18	------	------	DD No. 54
20	SCS Runoff	1.756	1	720	4,006	------	------	------	Area to DD No. 55
21	SCS Runoff	2.031	1	726	6,571	------	------	------	Area to DD No. 56
22	Combine	3.448	1	722	10,577	20, 21	------	------	DD No. 56
23	SCS Runoff	2.267	1	726	7,336	------	------	------	Area to DD No. 57
24	Combine	5.545	1	723	17,914	22, 23	------	------	DD No. 57
25	SCS Runoff	2.298	1	724	6,745	------	------	------	Area to DD No. 58
26	Combine	7.836	1	723	24,658	24, 25	------	------	DD No. 58
27	SCS Runoff	2.466	1	723	6,796	------	------	------	Area to DD No. 59
28	Combine	10.30	1	723	31,455	26, 27	------	------	DD No. 59
29	SCS Runoff	2.613	1	723	7,201	------	------	------	Area to DD No. 60
30	Combine	12.91	1	723	38,656	28, 29	------	------	DD No. 60
31	SCS Runoff	3.740	1	723	10,307	------	------	------	Area to DD No. 61
32	Combine	16.65	1	723	48,963	30, 31	------	------	DD No. 61
33	SCS Runoff	4.004	1	722	10,323	------	------	------	Area to DD No. 62

Hydrograph Summary Report

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Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
34	Combine	20.56	1	723	59,286	32, 33	------	------	DD No. 62
35	SCS Runoff	0.933	1	721	2,291	------	------	------	Area to DD No. 63
36	Combine	21.46	1	722	61,577	34, 35	------	------	DD No. 63
37	SCS Runoff	3.907	1	716	6,794	------	------	------	Area to Basin No. 4
38	Combine	37.69	1	721	117,374	19, 36, 37	------	------	Total Basin No. 4 Inflow
39	Reservoir	2.052	1	863	114,275	38	575.89	62,903	Sediment Pond No. 4
40	Reservoir	16.44	1	734	117,368	38	577.89	31,296	Sed Basin No. 4 BTB

Hydrograph Summary Report

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Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	3.173	1	720	7,676	------	------	------	Area to DD No. 45
2	SCS Runoff	2.781	1	718	5,883	------	------	------	Area to DD No. 46
3	Combine	5.874	1	719	13,559	1, 2	------	------	DD No. 46
4	SCS Runoff	2.986	1	718	6,315	------	------	------	Area to DD No. 47
5	Combine	8.860	1	719	19,874	3, 4	------	------	DD No. 47
6	SCS Runoff	2.986	1	718	6,315	------	------	------	Area to DD No. 48
7	Combine	11.85	1	719	26,189	5, 6	------	------	DD No. 48
8	SCS Runoff	3.177	1	719	7,187	------	------	------	Area to DD No. 49
9	Combine	15.02	1	719	33,376	7, 8	------	------	DD No. 49
10	SCS Runoff	3.285	1	720	7,947	------	------	------	Area to DD No. 50
11	Combine	18.22	1	719	41,324	9, 10	------	------	DD No. 50
12	SCS Runoff	3.509	1	720	8,489	------	------	------	Area to DD No. 51
13	Combine	21.65	1	719	49,813	11, 12	------	------	DD No. 51
14	SCS Runoff	3.698	1	721	9,345	------	------	------	Area to DD No. 52
15	Combine	25.14	1	719	59,159	13, 14	------	------	DD No. 52
16	SCS Runoff	3.692	1	722	9,937	------	------	------	Area to DD No. 53
17	Combine	28.61	1	720	69,096	15, 16	------	------	DD No. 53
18	SCS Runoff	5.622	1	738	27,505	------	------	------	Area to DD No. 54
19	Combine	31.41	1	720	96,602	17, 18	------	------	DD No. 54
20	SCS Runoff	3.491	1	719	7,897	------	------	------	Area to DD No. 55
21	SCS Runoff	4.131	1	725	12,954	------	------	------	Area to DD No. 56
22	Combine	7.033	1	721	20,851	20, 21	------	------	DD No. 56
23	SCS Runoff	4.612	1	725	14,463	------	------	------	Area to DD No. 57
24	Combine	11.30	1	722	35,313	22, 23	------	------	DD No. 57
25	SCS Runoff	4.653	1	723	13,296	------	------	------	Area to DD No. 58
26	Combine	15.95	1	723	48,609	24, 25	------	------	DD No. 58
27	SCS Runoff	4.977	1	722	13,398	------	------	------	Area to DD No. 59
28	Combine	20.90	1	723	62,007	26, 27	------	------	DD No. 59
29	SCS Runoff	5.274	1	722	14,196	------	------	------	Area to DD No. 60
30	Combine	26.15	1	723	76,203	28, 29	------	------	DD No. 60
31	SCS Runoff	7.548	1	722	20,319	------	------	------	Area to DD No. 61
32	Combine	33.69	1	722	96,522	30, 31	------	------	DD No. 61
33	SCS Runoff	8.053	1	721	20,350	------	------	------	Area to DD No. 62

Hydrograph Summary Report

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Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
34	Combine	41.70	1	722	116,872	32, 33	------	------	DD No. 62
35	SCS Runoff	1.867	1	720	4,516	------	------	------	Area to DD No. 63
36	Combine	43.49	1	722	121,388	34, 35	------	------	DD No. 63
37	SCS Runoff	7.609	1	716	13,392	------	------	------	Area to Basin No. 4
38	Combine	76.68	1	720	231,382	19, 36, 37	------	------	Total Basin No. 4 Inflow
39	Reservoir	3.170	1	901	225,197	38	576.90	139,334	Sediment Pond No. 4
40	Reservoir	41.29	1	730	231,377	38	578.23	58,909	Sed Basin No. 4 BTB

Hydrograph Summary Report

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Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	4.133	1	720	10,002	------	------	------	Area to DD No. 45
2	SCS Runoff	3.613	1	718	7,665	------	------	------	Area to DD No. 46
3	Combine	7.643	1	719	17,667	1, 2	------	------	DD No. 46
4	SCS Runoff	3.879	1	718	8,229	------	------	------	Area to DD No. 47
5	Combine	11.51	1	719	25,896	3, 4	------	------	DD No. 47
6	SCS Runoff	3.879	1	718	8,229	------	------	------	Area to DD No. 48
7	Combine	15.37	1	719	34,125	5, 6	------	------	DD No. 48
8	SCS Runoff	4.133	1	719	9,365	------	------	------	Area to DD No. 49
9	Combine	19.51	1	719	43,489	7, 8	------	------	DD No. 49
10	SCS Runoff	4.279	1	720	10,355	------	------	------	Area to DD No. 50
11	Combine	23.69	1	719	53,845	9, 10	------	------	DD No. 50
12	SCS Runoff	4.571	1	720	11,061	------	------	------	Area to DD No. 51
13	Combine	28.16	1	719	64,906	11, 12	------	------	DD No. 51
14	SCS Runoff	4.819	1	721	12,177	------	------	------	Area to DD No. 52
15	Combine	32.74	1	719	77,083	13, 14	------	------	DD No. 52
16	SCS Runoff	4.816	1	722	12,948	------	------	------	Area to DD No. 53
17	Combine	37.20	1	720	90,032	15, 16	------	------	DD No. 53
18	SCS Runoff	7.379	1	738	35,839	------	------	------	Area to DD No. 54
19	Combine	41.00	1	720	125,871	17, 18	------	------	DD No. 54
20	SCS Runoff	4.541	1	719	10,289	------	------	------	Area to DD No. 55
21	SCS Runoff	5.404	1	725	16,879	------	------	------	Area to DD No. 56
22	Combine	9.199	1	721	27,169	20, 21	------	------	DD No. 56
23	SCS Runoff	6.033	1	725	18,845	------	------	------	Area to DD No. 57
24	Combine	14.80	1	722	46,013	22, 23	------	------	DD No. 57
25	SCS Runoff	6.077	1	723	17,324	------	------	------	Area to DD No. 58
26	Combine	20.84	1	723	63,337	24, 25	------	------	DD No. 58
27	SCS Runoff	6.493	1	722	17,457	------	------	------	Area to DD No. 59
28	Combine	27.31	1	722	80,795	26, 27	------	------	DD No. 59
29	SCS Runoff	6.880	1	722	18,498	------	------	------	Area to DD No. 60
30	Combine	34.19	1	722	99,293	28, 29	------	------	DD No. 60
31	SCS Runoff	9.848	1	722	26,475	------	------	------	Area to DD No. 61
32	Combine	44.04	1	722	125,768	30, 31	------	------	DD No. 61
33	SCS Runoff	10.49	1	721	26,516	------	------	------	Area to DD No. 62

Hydrograph Summary Report

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Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
34	Combine	54.44	1	722	152,284	32, 33	------	------	DD No. 62
35	SCS Runoff	2.431	1	720	5,884	------	------	------	Area to DD No. 63
36	Combine	56.77	1	722	158,168	34, 35	------	------	DD No. 63
37	SCS Runoff	9.808	1	716	17,450	------	------	------	Area to Basin No. 4
38	Combine	100.27	1	720	301,489	19, 36, 37	------	------	Total Basin No. 4 Inflow
39	Reservoir	4.624	1	856	292,989	38	577.49	184,382	Sediment Pond No. 4
40	Reservoir	57.47	1	730	301,484	38	578.41	74,204	Sed Basin No. 4 BTB

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	5.448	1	720	13,244	------	------	------	Area to DD No. 45
2	SCS Runoff	4.751	1	718	10,149	------	------	------	Area to DD No. 46
3	Combine	10.06	1	719	23,393	1, 2	------	------	DD No. 46
4	SCS Runoff	5.100	1	718	10,895	------	------	------	Area to DD No. 47
5	Combine	15.13	1	719	34,288	3, 4	------	------	DD No. 47
6	SCS Runoff	5.100	1	718	10,895	------	------	------	Area to DD No. 48
7	Combine	20.19	1	719	45,183	5, 6	------	------	DD No. 48
8	SCS Runoff	5.441	1	719	12,399	------	------	------	Area to DD No. 49
9	Combine	25.64	1	719	57,582	7, 8	------	------	DD No. 49
10	SCS Runoff	5.640	1	720	13,711	------	------	------	Area to DD No. 50
11	Combine	31.17	1	719	71,293	9, 10	------	------	DD No. 50
12	SCS Runoff	6.025	1	720	14,646	------	------	------	Area to DD No. 51
13	Combine	37.08	1	719	85,939	11, 12	------	------	DD No. 51
14	SCS Runoff	6.354	1	721	16,123	------	------	------	Area to DD No. 52
15	Combine	43.15	1	719	102,062	13, 14	------	------	DD No. 52
16	SCS Runoff	6.358	1	722	17,144	------	------	------	Area to DD No. 53
17	Combine	49.00	1	719	119,206	15, 16	------	------	DD No. 53
18	SCS Runoff	9.803	1	737	47,453	------	------	------	Area to DD No. 54
19	Combine	54.15	1	720	166,659	17, 18	------	------	DD No. 54
20	SCS Runoff	5.978	1	719	13,624	------	------	------	Area to DD No. 55
21	SCS Runoff	7.151	1	725	22,349	------	------	------	Area to DD No. 56
22	Combine	12.17	1	721	35,972	20, 21	------	------	DD No. 56
23	SCS Runoff	7.984	1	725	24,951	------	------	------	Area to DD No. 57
24	Combine	19.62	1	722	60,924	22, 23	------	------	DD No. 57
25	SCS Runoff	8.032	1	723	22,938	------	------	------	Area to DD No. 58
26	Combine	27.58	1	722	83,862	24, 25	------	------	DD No. 58
27	SCS Runoff	8.572	1	722	23,114	------	------	------	Area to DD No. 59
28	Combine	36.15	1	722	106,976	26, 27	------	------	DD No. 59
29	SCS Runoff	9.083	1	722	24,492	------	------	------	Area to DD No. 60
30	Combine	45.24	1	722	131,468	28, 29	------	------	DD No. 60
31	SCS Runoff	13.00	1	722	35,054	------	------	------	Area to DD No. 61
32	Combine	58.24	1	722	166,522	30, 31	------	------	DD No. 61
33	SCS Runoff	13.84	1	721	35,109	------	------	------	Area to DD No. 62

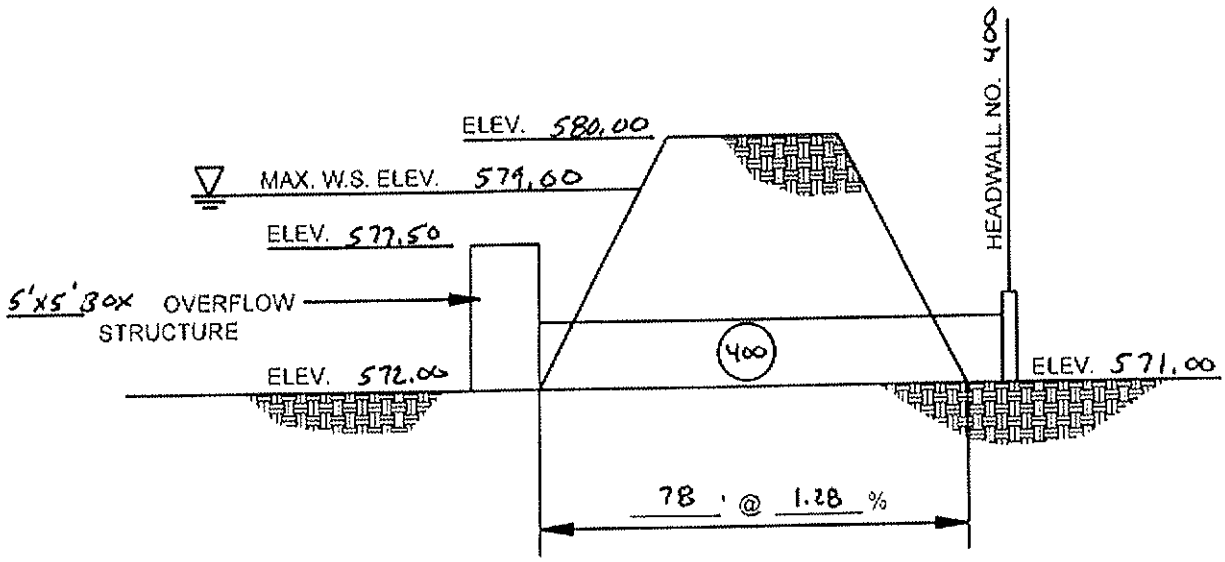
Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
34	Combine	71.92	1	722	201,631	32, 33	------	------	DD No. 62
35	SCS Runoff	3.205	1	720	7,790	------	------	------	Area to DD No. 63
36	Combine	74.98	1	722	209,422	34, 35	------	------	DD No. 63
37	SCS Runoff	12.84	1	715	23,105	------	------	------	Area to Basin No. 4
38	Combine	132.66	1	720	399,185	19, 36, 37	------	------	Total Basin No. 4 Inflow
39	Reservoir	17.95	1	760	389,679	38	577.85	211,758	Sediment Pond No. 4
40	Reservoir	80.17	1	729	399,180	38	578.64	94,022	Sed Basin No. 4 BTB

e. Riser Pipe and Carrier Pipe Design

OVERFLOW STRUCTURE NO. 4



DESIGN OF OVERFLOW STRUCTURE AS EMERGENCY SPILLWAY

FLOW (Q) WORST CASE = 100 YEAR STORM EVENT OCCURS WHEN THE WATER SURFACE ELEVATION AT THE TOP OF THE OVERFLOW STRUCTURE AND ALL DEWATERING HOLES ARE PLUGGED

FLOW (Q) MAXIMUM = 167 CFS

HEAD (H) MAXIMUM = MAXIMUM WATER SURFACE ELEVATION FOR WORST CASE FLOW MINUS THE ELEVATION AT THE CREST OF THE OVERFLOW STRUCTURE

= 579.00 - 577.50 = 1.5 FEET

BASED ON ABOVE HEAD, USE 5'x5' Box OVERFLOW STRUCTURE

(SEE CHART ON NEXT PAGE)

WEIR FLOW (Q) OVER RISER CREST FOR CIRCULAR RISERS WITH TRASH RACK

$$Q = CLh^{3/2}$$

$$Q = 3.1 \times (\pi) \times (D/12) \times h^{3/2}$$

HEAD-h in feet	Riser Diameter (D_r) in inches: 12	18	24	30	36	48	54	60	HEAD-h in feet
				Flow In Cubic Feet Per Second					
0.1	0.3	0.5	0.6	0.8	0.9	1.2	1.4	1.5	0.1
0.2	0.9	1.3	1.7	2.2	2.6	3.5	3.9	4.4	0.2
0.3	1.6	2.4	3.2	4.0	4.8	6.4	7.2	8.0	0.3
0.4	2.5	3.7	4.9	6.2	7.4	9.9	11.1	12.3	0.4
0.6	4.5	6.8	9.1	11.3	13.6	18.1	20.4	22.6	0.6
0.8		10.5	13.9	17.4	20.9	27.9	31.4	34.8	0.8
1.0			19.5	24.3	29.2	39.0	43.8	48.7	1.0
1.2			25.6	32.0	38.4	51.2	57.6	64.0	1.2
1.4				40.3	48.4	64.5	72.6	80.7	1.4
1.6				49.3	59.1	78.8	88.7	98.6	1.6
1.8					70.6	94.1	105.8	117.6	1.8
2.0					82.6	110.2	124.0	137.7	2.0
2.2						127.1	143.0	158.9	2.2
2.4							162.9	181.0	2.4
2.6							183.7	204.1	2.6
2.8								228.1	2.8
3.0								253.0	3.0

5' x 5' Box ≈ 72" Pipe

$Q_{max} \approx 9.739 (6)(1.5)^{3/2}$

$Q_{max} = 107$ cfs

Table 6-22.2

Pipe, Riser, and Trash Rack Proportions

Eq. 6-10 $D_r \geq (1.50)(D_{ps})$

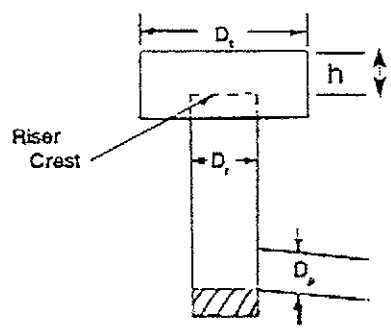
where D_r = diameter of riser

D_{ps} = diameter of principal spillway

Eq. 6-11 $D_t \geq (1.4)(D_r)$

where D_t = diameter of trash rack

D_r = diameter of riser



EXAMPLE: The peak runoff for a 2-year, 24-hour rain is 32 cfs. Select a pipe size for a head of 12 feet and length of 100 feet. From Table 6-15.1, 38.2 x 0.89 = 34 cfs discharge for a 24-inch diameter pipe.

Using Equation 6-10 $D_r \geq (1.5)(D_p)$

$D_r \geq (1.5)(24) \geq$ 36 inch diameter riser

Using Equation 6-11 $D_t \geq (1.4)(D_r)$

$D_t \geq (1.4)(36) \geq$ 50 inch diameter (Use 54 inch)

Determine h - From Table 6-15.2

Q = 34 cfs D_r = 36" h = 1.2'

NOTE: h = minimum distance between the crest of the riser and the crest of the emergency spillway.

CARRIER PIPE NO. 400

Q = 107 CFS WORST CASE

MAXIMUM HEADWATER = TOP OF LEEVE ELEVATION MINUS 1' FREEBOARD
= 580.00 - 1 = 579.00

HEAD (H) = MAXIMUM WATER ELEVATION ALLOWED MINUS THE CENTERLINE ELEVATION AT THE DOWNSTREAM END OF THE CARRIER PIPE
= 579.00 - 572.75 = 6.25

LENGTH (L) = 78

LENGTH FACTOR = .99 FOR LENGTHS OTHER THAN 70'

Q (AVAILABLE) = Q FROM TABLE TIMES LENGTH FACTOR
= 132 X .99 = 130.68

Q (AVAILABLE) MUST BE GREATER THAN Q WORST CASE

USE 42 " DIAMETER RCP CARRIER PIPE

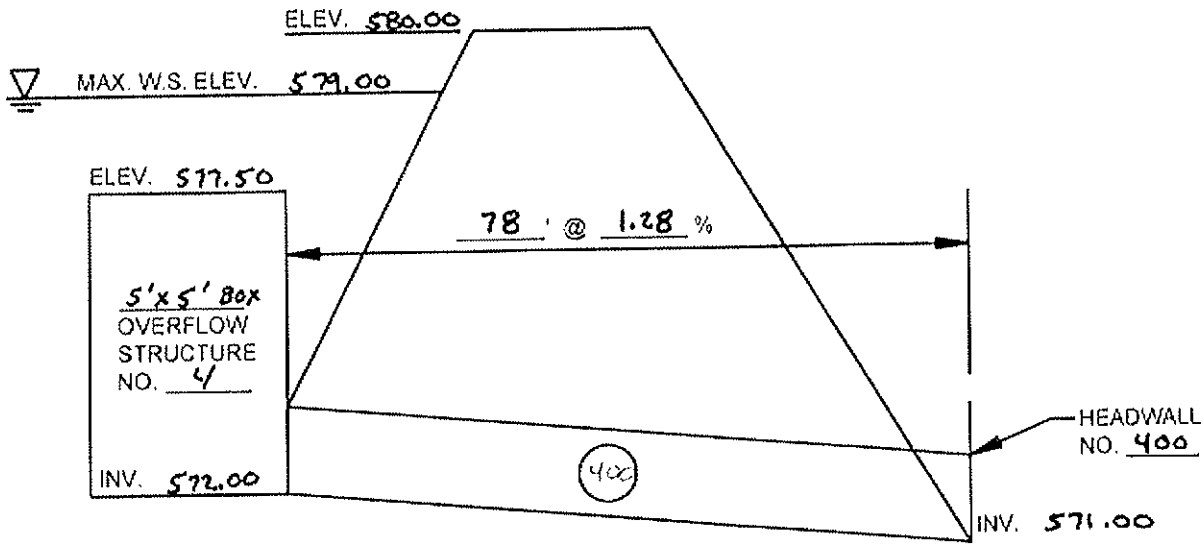


Table 6-25

PIPE FLOW CHART n = 0.025

FOR CORRUGATED METAL PIPE INLET $K_e = K_c + K_b = 1.0$ AND 70 FEET OF CORRUGATED METAL PIPE CONDUIT (full flow assumed)

Note correction factors for pipe lengths other than 70 feet

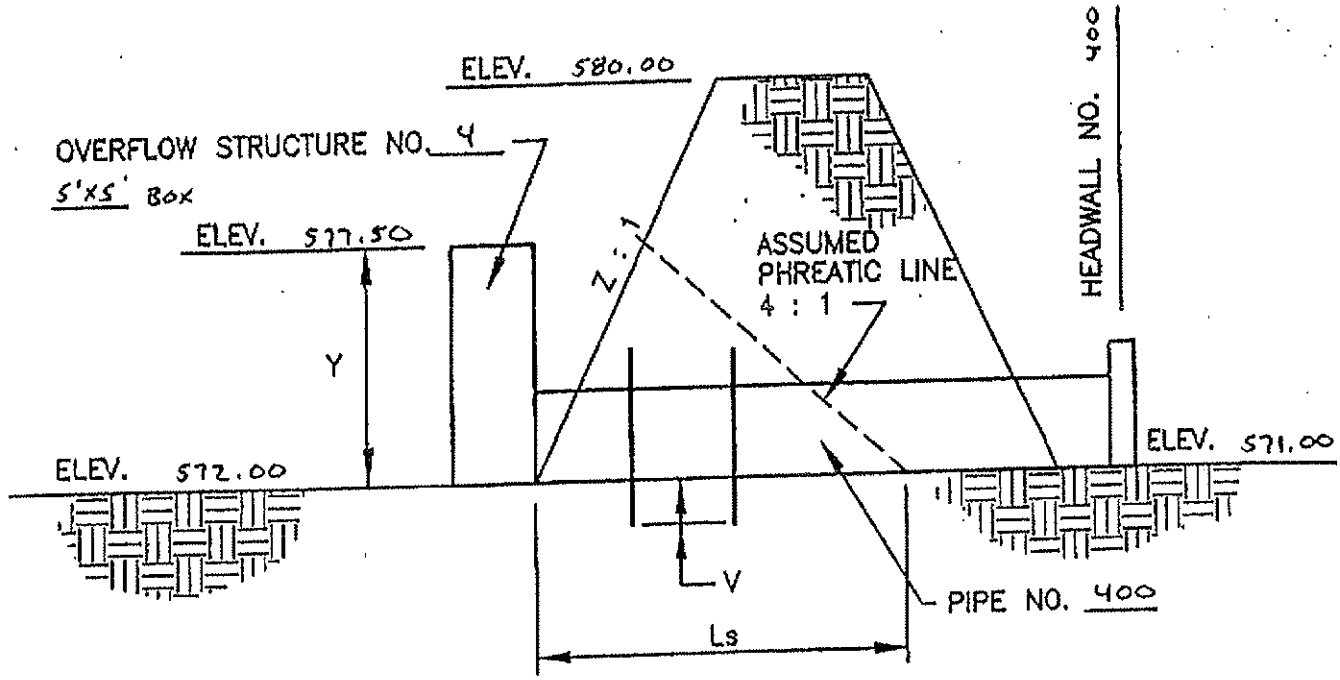
diameter of pipe in inches

H, in feet	12"	15"	18"	21"	24"	30"	36"	42"	48"	54"	60"	66"	72"	78"	84"	90"	96"	102"
1	3.22	5.44	8.29	11.8	15.9	26.0	38.6	53.8	71.4	91.5	114	139	167	197	229	264	302	342
2	4.55	7.69	11.7	16.7	22.5	36.8	54.6	76.0	101	129	161	197	236	278	324	374	427	483
3	5.57	9.42	14.4	20.4	27.5	45.0	66.9	93.1	124	159	198	241	289	341	397	458	523	592
4	6.43	10.9	16.6	23.5	31.8	52.0	77.3	108	143	183	228	278	334	394	459	529	604	683
5	7.19	12.2	18.5	26.3	35.5	58.1	86.4	120	160	205	255	311	373	440	513	591	675	764
6	7.88	13.3	20.3	28.8	38.9	67.7	94.6	132	175	224	280	341	409	482	562	647	739	837
7	8.51	14.4	21.9	31.1	42.0	68.8	102	142	189	242	302	368	441	521	607	699	798	904
8	9.10	15.4	23.5	33.3	44.9	73.5	109	152	202	259	323	394	472	557	685	748	854	966
9	9.65	16.3	24.9	35.3	47.7	78.0	116	161	214	275	342	418	500	590	688	793	905	1025
10	10.2	17.2	26.2	37.2	50.2	82.2	122	170	226	289	361	440	527	622	725	836	954	1080
11	10.7	18.0	27.5	39.0	52.7	86.2	128	178	237	304	379	462	553	653	761	877	1001	1133
12	11.1	18.9	28.7	40.8	55.0	90.1	134	186	247	317	395	482	578	682	794	916	1045	1184
13	11.6	19.6	29.9	42.4	57.3	93.7	139	194	257	330	411	502	601	710	827	953	1088	1232
14	12.0	20.4	31.0	44.1	59.4	97.3	145	201	267	342	427	521	624	736	858	989	1129	1278
15	12.5	21.1	32.1	45.6	61.5	101	150	208	277	354	442	539	646	762	888	1024	1169	1323
16	12.9	21.8	33.2	47.1	63.5	104	155	215	286	366	457	557	667	787	917	1057	1207	1367
17	13.3	22.4	34.2	48.5	65.5	107	159	222	294	377	471	574	688	812	945	1090	1244	1409
18	13.7	23.1	35.2	49.9	67.4	110	164	228	303	388	484	591	708	835	973	1121	1280	1450
19	14.0	23.8	36.1	51.3	69.2	113	168	234	311	399	497	607	727	858	1000	1152	1315	1489
20	14.4	24.3	37.1	52.6	71.0	116	173	240	319	409	510	623	746	880	1028	1182	1350	1528
21	14.7	24.9	38.0	53.9	72.8	119	177	246	327	419	523	638	764	902	1051	1211	1383	1566
22	15.1	25.5	38.9	55.2	74.5	122	181	252	335	429	535	653	782	923	1076	1240	1415	1603
23	15.4	26.1	39.8	56.5	76.2	125	186	258	342	439	547	668	800	944	1100	1268	1447	1639
24	15.8	26.7	40.6	57.7	77.8	127	189	263	350	448	559	682	817	964	1123	1295	1478	1674
25	16.1	27.2	41.5	58.9	79.4	130	193	269	357	458	571	696	834	984	1147	1322	1509	1708
26	16.4	27.7	42.3	60.0	81.0	133	197	274	364	467	582	710	850	1004	1169	1348	1539	1742
27	16.7	28.3	43.1	61.2	82.5	135	201	279	371	476	593	723	867	1023	1192	1373	1568	1775
28	17.0	28.8	43.9	62.3	84.1	138	204	285	378	484	604	737	883	1041	1214	1399	1597	1808
29	17.3	29.3	44.7	63.4	85.5	140	208	290	384	493	615	750	898	1060	1235	1423	1625	1840
30	17.6	29.8	45.4	64.5	87.0	142	212	294	391	501	625	763	913	1078	1256	1448	1653	1871
L, in feet	Correction Factors For Other Pipe Lengths																	
20	1.30	1.24	1.21	1.18	1.15	1.12	1.10	1.08	1.07	1.06	1.05	1.05	1.04	1.04	1.03	1.03	1.03	1.03
30	1.22	1.18	1.15	1.13	1.12	1.09	1.08	1.06	1.05	1.05	1.04	1.04	1.03	1.03	1.03	1.02	1.02	1.02
40	1.15	1.13	1.11	1.10	1.08	1.07	1.05	1.05	1.04	1.03	1.03	1.03	1.02	1.02	1.02	1.02	1.02	1.02
50	1.09	1.08	1.07	1.06	1.05	1.04	1.04	1.03	1.03	1.02	1.02	1.02	1.02	1.01	1.01	1.01	1.01	1.01
60	1.04	1.04	1.03	1.03	1.03	1.02	1.02	1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
70	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	.98	.97	.97	.97	.98	.98	.98	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99
90	.93	.94	.94	.95	.95	.96	.97	.97	.98	.98	.98	.98	.98	.99	.99	.99	.99	.99
100	.90	.91	.92	.93	.93	.95	.95	.96	.97	.97	.97	.98	.98	.98	.98	.98	.98	.99
120	.84	.86	.87	.89	.90	.91	.93	.94	.94	.95	.96	.96	.96	.97	.97	.97	.97	.98
140	.80	.82	.83	.85	.86	.88	.90	.91	.92	.93	.94	.94	.95	.95	.96	.96	.96	.97
160	.76	.78	.80	.82	.83	.86	.88	.89	.90	.91	.92	.93	.94	.94	.95	.95	.95	.96

Source: USDA - SCS

f. Anti-Seep Collar Design

ANTI – SEEP COLLAR DESIGN



Ls = LENGTH IN SATURATION ZONE

Y = OVERFLOW STRUCTURE HEIGHT = 5.5 FEET

Z = INSIDE SLOPE OF LEVEE = 3

PIPE SLOPE = 1.28 % = .0128 FEET/FEET

$$Ls = Y(Z + 4)\left(1 + \frac{\text{PIPE SLOPE}}{0.25 - \text{PIPE SLOPE}}\right)$$

Ls = 40.6 FEET

FROM ANTI – SEEP COLLAR DESIGN CHART ON THE NEXT PAGE :

V = COLLAR PROJECTION = 1.5 FEET

DIMENSIONS OF 12" THICK COLLAR = 7' x 7'

NUMBER OF REQUIRED COLLARS = 2

ANTI-SEEP COLLAR DESIGN

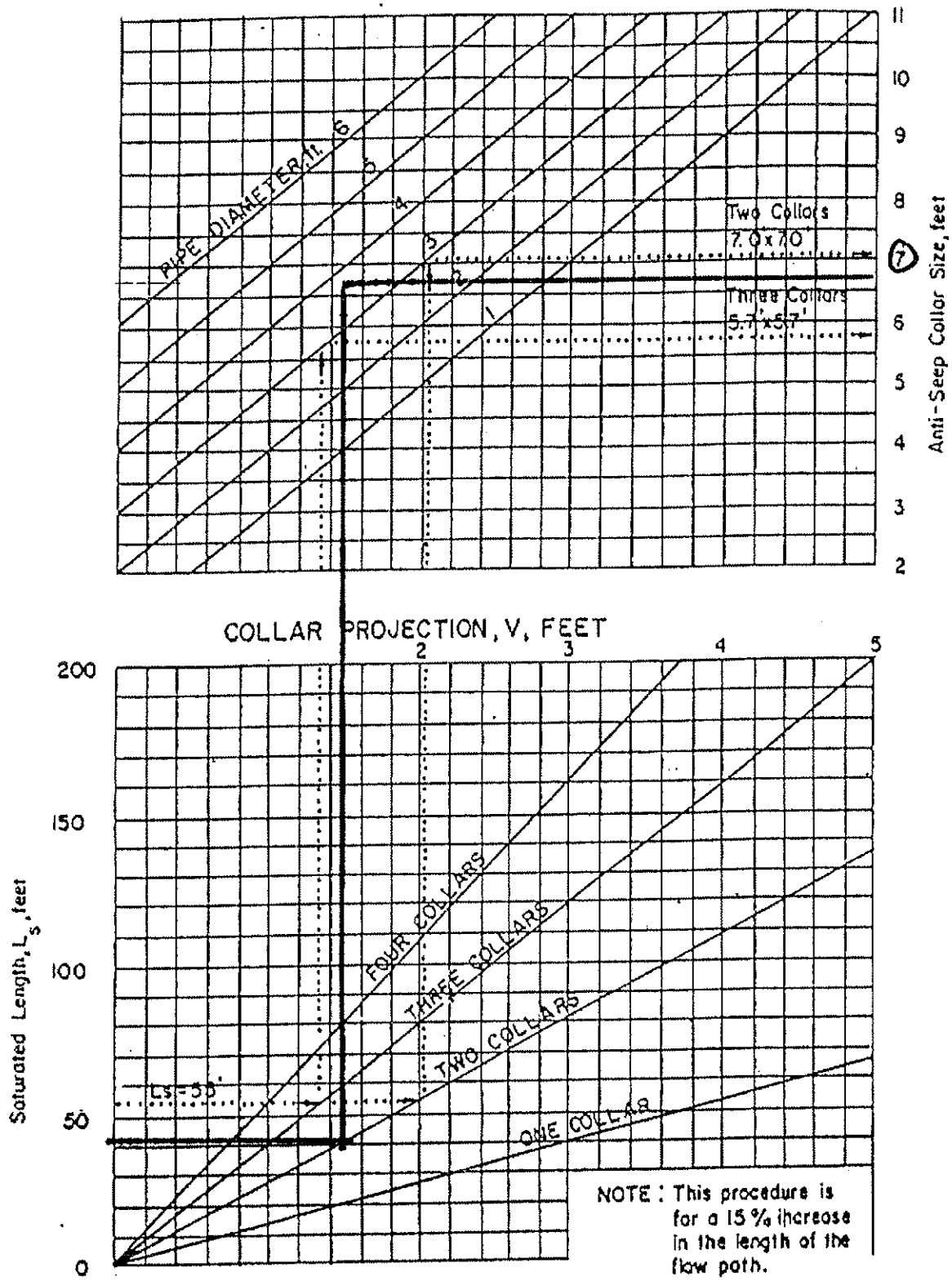


FIGURE A-13

g. Riser Base Foundation Design

OVERFLOW STRUCTURE BASE FOUNDATION DESIGN

A certain volume of concrete will be used to overcome the buoyancy of an empty overflow structure and carrier pipe that are below the assumed phreatic water surface. This volume is equal to:

Overflow Structure

$= (L_2)(w_2)(h)(62.4) - (w_2^2 - w_1^2)(h)(150-62.4)$

$L_1 = w_1 = 5'$ inside
$L_2 = w_2 = 6'$ outside

$= (6)(6)(5.5)(62.4) - (6^2 - 5^2)(.55)(150-62.4)$

h = height = 5.5'

= 7,055 #

Carrier Pipe

$= 3.1416(R_2^2)(Ls)(62.4)-(3.1416)(R_2^2-r_2^2)(150-62.4)(Ls)$

$= 3.1416(1.94)(1.94)(41)(62.4)-3.1416\ (1.94^2-1.75^2)(87.6)(41)$

= 22,339 #

TOTAL WEIGHT

= 29,394 # x 1.5 (SAFETY FACTOR)

Ls = length in saturation zone = 41'
R_2 = outside radius = 23.25" = 1.94'
r_2 = inside radius = 21" = 1.75'

= 44,091 #

TOTAL REVISED VOLUME OF CONCRETE =
TOTAL WEIGHT / WEIGHT OF CONC. IN WATER

= 44,091 / 87.6 pcf (87.6 pcf = Wt. of conc. in submerged water)

= 503 C.F.

This volume of concrete will be made up from four areas.

1. Anti-Seep Collars
2. Overflow Structure Base
3. Carrier Pipe Encasement
4. Weight of Saturated Soil Directly Above Carrier Pipe

1. Anti-seep collars = area of square collar around carrier pipe x 12" thick x # of collars

= [(7' x 7') - (3.1416)(R_2^2) R_2 = outside radius of carrier pipe = 23.25" = 1.94'

x 1' x 2 r_2 = inside radius of carrier pipe = 21" = 1.75'

= 74 C.F.

2. Overflow Structure Base = Volume to handle riser bouyance x 1.5

= (7,055)(1.5)/87.6

= 121 C.F.

Use 10' x 10' x 2' = 200 C.F.

3. Carrier Pipe Encasement

Must extend 5' into dam. Distance from overflow structure to dam is equal to approximately 18'. Therefore, encasement length will be 23'.

Use 5' x 3.5' x 23' long

Carrier pipe encasement volume = 191 C.F.

4. Weight of Saturated Soil in Length of Saturation =

a. Weight of Soil = 100 lbs/C.F.

f. Weight of Saturated Soil = 100 lbs/C.F. – 62.4 lbs/C.F. = 37 lbs/C.F.

g. Volume of Soil in Length of Saturation over Carrier Pipe = 64 s.f. x 3.88 = 248 C.F.

h. 248 C.F. x 37 lbs/C.F. = 9,176 lbs

i. 9,176 lbs ÷ 87.6 lbs/C.F. = 105 C.F. (equivalent of submerged concrete)

TOTAL REQUIRED VOLUME = 503 C.F.

Actual Total Volume

Anti-Seep Collars	= 74 C.F.
Overflow Structure Base	= 200 C.F.
Carrier Pipe Encasement	= 191 C.F.
Weight of Saturated Soil	= 105 C.F.
TOTAL	= 570 C.F. => Okay (Factor of Safety = 1.13)

4. SEDIMENT BASIN NO. 5

a. Sediment Basin Design Criteria

Sediment Basin No. 5 at the Charlotte Motor Speedway Landfill V was designed utilizing the following design criteria.

- Minimum Length to Width Ratio = 2:1
- Minimum Surface Area @ 10 year storm = 0.01 acres min. per cfs of flow.
- Sediment Storage = 1,800 cubic feet of volume per acre of disturbed land measured at 3' depth elevation.
- Retain the 25 year, 24 hour storm event below the crest of the riser.
- Permanent Pool Depth = 3 feet
- Freeboard shall be a minimum of 1 foot above the maximum stage of the basin.
- Minimum dewatering time from top of riser = 24 hours

For Sediment Basin No. 5, the actual Phase 3 design criteria is compared to the NCDENR recommended criteria for sediment basins.

Sediment Basin No. 5

Criteria	NCDENR	Phase III Design
Length	2:1	2:1
Surface Area	.010 Acre/cfs	0.014 Acre/cfs
Volume at 3' Depth Elevation	1,800 C.F./Acre	6,516 C.F./Acre
Storm Retention	25 year	25 year
Permanent Pool Depth	3 feet	3 feet
Freeboard	1 foot	3.82 feet

b. Sediment Volumes and Surface Area Calculations

SEDIMENT VOLUME STORAGE REQUIREMENTS = 1,800 cu.ft. / acre

= 14.9 acres

= 1,800 x 14.9 acres

= 26,820 cf

From the Hydraflow Hydrographs Computer Program, this volume of sediment will occupy a depth of approximately 0.86 feet (interpolated from printout on next page). This sediment volume corresponds to elevation = 576.86 feet.

TOTAL VOLUME IN 3 FOOT PERMANENT POOL = 97,092 c.f.

AVAILABLE SEDIMENT STORAGE = 97,092 c.f. ÷ 14.9 ac = 6,516 c.f./ac

RECOMMENDED SURFACE AREA REQUIREMENTS = 0.01 ACRE PER CFS

Q_{10} = 59.28 cfs

Minimum Surface Area = 0.01 acres x Q_{10}

= 0.59 acres

= 25,822 s.f.

Actual Surface Area At Permanent Pool (El. 579.00) =
Sediment Basin No. 5 Area

= 36,104 s.f.

Actual Surface Area is greater than minimum surface area.

Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Thursday, Apr 30, 2009

Pond No. 5 - Proposed Sediment Basin No. 5

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 576.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	576.00	28,734	0	0
2.00	578.00	33,591	62,256	62,256
3.00	579.00	36,104	34,836	97,092
4.00	580.00	38,674	37,378	134,470
6.00	582.00	43,983	82,592	217,062
8.00	584.00	49,518	93,437	310,499
10.00	586.00	55,280	104,735	415,234

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 48.00	4.00	0.00	0.00
Span (in)	= 48.00	10.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 578.00	579.00	0.00	0.00
Length (ft)	= 78.00	0.00	0.00	0.00
Slope (%)	= 3.85	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 20.00	0.00	0.00	0.00
Crest El. (ft)	= 583.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	576.00	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
2.00	62,256	578.00	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
3.00	97,092	579.00	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
4.00	134,470	580.00	1.25 ic	1.22 ic	---	---	0.00	---	---	---	---	---	1.221
6.00	217,062	582.00	2.32 ic	2.25 ic	---	---	0.00	---	---	---	---	---	2.251
8.00	310,499	584.00	69.00 ic	2.20 ic	---	---	66.60	---	---	---	---	---	68.80
10.00	415,234	586.00	145.55 ic	0.62 ic	---	---	144.93 s	---	---	---	---	---	145.54

Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Thursday, Apr 30, 2009

Pond No. 7 - Sediment Basin No. 5w/ Pool

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 579.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	579.00	36,104	0	0
4.00	580.00	38,674	149,512	149,512
6.00	582.00	43,983	82,592	232,103
8.00	584.00	49,518	93,437	325,540
10.00	586.00	55,280	104,735	430,275

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 48.00	4.00	0.00	0.00
Span (in)	= 48.00	10.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 578.00	579.00	0.00	0.00
Length (ft)	= 78.00	0.00	0.00	0.00
Slope (%)	= 3.85	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 20.00	0.00	0.00	0.00
Crest El. (ft)	= 583.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	579.00	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
4.00	149,512	580.00	8.47 ic	1.22 ic	---	---	0.00	---	---	---	---	---	1.221
6.00	232,103	582.00	8.47 ic	2.25 ic	---	---	0.00	---	---	---	---	---	2.251
8.00	325,540	584.00	69.00 ic	2.20 ic	---	---	66.60	---	---	---	---	---	68.80
10.00	430,275	586.00	145.55 ic	0.62 ic	---	---	144.91 s	---	---	---	---	---	145.52

Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Thursday, Apr 30, 2009

Pond No. 6 - Sediment Basin No. 5 Back to Back

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 583.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	583.00	46,722	0	0
1.00	584.00	49,518	48,108	48,108
3.00	586.00	55,280	104,735	152,843

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 48.00	0.00	0.00	0.00
Span (in)	= 48.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 578.00	0.00	0.00	0.00
Length (ft)	= 78.00	0.00	0.00	0.00
Slope (%)	= 3.85	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 20.00	0.00	0.00	0.00
Crest El. (ft)	= 583.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	583.00	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.00	48,108	584.00	104.79 ic	---	---	---	66.60	---	---	---	---	---	66.60
3.00	152,843	586.00	145.52 ic	---	---	---	145.51 s	---	---	---	---	---	145.51

c. Basin Dewatering

Total Basin Dewatering at Top of Riser

Retention time within the basin is an important factor in effective sediment retention. The perforated riser pipe method has been used for the proposed sediment basin.

The 5' x 5' square concrete overflow structure shall have one 4" (h) x 10" (w) dewatering orifice at elevation 579.00.

The calculation below has been performed to confirm that the dewatering (retention) time within the basin is >24 hours. This dewatering time will ensure the storm water is retained for an adequate length of time to allow the sediment to settle (minimum 24 hours).

$$T = \frac{(As)(2h)^{1/2}}{(Ao)(Cd)(20428)}$$

Where T = Dewatering Time (hr.)
As = Surface Area at Basin (ft^2)
h = Head of Water (ft)
Ao = Surface Area of Dewatering Orifice (ft^2)
Cd = Coefficient of Discharge for an Orifice (use 0.6)

T > 24 hours

Ao = 0.28 s.f. @ Elev. 579.00

As = 46,722 s.f. @ Elev. 583.00 (top of riser)

h = 583.00 – 579.00 = 4.00'

$$T = \frac{46{,}722\ (2 \times 4)^{1/2}}{(0.28)\ (0.6)\ (20{,}428)} = 38.5 \text{ hours}$$

(okay between 24 - 72 hours)

d. Reservoir Routing

Reservoir routing is determined by using the HydraFlow Computer Program.

Peak inflow rates (Q) are determined using the SCS Method and HydraFlow computer program. Peak inflow rates are calculated for the 2 year, 10 year, 25-year, and 100 year storm events and are summarized below.

Q_2 = 29.48 cfs
Q_{10} = 59.28 cfs
Q_{25} = 77.19 cfs
Q_{100} = 101.71 cfs

The bottom of the sediment basin has been set at 576.00. The permanent pool has been set at elevation 579.00. Dewatering of the sediment basin is accomplished by a 4" x 10" rectangular opening beginning at an invert elevation of 579.00.

For routing calculations, a 5' x 5' square riser with a 4" x 10" rectangular opening beginning at an invert elevation of 579.00 is used. The top of the riser is at an elevation of 583.00. The bottom of the sediment basin is elevation 576.00. The invert of the carrier pipe is 578.00. The top of the levee around the sediment basin is at an elevation of 586.00.

Based on the above information the reservoir routing calculations are performed and summarized below.

STORM YEAR	PEAK INFLOW CFS	PEAK OUTFLOW CFS	PEAK ELEV. FEET
2	29.48	1.26	580.07
10	59.28	1.98	581.35
25	77.19	2.32	582.18
100	101.71	2.48	582.60

Based on these routing calculations, the riser is large enough and the sediment basin has sufficient storage volume to retain the sediment from 15 disturbed acres plus the 10-year storm event from the entire drainage area below the crest of the riser (elev. 583.00).

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	2.254	1	723	6,211	------	------	------	Area to DD No. 1
2	SCS Runoff	4.165	1	727	14,223	------	------	------	Area to DD No. 2
3	Combine	6.209	1	725	20,434	1, 2	------	------	DD No. 2
4	SCS Runoff	1.829	1	723	5,041	------	------	------	Area to DD No. 3
5	Combine	7.965	1	724	25,475	3, 4	------	------	DD No. 3
6	SCS Runoff	1.943	1	723	5,356	------	------	------	Area to DD No. 4
7	Combine	9.869	1	724	30,832	5, 6	------	------	DD No. 4
8	SCS Runoff	1.878	1	723	5,176	------	------	------	Area to DD No. 5
9	Combine	11.72	1	723	36,008	7, 8	------	------	DD No. 5
10	SCS Runoff	1.911	1	723	5,266	------	------	------	Area to DD No. 6
11	Combine	13.63	1	723	41,274	9, 10	------	------	DD No. 6
12	SCS Runoff	1.960	1	723	5,401	------	------	------	Area to DD No. 7
13	Combine	15.59	1	723	46,675	11, 12	------	------	DD No. 7
14	SCS Runoff	1.927	1	723	5,311	------	------	------	Area to DD No. 8
15	Combine	17.51	1	723	51,986	13, 14	------	------	DD No. 8
16	SCS Runoff	3.177	1	720	7,246	------	------	------	Area to DD No. 9
17	SCS Runoff	1.559	1	720	3,556	------	------	------	Area to DD No 10
18	Combine	4.736	1	720	10,802	16, 17	------	------	DD No. 10
19	SCS Runoff	1.657	1	719	3,511	------	------	------	Area to DD No. 11
20	Combine	6.351	1	719	14,313	18, 19	------	------	DD No. 11
21	SCS Runoff	1.657	1	719	3,511	------	------	------	Area to DD No. 12
22	Combine	8.008	1	719	17,824	20, 21	------	------	DD No. 12
23	SCS Runoff	1.657	1	719	3,511	------	------	------	Area to DD No. 13
24	Combine	9.665	1	719	21,334	22, 23	------	------	DD No. 13
25	SCS Runoff	1.699	1	719	3,598	------	------	------	Area to DD No. 14
26	Combine	11.36	1	719	24,933	24, 25	------	------	DD No. 14
27	SCS Runoff	1.579	1	720	3,601	------	------	------	Area to DD No. 15
28	Combine	12.93	1	719	28,533	26, 27	------	------	DD No. 15
29	SCS Runoff	1.719	1	719	3,642	------	------	------	Area to DD No. 16
30	Combine	14.65	1	719	32,176	28, 29	------	------	DD No. 16
31	SCS Runoff	1.512	1	747	9,505	------	------	------	Area to DD No. 17
32	SCS Runoff	1.383	1	725	4,227	------	------	------	Area to DD No. 18
33	SCS Runoff	1.650	1	722	4,253	------	------	------	Area to DD No. 19

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Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
34	Combine	2.963	1	723	8,481	32, 33	------	------	DD No. 19
35	SCS Runoff	1.855	1	720	4,231	------	------	------	Area to DD No. 20
36	Combine	4.691	1	721	12,711	34, 35	------	------	DD No. 20
37	SCS Runoff	2.009	1	719	4,257	------	------	------	Area to DD No. 21
38	Combine	6.559	1	720	16,968	36, 37	------	------	DD No. 21
39	SCS Runoff	2.092	1	719	4,432	------	------	------	Area to DD No. 22
40	Combine	8.567	1	720	21,400	38, 39	------	------	DD No. 22
41	SCS Runoff	2.092	1	720	4,771	------	------	------	Area to DD No. 23
42	Combine	10.66	1	720	26,171	40, 41	------	------	DD No. 23
43	SCS Runoff	2.165	1	721	5,314	------	------	------	Area to DD No. 24
44	Combine	12.81	1	720	31,486	42, 43	------	------	DD No. 24
45	SCS Runoff	2.202	1	721	5,406	------	------	------	Area to DD No. 25
46	Combine	15.00	1	720	36,892	44, 45	------	------	DD No. 25
47	SCS Runoff	2.333	1	721	5,727	------	------	------	Area to DD No. 26
48	Combine	17.31	1	720	42,618	46, 47	------	------	DD No. 26
49	SCS Runoff	2.237	1	723	6,166	------	------	------	Area to DD No. 27
50	Combine	19.40	1	720	48,784	48, 49	------	------	DD No. 27
51	Combine	34.26	1	720	90,465	30, 31, 50	------	------	DD No. 17
52	SCS Runoff	7.643	1	716	13,292	------	------	------	Area to Basin No. 3
53	Combine	53.76	1	720	155,742	15, 51, 52	------	------	Total Basin No. 3 Inflow
54	SCS Runoff	1.456	1	721	3,573	------	------	------	Area to DD No. 28
55	SCS Runoff	0.840	1	717	1,575	------	------	------	Area to DD No. 29
56	Combine	2.109	1	719	5,149	54, 55	------	------	DD No. 29
57	SCS Runoff	2.217	1	719	4,696	------	------	------	Area to DD No. 30
58	SCS Runoff	1.677	1	720	3,826	------	------	------	Area to DD No. 31
59	Combine	3.879	1	719	8,521	57, 58	------	------	DD No. 31
60	SCS Runoff	1.119	1	719	2,370	------	------	------	Area to DD No. 32
61	Combine	4.997	1	719	10,891	59, 60	------	------	DD No. 32
62	SCS Runoff	1.284	1	719	2,721	------	------	------	Area to DD No. 33
63	Combine	6.282	1	719	13,612	61, 62	------	------	DD No. 33
64	SCS Runoff	1.480	1	720	3,376	------	------	------	Area to DD No. 34
65	Combine	7.749	1	719	16,987	63, 64	------	------	DD No. 34
66	SCS Runoff	1.624	1	721	3,986	------	------	------	Area to DD No. 35

Hydrograph Summary Report

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Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
67	Combine	9.304	1	719	20,973	65, 66	------	------	DD No. 35
68	SCS Runoff	1.753	1	722	4,519	------	------	------	Area to DD No. 36
69	Combine	10.92	1	719	25,492	67, 68	------	------	DD No. 36
70	SCS Runoff	0.967	1	718	1,949	------	------	------	Area to DD No. 37
71	Combine	11.85	1	719	27,442	69, 70	------	------	DD No. 37
72	SCS Runoff	1.358	1	722	3,500	------	------	------	Area to DD No. 38
73	SCS Runoff	1.367	1	719	2,896	------	------	------	Area to DD No. 39
74	SCS Runoff	1.440	1	720	3,286	------	------	------	Area to DD No. 40
75	Combine	2.795	1	719	6,182	73, 74	------	------	DD No. 40
76	SCS Runoff	1.624	1	721	3,986	------	------	------	Area to DD No. 41
77	Combine	4.365	1	720	10,168	75, 76	------	------	DD No. 41
78	SCS Runoff	1.616	1	722	4,165	------	------	------	Area to DD No. 42
79	Combine	5.934	1	720	14,332	77, 78	------	------	DD No. 42
80	SCS Runoff	1.753	1	722	4,519	------	------	------	Area to DD No. 43
81	Combine	7.635	1	720	18,852	79, 80	------	------	DD No. 43
82	SCS Runoff	1.829	1	723	5,041	------	------	------	Area to DD No. 44
83	Combine	9.374	1	721	23,893	81, 82	------	------	DD No. 44
84	Combine	22.42	1	720	54,835	71, 72, 83	------	------	DD No. 38
85	SCS Runoff	8.032	1	716	13,967	------	------	------	Area to Basin No. 5
86	Combine	29.48	1	718	73,950	56, 84, 85	------	------	Total Basin No. 5 Inflow
87	Reservoir	2.147	1	931	149,274	53	578.17	89,611	Sediment Basin No. 3
88	Reservoir	21.48	1	732	155,738	53	581.47	42,885	Sed Basin No. 3 BTB
90	Reservoir	1.261	1	864	73,343	86	580.07	39,847	Sediment Basin No. 5
91	Reservoir	15.30	1	726	73,948	86	583.37	17,987	Sed Basin No. 5 BTB

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Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	4.549	1	722	12,244	------	------	------	Area to DD No. 1
2	SCS Runoff	8.490	1	726	28,039	------	------	------	Area to DD No. 2
3	Combine	12.63	1	724	40,283	1, 2	------	------	DD No. 2
4	SCS Runoff	3.692	1	722	9,937	------	------	------	Area to DD No. 3
5	Combine	16.21	1	724	50,221	3, 4	------	------	DD No. 3
6	SCS Runoff	3.922	1	722	10,559	------	------	------	Area to DD No. 4
7	Combine	20.07	1	723	60,779	5, 6	------	------	DD No. 4
8	SCS Runoff	3.791	1	722	10,204	------	------	------	Area to DD No. 5
9	Combine	23.85	1	723	70,983	7, 8	------	------	DD No. 5
10	SCS Runoff	3.856	1	722	10,381	------	------	------	Area to DD No. 6
11	Combine	27.68	1	723	81,364	9, 10	------	------	DD No. 6
12	SCS Runoff	3.955	1	722	10,647	------	------	------	Area to DD No. 7
13	Combine	31.62	1	723	92,011	11, 12	------	------	DD No. 7
14	SCS Runoff	3.889	1	722	10,470	------	------	------	Area to DD No. 8
15	Combine	35.49	1	723	102,481	13, 14	------	------	DD No. 8
16	SCS Runoff	6.314	1	719	14,285	------	------	------	Area to DD No. 9
17	SCS Runoff	3.098	1	719	7,009	------	------	------	Area to DD No 10
18	Combine	9.413	1	719	21,295	16, 17	------	------	DD No. 10
19	SCS Runoff	3.272	1	718	6,921	------	------	------	Area to DD No. 11
20	Combine	12.68	1	719	28,215	18, 19	------	------	DD No. 11
21	SCS Runoff	3.272	1	718	6,921	------	------	------	Area to DD No. 12
22	Combine	15.96	1	719	35,136	20, 21	------	------	DD No. 12
23	SCS Runoff	3.272	1	718	6,921	------	------	------	Area to DD No. 13
24	Combine	19.23	1	719	42,057	22, 23	------	------	DD No. 13
25	SCS Runoff	3.354	1	718	7,094	------	------	------	Area to DD No. 14
26	Combine	22.58	1	719	49,151	24, 25	------	------	DD No. 14
27	SCS Runoff	3.138	1	719	7,098	------	------	------	Area to DD No. 15
28	Combine	25.72	1	719	56,249	26, 27	------	------	DD No. 15
29	SCS Runoff	3.395	1	718	7,180	------	------	------	Area to DD No. 16
30	Combine	29.11	1	719	63,429	28, 29	------	------	DD No. 16
31	SCS Runoff	3.132	1	746	18,737	------	------	------	Area to DD No. 17
32	SCS Runoff	2.806	1	724	8,333	------	------	------	Area to DD No. 18
33	SCS Runoff	3.318	1	721	8,385	------	------	------	Area to DD No. 19

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Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
34	Combine	6.008	1	722	16,718	32, 33	------	------	DD No. 19
35	SCS Runoff	3.687	1	719	8,340	------	------	------	Area to DD No. 20
36	Combine	9.459	1	721	25,058	34, 35	------	------	DD No. 20
37	SCS Runoff	3.967	1	718	8,391	------	------	------	Area to DD No. 21
38	Combine	13.19	1	720	33,450	36, 37	------	------	DD No. 21
39	SCS Runoff	4.131	1	718	8,737	------	------	------	Area to DD No. 22
40	Combine	17.23	1	719	42,187	38, 39	------	------	DD No. 22
41	SCS Runoff	4.157	1	719	9,405	------	------	------	Area to DD No. 23
42	Combine	21.39	1	719	51,592	40, 41	------	------	DD No. 23
43	SCS Runoff	4.330	1	720	10,476	------	------	------	Area to DD No. 24
44	Combine	25.61	1	719	62,068	42, 43	------	------	DD No. 24
45	SCS Runoff	4.405	1	720	10,657	------	------	------	Area to DD No. 25
46	Combine	30.00	1	720	72,725	44, 45	------	------	DD No. 25
47	SCS Runoff	4.666	1	720	11,289	------	------	------	Area to DD No. 26
48	Combine	34.67	1	720	84,014	46, 47	------	------	DD No. 26
49	SCS Runoff	4.516	1	722	12,156	------	------	------	Area to DD No. 27
50	Combine	38.97	1	720	96,170	48, 49	------	------	DD No. 27
51	Combine	68.76	1	719	178,335	30, 31, 50	------	------	DD No. 17
52	SCS Runoff	14.89	1	716	26,202	------	------	------	Area to Basin No. 3
53	Combine	108.98	1	719	307,019	15, 51, 52	------	------	Total Basin No. 3 Inflow
54	SCS Runoff	2.912	1	720	7,044	------	------	------	Area to DD No. 28
55	SCS Runoff	1.646	1	717	3,105	------	------	------	Area to DD No. 29
56	Combine	4.233	1	718	10,150	54, 55	------	------	DD No. 29
57	SCS Runoff	4.376	1	718	9,256	------	------	------	Area to DD No. 30
58	SCS Runoff	3.334	1	719	7,542	------	------	------	Area to DD No. 31
59	Combine	7.710	1	719	16,798	57, 58	------	------	DD No. 31
60	SCS Runoff	2.209	1	718	4,671	------	------	------	Area to DD No. 32
61	Combine	9.918	1	719	21,470	59, 60	------	------	DD No. 32
62	SCS Runoff	2.536	1	718	5,364	------	------	------	Area to DD No. 33
63	Combine	12.45	1	719	26,833	61, 62	------	------	DD No. 33
64	SCS Runoff	2.941	1	719	6,655	------	------	------	Area to DD No. 34
65	Combine	15.40	1	719	33,488	63, 64	------	------	DD No. 34
66	SCS Runoff	3.248	1	720	7,857	------	------	------	Area to DD No. 35

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
67	Combine	18.56	1	719	41,345	65, 66	------	------	DD No. 35
68	SCS Runoff	3.525	1	721	8,909	------	------	------	Area to DD No. 36
69	Combine	21.89	1	719	50,254	67, 68	------	------	DD No. 36
70	SCS Runoff	1.907	1	718	3,843	------	------	------	Area to DD No. 37
71	Combine	23.70	1	719	54,097	69, 70	------	------	DD No. 37
72	SCS Runoff	2.730	1	721	6,900	------	------	------	Area to DD No. 38
73	SCS Runoff	2.699	1	718	5,710	------	------	------	Area to DD No. 39
74	SCS Runoff	2.863	1	719	6,477	------	------	------	Area to DD No. 40
75	Combine	5.562	1	719	12,187	73, 74	------	------	DD No. 40
76	SCS Runoff	3.248	1	720	7,857	------	------	------	Area to DD No. 41
77	Combine	8.728	1	719	20,044	75, 76	------	------	DD No. 41
78	SCS Runoff	3.249	1	721	8,210	------	------	------	Area to DD No. 42
79	Combine	11.86	1	720	28,254	77, 78	------	------	DD No. 42
80	SCS Runoff	3.525	1	721	8,909	------	------	------	Area to DD No. 43
81	Combine	15.33	1	720	37,163	79, 80	------	------	DD No. 43
82	SCS Runoff	3.692	1	722	9,937	------	------	------	Area to DD No. 44
83	Combine	18.85	1	720	47,100	81, 82	------	------	DD No. 44
84	Combine	44.83	1	720	108,097	71, 72, 83	------	------	DD No. 38
85	SCS Runoff	15.64	1	716	27,533	------	------	------	Area to Basin No. 5
86	Combine	59.28	1	718	145,780	56, 84, 85	------	------	Total Basin No. 5 Inflow
87	Reservoir	3.268	1	962	290,359	53	579.50	197,386	Sediment Basin No. 3
88	Reservoir	55.63	1	729	307,015	53	581.89	81,055	Sed Basin No. 3 BTB
90	Reservoir	1.975	1	899	143,513	86	581.35	87,847	Sediment Basin No. 5
91	Reservoir	37.42	1	724	145,777	86	583.68	32,739	Sed Basin No. 5 BTB

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	5.934	1	722	15,954	------	------	------	Area to DD No. 1
2	SCS Runoff	11.11	1	726	36,534	------	------	------	Area to DD No. 2
3	Combine	16.54	1	724	52,489	1, 2	------	------	DD No. 2
4	SCS Runoff	4.816	1	722	12,948	------	------	------	Area to DD No. 3
5	Combine	21.18	1	723	65,437	3, 4	------	------	DD No. 3
6	SCS Runoff	5.117	1	722	13,758	------	------	------	Area to DD No. 4
7	Combine	26.26	1	723	79,195	5, 6	------	------	DD No. 4
8	SCS Runoff	4.945	1	722	13,295	------	------	------	Area to DD No. 5
9	Combine	31.17	1	723	92,490	7, 8	------	------	DD No. 5
10	SCS Runoff	5.031	1	722	13,527	------	------	------	Area to DD No. 6
11	Combine	36.16	1	723	106,016	9, 10	------	------	DD No. 6
12	SCS Runoff	5.160	1	722	13,873	------	------	------	Area to DD No. 7
13	Combine	41.28	1	723	119,890	11, 12	------	------	DD No. 7
14	SCS Runoff	5.074	1	722	13,642	------	------	------	Area to DD No. 8
15	Combine	46.32	1	723	133,532	13, 14	------	------	DD No. 8
16	SCS Runoff	8.214	1	719	18,613	------	------	------	Area to DD No. 9
17	SCS Runoff	4.031	1	719	9,133	------	------	------	Area to DD No 10
18	Combine	12.25	1	719	27,747	16, 17	------	------	DD No. 10
19	SCS Runoff	4.251	1	718	9,018	------	------	------	Area to DD No. 11
20	Combine	16.48	1	719	36,764	18, 19	------	------	DD No. 11
21	SCS Runoff	4.251	1	718	9,018	------	------	------	Area to DD No. 12
22	Combine	20.72	1	719	45,782	20, 21	------	------	DD No. 12
23	SCS Runoff	4.251	1	718	9,018	------	------	------	Area to DD No. 13
24	Combine	24.95	1	719	54,800	22, 23	------	------	DD No. 13
25	SCS Runoff	4.357	1	718	9,243	------	------	------	Area to DD No. 14
26	Combine	29.30	1	719	64,043	24, 25	------	------	DD No. 14
27	SCS Runoff	4.082	1	719	9,249	------	------	------	Area to DD No. 15
28	Combine	33.38	1	719	73,292	26, 27	------	------	DD No. 15
29	SCS Runoff	4.410	1	718	9,356	------	------	------	Area to DD No. 16
30	Combine	37.77	1	719	82,648	28, 29	------	------	DD No. 16
31	SCS Runoff	4.117	1	746	24,414	------	------	------	Area to DD No. 17
32	SCS Runoff	3.667	1	724	10,858	------	------	------	Area to DD No. 18
33	SCS Runoff	4.323	1	721	10,925	------	------	------	Area to DD No. 19

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
34	Combine	7.844	1	722	21,784	32, 33	------	------	DD No. 19
35	SCS Runoff	4.796	1	719	10,867	------	------	------	Area to DD No. 20
36	Combine	12.33	1	721	32,651	34, 35	------	------	DD No. 20
37	SCS Runoff	5.154	1	718	10,934	------	------	------	Area to DD No. 21
38	Combine	17.17	1	720	43,585	36, 37	------	------	DD No. 21
39	SCS Runoff	5.367	1	718	11,385	------	------	------	Area to DD No. 22
40	Combine	22.46	1	719	54,970	38, 39	------	------	DD No. 22
41	SCS Runoff	5.408	1	719	12,255	------	------	------	Area to DD No. 23
42	Combine	27.87	1	719	67,224	40, 41	------	------	DD No. 23
43	SCS Runoff	5.641	1	720	13,650	------	------	------	Area to DD No. 24
44	Combine	33.38	1	719	80,875	42, 43	------	------	DD No. 24
45	SCS Runoff	5.738	1	720	13,886	------	------	------	Area to DD No. 25
46	Combine	39.01	1	720	94,761	44, 45	------	------	DD No. 25
47	SCS Runoff	6.078	1	720	14,709	------	------	------	Area to DD No. 26
48	Combine	45.08	1	720	109,470	46, 47	------	------	DD No. 26
49	SCS Runoff	5.891	1	722	15,839	------	------	------	Area to DD No. 27
50	Combine	50.73	1	720	125,309	48, 49	------	------	DD No. 27
51	Combine	89.61	1	719	232,370	30, 31, 50	------	------	DD No. 17
52	SCS Runoff	19.19	1	716	34,141	------	------	------	Area to Basin No. 3
53	Combine	142.30	1	719	400,044	15, 51, 52	------	------	Total Basin No. 3 Inflow
54	SCS Runoff	3.793	1	720	9,179	------	------	------	Area to DD No. 28
55	SCS Runoff	2.126	1	717	4,046	------	------	------	Area to DD No. 29
56	Combine	5.514	1	718	13,225	54, 55	------	------	DD No. 29
57	SCS Runoff	5.686	1	718	12,061	------	------	------	Area to DD No. 30
58	SCS Runoff	4.337	1	719	9,827	------	------	------	Area to DD No. 31
59	Combine	10.00	1	719	21,888	57, 58	------	------	DD No. 31
60	SCS Runoff	2.869	1	718	6,087	------	------	------	Area to DD No. 32
61	Combine	12.86	1	719	27,975	59, 60	------	------	DD No. 32
62	SCS Runoff	3.295	1	718	6,989	------	------	------	Area to DD No. 33
63	Combine	16.14	1	719	34,964	61, 62	------	------	DD No. 33
64	SCS Runoff	3.827	1	719	8,671	------	------	------	Area to DD No. 34
65	Combine	19.97	1	719	43,635	63, 64	------	------	DD No. 34
66	SCS Runoff	4.231	1	720	10,238	------	------	------	Area to DD No. 35

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
67	Combine	24.11	1	719	53,872	65, 66	------	------	DD No. 35
68	SCS Runoff	4.594	1	721	11,608	------	------	------	Area to DD No. 36
69	Combine	28.47	1	719	65,480	67, 68	------	------	DD No. 36
70	SCS Runoff	2.467	1	718	5,007	------	------	------	Area to DD No. 37
71	Combine	30.81	1	719	70,488	69, 70	------	------	DD No. 37
72	SCS Runoff	3.558	1	721	8,991	------	------	------	Area to DD No. 38
73	SCS Runoff	3.507	1	718	7,440	------	------	------	Area to DD No. 39
74	SCS Runoff	3.725	1	719	8,440	------	------	------	Area to DD No. 40
75	Combine	7.219	1	719	15,879	73, 74	------	------	DD No. 40
76	SCS Runoff	4.231	1	720	10,238	------	------	------	Area to DD No. 41
77	Combine	11.36	1	719	26,117	75, 76	------	------	DD No. 41
78	SCS Runoff	4.233	1	721	10,698	------	------	------	Area to DD No. 42
79	Combine	15.42	1	720	36,815	77, 78	------	------	DD No. 42
80	SCS Runoff	4.594	1	721	11,608	------	------	------	Area to DD No. 43
81	Combine	19.95	1	720	48,423	79, 80	------	------	DD No. 43
82	SCS Runoff	4.816	1	722	12,948	------	------	------	Area to DD No. 44
83	Combine	24.56	1	720	61,371	81, 82	------	------	DD No. 44
84	Combine	58.33	1	719	140,849	71, 72, 83	------	------	DD No. 38
85	SCS Runoff	20.16	1	716	35,876	------	------	------	Area to Basin No. 5
86	Combine	77.19	1	718	189,950	56, 84, 85	------	------	Total Basin No. 5 Inflow
87	Reservoir	3.800	1	988	367,646	53	580.32	266,722	Sediment Basin No. 3
88	Reservoir	78.03	1	728	400,039	53	582.11	102,053	Sed Basin No. 3 BTB
90	Reservoir	2.322	1	915	185,585	86	582.18	118,880	Sediment Basin No. 5
91	Reservoir	51.78	1	724	189,948	86	583.85	40,650	Sed Basin No. 5 BTB

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	7.834	1	722	21,124	------	------	------	Area to DD No. 1
2	SCS Runoff	14.72	1	726	48,373	------	------	------	Area to DD No. 2
3	Combine	21.91	1	724	69,497	1, 2	------	------	DD No. 2
4	SCS Runoff	6.358	1	722	17,144	------	------	------	Area to DD No. 3
5	Combine	28.06	1	723	86,642	3, 4	------	------	DD No. 3
6	SCS Runoff	6.756	1	722	18,216	------	------	------	Area to DD No. 4
7	Combine	34.75	1	723	104,858	5, 6	------	------	DD No. 4
8	SCS Runoff	6.529	1	722	17,604	------	------	------	Area to DD No. 5
9	Combine	41.21	1	723	122,461	7, 8	------	------	DD No. 5
10	SCS Runoff	6.642	1	722	17,910	------	------	------	Area to DD No. 6
11	Combine	47.79	1	723	140,371	9, 10	------	------	DD No. 6
12	SCS Runoff	6.812	1	722	18,369	------	------	------	Area to DD No. 7
13	Combine	54.54	1	723	158,740	11, 12	------	------	DD No. 7
14	SCS Runoff	6.699	1	722	18,063	------	------	------	Area to DD No. 8
15	Combine	61.17	1	723	176,802	13, 14	------	------	DD No. 8
16	SCS Runoff	10.81	1	719	24,645	------	------	------	Area to DD No. 9
17	SCS Runoff	5.307	1	719	12,093	------	------	------	Area to DD No 10
18	Combine	16.12	1	719	36,738	16, 17	------	------	DD No. 10
19	SCS Runoff	5.589	1	718	11,940	------	------	------	Area to DD No. 11
20	Combine	21.67	1	719	48,678	18, 19	------	------	DD No. 11
21	SCS Runoff	5.589	1	718	11,940	------	------	------	Area to DD No. 12
22	Combine	27.22	1	719	60,617	20, 21	------	------	DD No. 12
23	SCS Runoff	5.589	1	718	11,940	------	------	------	Area to DD No. 13
24	Combine	32.78	1	719	72,557	22, 23	------	------	DD No. 13
25	SCS Runoff	5.729	1	718	12,238	------	------	------	Area to DD No. 14
26	Combine	38.47	1	719	84,796	24, 25	------	------	DD No. 14
27	SCS Runoff	5.374	1	719	12,246	------	------	------	Area to DD No. 15
28	Combine	43.84	1	719	97,042	26, 27	------	------	DD No. 15
29	SCS Runoff	5.799	1	718	12,388	------	------	------	Area to DD No. 16
30	Combine	49.60	1	719	109,429	28, 29	------	------	DD No. 16
31	SCS Runoff	5.475	1	746	32,325	------	------	------	Area to DD No. 17
32	SCS Runoff	4.848	1	724	14,377	------	------	------	Area to DD No. 18
33	SCS Runoff	5.701	1	721	14,466	------	------	------	Area to DD No. 19

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
34	Combine	10.36	1	722	28,842	32, 33	------	------	DD No. 19
35	SCS Runoff	6.314	1	719	14,389	------	------	------	Area to DD No. 20
36	Combine	16.27	1	720	43,231	34, 35	------	------	DD No. 20
37	SCS Runoff	6.777	1	718	14,477	------	------	------	Area to DD No. 21
38	Combine	22.63	1	720	57,708	36, 37	------	------	DD No. 21
39	SCS Runoff	7.057	1	718	15,074	------	------	------	Area to DD No. 22
40	Combine	29.62	1	719	72,782	38, 39	------	------	DD No. 22
41	SCS Runoff	7.120	1	719	16,226	------	------	------	Area to DD No. 23
42	Combine	36.74	1	719	89,008	40, 41	------	------	DD No. 23
43	SCS Runoff	7.435	1	720	18,074	------	------	------	Area to DD No. 24
44	Combine	44.03	1	719	107,082	42, 43	------	------	DD No. 24
45	SCS Runoff	7.563	1	720	18,385	------	------	------	Area to DD No. 25
46	Combine	51.45	1	719	125,468	44, 45	------	------	DD No. 25
47	SCS Runoff	8.012	1	720	19,476	------	------	------	Area to DD No. 26
48	Combine	59.33	1	720	144,943	46, 47	------	------	DD No. 26
49	SCS Runoff	7.778	1	722	20,971	------	------	------	Area to DD No. 27
50	Combine	66.83	1	720	165,915	48, 49	------	------	DD No. 27
51	Combine	118.17	1	719	307,669	30, 31, 50	------	------	DD No. 17
52	SCS Runoff	25.13	1	715	45,205	------	------	------	Area to Basin No. 3
53	Combine	188.02	1	719	529,676	15, 51, 52	------	------	Total Basin No. 3 Inflow
54	SCS Runoff	5.000	1	720	12,153	------	------	------	Area to DD No. 28
55	SCS Runoff	2.780	1	717	5,358	------	------	------	Area to DD No. 29
56	Combine	7.269	1	718	17,511	54, 55	------	------	DD No. 29
57	SCS Runoff	7.476	1	718	15,969	------	------	------	Area to DD No. 30
58	SCS Runoff	5.710	1	719	13,011	------	------	------	Area to DD No. 31
59	Combine	13.13	1	719	28,981	57, 58	------	------	DD No. 31
60	SCS Runoff	3.773	1	718	8,059	------	------	------	Area to DD No. 32
61	Combine	16.88	1	719	37,040	59, 60	------	------	DD No. 32
62	SCS Runoff	4.332	1	718	9,253	------	------	------	Area to DD No. 33
63	Combine	21.18	1	719	46,294	61, 62	------	------	DD No. 33
64	SCS Runoff	5.038	1	719	11,481	------	------	------	Area to DD No. 34
65	Combine	26.22	1	719	57,774	63, 64	------	------	DD No. 34
66	SCS Runoff	5.576	1	720	13,555	------	------	------	Area to DD No. 35

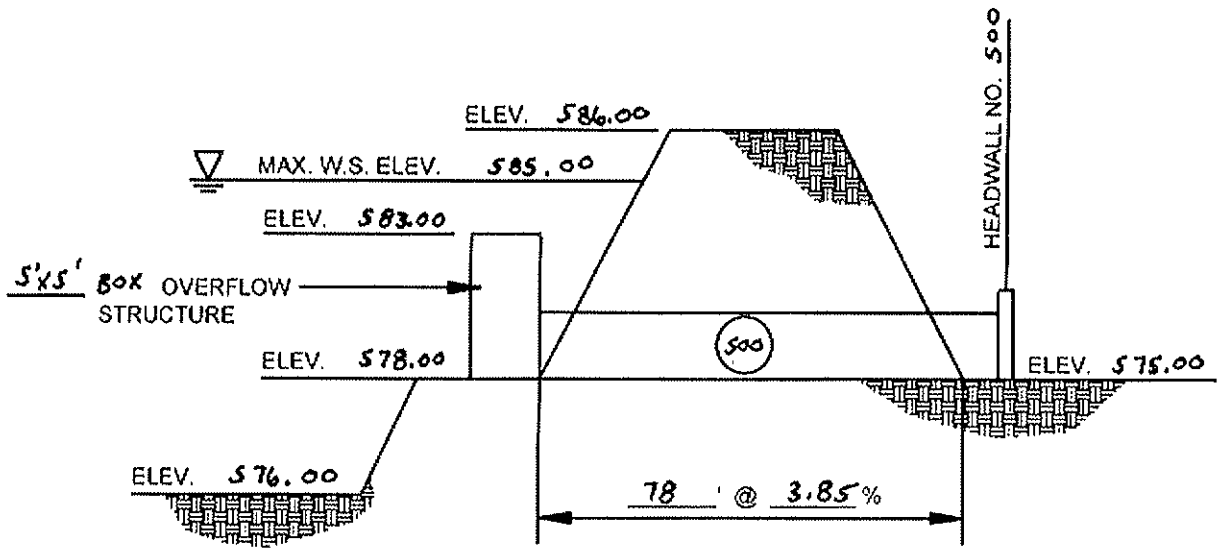
Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
67	Combine	31.69	1	719	71,329	65, 66	------	------	DD No. 35
68	SCS Runoff	6.057	1	721	15,370	------	------	------	Area to DD No. 36
69	Combine	37.48	1	719	86,699	67, 68	------	------	DD No. 36
70	SCS Runoff	3.232	1	718	6,630	------	------	------	Area to DD No. 37
71	Combine	40.53	1	719	93,329	69, 70	------	------	DD No. 37
72	SCS Runoff	4.691	1	721	11,904	------	------	------	Area to DD No. 38
73	SCS Runoff	4.611	1	718	9,850	------	------	------	Area to DD No. 39
74	SCS Runoff	4.903	1	719	11,174	------	------	------	Area to DD No. 40
75	Combine	9.483	1	719	21,025	73, 74	------	------	DD No. 40
76	SCS Runoff	5.576	1	720	13,555	------	------	------	Area to DD No. 41
77	Combine	14.95	1	719	34,580	75, 76	------	------	DD No. 41
78	SCS Runoff	5.582	1	721	14,164	------	------	------	Area to DD No. 42
79	Combine	20.29	1	720	48,744	77, 78	------	------	DD No. 42
80	SCS Runoff	6.057	1	721	15,370	------	------	------	Area to DD No. 43
81	Combine	26.27	1	720	64,114	79, 80	------	------	DD No. 43
82	SCS Runoff	6.358	1	722	17,144	------	------	------	Area to DD No. 44
83	Combine	32.40	1	720	81,258	81, 82	------	------	DD No. 44
84	Combine	76.94	1	719	186,491	71, 72, 83	------	------	DD No. 38
85	SCS Runoff	26.40	1	715	47,501	------	------	------	Area to Basin No. 5
86	Combine	101.71	1	718	251,503	56, 84, 85	------	------	Total Basin No. 5 Inflow
87	Reservoir	8.292	1	843	473,451	53	581.14	339,503	Sediment Basin No. 3
88	Reservoir	107.63	1	727	529,672	53	582.40	129,995	Sed Basin No. 3 BTB
90	Reservoir	2.478	1	1887	222,048	86	582.60	181,599	Sediment Basin No. 5
91	Reservoir	71.71	1	723	251,501	86	584.05	50,663	Sed Basin No. 5 BTB

e. Riser Pipe and Carrier Pipe Design

OVERFLOW STRUCTURE NO. 5



DESIGN OF OVERFLOW STRUCTURE AS EMERGENCY SPILLWAY

FLOW (Q) WORST CASE = 100 YEAR STORM EVENT OCCURS WHEN THE WATER SURFACE ELEVATION AT THE TOP OF THE OVERFLOW STRUCTURE AND ALL DEWATERING HOLES ARE PLUGGED

FLOW (Q) MAXIMUM = 165 CFS

HEAD (H) MAXIMUM = MAXIMUM WATER SURFACE ELEVATION FOR WORST CASE FLOW MINUS THE ELEVATION AT THE CREST OF THE OVERFLOW STRUCTURE

= 585.00 - 583.00 = 2.00 FEET

BASED ON ABOVE HEAD, USE 5'x5' BOX OVERFLOW STRUCTURE

(SEE CHART ON NEXT PAGE)

WEIR FLOW (Q) OVER RISER CREST FOR CIRCULAR RISERS WITH TRASH RACK

$$Q = CLh^{3/2}$$

$$Q = 3.1 \times (\pi) \times (D/12) \times h^{3/2}$$

Riser Diameter (D_r) in inches

HEAD-h in feet	12	18	24	30	36	48	54	60	HEAD-h in feet
				Flow In Cubic Feet Per Second					
0.1	0.3	0.5	0.6	0.8	0.9	1.2	1.4	1.5	0.1
0.2	0.9	1.3	1.7	2.2	2.6	3.5	3.9	4.4	0.2
0.3	1.6	2.4	3.2	4.0	4.8	6.4	7.2	8.0	0.3
0.4	2.5	3.7	4.9	6.2	7.4	9.9	11.1	12.3	0.4
0.6	4.5	6.8	9.1	11.3	13.6	18.1	20.4	22.6	0.6
0.8		10.5	13.9	17.4	20.9	27.9	31.4	34.8	0.8
1.0			19.5	24.3	29.2	39.0	43.8	48.7	1.0
1.2			25.6	32.0	38.4	51.2	57.6	64.0	1.2
1.4				40.3	48.4	64.5	72.6	80.7	1.4
1.6				49.3	59.1	78.8	88.7	98.6	1.6
1.8					70.6	94.1	105.8	117.6	1.8
2.0					82.6	110.2	124.0	137.7	2.0
2.2						127.1	143.0	158.9	2.2
2.4							162.9	181.0	2.4
2.6							183.7	204.1	2.6
2.8								228.1	2.8
3.0								253.0	3.0

5' x 5' Box ≈ 72" pipe

$Q_{max} = 9.739\ (4)(2)^{3/2}$

≈ 165 cfs

Table 6-22.2

Pipe, Riser, and Trash Rack Proportions

Eq. 6-10 $D_r \geq (1.50)\ (D_{ps})$

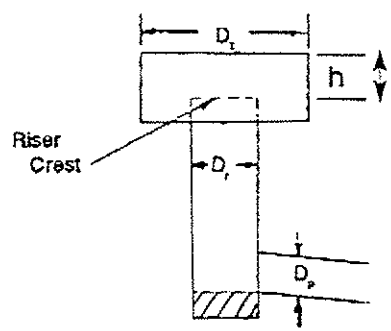
where D_r = diameter of riser

D_{ps} = diameter of principal spillway

Eq. 6-11 $D_t \geq (1.4)\ (D_r)$

where D_t = diameter of trash rack

D_r = diameter of riser



EXAMPLE: The peak runoff for a 2-year, 24-hour rain is 32 cfs. Select a pipe size for a head of 12 feet and length of 100 feet. From Table 6-15.1, 38.2 x 0.89 = 34 cfs discharge for a 24-inch diameter pipe.

Using Equation 6-10 $D_r \geq (1.5)\ (D_p)$

$D_r \geq (1.5)\ (24) \geq$ 36 inch diameter riser

Using Equation 6-11 $D_t \geq (1.4)\ (D_r)$

$D_t \geq (1.4)\ (36) \geq$ 50 inch diameter (Use 54 inch)

Determine h - From Table 6-15.2

Q = 34 cfs D_r = 36" h = 1.2'

NOTE: h = minimum distance between the crest of the riser and the crest of the emergency spillway.

CARRIER PIPE NO. 500

Q = 165 CFS WORST CASE

MAXIMUM HEADWATER = TOP OF LEEVE ELEVATION MINUS 1' FREEBOARD
= 586.00 - 1.00 = 585.00

HEAD (H) = MAXIMUM WATER ELEVATION ALLOWED MINUS THE CENTERLINE ELEVATION AT THE DOWNSTREAM END OF THE CARRIER PIPE
= 585.00 - 577.00 = 8

LENGTH (L) = 78

LENGTH FACTOR = .99 FOR LENGTHS OTHER THAN 70'

Q (AVAILABLE) = Q FROM TABLE TIMES LENGTH FACTOR
= 202 X .99 = 199.98

Q (AVAILABLE) MUST BE GREATER THAN Q WORST CASE

USE 48 " DIAMETER RCP CARRIER PIPE

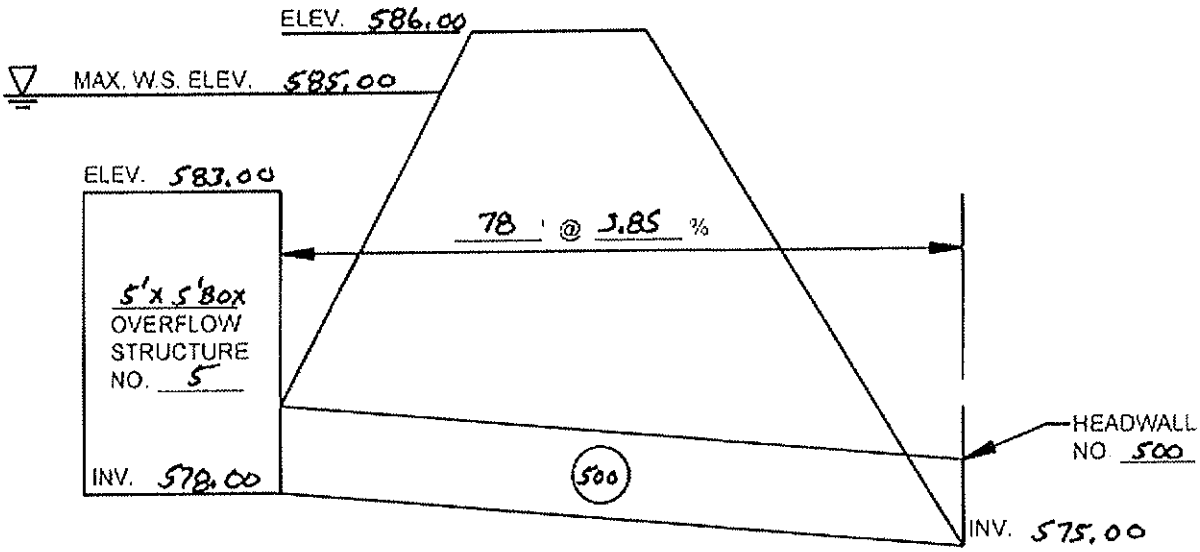


Table 6-25

PIPE FLOW CHART n = 0.025

FOR CORRUGATED METAL PIPE INLET $K_a = K_e = K_b = 1.0$ AND 70 FEET OF CORRUGATED METAL PIPE CONDUIT (full flow assumed)

Note correction factors for pipe lengths other than 70 feet

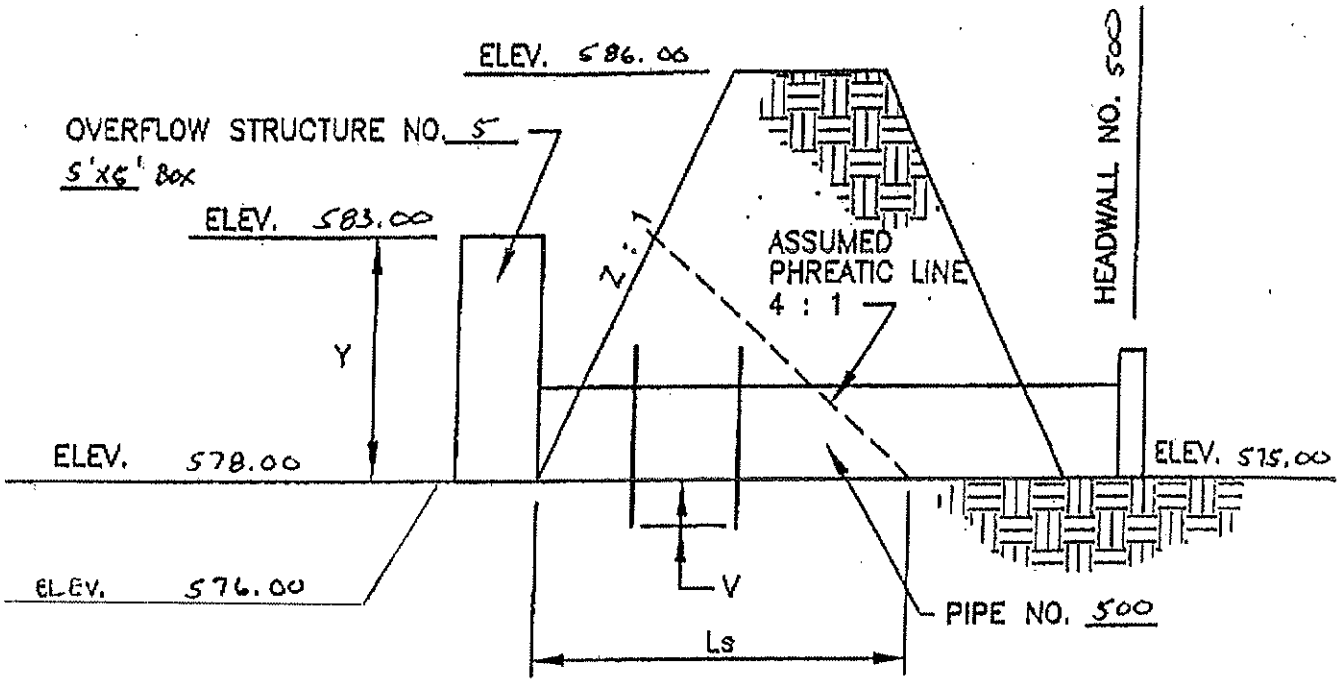
diameter of pipe in inches

H, in feet	12"	15"	18"	21"	24"	30"	36"	42"	48"	54"	60"	66"	72"	78"	84"	90"	96"	102"
1	3.22	5.44	8.29	11.8	15.9	26.0	38.6	53.8	71.4	91.5	114	139	167	197	229	264	302	342
2	4.55	7.69	11.7	16.7	22.5	36.8	54.6	76.0	101	129	161	197	236	278	324	374	427	483
3	5.57	9.42	14.4	20.4	27.5	45.0	66.9	93.1	124	159	198	241	289	341	397	458	523	592
4	6.43	10.9	16.6	23.5	31.8	52.0	77.3	108	143	183	228	278	334	394	459	529	604	683
5	7.19	12.2	18.5	26.3	35.5	58.1	86.4	120	160	205	255	311	373	440	513	591	675	764
6	7.88	13.3	20.3	28.8	38.9	67.7	94.6	132	175	224	280	341	409	482	562	647	739	837
7	8.51	14.4	21.9	31.1	42.0	68.8	102	142	189	242	302	368	441	521	607	699	798	904
8	9.10	15.4	23.5	33.3	44.9	73.5	109	152	202	259	323	394	472	557	685	748	854	966
9	9.65	16.3	24.9	35.3	47.7	78.0	116	161	214	275	342	418	500	590	688	793	905	1025
10	10.2	17.2	26.2	37.2	50.2	82.2	122	170	226	289	361	440	527	622	725	836	954	1080
11	10.7	18.0	27.5	39.0	52.7	86.2	128	178	237	304	379	462	553	653	761	877	1001	1133
12	11.1	18.9	28.7	40.8	55.0	90.1	134	186	247	317	395	482	578	682	794	916	1045	1184
13	11.6	19.6	29.9	42.4	57.3	93.7	139	194	257	330	411	502	601	710	827	953	1088	1232
14	12.0	20.4	31.0	44.1	59.4	97.3	145	201	267	342	427	521	624	736	858	989	1129	1278
15	12.5	21.1	32.1	45.6	61.5	101	150	208	277	354	442	539	646	762	888	1024	1169	1323
16	12.9	21.8	33.2	47.1	63.5	104	155	215	286	366	457	557	667	787	917	1057	1207	1367
17	13.3	22.4	34.2	48.5	65.5	107	159	222	294	377	471	574	688	812	946	1090	1244	1409
18	13.7	23.1	35.2	49.9	67.4	110	164	228	303	388	484	591	708	835	973	1121	1280	1450
19	14.0	23.8	36.1	51.3	69.2	113	168	234	311	399	497	607	727	858	1000	1152	1315	1489
20	14.4	24.3	37.1	52.6	71.0	116	173	240	319	409	510	623	746	880	1028	1182	1350	1528
21	14.7	24.9	38.0	53.9	72.8	119	177	246	327	419	523	638	764	902	1051	1211	1383	1566
22	15.1	25.5	38.9	55.2	74.5	122	181	252	335	429	535	653	782	923	1076	1240	1415	1603
23	15.4	26.1	39.8	56.5	76.2	125	186	258	342	439	547	668	800	944	1100	1268	1447	1639
24	15.8	26.7	40.6	57.7	77.8	127	189	263	350	448	559	682	817	964	1123	1295	1478	1674
25	16.1	27.2	41.5	58.9	79.4	130	193	269	357	458	571	696	834	984	1147	1322	1509	1708
26	16.4	27.7	42.3	60.0	81.0	133	197	274	364	467	582	710	850	1004	1169	1348	1539	1742
27	16.7	28.3	43.1	61.2	82.5	135	201	279	371	476	593	723	867	1023	1192	1373	1568	1775
28	17.0	28.8	43.9	62.3	84.1	138	204	285	378	484	604	737	883	1041	1214	1399	1597	1808
29	17.3	29.3	44.7	63.4	85.5	140	208	290	384	493	615	750	898	1060	1235	1423	1625	1840
30	17.6	29.8	45.4	64.5	87.0	142	212	294	391	501	625	763	913	1078	1256	1448	1653	1871
L in feet	Correction Factors For Other Pipe Lengths																	
20	1.30	1.24	1.21	1.18	1.15	1.12	1.10	1.08	1.07	1.06	1.05	1.05	1.04	1.04	1.03	1.03	1.03	1.03
30	1.22	1.18	1.15	1.13	1.12	1.09	1.08	1.06	1.05	1.05	1.04	1.04	1.03	1.03	1.03	1.02	1.02	1.02
40	1.15	1.13	1.11	1.10	1.08	1.07	1.05	1.05	1.04	1.03	1.03	1.03	1.02	1.02	1.02	1.02	1.02	1.02
50	1.09	1.08	1.07	1.06	1.05	1.04	1.04	1.03	1.03	1.02	1.02	1.02	1.02	1.01	1.01	1.01	1.01	1.01
60	1.04	1.04	1.03	1.03	1.03	1.02	1.02	1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
70	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	.96	.97	.97	.97	.98	.98	.98	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99
90	.93	.94	.94	.95	.95	.96	.97	.97	.98	.98	.98	.98	.98	.99	.99	.99	.99	.99
100	.90	.91	.92	.93	.93	.95	.95	.96	.97	.97	.97	.98	.98	.98	.98	.98	.98	.99
120	.84	.86	.87	.89	.90	.91	.93	.94	.94	.95	.96	.96	.96	.97	.97	.97	.97	.98
140	.80	.82	.83	.85	.86	.88	.90	.91	.92	.93	.94	.94	.95	.95	.96	.96	.96	.97
160	.76	.78	.80	.82	.83	.86	.88	.89	.90	.91	.92	.93	.94	.94	.95	.95	.95	.96

Source: USDA - SCS

f. Anti-Seep Collar Design

ANTI – SEEP COLLAR DESIGN



Ls = LENGTH IN SATURATION ZONE

Y = OVERFLOW STRUCTURE HEIGHT = 5 FEET

Z = INSIDE SLOPE OF LEVEE = 3

PIPE SLOPE = 3.85 % = .0385 FEET/FEET

$$Ls = Y\,(Z + 4)\left(1 + \frac{\text{PIPE SLOPE}}{0.25 - \text{PIPE SLOPE}}\right)$$

Ls = 41.4 FEET

FROM ANTI – SEEP COLLAR DESIGN CHART ON THE NEXT PAGE :

V = COLLAR PROJECTION = 1.5 FEET

DIMENSIONS OF 12" THICK COLLAR = 8' X 8'

NUMBER OF REQUIRED COLLARS = (1.5) 2

ANTI-SEEP COLLAR DESIGN

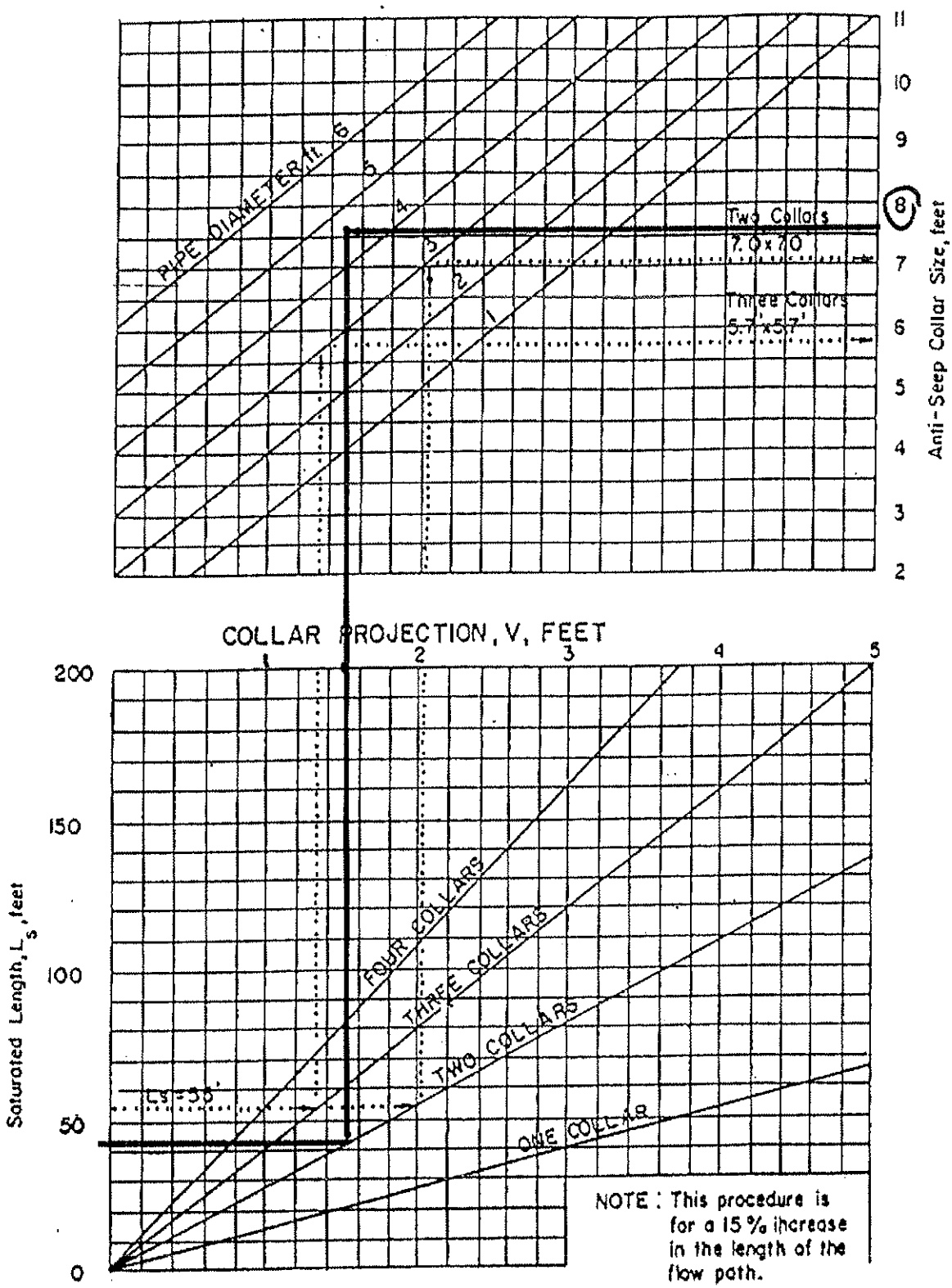


FIGURE A-13

g. Riser Base Foundation Design

OVERFLOW STRUCTURE BASE FOUNDATION DESIGN

A certain volume of concrete will be used to overcome the buoyancy of an empty overflow structure and carrier pipe that are below the assumed phreatic water surface. This volume is equal to:

Overflow Structure

$= (L_2)(w_2)(h)(62.4) - (w_2^2 - w_1^2)(h)(150-62.4)$

$L_1 = w_1 = 5'$ inside
$L_2 = w_2 = 6'$ outside

$= (6)(6)(5)(62.4) - (6^2 - 5^2)(5)(150-62.4)$

h = height = 5'

= 6,414 #

Carrier Pipe

$= 3.1416(R_2^2)(Ls)(62.4)-(3.1416)(R_2^2-r_2^2)(150-62.4)(Ls)$

$= 3.1416(2.42)(2.42)(41)(62.4)-3.1416\ (2.42^2-2^2)(87.6)(41)$

= 26,124 #

TOTAL WEIGHT

= 32,538 # x 1.5 (SAFETY FACTOR)

Ls = length in saturation zone = 41'
R_2 = outside radius = 29" = 2.42'
r_2 = inside radius = 24" = 2'

= 48,807 #

TOTAL REVISED VOLUME OF CONCRETE =
TOTAL WEIGHT / WEIGHT OF CONC. IN WATER

= 48,807 / 87.6 pcf (87.6 pcf = Wt. of conc. in submerged water)

= 557 C.F.

This volume of concrete will be made up from four areas.

1. Anti-Seep Collars
2. Overflow Structure Base
3. Carrier Pipe Encasement
4. Weight of Saturated Soil Directly Above Carrier Pipe

1. Anti-seep collars = area of square collar around carrier pipe x 12" thick x # of collars

= [(8' x 8') - (3.1416)(R_2^2) R_2 = outside radius of carrier pipe = 29" = 2.42'

x 1' x 2 r_2 = inside radius of carrier pipe = 24" = 2'

= 91 C.F.

2. Overflow Structure Base = Volume to handle riser bouyance x 1.5

= (6,414)(1.5)/87.6

= 110 C.F.

Use 10' x 10' x 2' = 200 C.F.

3. Carrier Pipe Encasement

Must extend 5' into dam. Distance from overflow structure to dam is equal to approximately 18'. Therefore, encasement length will be 23'.

Use 5' x 3.5' x 23' long

Carrier pipe encasement volume = 191 C.F.

4. Weight of Saturated Soil in Length of Saturation =

a. Weight of Soil = 100 lbs/C.F.

j. Weight of Saturated Soil = 100 lbs/C.F. – 62.4 lbs/C.F. = 37 lbs/C.F.

k. Volume of Soil in Length of Saturation over Carrier Pipe = 60 s.f. x 4.84 = 290 C.F.

l. 290 C.F. x 37 lbs/C.F. = 10,730 lbs

m. 10,730 lbs ÷ 87.6 lbs/C.F. = 122 C.F. (equivalent of submerged concrete)

TOTAL REQUIRED VOLUME = 557 C.F.

Actual Total Volume

Anti-Seep Collars	= 91 C.F.
Overflow Structure Base	= 200 C.F.
Carrier Pipe Encasement	= 191 C.F.
Weight of Saturated Soil	= 122 C.F.
TOTAL	= 604 C.F. => Okay (Factor of Safety = 1.08)

5. LEACHATE COLLECTION SYSTEM DESIGN CALCULATION

a. Leachate Flow Calculations

RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services

April 30, 2009

Mr. Bill Hodges, P.E.
Hodges, Harbin, Newberry & Tribble, Inc.
484 Mulberry Street, Suite 265
Macon, GA 31201

RE: Leachate Collection/Protective Cover System Evaluation
Charlotte Motor Speedway Landfill V - Phase 3
Cabarrus County, North Carolina

Dear Bill:

Richardson Smith Gardner & Associates, Inc. (RSG) has prepared this letter report in response to your request. This report presents the results of an evaluation of a leachate collection/protective cover system for the referenced lined municipal solid waste (MSW) landfill. This system consists of a layer of geocomposite drainage media with an overlying 24-inch thick of soil protective cover (permeability values ranging between 1×10^{-3} cm/sec and 1×10^{-5} cm/sec). The purpose of the evaluation is to 1) estimate leachate generation values and 2) to verify that along the maximum spacing of leachate collection piping the hydraulic head acting on the underlying geomembrane will be no greater than the thickness of the geocomposite drainage media during normal operating conditions.

Analysis of Leachate Collection/Protective Cover System

The analysis of the leachate collection/protective cover system was performed based on the following design parameters:

- Base Slope/Pipe Spacing:[1]
  2.2% slope and 330-foot spacing
  3.3% slope and 450-foot spacing

- Protective Cover: $k_{min} = 1 \times 10^{-3}$ cm/sec to 1×10^{-5} cm/sec ($k_{min} = 1 \times 10^{-3}$ cm/sec was conservatively used in the HELP model evaluations as this allows a greater impingement rate than less permeable soils, which may also be utilized as protective cover.)

- Impingement Rate: As determined by the HELP Model based on 15-feet of waste in-place with 6-inches of daily cover (Active Conditions - Case 1) and 100-feet of waste in-place with 12-inches of intermediate cover (Intermediate Conditions - Case 2). Final conditions were assumed based on 100 gallons/acre/day, which is much greater than the HELP Model predicts with the final cover installed (Case 3).

[1]Based on Leachate Collection Plan for Phase 3 (Cells 2I, 2J, 2K, & 2M) prepared by HHNT, Inc. (dated 4/30/09). The listed slope and spacing combinations appear to represent the worst cases (flatter slopes & longer flow distances).

The transmissivity of the geocomposite drainage media was selected to limit the maximum hydraulic head on the base geomembrane to no greater than the thickness of the geocomposite drainage media during normal operating conditions. The analysis (see **Attachment A**) was conducted using McEnroe's mounding equations in spreadsheet format. For this analysis, various impingement rates were used corresponding to active, intermediate, and final conditions (based on HELP Model and assumed projections). The analysis for active conditions conservatively included a factor of safety of 1.5. The analyses for intermediate and final conditions conservatively included a factor of safety plus reduction factors (intrusion, creep deformation, chemical clogging, and biological clogging plus an overall) to represent these longer-term cases.

HELP Model evaluations were performed both to determine the impingement rate into the geocomposite drainage media and to confirm the results of the spreadsheet analysis. The output for the HELP Model evaluations can be found in **Attachment B**. Note that the 25-year 24-hour storm for the site (6.0 inches estimated) was incorporated into the HELP Model input values. Additionally, from the HELP Model results, leachate generation values are as summarized below in **Table 1** for active, intermediate, and final cover conditions.

Table 1: HELP Model Results Summary

Case	Avg. Annual Leachate Generation (gal./acre/day)	Peak Daily Leachate Generation (gal./acre/day)
1. Active Conditions (15' Waste)	724	6,713
2. Intermediate Conditions (100' Waste)	576	4,202
3. Final Conditions (150' Waste)	0.3	2

Based on the conditions evaluated, a minimum transmissivity of 5.0×10^{-4} $m^3/m/sec$ is required for the geocomposite drainage media component of the leachate collection/protective cover system. As a verification, transmissivity tests should be conducted on samples of actual construction materials utilizing test parameters based on anticipated field conditions (maximum normal load, boundary conditions, and gradient) for a minimum 24 hour period.

Filter Geotextile Requirements

RSG recommends that the apparent opening size (AOS) of the upper geotextile component of the geocomposite drainage media be equal to a No. 70 (or finer) U.S. sieve based on AASHTO recommendations assuming the use of protective soil cover containing silts and clays. Note that this is a typical AOS value for 6 oz/yd^2 non-woven geotextiles. Prior to construction, the soils proposed for use as soil cover as well as the selected geocomposite drainage media should be evaluated to ensure

compatibility with the design assumptions stated herein. Likewise, a filter analysis must be performed on the upper geotextile component of the geocomposite drainage media considering the actual soils proposed for use as soil cover to ensure compatibility.

Recommended Geocomposite Drainage Media Properties

Based on the results of this analysis, the properties shown below in **Table 2** must be specified for the proposed geocomposite drainage media. Additionally, an analysis must be performed prior to construction using actual soils to be used as protective cover to verify the upper geotextile component of the geocomposite drainage media can function effectively as a filter.

Based on our past experience, a SKAPS Industries Transnet 300 (300 mil thick geonet drainage core) with a 6 oz/sy non-woven bonded to the top and bottom surfaces of the drainage core should satisfy the transmissivity requirements up to approximately a 15,000 psf load but must be verified through conformance testing.

TABLE 2: Recommended Geocomposite Drainage Media Properties

Property	Test Method	Units	Value[1]
Thickness (geonet only)	ASTM D 5199	inches	As Required to Achieve Required Transmissivity
Density (geonet only)	ASTM D 1505	g/cm^3	0.94
Mass per Unit Area (Unit Weight) (geotextile only)	ASTM D 5261	oz/yd^2	6 (Lower Geotextile) See Note 4 (Upper Geotextile)
Ultraviolet Resistance (500 hrs) (geotextile only)	ASTM D 4355	%	70
Apparent Opening Size (AOS) (geotextile only)	ASTM D 4751	U.S. Sieve	70+ (See Note 4 for Upper Geotextile)
Permittivity (geotextile only)	ASTM D 4491	sec^{-1}	1.0
Strength Class[2] (geotextile only)	AASHTO M 288	Class	2
Ply Adhesion	ASTM D 413/ GRI GC7	lb/inch	2.0 Typ. 1.0 Min. Avg.
Transmissivity[3]	ASTM D 4716	$m^3/m/sec$	5×10^{-4} (Load = Max. Design Load for Cell)

Notes:
1. Minimum Average Roll Value (MARV).
2. AASHTO M 288 includes requirements for the following properties (Class 2 values indicated):
   - Grab Tensile Strength (ASTM D 4632) (160 lbs),
   - Grab Tensile Elongation (ASTM D 4632) ($\geq$ 50%),
   - Trapezoidal Tear Strength (ASTM D 4533) (55 lbs),

- Puncture Resistance (ASTM D 4833) (55 lbs), and
- Burst Strength (ASTM D 3786) (200 psi).

3. Conduct tests for transmissivity at the normal compressive load indicated and at a minimum hydraulic gradient of 0.1 after a seating period of at least 24 hours. Boundary conditions are soil (sand) interface on the upper geotextile and the selected geomembrane against the lower geotextile.
4. The upper geotextile shall be selected by the Engineer based on an evaluation of soils to be used as protective cover.

Please contact us at your convenience with any further questions or comments which you may have on this evaluation.

Sincerely,
Richardson Smith Gardner & Associates, Inc.

Pieter K. Scheer, P.E.
Principal, Senior Engineer

NORTH CAROLINA PROFESSIONAL SEAL 021666 ENGINEER PIETER K. SCHEER
4/30/09

Attachments

Attachment A

Leachate Collection Drainage Layer Analysis

PROJECT CMS Landfill V - Phase 3

SUBJECT Leachate Collection Drainage Layer Analysis

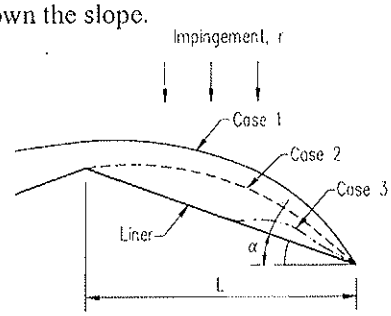
JOB NO. HHNT-09-3
DATE 4/27/09
COMPUTED BY PKS
CHECKED BY

Objective To evaluate the ability of the leachate collection system (LCS) to maintain at most 1 foot of head on the geomembrane under Normal Operating Conditions (for drainage geocomposites head should be maintained within the thickness of the geonet drainage core). The analysis determines the maximum head using input values for permeability (natural drainage media - stone/sand) or transmissivity (drainage geocomposite) and selected slope and collection pipe spacing combinations.

References McEnroe, Bruce (1993), "Maximum Saturated Depth Over Landfill Liners," Journal of Environmental Engineering, Vol. 119, No. 2, pp. 262-270.

Richardson, G.N., Giroud, J-P. and Zhao, A. (2000), Design of Lateral Drainage Systems for Landfills, Tenax Corp., Baltimore.

Analysis The McEnroe equations require the input of an impingement rate, a drainage media permeability, pipe spacing, and a liner slope. This information is used to find the maximum head on the liner. The McEnroe solution is for three cases (see figure below). Case 1 is for a saw-tooth bottom, with the liquid mound overtopping the peak. Case 2 has the liquid mound starting at the peak of the saw-tooth. Case three has the mound starting below the peak of the tooth. Cases two and three are appropriate for modeling a liner on an infinite slope with collector pipes uniformly spaced down the slope.



Step 1: Input the necessary physical factors: slope, permeability and impingement rate.

Step 2: The controlling value R is calculated

$$R = \frac{r}{k \sin^2 \alpha}$$

where:
- r = impingement rate
- k = design permeability of the drainage media (for Drainage Geocomposite, k = transmissivity/thickness) (See Note 1)
- α = slope angle of the liner

LCS DRAIN LAYER.WPD

RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services
14 N. Boylan Avenue, Raleigh, NC 27603
Telephone: (919) 828-0577

Note:

1. For stone/sand: The design permeability (k) = (specified minimum permeability)/(overall reduction factor (RF))
   For drainage geocomposites: k = (specified minimum transmissivity/thickness of geonet drainage core)/(RF)

$$RF = RF_{IN} \times RF_{CR} \times RF_{CC} \times RF_{BC} \times FS$$

where:
- RF_{IN} = reduction factor for intrusion
- RF_{CR} = reduction factor for creep
- RF_{CC} = reduction factor for chemical clogging
- RF_{BC} = reduction factor for biological clogging
- FS = overall factor of safety

Based on the recommendations of Richardson, Giroud, & Zhao, use the following values for a leachate collection system (LCS). An overall factor of safety of 2.0 for long-term conditions is also recommended. For shorter term (lower load) conditions, lower values may be used.

	RF_{IN}	RF_{CR}	RF_{CC}	RF_{BC}
Stone/Sand:	1.0	1.0	1.5-2.0	1.5-2.0
Dr. Geocomposite:	1.0-1.2	1.4-2.0	1.5-2.0	1.5-2.0

Step 3: The maximum head is calculated, using a formula dependent on the value of R:

For R > 1/4 (Case 1):

$$h_{max} = SL\left(R - RS + R^2S^2\right)^{\frac{1}{2}} \exp\left[\frac{1}{B}\arctan\left(\frac{2RS-1}{B}\right) - \frac{1}{B}\arctan\left(\frac{2R-1}{B}\right)\right]$$

For R = 1/4 (Case 2):

$$h_{max} = SL\frac{R(1-2RS)}{1-2R}\exp\left[\frac{2R(S-1)}{(1-2RS)(1-2R)}\right]$$

For R < 1/4 (Case 3):

$$h_{max} = SL\left(R - RS + R^2S^2\right)^{\frac{1}{2}}\left[\frac{(1-A-2R)(1+A-2RS)}{(1+A-2R)(1-A-2RS)}\right]^{\frac{1}{2A}}$$

where:

h_{max} = maximum head (m - convert to desired units)
L = horizontal length of pipe spacing or distance to peak (m) (see figure above)
S = liner slope (m/m)
A = $(1 - 4R)^{0.5}$
B = $(4R - 1)^{0.5}$

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Engineering and Geological Services
14 N. Boylan Avenue Tel: 919-828-0577
Raleigh, NC 27603 Fax: 919-828-3899

SHEET: 4 / 6
JOB #: HHNT-09-3
DATE: 4/27/09
BY: PKS
CHKD BY:

CMS Landfill V - Phase 3
Leachate Collection Drainage Layer Analysis - Active Conditions

Drainage Geocomposite:

Maximum Allowable Head (h_{max}):	0.25 inches	(= Thickness of Geonet Drainage Core)
Impingement (r):	7.3E-06 cm/sec	(Peak Daily Flow from HELP Model - Active Case)
Drainage Geocomposite Transmissivity (θ):	5.0E-04 m^3/m/sec	(Specified Minimum)
Thickness of Geonet Drainage Core:	0.25 inches	(Specified Minimum)
Reduction Factors for Drainage Geocomposite:		(Per Richardson, Zhao, & Giroud)
$RF_{intrusion}$:	1.0	
RF_{creep}:	1.0	
$RF_{chemical\ clogging}$:	1.0	
$RF_{biological\ clogging}$:	1.0	
Overall Factor of Safety:	1.5	
Reduction Factor for Drainage Geocomposite in LCS:	1.5	
Design Drainage Geocomposite Transmissivity (θ):	3.3E-04 m^3/m/sec	
Design Drainage Geocomposite Permeability (k):	5.25 cm/sec	(Design Transmissivity/Thickness of Geonet Drainage Core)

Slope (%)	Slope (Deg.)	S	R	Pipe Spacing (ft)	Pipe Spacing (m)	A	B	h_{max} (in) R < 0.25	R = 0.25	R > 0.25	Comment
2.2	1.26	0.022	0.00287	330	100.6	0.994	NA	0.25	N/A	N/A	O.K.
3.3	1.89	0.033	0.00128	450	137.2	0.997	NA	0.23	N/A	N/A	O.K.

Note: Spreadsheet Converts Units as Required.

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Engineering and Geological Services
14 N. Boylan Avenue Tel: 919-828-0577
Raleigh, NC 27603 Fax: 919-828-3899

SHEET: 5/6
JOB #: HHNT-09-3
DATE: 4/30/09
BY: PKS
CHKD BY:

CMS Landfill V - Phase 3
Leachate Collection Drainage Layer Analysis - Intermediate Conditions

Drainage Geocomposite:

Maximum Allowable Head (h_{max}):	0.25 inches	(= Thickness of Geonet Drainage Core)
Impingement (r):	4.5E-06 cm/sec	(Peak Daily Flow from HELP Model - Intermediate Case)
Drainage Geocomposite Transmissivity (θ):	5.0E-04 m^3/m/sec	(Specified Minimum)
Thickness of Geonet Drainage Core:	0.25 inches	(Specified Minimum)
Reduction Factors for Drainage Geocomposite:		(Per Richardson, Zhao, & Giroud)
$RF_{intrusion}$:	1.0	
RF_{creep}:	1.0	
$RF_{chemical\ clogging}$:	1.2	
$RF_{biological\ clogging}$:	1.2	
Overall Factor of Safety:	1.5	
Reduction Factor for Drainage Geocomposite in LCS:	2.0	
Design Drainage Geocomposite Transmissivity (θ):	2.5E-04 m^3/m/sec	
Design Drainage Geocomposite Permeability (k):	3.97 cm/sec	(Design Transmissivity/Thickness of Geonet Drainage Core)

Slope (%)	Slope (Deg.)	S	R	Pipe Spacing (ft)	Pipe Spacing (m)	A	B	h_{max} (in) R < 0.25	R = 0.25	R > 0.25	Comment
2.2	1.26	0.022	0.00234	330	100.6	0.995	NA	0.20	N/A	N/A	O.K.
3.3	1.89	0.033	0.00104	450	137.2	0.998	NA	0.18	N/A	N/A	O.K.

Note: Spreadsheet Converts Units as Required.

RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services
14 N. Boylan Avenue Tel: 919-828-0577
Raleigh, NC 27603 Fax: 919-828-3899

SHEET: 6/6
JOB #: HHNT-09-3
DATE: 4/27/09
BY: PKS
CHKD BY:

CMS Landfill V - Phase 3
Leachate Collection Drainage Layer Analysis - Final Conditions

Drainage Geocomposite:

Maximum Allowable Head (h_{max}):	0.25 inches	(= Thickness of Geonet Drainage Core)
Impingement (r):	1.1E-07 cm/sec	(Assumed 100 gallons/acre/day >>> HELP Model Prediction for Final Case)
Drainage Geocomposite Transmissivity (θ):	5.0E-04 m^3/m/sec	(Specified Minimum)
Thickness of Geonet Drainage Core:	0.25 inches	(Specified Minimum)
Reduction Factors for Drainage Geocomposite:		(Per Richardson, Zhao, & Giroud)
$RF_{intrusion}$:	1.2	
RF_{creep}:	2.0	
$RF_{chemical\ clogging}$:	2.0	
$RF_{biological\ clogging}$:	2.0	
Overall Factor of Safety:	2.0	
Reduction Factor for Drainage Geocomposite in LCS:	19.2	
Design Drainage Geocomposite Transmissivity (θ):	2.6E-05 m^3/m/sec	
Design Drainage Geocomposite Permeability (k):	0.41 cm/sec	(Design Transmissivity/Thickness of Geonet Drainage Core)

Slope (%)	Slope (Deg.)	S	R	Pipe Spacing (ft)	Pipe Spacing (m)	A	B	h_{max} (in) R < 0.25	R = 0.25	R > 0.25	Comment
2.2	1.26	0.022	0.00055	350	106.7	0.999	NA	0.05	N/A	N/A	O.K.
3.3	1.89	0.033	0.00025	450	137.2	1.000	NA	0.04	N/A	N/A	O.K.

Note: Spreadsheet Converts Units as Required.

Attachment B

HELP Model Output

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


PRECIPITATION DATA FILE:     C:\PROGRA~1\HELP3\CHARNC25.D4
TEMPERATURE DATA FILE:       C:\PROGRA~1\HELP3\CHARNC25.D7
SOLAR RADIATION DATA FILE:   C:\PROGRA~1\HELP3\CHARNC25.D13
EVAPOTRANSPIRATION DATA:     C:\PROGRA~1\HELP3\CHARNC25.D11
SOIL AND DESIGN DATA FILE:   C:\PROGRA~1\HELP3\CMSC1.D10
OUTPUT DATA FILE:            C:\PROGRA~1\HELP3\CMSC1.OUT


TIME:  16:55     DATE:   4/27/2009


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

     TITLE:  CMS Landfill V Phase 3 - 15' Waste w/6" Cover (Case 1)

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


     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   7
          THICKNESS                  =      6.00   INCHES
          POROSITY                   =      0.4730 VOL/VOL
          FIELD CAPACITY             =      0.2220 VOL/VOL
          WILTING POINT              =      0.1040 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.1880 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.520000001000E-03 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
                 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                  LAYER  2
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  18
THICKNESS                    =    180.00   INCHES
POROSITY                     =      0.6710 VOL/VOL
FIELD CAPACITY               =      0.2920 VOL/VOL
WILTING POINT                =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.3033 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC


                                  LAYER  3
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   5
THICKNESS                    =     24.00   INCHES
POROSITY                     =      0.4570 VOL/VOL
FIELD CAPACITY               =      0.1310 VOL/VOL
WILTING POINT                =      0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.1662 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC


                                  LAYER  4
                                  --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER   0
THICKNESS                    =      0.25   INCHES
POROSITY                     =      0.8500 VOL/VOL
FIELD CAPACITY               =      0.0100 VOL/VOL
WILTING POINT                =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0139 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =   5.25000000000      CM/SEC
SLOPE                        =      2.20   PERCENT
DRAINAGE LENGTH              =    330.0    FEET


                                  LAYER  5
                                  --------

                     TYPE 4 - FLEXIBLE MEMBRANE LINER
                         MATERIAL TEXTURE NUMBER  35
THICKNESS                    =      0.06   INCHES
POROSITY                     =      0.0000 VOL/VOL
FIELD CAPACITY               =      0.0000 VOL/VOL
WILTING POINT                =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY          =      0.00   HOLES/ACRE
FML INSTALLATION DEFECTS     =      4.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD
```

1/10

LAYER 6

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.	=	0.100000001000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 7 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 5.% AND A SLOPE LENGTH OF 300. FEET.

SCS RUNOFF CURVE NUMBER	=	88.50	
FRACTION OF AREA ALLOWING RUNOFF	=	0.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	20.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	5.083	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	12.232	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.702	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	69.962	INCHES
TOTAL INITIAL WATER	=	69.962	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM CHARLOTTE NORTH CAROLINA

STATION LATITUDE	=	35.20	DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00	
START OF GROWING SEASON (JULIAN DATE)	=	83	
END OF GROWING SEASON (JULIAN DATE)	=	312	
EVAPORATIVE ZONE DEPTH	=	20.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	7.30	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	64.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	74.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	70.00	%

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

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.80	3.81	4.83	3.27	3.64	3.57
3.92	3.75	3.59	2.72	2.86	3.40

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

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
40.50	42.90	50.40	60.30	68.20	75.00
78.50	77.90	72.00	60.70	50.70	42.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR CHARLOTTE NORTH CAROLINA AND STATION LATITUDE = 35.20 DEGREES

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.35	3.78	5.83	2.89	3.89	4.60
	3.88	3.64	3.32	3.80	1.67	3.27
STD. DEVIATIONS	2.40	1.67	2.83	1.83	2.41	1.14
	1.36	2.89	1.20	2.01	1.40	1.72
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	1.517	1.982	3.092	3.401	4.531	4.307
	4.944	2.872	3.059	1.761	1.264	1.077
STD. DEVIATIONS	0.220	0.167	0.131	0.769	1.354	1.482
	1.638	1.944	1.340	0.260	0.131	0.150

2/10

LATERAL DRAINAGE COLLECTED FROM LAYER 4

TOTALS	0.4850	1.0807	1.9861	2.3972	1.1367	1.0311
	0.3573	0.1673	0.1084	0.0886	0.3210	0.5631
STD. DEVIATIONS	0.3378	1.1335	1.7921	0.5214	1.1907	1.0912
	0.3268	0.0789	0.0347	0.0360	0.4628	0.6658

PERCOLATION/LEAKAGE THROUGH LAYER 6

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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5

AVERAGES	0.0079	0.0194	0.0323	0.0403	0.0185	0.0173
	0.0058	0.0027	0.0018	0.0014	0.0056	0.0092
STD. DEVIATIONS	0.0055	0.0204	0.0291	0.0088	0.0194	0.0183
	0.0053	0.0013	0.0006	0.0006	0.0078	0.0108

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	INCHES		CU. FEET	PERCENT
PRECIPITATION	43.91	(5.510)	159407.8	100.00
RUNOFF	0.000	(0.0000)	0.00	0.000
EVAPOTRANSPIRATION	33.806	(1.9507)	122714.64	76.962
LATERAL DRAINAGE COLLECTED FROM LAYER 4	9.73234	(3.41501)	35328.406	22.16228
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00002	(0.00001)	0.067	0.00004
AVERAGE HEAD ON TOP OF LAYER 5	0.014	(0.005)		
CHANGE IN WATER STORAGE	0.376	(1.9038)	1364.69	0.856

724 gpad

PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	6.00	21780.000
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 4	0.24722	897.42218
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000000	0.00132
AVERAGE HEAD ON TOP OF LAYER 5	0.128	
MAXIMUM HEAD ON TOP OF LAYER 5	0.246	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	4.3 FEET	
SNOW WATER	2.24	8132.3433

7.3×10^{-6} cm/sec

6713 gpad

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4848

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0851

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

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

FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	1.4012	0.2336
2	54.4043	0.3022
3	5.7860	0.2411
4	0.0025	0.0102
5	0.0000	0.0000
6	10.2480	0.4270
SNOW WATER	0.000	

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


PRECIPITATION DATA FILE:     C:\PROGRA~1\HELP3\CHARNC25.D4
TEMPERATURE DATA FILE:       C:\PROGRA~1\HELP3\CHARNC25.D7
SOLAR RADIATION DATA FILE:   C:\PROGRA~1\HELP3\CHARNC25.D13
EVAPOTRANSPIRATION DATA:     C:\PROGRA~1\HELP3\CHARNC25.D11
SOIL AND DESIGN DATA FILE:   C:\PROGRA~1\HELP3\CMSC2.D10
OUTPUT DATA FILE:            C:\PROGRA~1\HELP3\CMSC2.OUT


TIME:  14:47     DATE:   4/30/2009


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

     TITLE:  CMS Landfill V Phase 3 -100' Waste w/12" Cover (Case 2)

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


     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   7
        THICKNESS                  =     12.00   INCHES
        POROSITY                   =      0.4730 VOL/VOL
        FIELD CAPACITY             =      0.2220 VOL/VOL
        WILTING POINT              =      0.1040 VOL/VOL
        INITIAL SOIL WATER CONTENT =      0.2017 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  0.520000001000E-03 CM/SEC
      NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
               FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                                  LAYER  2
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER  18
        THICKNESS                  =   1200.00   INCHES
        POROSITY                   =      0.6710 VOL/VOL
        FIELD CAPACITY             =      0.2920 VOL/VOL
        WILTING POINT              =      0.0770 VOL/VOL
        INITIAL SOIL WATER CONTENT =      0.2938 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC

                                  LAYER  3
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   5
        THICKNESS                  =     24.00   INCHES
        POROSITY                   =      0.4570 VOL/VOL
        FIELD CAPACITY             =      0.1310 VOL/VOL
        WILTING POINT              =      0.0580 VOL/VOL
        INITIAL SOIL WATER CONTENT =      0.1657 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC

                                  LAYER  4
                                  --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER   0
        THICKNESS                  =      0.25   INCHES
        POROSITY                   =      0.8500 VOL/VOL
        FIELD CAPACITY             =      0.0100 VOL/VOL
        WILTING POINT              =      0.0050 VOL/VOL
        INITIAL SOIL WATER CONTENT =      0.0113 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =   3.97000003000      CM/SEC
        SLOPE                      =      2.20   PERCENT
        DRAINAGE LENGTH            =    330.0    FEET

                                  LAYER  5
                                  --------

                     TYPE 4 - FLEXIBLE MEMBRANE LINER
                        MATERIAL TEXTURE NUMBER  35
        THICKNESS                  =      0.06   INCHES
        POROSITY                   =      0.0000 VOL/VOL
        FIELD CAPACITY             =      0.0000 VOL/VOL
        WILTING POINT              =      0.0000 VOL/VOL
        INITIAL SOIL WATER CONTENT =      0.0000 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  0.199999996000E-12 CM/SEC
        FML PINHOLE DENSITY        =      0.00   HOLES/ACRE
        FML INSTALLATION DEFECTS   =      4.00   HOLES/ACRE
        FML PLACEMENT QUALITY      =  3 - GOOD
```

4/10

LAYER 6

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.	=	0.100000001000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 7 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 5.% AND A SLOPE LENGTH OF 300. FEET.

SCS RUNOFF CURVE NUMBER	=	88.50	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	20.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	4.642	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	11.044	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.864	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	369.168	INCHES
TOTAL INITIAL WATER	=	369.168	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM CHARLOTTE NORTH CAROLINA

STATION LATITUDE	=	35.20	DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00	
START OF GROWING SEASON (JULIAN DATE)	=	83	
END OF GROWING SEASON (JULIAN DATE)	=	312	
EVAPORATIVE ZONE DEPTH	=	20.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	7.50	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	64.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	74.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	70.00	%

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

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.80	3.81	4.83	3.27	3.64	3.57
3.92	3.75	3.59	2.72	2.86	3.40

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

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
40.50	42.90	50.40	60.30	68.20	75.00
78.50	77.90	72.00	60.70	50.70	42.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR CHARLOTTE NORTH CAROLINA AND STATION LATITUDE = 35.20 DEGREES

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.35	3.78	5.83	2.89	3.89	4.60
	3.88	3.64	3.32	3.80	1.67	3.27
STD. DEVIATIONS	2.40	1.67	2.83	1.83	2.41	1.14
	1.36	2.89	1.20	2.01	1.40	1.72
RUNOFF						
TOTALS	0.226	0.132	0.961	0.051	0.253	0.170
	0.045	0.148	0.295	0.307	0.036	0.138
STD. DEVIATIONS	0.314	0.102	1.628	0.090	0.478	0.141
	0.058	0.230	0.212	0.303	0.058	0.137
EVAPOTRANSPIRATION						
TOTALS	1.538	2.000	3.113	3.420	4.405	3.883
	4.817	2.789	3.024	1.707	1.310	1.100
STD. DEVIATIONS	0.222	0.162	0.139	0.767	1.534	1.364
	1.636	1.795	1.383	0.445	0.131	0.153

5/10

LATERAL DRAINAGE COLLECTED FROM LAYER 4

TOTALS	0.2482	0.7702	0.9970	1.7689	1.7191	0.9647
	0.3220	0.1657	0.1039	0.0994	0.1991	0.3905
STD. DEVIATIONS	0.3093	0.5623	0.7673	0.8769	0.9981	0.8631
	0.2034	0.0609	0.0262	0.0352	0.2749	0.4362

PERCOLATION/LEAKAGE THROUGH LAYER 6

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

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5

AVERAGES	0.0053	0.0182	0.0214	0.0393	0.0370	0.0214
	0.0069	0.0036	0.0023	0.0021	0.0044	0.0084
STD. DEVIATIONS	0.0067	0.0134	0.0165	0.0195	0.0215	0.0192
	0.0044	0.0013	0.0006	0.0008	0.0061	0.0094

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	INCHES		CU. FEET	PERCENT
PRECIPITATION	43.91	(5.510)	159407.8	100.00
RUNOFF	2.761	(1.7832)	10024.03	6.288
EVAPOTRANSPIRATION	33.106	(1.9523)	120173.10	75.387
LATERAL DRAINAGE COLLECTED FROM LAYER 4	7.74877	(2.75657)	28128.041	17.64533
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00002	(0.00001)	0.070	0.00004
AVERAGE HEAD ON TOP OF LAYER 5	0.014	(0.005)		
CHANGE IN WATER STORAGE	0.298	(1.6891)	1082.60	0.679

576 gpad

PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	6.00	21780.000
RUNOFF	3.284	11919.1748
DRAINAGE COLLECTED FROM LAYER 4	0.15476	561.76288
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000000	0.00112
AVERAGE HEAD ON TOP OF LAYER 5	0.103	
MAXIMUM HEAD ON TOP OF LAYER 5	0.204	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	4.2 FEET	
SNOW WATER	2.34	8132.3433

4.5×10^{-6} cm/sec

4,202 gpad

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3312
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0932

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

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

FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	3.0421	0.2535
2	351.9661	0.2933
3	5.3957	0.2248
4	0.0075	0.0300
5	0.0000	0.0000
6	10.2480	0.4270
SNOW WATER	0.000	

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


PRECIPITATION DATA FILE:      C:\PROGRA~1\HELP3\CHARNC25.D4
TEMPERATURE DATA FILE:        C:\PROGRA~1\HELP3\CHARNC25.D7
SOLAR RADIATION DATA FILE:    C:\PROGRA~1\HELP3\CHARNC25.D13
EVAPOTRANSPIRATION DATA:      C:\PROGRA~1\HELP3\CHARNC25.D11
SOIL AND DESIGN DATA FILE:    C:\PROGRA~1\HELP3\CMSC3.D10
OUTPUT DATA FILE:             C:\PROGRA~1\HELP3\CMSC3.OUT


TIME:  14:48      DATE:   4/30/2009


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

     TITLE:  CMS Landfill V Phase 3 -150' Waste w/ Final Cover (Case 3)

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


     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   7
        THICKNESS                  =     24.00   INCHES
        POROSITY                   =      0.4730 VOL/VOL
        FIELD CAPACITY             =      0.2220 VOL/VOL
        WILTING POINT              =      0.1040 VOL/VOL
        INITIAL SOIL WATER CONTENT =      0.2397 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  0.5200000010000E-03 CM/SEC
      NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
             FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                  LAYER  2
                                  --------

              TYPE 2 - LATERAL DRAINAGE LAYER
                  MATERIAL TEXTURE NUMBER  20
        THICKNESS                  =      0.25   INCHES
        POROSITY                   =      0.8500 VOL/VOL
        FIELD CAPACITY             =      0.0100 VOL/VOL
        WILTING POINT              =      0.0050 VOL/VOL
        INITIAL SOIL WATER CONTENT =      0.0343 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  10.0000000000      CM/SEC
        SLOPE                      =      5.00   PERCENT
        DRAINAGE LENGTH            =    300.0    FEET


                                  LAYER  3
                                  --------

              TYPE 4 - FLEXIBLE MEMBRANE LINER
                  MATERIAL TEXTURE NUMBER  36
        THICKNESS                  =      0.03   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.  =  0.3999999993000E-12 CM/SEC
        FML PINHOLE DENSITY        =      0.00   HOLES/ACRE
        FML INSTALLATION DEFECTS   =      4.00   HOLES/ACRE
        FML PLACEMENT QUALITY      =  3 - GOOD


                                  LAYER  4
                                  --------

                 TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER   7
        THICKNESS                  =     12.00   INCHES
        POROSITY                   =      0.4730 VOL/VOL
        FIELD CAPACITY             =      0.2220 VOL/VOL
        WILTING POINT              =      0.1040 VOL/VOL
        INITIAL SOIL WATER CONTENT =      0.2220 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  0.5200000010000E-03 CM/SEC


                                  LAYER  5
                                  --------

                 TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER  15
        THICKNESS                  =   1800.00   INCHES
        POROSITY                   =      0.6710 VOL/VOL
        FIELD CAPACITY             =      0.2920 VOL/VOL
        WILTING POINT              =      0.0770 VOL/VOL
        INITIAL SOIL WATER CONTENT =      0.2920 VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =  0.1000000005000E-02 CM/SEC
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LAYER 6

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 5

THICKNESS	=	24.00	INCHES
POROSITY	=	0.4570	VOL/VOL
FIELD CAPACITY	=	0.1310	VOL/VOL
WILTING POINT	=	0.0580	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1310	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

LAYER 7

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	0.25	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0112	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.409999996000	CM/SEC
SLOPE	=	2.20	PERCENT
DRAINAGE LENGTH	=	330.0	FEET

LAYER 8

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	0.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	4.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 9

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.	=	0.100000001000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 7 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 5.% AND A SLOPE LENGTH OF 300. FEET.

SCS RUNOFF CURVE NUMBER	=	88.50	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	20.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	4.597	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	9.460	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.080	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	547.420	INCHES
TOTAL INITIAL WATER	=	547.420	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
CHARLOTTE NORTH CAROLINA

STATION LATITUDE	=	35.20	DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00	
START OF GROWING SEASON (JULIAN DATE)	=	83	
END OF GROWING SEASON (JULIAN DATE)	=	312	
EVAPORATIVE ZONE DEPTH	=	20.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	7.50	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	64.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	74.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	70.00	%

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

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.80	3.81	4.83	3.27	3.64	3.57
3.98	3.75	3.59	2.72	2.86	3.40

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

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
40.50	42.90	50.40	60.30	68.20	75.00
78.50	77.90	72.00	60.70	50.70	42.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR CHARLOTTE NORTH CAROLINA
AND STATION LATITUDE = 35.20 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.35	3.78	5.83	2.89	3.89	4.60
	3.88	3.64	3.32	3.80	1.67	3.27
STD. DEVIATIONS	2.40	1.67	2.83	1.83	2.41	1.14
	1.36	2.89	1.20	2.01	1.40	1.72
RUNOFF						
TOTALS	0.247	0.151	0.984	0.054	0.266	0.172
	0.050	0.153	0.299	0.327	0.037	0.155
STD. DEVIATIONS	0.343	0.125	1.636	0.096	0.500	0.140
	0.065	0.236	0.213	0.338	0.058	0.152
EVAPOTRANSPIRATION						
TOTALS	1.555	2.015	3.130	3.399	4.236	3.569
	4.827	2.774	3.032	1.656	1.351	1.122
STD. DEVIATIONS	0.223	0.158	0.144	0.772	1.696	1.147
	1.653	1.819	1.386	0.430	0.140	0.151
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	1.4154	1.4150	1.6749	0.7561	0.6220	0.0901
	0.0014	0.0008	0.1354	0.4243	0.4363	1.1468
STD. DEVIATIONS	1.1731	2.0162	0.7336	0.8346	0.8475	0.1462
	0.0012	0.0006	0.3021	0.7530	0.5152	0.8679
PERCOLATION/LEAKAGE THROUGH LAYER 3						
TOTALS	0.0006	0.0005	0.0007	0.0004	0.0003	0.0001
	0.0000	0.0000	0.0001	0.0002	0.0002	0.0005
STD. DEVIATIONS	0.0004	0.0006	0.0003	0.0003	0.0005	0.0001
	0.0000	0.0000	0.0002	0.0003	0.0002	0.0003
LATERAL DRAINAGE COLLECTED FROM LAYER 7						
TOTALS	0.0006	0.0005	0.0007	0.0004	0.0003	0.0001
	0.0000	0.0000	0.0001	0.0001	0.0002	0.0003
STD. DEVIATIONS	0.0004	0.0006	0.0002	0.0003	0.0003	0.0002
	0.0000	0.0000	0.0001	0.0002	0.0003	0.0002
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	0.0048	0.0053	0.0057	0.0027	0.0021	0.0003
	0.0000	0.0000	0.0005	0.0015	0.0015	0.0039
STD. DEVIATIONS	0.0040	0.0076	0.0025	0.0030	0.0029	0.0005
	0.0000	0.0000	0.0011	0.0026	0.0018	0.0030
DAILY AVERAGE HEAD ON TOP OF LAYER 8						
AVERAGES	0.0001	0.0001	0.0002	0.0001	0.0001	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
STD. DEVIATIONS	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	INCHES		CU. FEET	PERCENT
PRECIPITATION	43.91	(5.510)	159407.8	100.00
RUNOFF	2.896	(1.8097)	10512.61	6.595
EVAPOTRANSPIRATION	32.667	(1.8913)	118579.89	74.388
LATERAL DRAINAGE COLLECTED FROM LAYER 2	8.11854	(2.37709)	29470.312	18.48737
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.00342	(0.00086)	12.407	0.00778
AVERAGE HEAD ON TOP OF LAYER 3	0.002	(0.001)		
LATERAL DRAINAGE COLLECTED FROM LAYER 7	0.00342	(0.00098)	12.399	0.00778
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.00000	(0.00000)	0.009	0.00001
AVERAGE HEAD ON TOP OF LAYER 8	0.000	(0.000)		
CHANGE IN WATER STORAGE	0.229	(0.5981)	832.57	0.522

0.3 spad

PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	6.00	21780.000
RUNOFF	3.304	11993.2871
DRAINAGE COLLECTED FROM LAYER 2	0.54201	1967.50928
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.000140	0.50846
AVERAGE HEAD ON TOP OF LAYER 3	0.058	
MAXIMUM HEAD ON TOP OF LAYER 3	0.114	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	0.9 FEET	
DRAINAGE COLLECTED FROM LAYER 7	0.00008	0.28332
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.000000	0.00003
AVERAGE HEAD ON TOP OF LAYER 8	0.001	
MAXIMUM HEAD ON TOP OF LAYER 8	0.001	
LOCATION OF MAXIMUM HEAD IN LAYER 7 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	2.24	8132.3433
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3351	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1040	

2.4×10^{-9} cm/sec

2 spad

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

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

FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	6.8810	0.2867
2	0.0271	0.1083
3	0.0000	0.0000
4	2.6640	0.2220
5	525.6000	0.2920
6	3.1442	0.1310
7	0.0096	0.0105
8	0.0000	0.0000
9	10.2480	0.4270
SNOW WATER	0.000	

10/10

b. Leachate Collection Pipe Design

The 8" diameter leachate collection pipes in the cells were evaluated to determine the case where the greatest flow would be anticipated. This location is immediately upstream of the sideslope riser in Cell No. 2J. At this point, approximately 10 acres of base liner leachate collection system contributes to the flow. Results of the HELP Model indicate maximum flows of 6,713 gallons per day per acre of contributing base liner, for a total flow at this point of 67,130 gallons per day or 46.6 gpm.

Utilizing the Flow Master computer program for 8" diameter pipe, the capacity of this pipe is:

$$Q = 0.63 \text{ cfs} = 283 \text{ gpm}$$

At an estimated minimum post-settlement slope of 0.70%, the velocity (v) in the 8" diameter leachate collection pipe will be 2.31 feet per second, which exceeds two (2) feet per second recommended minimum velocity.

The capacity of the 8" diameter pipe is 283 gpm, and the actual worst case flow is 46.6 gpm, for a Factor of Safety of 6.1.

In summary, the 8" diameter leachate collection pipe is adequate for flow.

CMS LANDFILL V - PHASE 3
Worksheet for Circular Channel

Project Description	
Project File	untitled.fm2
Worksheet	8" DIA. LEACHATE COLLECTION PIPE
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Capacity

Input Data		
Mannings Coefficient	0.015	
Channel Slope	0.007000	ft/ft
Diameter	7.06	in

Results		
Depth	0.59	ft
Discharge	0.63	cfs
Flow Area	0.27	ft^2
Wetted Perimeter	1.85	ft
Top Width	0.00	ft
Critical Depth	0.39	ft
Percent Full	100.00	
Critical Slope	0.011802	ft/ft
Velocity	2.31	ft/s
Velocity Head	0.08	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	0.68	cfs
Full Flow Capacity	0.63	cfs
Full Flow Slope	0.007000	ft/ft

c. Burial Design of Leachate Collection Pipe

Leachate Collection Pipe in the Charlotte Motor Speedway Landfill V serves as one of the conveyance devices whereby leachate is gravity drained. The leachate collection pipe is encased in ASTM No. 57 gravel encasement. This gravel encasement serves the dual purpose of bedding and a secondary means of leachate transport. The open spaces in the gravel provide an additional porous transport pathway.

In order to assure that the leachate collection pipe does not collapse, wall crushing and wall buckling calculations should be performed. Wall crushing would theoretically occur when the stress in a pipe wall, due to the external vertical pressure, exceeds the long-term compressive strength of the pipe material. Wall buckling is a longitudinal wrinkling of the pipe wall. Wall buckling can be forced to occur over the long term in non-pressurized pipe if the total external soil pressure is allowed to exceed the pipe-soil system's critical buckling pressure.

A report entitled "Summary of HDPE Pipe Stress Anaylis" has been prepared by Bunnell – Lammons Engineering, Inc. and dated April 29, 2008, for use in determining the factor of the safety against wall crushing and wall buckling for varying SDR's of leachate pipe under varying waste heights. The report is attached to this section and a sample calculation is included in the report along with charts showing the results.

The allowable factor of safety for wall crushing and wall buckling should be a minimum of 1.5. The greatest depth of waste over a leachate pipe in Cell No. 2J of Phase 3 is approximately 196'. An SDR 11 HDPE leachate collection pipe will be used in Cell No. 2J which yields a 4.4 factor of safety against the wall crushing and a 4.4 factor of safety against wall buckling.

BLE INC.
BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL, ENVIRONMENTAL AND CONSTRUCTION MATERIALS CONSULTANTS

April 29, 2008

HHNT - Lane Engineering, LLC
P.O. Box 68
Statesboro, Georgia 30458

Attention: Mr. Brant Lane, P.E.

Subject: Summary of HDPE Pipe Stress Analysis

Dear Mr. Lane,

Bunnell-Lammons Engineering, Inc. (BLE) is pleased to present this report of the evaluation of HDPE pipe stress and ring deflection considerations for HDPE pipe to be used in various landfill leachate collection systems. This report considers previous analysis methods for pipe crushing and buckling and applies these methods in accordance with the current state of practice.

Analysis of potential loads subjected to HDPE pipe used in leachate collection systems in solid waste landfills typically includes calculation of wall crushing and buckling stresses. The analysis yields a pipe SDR for a selected pipe diameter to provide a selected factor of safety against failure. Pipeline design must select a suitable standard dimension ratio (SDR) and specify the backfill conditions to obtain the desired performance of the system. Pipe wall crushing occurs when external vertical pressure causes the compressive stress in the pipe wall to exceed the long-term compressive strength of the pipe material. Pipe wall buckling is a longitudinal wrinkling of the pipe wall. Buckling can occur in the non-pressurized pipe if the total external pressure exceeds the critical buckling pressure of the pipe.

ASTM[5] says that polyethylene pipes made to this specification may deflect or otherwise distort without kinking or buckling and remain structurally stable up to 20 % or more of the vertical diameter. Table x2.1 in ASTM F714, indicates a conservative allowable deflection, based on a given SDR.

Richardson[3] does not compute ring deflection, but bases SDR selection on crushing and buckling computations.

Zansinger and Gartung[4] suggest that the structural performance of the pipe is governed by the interaction with the surrounding soil. Driscopipe[6] indicates the elastic behavior of the soil or stone around the pipe may be used to approximate the pipe deflection.

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CONCLUSIONS

Based on these findings, it is suggested that the appropriate SDR for a given pipe be selected based on crushing and buckling analysis to provide a factor of safety of 1.5 or more. Stresses should be estimated considering the three dimensional waste mound configuration and side slopes rather than the soil prism above the pipe. Ring deflection should not be a governing consideration.

The attached analysis results presents a summary table for use in selection of appropriate leachate pipe and liner penetration sump SDR based on the maximum waste height to achieve a factor of safety of 1.5 or more.

Sincerely,

BUNNELL-LAMMONS ENGINEERING, INC.

Jeffrey C. Helvey, P.E.
Project Engineer
Registered, NC #33318

NORTH CAROLINA PROFESSIONAL SEAL NO. 033318 5-23-08 ENGINEER JEFFREY C. HELVEY

Daniel B. Bunnell, P.E. 5/23/08
Principal Engineer
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SEAL No. 13814 ENGINEER DANIEL B. BUNNELL

Attachments: References
Design Method and Example
Analysis Results, HDPE Leachate Pipe and Wall Crushing & Bulking

REFERENCES:
(HDPE Pipe Stress)

1. Brachman, Rowe, Moore & Tognon, Laboratory Investigation of the Effect of Coarse Stone Backfill on the Performance of Leachate Collection Pipe, *Sixth International Conference on Geosynthetics*, 1998.

2. Brachman, Hoop Compression Testing of HDPE Leachate Collection Pipe, *Conference Proceedings for Geosynthetics 97*, 1997.

3. Richardson, Design of Waste Containment Liner and Final Closure Systems, ASCE Course Notes

4. Zanzinger and Gartung, HDPE – Geopipes, Soil – Structure Interaction, *Sixth International Conference on Geosynthetics*, 1998.

5. ASTM F 714, *Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.*

6. Driscopipe Burial Design (with updates from the Chevron Phillips Chemical Company Design Manual – 2003)

Design Method and Example

(Ref. DRISCO PIPE design manual - applicable equations)

1. Determine the total pressure at the top of the pipe: (sump in this example)

$P_t = P_s + P_l + P_i$

P_t:	Total Pressure
P_s:	Total Static Pressure
P_l:	Total Live Pressure
P_i:	Total Internal Pressure

$P_l = 0$ (No Live Load)
$P_i = 0$ (Gravity Flow Pipe)
$P_s = P_{de} + P_{we} + P_b$

P_{de}:	Static load pressure of dry or slightly moist soil
P_{we}:	Static load pressure of wet, saturated soil under the water table
P_b:	Static load pressure due to stationary structures

P_{we}: Soil and waste are moist but not saturated. Top of pipe is above leachate. Therefore $P_{we} = 0$
P_b: Not structures. Therefore $P_b = 0$
P_{de}: Varies with waste height (80' in this example).

$P_{de} = (H_{waste} - 4'_{waste}) \times \gamma_{waste} + H_{\text{leachate collection stone}} \times \gamma_{stone} + H_{\text{soil cover}} \times \gamma_{\text{soil cover}}$

$H_{waste} = 80'$
$\gamma_{waste} = 70$ pcf
$H_{\text{leachate collection stone}} = 4'$
$\gamma_{stone} = 150$ pcf
$H_{\text{soil cover}} = 2'$
$\gamma_{\text{soil cover}} = 120$ pcf

For this example, $P_{de} = 6{,}160$ psf $= 43$ psi

$P_t = P_s = P_{de}$ (for this example).

Total Pressure (P_t) = 43 psi

Design Method and Example

(Ref. DRISCO PIPE design manual - applicable equations)

2. Calculate Factor of Safety against Wall Crushing:

Wall Crushing occurs when total pressure (P_t) exceeds Actual Compressive Pressure (S_a).

$S_a = [(SDR - 1)/2] \times P_t$

- S_a: Actual Compressive Pressure (in this example, under 80' of waste)
- SDR: Standard Dimension Ratio (SDR 17 in this example)
- P_t: Total Pressure (calculated in step 1)

$P_t = 43$ psi
SDR = 17

$S_a = 344$ psi

FS against wall crushing equals the compressive strength of HDPE pipe, 1500 psi, divided by the Actual Compressive Pressure, S_a.

FS = 4.4 (should be equal to or greater than 1.5).

Design Method and Example

(Ref. DRISCO PIPE design manual - applicable equations)

3. Calculate Factor of Safety against Wall Buckling:

Buckling occurs when total pressure (P_t) exceeds critical buckling soil pressure (P_{cb}).

$P_{cb} = 0.8\sqrt{(E' \times P_c)}$

- P_{cb}: Critical buckling pressure
- P_c: Critical collapse differential pressure
- E': Soil Modulus. In this case, 3,000 psi for coarse grained soils (leachate collection ASTM #57 stone).

$P_c = 2.32 \times E / SDR^3$

E: Tensile Modulus of Elasticity. In the case of buried pipe in landfills, use 28,200 psi. This value corresponds to an elastic modulus for HDPE pipe (PE 3608) at 50 years and 73° F. See Table 1: Typical Elastic Modulus for DriscoPlex PE 3608 (attached) in Book 2 Chapter 5 in the Performance Pipe Engineering Manual. First Addition, 2003.

$P_c = 13.3$ psi
$P_{cb} = 160$ psi

FS against wall buckling equals the Critical Buckling Soil Pressure (P_{cb}) divided by the Total Pressure (P_t); (160 / 43 = 3.7)

FS = 3.7 (should be equal to or greater than 1.5).

ANALYSIS RESULTS

HDPE LEACHATE PIPE WALL CRUSHING & BUCKLING - 50 YR DESIGN LIFE (73° F)

Bunnell-Lammons Engineering, Inc.
January 2008

The pipeline design must select a suitable standard dimension ratio (SDR) and specify the backfill conditions to obtain the desired performance of the system. Pipe wall crushing occurs when external vertical pressure causes the compressive stress in the pipe wall to exceed the long-term compressive strength of the pipe material. Pipe wall buckling is a longitudinal wrinkling of the pipe wall. Buckling can occur in the non-pressurized pipe if the total external soil pressure exceeds the critical buckling pressure, P_{cb} of the pipe-soil system. A waste unit weight of 70 pcf is assumed.

Leachate Pipe (SDR 9)

SDR 9										
Waste Height (feet)	20	40	80	100	125	150	200	250	300	350
Total External Pressure (psi)	13	22	42	51	64	76	100	124	149	173
Wall Crushing (psi)	50	89	167	206	254	303	400	497	594	692
Factor of Safety against Wall Crushing	**30.0**	**16.9**	**9.0**	**7.3**	**5.9**	**5.0**	**3.8**	**3.0**	**2.5**	**2.2**
Critical Collapse Differential Pressure (psi)	90	90	90	90	90	90	90	90	90	90
Total Buckling Pressure (psi)	415	415	415	415	415	415	415	415	415	415
Factor of Safety against Wall Buckling	**33.2**	**18.7**	**10.0**	**8.1**	**6.5**	**5.5**	**4.2**	**3.3**	**2.8**	**2.4**

Leachate Pipe (SDR 11)

SDR 11										
Waste Height (feet)	20	40	80	100	125	150	200	250	300	350
Total External Pressure (psi)	13	22	42	51	64	76	100	124	149	173
Wall Crushing (psi)	63	111	208	257	318	378	500	622	743	865
Factor of Safety against Wall Crushing	**24.0**	**13.5**	**7.2**	**5.8**	**4.7**	**4.0**	**3.0**	**2.4**	**2.0**	**1.7**
Critical Collapse Differential Pressure (psi)	49	49	49	49	49	49	49	49	49	49
Total Buckling Pressure (psi)	307	307	307	307	307	307	307	307	307	307
Factor of Safety against Wall Buckling	**24.6**	**13.8**	**7.4**	**6.0**	**4.8**	**4.1**	**3.1**	**2.5**	**2.1**	**1.8**

Leachate Pipe (SDR 13)

SDR 13										
Waste Height (feet)	20	40	80	100	125	150	200	250	300	350
Total External Pressure (psi)	13	22	42	51	64	76	100	124	149	173
Wall Crushing (psi)	75	133	250	308	381	454	600	746	892	1038
Factor of Safety against Wall Crushing	**20.0**	**11.3**	**6.0**	**4.9**	**3.9**	**3.3**	**2.5**	**2.0**	**1.7**	**1.4**
Critical Collapse Differential Pressure (psi)	30	30	30	30	30	30	30	30	30	30
Total Buckling Pressure (psi)	239	239	239	239	239	239	239	239	239	239
Factor of Safety against Wall Buckling	**19.1**	**10.8**	**5.7**	**4.7**	**3.8**	**3.2**	**2.4**	**1.9**	**1.6**	**1.4**

See Attached Bibliography for References

ANALYSIS RESULTS

HDPE LEACHATE PIPE WALL CRUSHING & BUCKLING - 50 YR DESIGN LIFE (73° F)

Bunnell-Lammons Engineering, Inc.
January 2008

The pipeline design must select a suitable standard dimension ratio (SDR) and specify the backfill conditions to obtain the desired performance of the system. Pipe wall crushing occurs when external vertical pressure causes the compressive stress in the pipe wall to exceed the long-term compressive strength of the pipe material. Pipe wall buckling is a longitudinal wrinkling of the pipe wall. Buckling can occur in the non-pressurized pipe if the total external soil pressure exceeds the critical buckling pressure, P_{cb} of the pipe-soil system. A waste unit weight of 70 pcf is assumed.

Leachate Pipe (SDR 17)

SDR 17										
Waste Height (feet)	20	40	80	100	125	150	200	250	300	350
Total External Pressure (psi)	13	22	42	51	64	76	100	124	149	173
Wall Crushing (psi)	100	178	333	411	508	606	800	994	1189	1383
Factor of Safety against Wall Crushing	15.0	8.4	4.5	3.6	3.0	2.5	1.9	1.5	1.3	1.1
Critical Collapse Differential Pressure (psi)	13	13	13	13	13	13	13	13	13	13
Total Buckling Pressure (psi)	160	160	160	160	160	160	160	160	160	160
Factor of Safety against Wall Buckling	12.8	7.2	3.8	3.1	2.5	2.1	1.6	1.3	1.1	0.9

Leachate Pipe (SDR 21)

SDR 21										
Waste Height (feet)	20	40	80	100	125	150	200	250	300	350
Total External Pressure (psi)	13	22	42	51	64	76	100	124	149	173
Wall Crushing (psi)	125	222	417	514	635	757	1000	1243	1486	1729
Factor of Safety against Wall Crushing	12.0	6.8	3.6	2.9	2.4	2.0	1.5	1.2	1.0	0.9
Critical Collapse Differential Pressure (psi)	7	7	7	7	7	7	7	7	7	7
Total Buckling Pressure (psi)	116	116	116	116	116	116	116	116	116	116
Factor of Safety against Wall Buckling	9.3	5.2	2.8	2.3	1.8	1.5	1.2	0.9	0.8	0.7

Leachate Pipe (SDR 26)

SDR 26										
Waste Height (feet)	20	40	80	100	125	150	200	250	300	350
Total External Pressure (psi)	13	22	42	51	64	76	100	124	149	173
Wall Crushing (psi)	156	278	521	642	794	946	1250	1554	1858	2161
Factor of Safety against Wall Crushing	9.6	5.4	2.9	2.3	1.9	1.6	1.2	1.0	0.8	0.7
Critical Collapse Differential Pressure (psi)	4	4	4	4	4	4	4	4	4	4
Total Buckling Pressure (psi)	85	85	85	85	85	85	85	85	85	85
Factor of Safety against Wall Buckling	6.8	3.8	2.0	1.6	1.3	1.1	0.8	0.7	0.6	0.5

See Attached Bibliography for References

ANALYSIS RESULTS

HDPE LEACHATE PIPE WALL CRUSHING & BUCKLING - 50 YR DESIGN LIFE (73° F)

Bunnell-Lammons Engineering, Inc.
January 2008

The pipeline design must select a suitable standard dimension ratio (SDR) and specify the backfill conditions to obtain the desired performance of the system. Pipe wall crushing occurs when external vertical pressure causes the compressive stress in the pipe wall to exceed the long-term compressive strength of the pipe material. Pipe wall buckling is a longitudinal wrinkling of the pipe wall. Buckling can occur in the non-pressurized pipe if the total external soil pressure exceeds the critical buckling pressure, P_{cb} of the pipe-soil system. A waste unit weight of 70 pcf is assumed.

Sumps (SDR 11)

SDR 11										
Waste Height (feet)	20	40	80	100	125	150	200	250	300	350
Total External Pressure (psi)	14	23	43	53	65	77	101	125	150	174
Wall Crushing (psi)	68	117	214	263	323	384	506	627	749	870
Factor of Safety against Wall Crushing	22.0	12.9	7.0	5.7	4.6	3.9	3.0	2.4	2.0	1.7
Critical Collapse Differential Pressure (psi)	49	49	49	49	49	49	49	49	49	49
Total Buckling Pressure (psi)	307	307	307	307	307	307	307	307	307	307
Factor of Safety against Wall Buckling	22.6	13.2	7.2	5.9	4.8	4.0	3.0	2.4	2.1	1.8

Sumps (SDR 13)

SDR 13										
Waste Height (feet)	20	40	80	100	125	150	200	250	300	350
Total External Pressure (psi)	14	23	43	53	65	77	101	125	150	174
Wall Crushing (psi)	82	140	257	315	388	461	607	753	898	1044
Factor of Safety against Wall Crushing	18.4	10.7	5.8	4.8	3.9	3.3	2.5	2.0	1.7	1.4
Critical Collapse Differential Pressure (psi)	30	30	30	30	30	30	30	30	30	30
Total Buckling Pressure (psi)	239	239	239	239	239	239	239	239	239	239
Factor of Safety against Wall Buckling	17.6	10.2	5.6	4.6	3.7	3.1	2.4	1.9	1.6	1.4

Sumps (SDR 17)

SDR 17										
Waste Height (feet)	20	40	80	100	125	150	200	250	300	350
Total External Pressure (psi)	14	23	43	53	65	77	101	125	150	174
Wall Crushing (psi)	109	187	342	420	517	614	809	1003	1198	1392
Factor of Safety against Wall Crushing	13.8	8.0	4.4	3.6	2.9	2.4	1.9	1.5	1.3	1.1
Critical Collapse Differential Pressure (psi)	13	13	13	13	13	13	13	13	13	13
Total Buckling Pressure (psi)	160	160	160	160	160	160	160	160	160	160
Factor of Safety against Wall Buckling	11.7	6.9	3.7	3.0	2.5	2.1	1.6	1.3	1.1	0.9

See Attached Bibliography for References

ANALYSIS RESULTS

HDPE LEACHATE PIPE WALL CRUSHING & BUCKLING - 50 YR DESIGN LIFE (73° F)

Bunnell-Lammons Engineering, Inc.
January 2008

The pipeline design must select a suitable standard dimension ratio (SDR) and specify the backfill conditions to obtain the desired performance of the system. Pipe wall crushing occurs when external vertical pressure causes the compressive stress in the pipe wall to exceed the long-term compressive strength of the pipe material. Pipe wall buckling is a longitudinal wrinkling of the pipe wall. Buckling can occur in the non-pressurized pipe if the total external soil pressure exceeds the critical buckling pressure, P_{cb} of the pipe-soil system. A waste unit weight of 70 pcf is assumed.

Sumps (SDR 21)

SDR 21										
Waste Height (feet)	20	40	80	100	125	150	200	250	300	350
Total External Pressure (psi)	14	23	43	53	65	77	101	125	150	174
Wall Crushing (psi)	136	233	428	525	647	768	1011	1254	1497	1740
Factor of Safety against Wall Crushing	11.0	6.4	3.5	2.9	2.3	2.0	1.5	1.2	1.0	0.9
Critical Collapse Differential Pressure (psi)	7	7	7	7	7	7	7	7	7	7
Total Buckling Pressure (psi)	116	116	116	116	116	116	116	116	116	116
Factor of Safety against Wall Buckling	8.6	5.0	2.7	2.2	1.8	1.5	1.2	0.9	0.8	0.7

Sumps (SDR 26)

SDR 26										
Waste Height (feet)	20	40	80	100	125	150	200	250	300	350
Total External Pressure (psi)	14	23	43	53	65	77	101	125	150	174
Wall Crushing (psi)	170	292	535	656	808	960	1264	1568	1872	2175
Factor of Safety against Wall Crushing	8.8	5.1	2.8	2.3	1.9	1.6	1.2	1.0	0.8	0.7
Critical Collapse Differential Pressure (psi)	4	4	4	4	4	4	4	4	4	4
Total Buckling Pressure (psi)	85	85	85	85	85	85	85	85	85	85
Factor of Safety against Wall Buckling	6.2	3.6	2.0	1.6	1.3	1.1	0.8	0.7	0.6	0.5

See Attached Bibliography for References

d. Side slope Riser Pump Design

As cells are constructed, detailed calculations will be performed to adequately size each side slope riser pump to handle leachate from the cell area collected by that side slope riser assembly, taking into account leachate force main flow from other cell areas.

VIII. REPORT OF GEOTECHNICAL EVALUATION

BLE INC.
BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL, ENVIRONMENTAL AND CONSTRUCTION MATERIALS CONSULTANTS

April 28, 2009

Mr. William F. Hodges, P. E.
Hodges, Harbin, Newberry & Tribble, Inc.
484 Mulberry Street, Suite 265
Macon, Georgia 31201

Subject: **Report of Geotechnical Evaluation**
Proposed MSW Phase 3
Charlotte Motor Speedway Landfill
Cabarrus County, North Carolina
BLE Project Number J09-6452-01
HHNT Project Number 6703-351-01

Dear Mr. Hodges:

Bunnell-Lammons Engineering, Inc. (BLE) is pleased to present this Report of Geotechnical Evaluation in support of the Hodges, Harbin, Newberry and Tribble, Inc. (HHNT) redesign of Cells 2I to 2K and 2M at the Charlotte Motor Speedway (CMS) Landfill. This report is presented to address geotechnical related issues consisting of potential subgrade settlement, base liner and closure cap stability and global stability of the waste mound closure slopes.

PROJECT INFORMATION

The site is located approximately 4 miles southwest of Concord, North Carolina in central Cabarrus County. The proposed base liner and closure cap configuration and initial and final grading plans were provided for our evaluation and are indicated in the attached Figure 1. We have been furnished a copy of the Design Hydrogeologic Report, (DHR) for CMS Landfill dated, August 2008 prepared by David Garrett and Associates. The planned Phase 3 expansion of the Landfill will consist of lined Cells No. 2I through 2K and 2M.

The MSW cells will have a base liner consisting of from bottom to top:

- Compacted subgrade soils
- 24-inches of compacted clay liner, ($k \leq 1.0 \times 10^{-7}$ cm/sec)
- 60-mil minimum HDPE flexible membrane liner (FML)
- 24-inches of protective cover sand, ($k \geq 1.0 \times 10^{-2}$ cm/sec)

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Optionally; an alternate base liner system may be used consisting of:

- Compacted subgrade soils
- 24-inches of compacted soil liner ($k \leq 1.0 \times 10^{-5}$ cm/sec)
- Geosynthetic Clay Liner (GCL)
- 60-mil minimum HDPE flexible membrane liner (FML)
- 24-inches of protective cover sand, ($k \geq 1.0 \times 10^{-2}$ cm/sec)

Also the protective cover may be an alternate protective cover system consisting of a geonet composite (double-sided geonet drainage media, GDM) overlain by on-site native sandy soils in lieu of the protective cover sand.

The closure cap will consist of the following cross section from bottom to top in areas with less than 5 percent grade:

- 18-inches of compacted soil liner, ($k \leq 1.0 \times 10^{-5}$ cm/sec)
- 40 mil LLDPE textured flexible membrane liner (FML)
- Double-sided Geonet Composite Drainage Media (GDM)
- 18-inches of protective cover soil
- 6-inches of vegetative growth layer

The 18-inch thick compacted soil liner noted above is not required in areas of the closure cap with grades greater than 5 percent.

The base liner of the cells will have maximum side slopes of 3 horizontal to 1 vertical with a maximum height of approximately 14 feet. The closure cap slopes will be at a maximum inclination of 3 horizontal to 1 vertical. The top of clay elevations, range from a low of approximately 574 feet MSL in the eastern end of Cell 2I, to a maximum of approximately 590 feet in the middle of Cell 2M. The maximum elevation of the closure cap is at 788 feet, resulting in a maximum height of waste of approximately 200 feet.

The purpose of this evaluation is to provide geotechnical analysis and evaluation of the planned base liner and cap slopes. The analysis was based on the proposed landfill initial and final grading plans prepared by HHNT and site specific data presented in the provided Design Hydrogeologic Report noted above.

GEOLOGY AND SUBSURFACE CONDITIONS

Geologic Conditions: The project site is located in the Piedmont Physiographic Province, an area underlain by ancient igneous and metamorphic rocks. The virgin soils encountered in this area are the residual product of in-place chemical weathering of rock which was similar to the rock presently underlying the site. In areas not altered by erosion or disturbed by the activities of man, the typical residual soil profile consists of clayey soils near the surface, where soil weathering is more advanced, underlain by sandy silts and silty sands. The boundary between soil and rock is not sharply defined. This transitional zone, termed "partially weathered rock," is normally found overlying the parent bedrock. Partially weathered rock is defined, for engineering purposes, as residual material with standard penetration resistances in excess of 100 blows per foot. Weathering is facilitated by fractures, joints, and the presence of less resistant rock types. Consequently, the profile of the partially weathered rock and hard rock is quite irregular and erratic, even over short horizontal distances. Also, it is not unusual to find lenses and boulders of hard rock and zones of partially weathered rock within the soil mantle, well above the general bedrock level.

Subsurface Conditions: The borings performed for the Design Hydrogeologic Report by others, (report dated August 2008), encountered residual soils underlain by partially weathered rock and rock at depth, consistent with the area geology. The residual site soils are primarily firm to hard sandy silt and very firm to dense silty sand, generally with standard penetration resistance increasing with depth. The subgrade of the cells will be formed by structural fill and residual soils. The groundwater flow direction is generally from north to south across the site with a difference in elevation of approximately 25 feet (elevation 585 to 560 feet).

RESULTS OF EVALUATION

Slope Stability

According to the definition of Seismic Impact Zones in I5A NCAC 13B.1622 (5), the site is in a Seismic Impact Zone. The peak ground acceleration for the site is 0.12g based on the 2006 USGS Seismic Hazard Maps presented with the International Building Code (IBC) for a maximum horizontal acceleration with a 10 % chance of being exceeded in 250 years. Shear strength parameters for structural fill, residual soils and the waste were developed based on the subsurface data reported in the Design Hydrogeologic Report, our experience with similar subsurface and site conditions and published correlations.

Static and seismic slope stability analyses were performed including both circular and sliding block potential failure modes of the capped landfill and perimeter embankment configuration, using the computer program Slope/W by Geo-Slope International. The results of the analyses are attached.

The analysis indicates that the planned 3H : 1V waste slope has a factor of safety of approximately 2.0. Likewise, the drainage berm has a factor of safety of 1.6. The analysis indicates that the planned slopes are stable. The factors of safety were greater than 1.5 for all of the configurations under static loads and greater than 1.0 for seismic conditions. A safety factor of 1.5 or more is considered acceptable for long term (steady state) static conditions. A factor of safety of 1.0 or more is considered acceptable for seismic conditions.

The sliding resistance for the planned base liner of the cells and the cap system was also analyzed. The attached calculations indicate that the geosynthetic layers of the cap system, (HDPE geomembrane (FML), GCL, and geocomposite), and base liner, permitted system or alternative protective cover using GDM, have an adequate factor of safety against sliding, (1.5) when provided with an interface friction resistance, (combination of cohesion and friction angle) equivalent to a peak interface friction angle of 26.4 degrees, for the 3H : 1V slopes.

In summary, the stability analysis indicates that the planned landfill side slopes will be stable.

Settlement

A subgrade settlement analysis was performed at the proposed low end, midpoint and upper end of each leachate line location, using the boring data from the Design Hydrogeologic Report. The compressibility parameters for the soil and partially weathered rock were estimated based on published correlations with standard penetration resistance (N-value) and our experience with similar conditions. The magnitude of the settlement generally varies with the height of the overlying waste and is also influenced by the proposed excavation or structural fill thickness. The maximum total subgrade settlement due to the planned waste height is estimated to be approximately one foot and located at a location beneath the maximum height of waste. The projected subgrade settlement is anticipated to be less than 0.25 foot at the edges of the landfill.

Based on the estimated settlement and the design groundwater elevation data, the separation between the post-settlement proposed clay liner subgrade elevation and the groundwater elevation varies from 4.9 feet beneath the Cell 2I sump, to 16.9 feet in Cell 2K, which exceeds the required minimum of 4 feet. The bedrock separation with the post-settlement clay liner subgrade elevation ranges from approximately 14 to over 40 feet, which also exceeds the 4-foot minimum. The leachate collection system has been designed to incorporate the anticipated settlements. The estimated maximum total and differential settlements are within tolerable limits of the geomembrane landfill liner system. The results of our analysis of subgrade settlement for the site are provided in the attachments.

CLOSING

We appreciate the opportunity to be of assistance to HHNT on this project. If you have any questions, comments or clarifications regarding this report, please contact us.

Sincerely,
BUNNELL-LAMMONS ENGINEERING, INC.

Gary L. Weekley, P.E.
Senior Engineer
Registered NC # 8251

Daniel B. Bunnell, P.E.
Principal Engineer
Registered NC # 13814

4/29/09

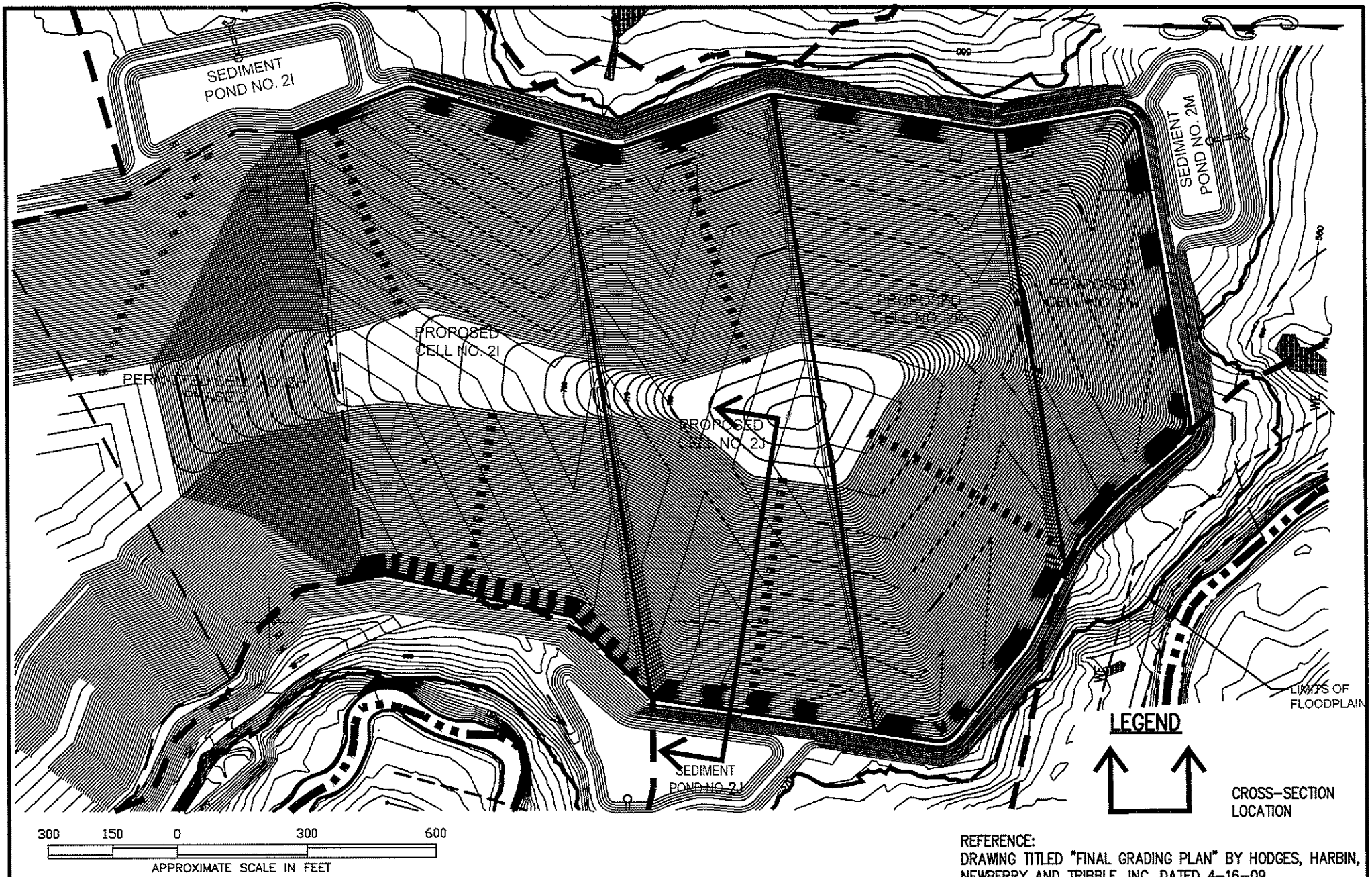
NORTH CAROLINA PROFESSIONAL SEAL No. 13814 ENGINEER DANIEL B. BUNNELL

Attachments

Attachments:

Cross-Section Location Plan (Figure 1)
Cross-Section (Figure 2)
Summary of Stability Analysis
Results of Stability Analysis (for various conditions)
Stability of Final Cover Veneer Against Sliding
Settlement Analysis
- **Surcharge Determination**
- **Settlement Calculations**

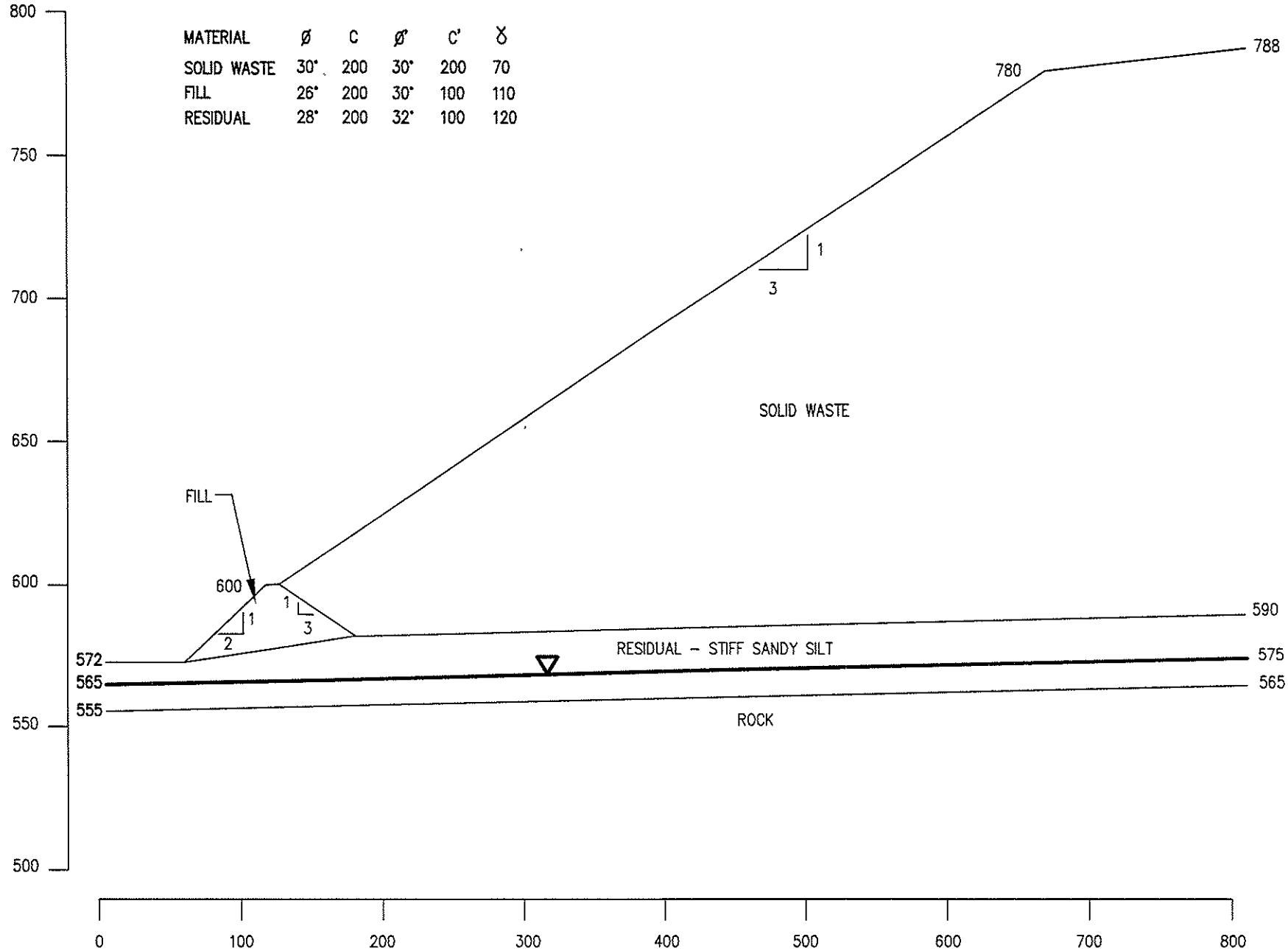
Groundwater Separation (below the post-settlement clay liner subgrade)
Bedrock Separation (below the post-settlement clay liner subgrade)



REFERENCE:
DRAWING TITLED "FINAL GRADING PLAN" BY HODGES, HARBIN, NEWBERRY AND TRIBBLE, INC. DATED 4-16-09.

DRAWN: ACE	DATE: 04-27-09	BLE INC. BUNNELL-LAMMONS ENGINEERING, INC. 6004 PONDERS COURT GREENVILLE, SOUTH CAROLINA 29615 PHONE: (864)288-1265 FAX: (864)288-4430	STABILITY LOCATION PLAN CMS LANDFILL CABARRUS COUNTY, NORTH CAROLINA
CHECKED: GLW	CAD: CMSLF-CSLP		
APPROVED:	JOB NO: J09-6452-01		

FIGURE 1



DRAWN: ACE	DATE: 04-27-09	BLE INC. BURNELL-LAMMONS ENGINEERING, INC. 6004 PONDERS COURT GREENVILLE, SOUTH CAROLINA 29615 PHONE: (864)288-1265 FAX: (864)288-4430	STABILITY CROSS-SECTION CMS LANDFILL CABARRUS COUNTY, NORTH CAROLINA	FIGURE 2
CHECKED: GLW	CAD: CMSLF-SECT			
APPROVED:	JOB NO: J09-6452-01			

SUMMARY OF STABILITY ANALYSIS

CMS LANDFILL - PHASE 3
CABARRUS COUNTY, NORTH CAROLINA

April 2009

BLE Project No. J09-6452-01

	Factor of Safety		
	Static Conditions		Seismic
Slope Stability*	Total Stress	Effective Stress	Conditions
Waste Slope (3H : 1V)	2.05	2.06	1.44
Drainage Berm (Flooded)	--	1.60	--
Embankment Fill (2H : 1V)	1.85	1.70	1.31

* Seismic horizontal acceleration at bedrock level = 0.12g

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Comments: BLE Project No. J09-6452-01
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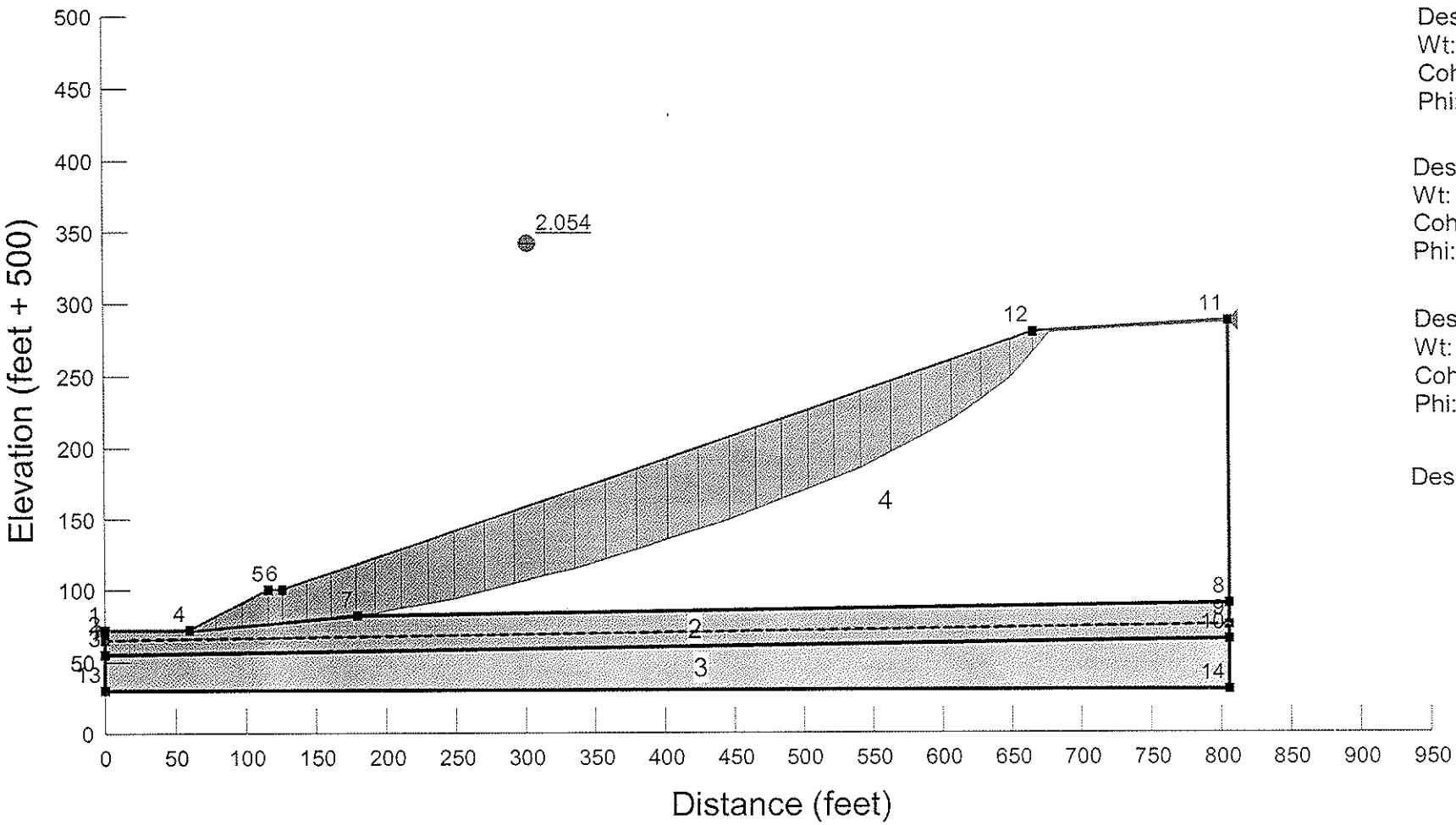
Time: 11:40:44 AM
Horz Seismic Load: 0g



Description: Solid Waste
Wt: 70
Cohesion: 200
Phi: 30

Description: Fill
Wt: 110
Cohesion: 200
Phi: 26

Description: Residuum
Wt: 120
Cohesion: 200
Phi: 28

Description: Bedrock

Title: CMS Landfill Phase 3
Comments: BLE Project No. J09-6452-01
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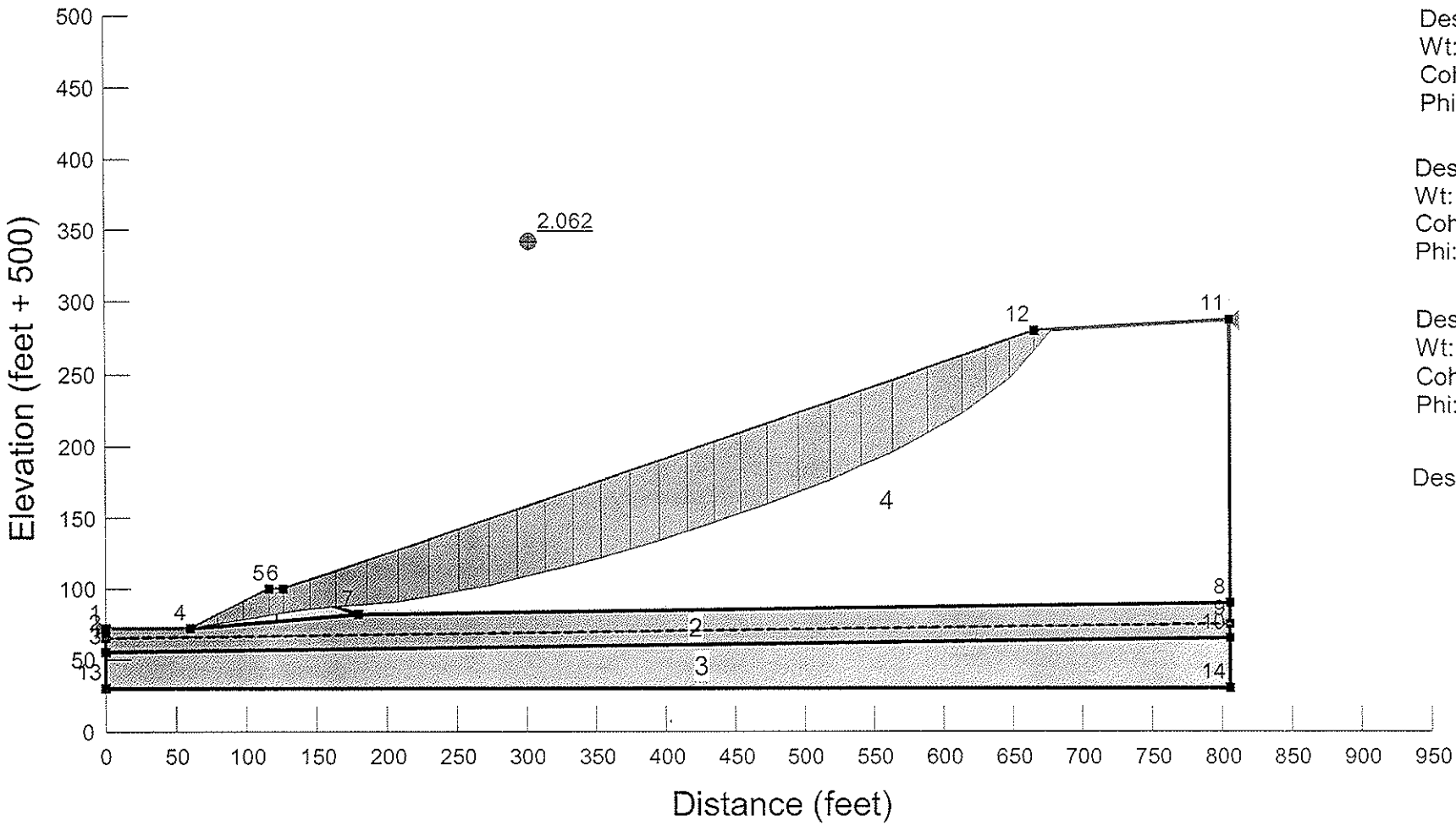

Description: Solid Waste
Wt: 70
Cohesion: 200
Phi: 30

Description: Fill
Wt: 110
Cohesion: 100
Phi: 30

Description: Residuum
Wt: 120
Cohesion: 100
Phi: 32

Description: Bedrock

Title: CMS Landfill Phase 3
Comments: BLE Project No. J09-6452-01
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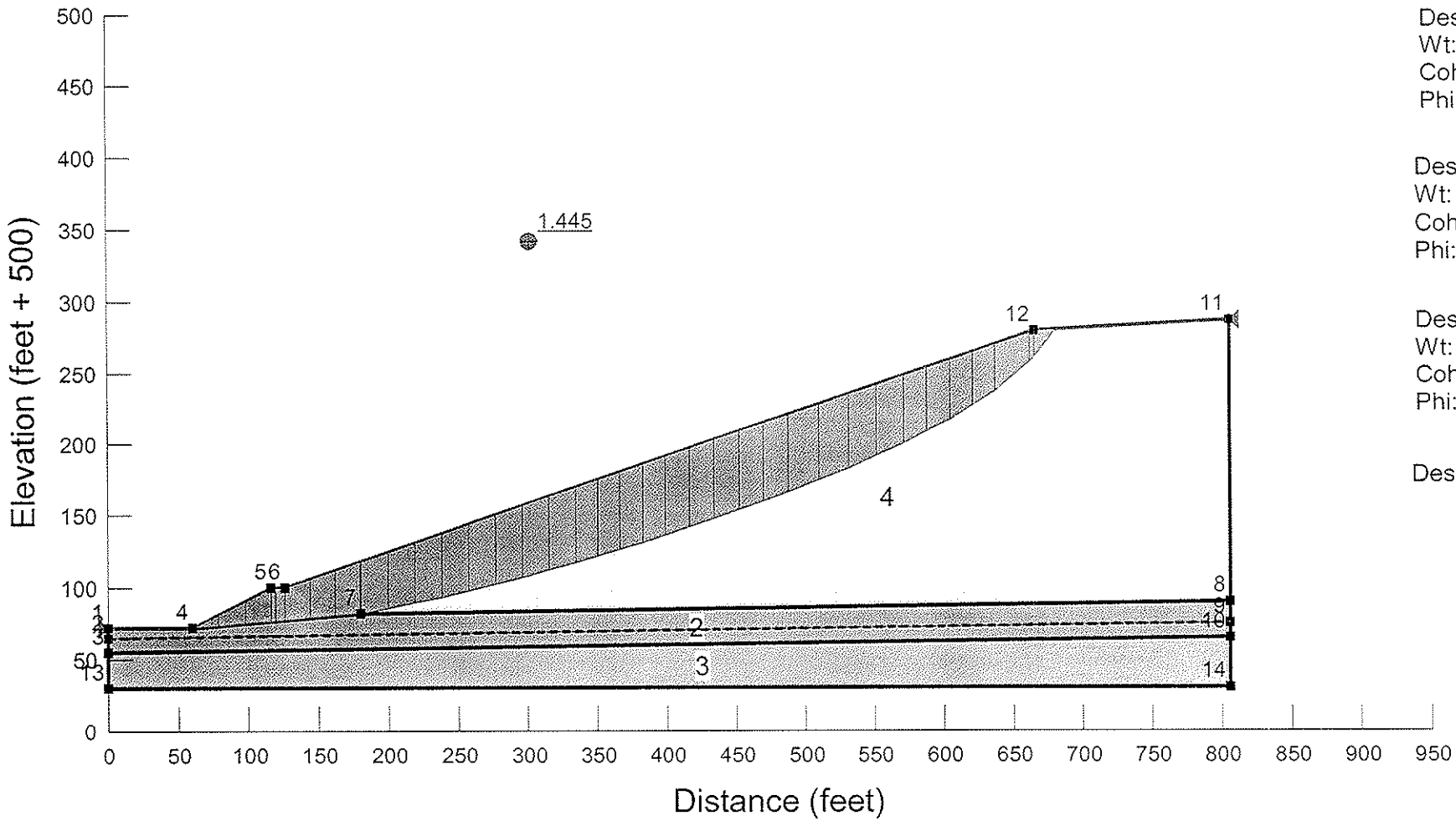

Description: Solid Waste
Wt: 70
Cohesion: 200
Phi: 30

Description: Fill
Wt: 110
Cohesion: 200
Phi: 26

Description: Residuum
Wt: 120
Cohesion: 200
Phi: 28

Description: Bedrock

Description: Berm Stability
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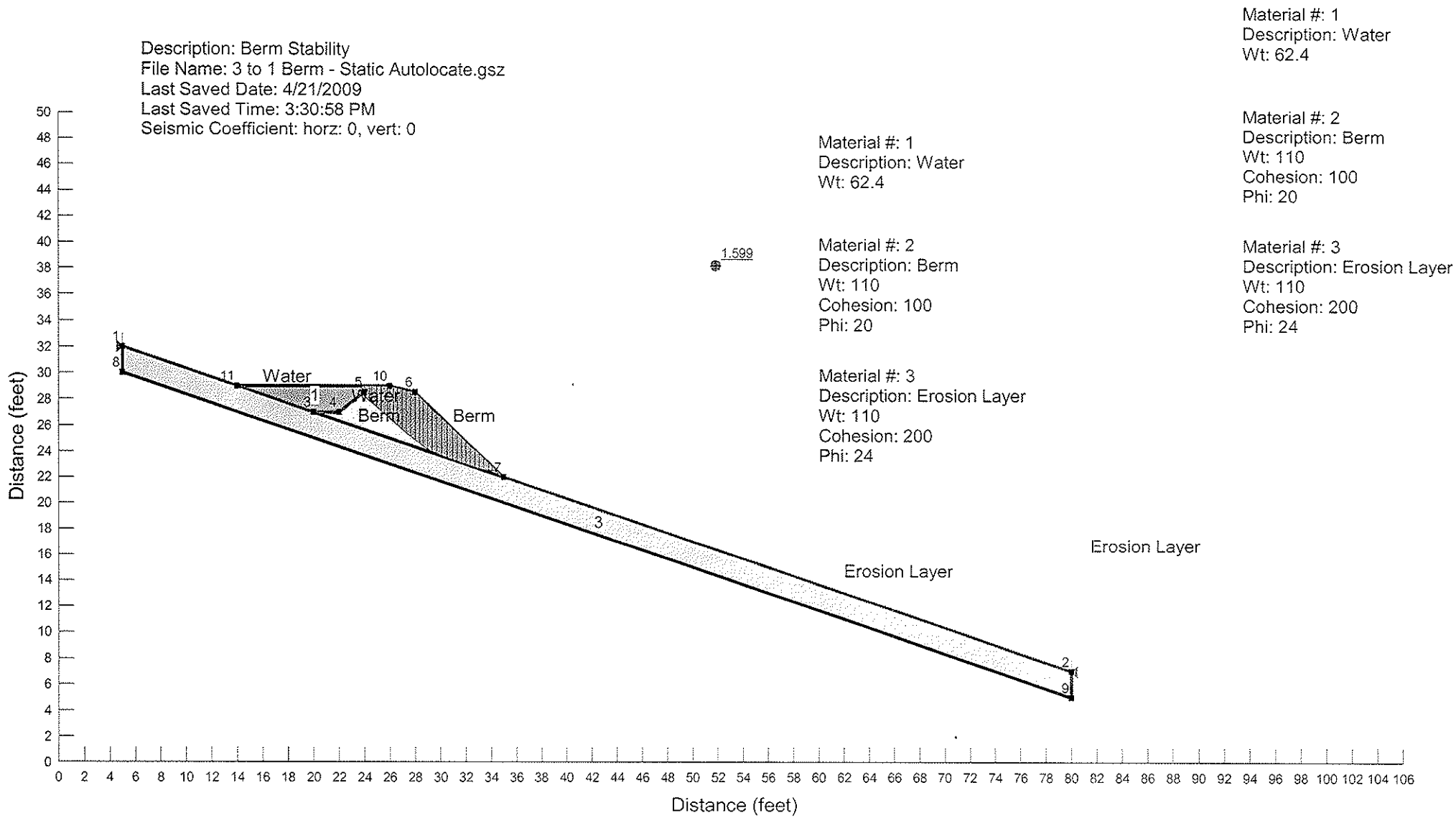
Last Saved Time: 3:30:58 PM
Seismic Coefficient: horz: 0, vert: 0



Material #: 1
Description: Water
Wt: 62.4

Material #: 2
Description: Berm
Wt: 110
Cohesion: 100
Phi: 20

Material #: 3
Description: Erosion Layer
Wt: 110
Cohesion: 200
Phi: 24

Title: CMS Landfill Phase 3
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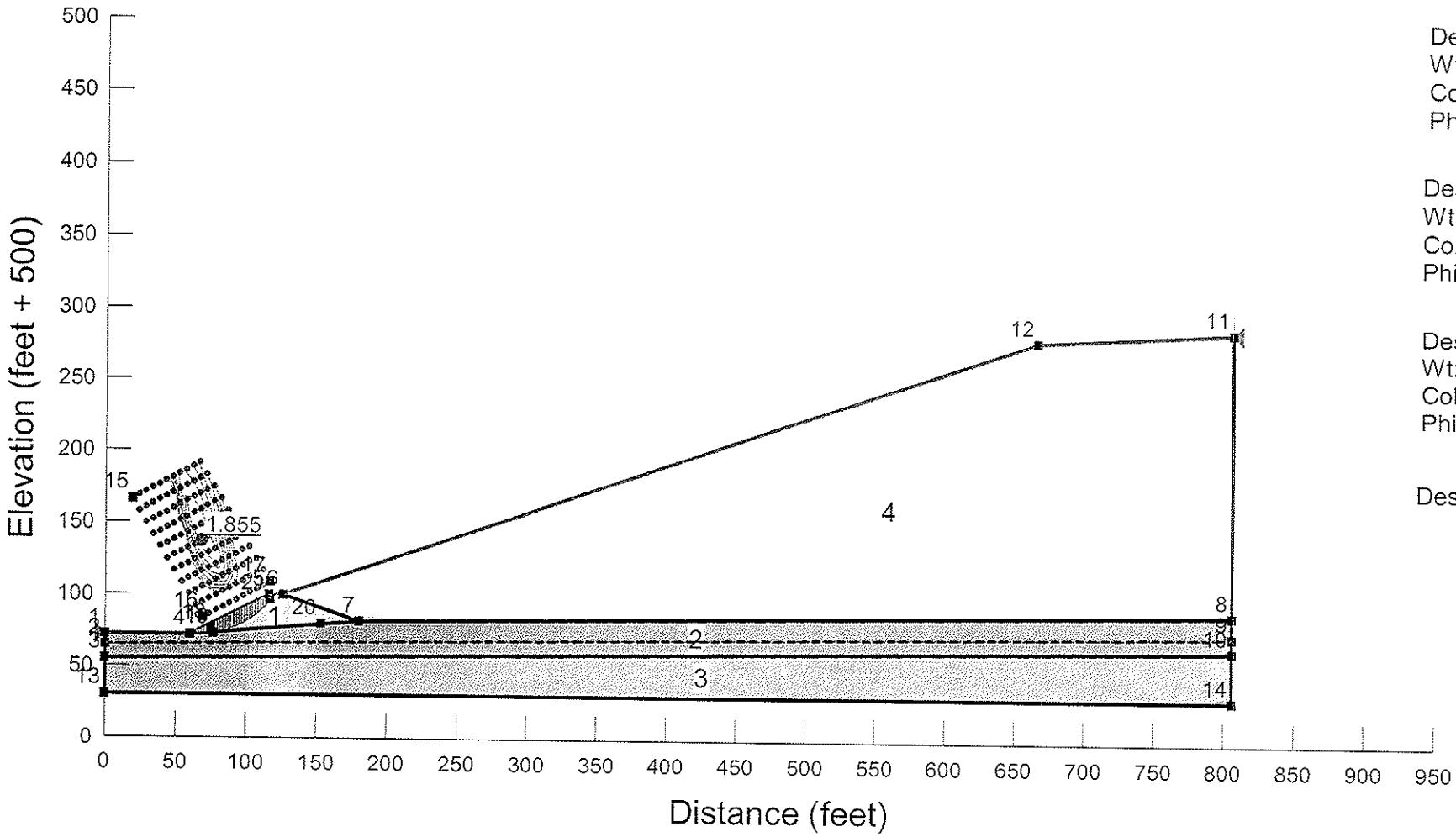

Description: Solid Waste
Wt: 70
Cohesion: 200
Phi: 30

Description: Fill
Wt: 110
Cohesion: 200
Phi: 26

Description: Residuum
Wt: 120
Cohesion: 200
Phi: 28

Description: Bedrock

Title: CMS Landfill Phase 3
Comments: BLE Project No. J09-6452-01
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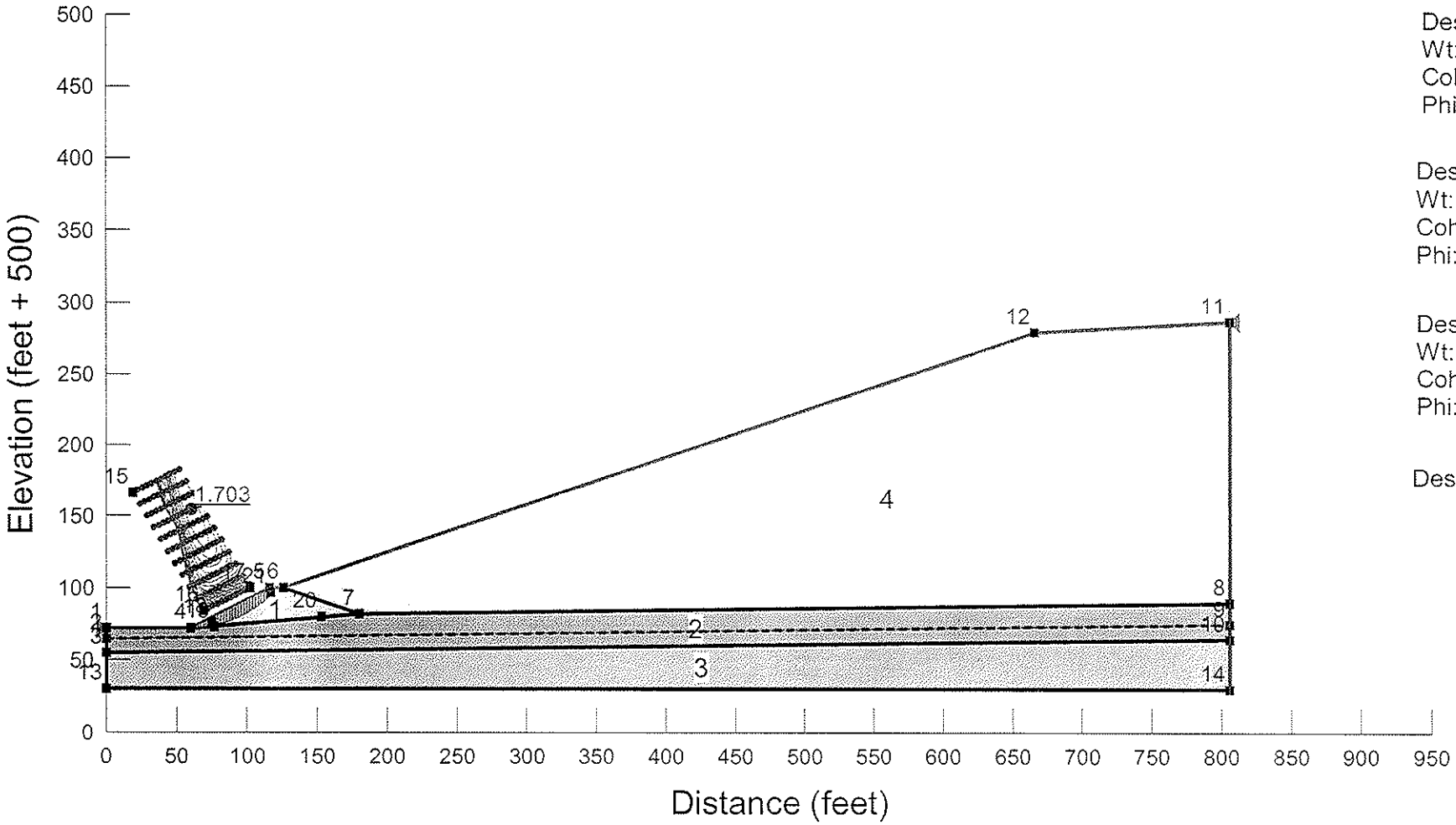
Horz Seismic Load: 0g



Description: Solid Waste
Wt: 70
Cohesion: 200
Phi: 30

Description: Fill
Wt: 110
Cohesion: 100
Phi: 30

Description: Residuum
Wt: 120
Cohesion: 100
Phi: 32

Description: Bedrock

Title: CMS Landfill Phase 3
Comments: BLE Project No. J09-6452-01
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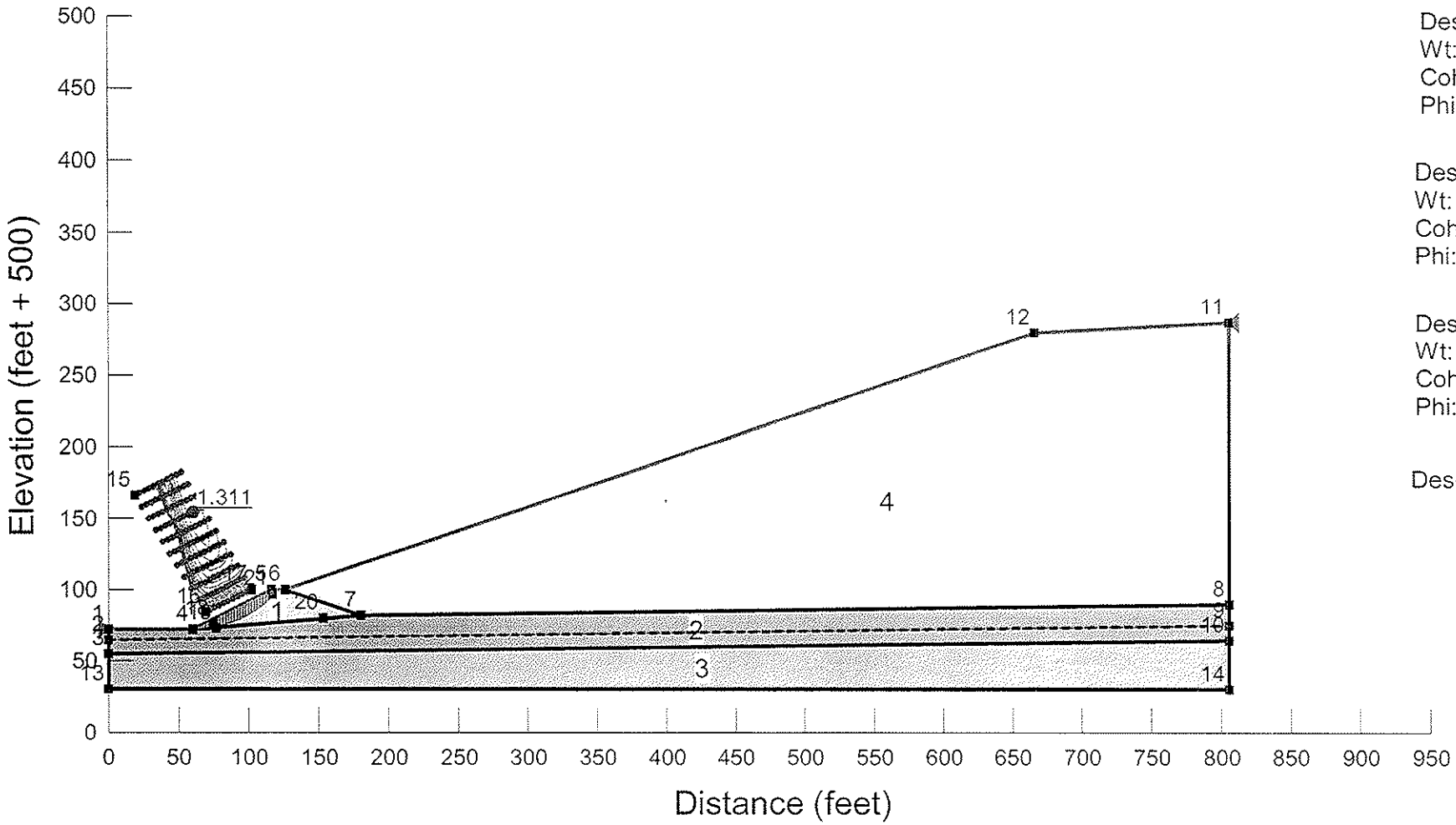

Description: Solid Waste
Wt: 70
Cohesion: 200
Phi: 30

Description: Fill
Wt: 110
Cohesion: 100
Phi: 30

Description: Residuum
Wt: 120
Cohesion: 100
Phi: 32

Description: Bedrock

BLE INC. BUNNELL-LAMMONS ENGINEERING, INC. GEOTECHNICAL, ENVIRONMENTAL AND CONSTRUCTION MATERIALS CONSULTANTS GREENVILLE, SOUTH CAROLINA · ASHEVILLE, NORTH CAROLINA	JOB NO. J09-6452 SHEET ____ OF ____ PHASE 01 TASK ____ JOB NAME CMS Landfill BY G. Weekley DATE 4-27-09 CHECKED BY D. BUNNELL DATE 4-27-09

Seismic Condition

$$FS = \frac{0.252 + 0.424 - 0.12 \tan 18.4^\circ \tan 23^\circ}{0.12 + \tan 18.4^\circ}$$

$$FS = \frac{0.252 + 0.424 - 0.017}{0.483} = 1.36 \quad > 1.0 \quad OK$$

STABILITY OF BASE LINER PROTECTIVE COVER

REQUIRED INTERFACE FRICTION OF BASE LINER SYSTEM FOR FS = 1.5 :

$$1.5 = \frac{\text{TAN INTERFACE RESISTANCE ANGLE}}{\text{TAN OF MAXIMUM SIDE SLOPE}}$$

$$1.5 = \frac{\tan X^\circ}{\tan 18.4^\circ}$$

$$X = 26.4^\circ$$

∴ INTERFACE FRICTION OF BASE LINER SHOULD HAVE INTERFACE SHEAR STRENGTH (COHESION + FRICTION) = ϕ OF 26.4°.

BLE INC. BUNNELL-LAMMONS ENGINEERING, INC. GEOTECHNICAL, ENVIRONMENTAL AND CONSTRUCTION MATERIALS CONSULTANTS GREENVILLE, SOUTH CAROLINA • ASHEVILLE, NORTH CAROLINA	JOB NO. J09-6452 SHEET ____ OF ____ PHASE 01 TASK ____ JOB NAME CMS Landfill BY G. Weekley DATE 4-27-09 CHECKED BY D. BUNNELL DATE 4-27-09

Stability of Final Cover Veneer Against Sliding

Reference: Matasovic N. (1991) Selection of Method for Seismic Slope Stability Analysis" Proceedings of Second International Conference on Recent Advances in Geotechnical Earthquake Engineering & Soil Dynamics, St. Louis, Volume 2, pages 1057-1062

$$FS = \frac{C/(\gamma z \cos^2\beta) + \tan\phi\left(1 - \gamma_w (z - d_w)/(\gamma z)\right) - k_s \tan\beta \tan\phi}{k_s + \tan\beta}$$

k_s = seismic coefficient

β = cap slope angle (3H:1V or 18.4°)

ϕ = angle of internal friction of cover material (23°)

γ_w = unit weight of water

γ = unit weight of cover layer (110 pcf)

d_w = depth of seepage surface (2 Feet)

z = depth to failure surface (2 Feet)

c = cohesion of cover layer (50 psf)

Static Condition ($k_s = 0$)

$$FS = \frac{50/(110 \times 2 \times \cos^2 18.4°) + \tan 23° \left(1 - 62.4(2-2)/(110 \times 2)\right)}{\tan 18.4°}$$

$$FS = \frac{0.252 + 0.424}{0.333} = 2.03 > 1.5 \quad \text{ok}$$

SURCHARGE DETERMINATION AT CELL LOCATIONS
SETTLEMENT CALCULATIONS

GEOTECHNICAL ANALYSIS - PHASE 3
CMS LANDFILL
BLE Project No. J09-6452-01
April 2009

Cell Location	Boring No.	Existing Ground Elevation Feet	Maximum Elevation of Finished Cap Feet	Elevation Top of Clay Liner (Geomembrane) Feet	Height of Cap Above Geomembrane Feet	Cut Depth to FML Cut (-) Fill (+) Feet	Net Surcharge Pressure at FML Grade PSF
2I Sump	P-8	571.0	618	574.0	40.5	3	3,100
2I Midpoint	P-78	578.0	759	588.3	167.2	10	11,969
2I Upper	P-10	578.0	618	592.0	22.5	14	1,840
2J E Low Point	P-58	578.0	634	580.0	50.5	2	3,800
2J E Midpoint	P-75	579.0	730	583.0	143.5	4	10,310
2J E Upper	P-52	576.0	770	586.0	180.5	10	12,900
2J W Sump	P-73	581.5	636	582.0	50.5	1	3,800
2J W Midpoint	P-73	581.0	700	584.0	112.5	3	8,140
2J W Upper	P-74	578.0	748	586.0	158.5	8	11,360
2K E Sump	P-59	589.0	622	580.0	38.5	-9	2,145
2K E Midpoint	P-61	593.5	702	585.4	113.1	-8	7,471
2K E Upper	P-62	583.0	734	589.0	141.5	6	10,170

Net Surcharge = cap weight + weight of waste down to original ground
- net stress relief between original ground and FML grade

Geomembrane and cap elevations obtained from HHNT Drawing FG2 dated 4-16-09.

Assumed unit weight of materials:

Solid Waste	70 pcf
Residual Soil	120 pcf
Cap Soil	110 pcf

SURCHARGE DETERMINATION AT CELL LOCATIONS
SETTLEMENT CALCULATIONS

GEOTECHNICAL ANALYSIS - PHASE 3
CMS LANDFILL
BLE Project No. J09-6452-01
April 2009

Cell Location	Boring No.	Existing Ground Elevation Feet	Maximum Elevation of Finished Cap Feet	Elevation Top of Clay Liner (Geomembrane) Feet	Height of Cap Above Geomembrane Feet	Cut Depth to FML Cut (-) Fill (+) Feet	Net Surcharge Pressure at FML Grade PSF
2K W Low Poin	P-115	579.0	612	584.0	24.5	5	1,980
2K W Midpoint	P-67	588.0	660	585.7	70.8	-2	5,177
2K W Upper	P-62	583.0	734	589.0	141.5	6	10,170
2M Sump	P-60	569.0	610	584.0	22.5	15	1,840
2M Midpoint	P-63	577.0	648	585.1	59.4	8	4,423
2M Upper	P-91	579.0	618	588.0	26.5	9	2,120

Net Surcharge = cap weight + weight of waste down to original ground
- net stress relief between original ground and FML grade

Geomembrane and cap elevations obtained from HHNT Drawing FG2 dated 4-16-09.

Assumed unit weight of materials:

Solid Waste	70 pcf
Residual Soil	120 pcf
Cap Soil	110 pcf

SETTLEMENT CALCULATIONS

CMS LANDFILL
CABARRUS COUNTY, NORTH CAROLINA
Bunnell-Lammons Engineering, Inc. Project No. J09-6452-01

April 2009

Subsurface Layer (feet - feet)	Soil Type	Standard Penetration Resistance N-Value (bpf)	Layer Thickness (feet)	Total Soil Unit Weight (pcf)	Effective Soil Unit Weight (pcf)	Surcharge Pressure[1] (psf)	Soil Modulus (ksf)	Layer Settlement (inches)
CELL 2I SUMP (using boring P-8)								
574-571	Fill	NA	3	110	110	3,100	240	0.5
571-558	Hard sandy SILT	58	13	130	68	3,100	1200	0.4
558-552	PWR	100	6	140	78	3,100	1710	0.1
Total Thickness of Compressible Material			22	Feet				
							TOTAL ESTIMATED SETTLEMENT (inches)	**1.0**
CELL 2I MIDPOINT FLOOR (using boring P-78)								
588-578	Fill	NA	10	110	110	11,969	240	6.0
578-565	Stiff sandy SILT	15	13	120	120	11,969	490	3.8
565-560	Very Dense silty SAND	52	5	130	68	11,969	1110	0.6
560-554	Very Firm silty SAND	24	6	120	58	11,969	670	1.3
Total Thickness of Compressible Material			34	Feet				
							TOTAL ESTIMATED SETTLEMENT (inches)	**11.7**
CELL 2I UPPER FLOOR (using boring P-10)								
592-578	Fill	NA	14	110	110	1,840	240	1.3
578-570	Stiff sandy silty CLAY	12	8	120	120	1,840	420	0.4
570-563	PWR	100	7	140	58	1,840	1710	0.1
Total Thickness of Compressible Material			29	Feet				
							TOTAL ESTIMATED SETTLEMENT (inches)	**1.8**

[1] Surcharge pressure assumes weight of solid waste of 70 pcf

SETTLEMENT CALCULATIONS

CMS LANDFILL
CABARRUS COUNTY, NORTH CAROLINA
Bunnell-Lammons Engineering, Inc. Project No. J09-6452-01

April 2009

Subsurface Layer (feet - feet)	Soil Type	Standard Penetration Resistance N-Value (bpf)	Layer Thickness (feet)	Total Soil Unit Weight (pcf)	Effective Soil Unit Weight (pcf)	Surcharge Pressure[1] (psf)	Soil Modulus (ksf)	Layer Settlement (inches)
CELL 2J EAST SUMP (using boring P-58)								
580-578	Fill	NA	2	110	110	3,800	240	0.4
578-570	Very Stiff silty CLAY	19	8	120	120	3,800	570	0.6
570-550	Stiff SILT	13	20	120	120	3,800	450	2.0
550-543	PWR	100	7	140	78	3,800	1710	0.2
Total Thickness of Compressible Material			37	Feet				
							TOTAL ESTIMATED SETTLEMENT (inches)	**3.2**
CELL 2J EAST MIDPOINT FLOOR (using boring P-75)								
583-579	Fill	NA	4	110	120	10,310	240	2.1
579-571	Firm silty SAND	15	8	120	120	10,310	490	2.0
571-566	Very Dwnsw silty SAND	54	5	130	68	10,310	1140	0.5
Total Thickness of Compressible Material			17	Feet				
							TOTAL ESTIMATED SETTLEMENT (inches)	**4.6**
CELL 2J EAST UPPER FLOOR (using boring P-52)								
586-576	Fill	NA	10	110	110	12,900	240	6.5
576-570	Hard silty CLAY	42	6	120	58	12,900	970	1.0
570-563	PWR	100	7	140	78	12,900	1710	0.6
Total Thickness of Compressible Material			57	Feet				
							TOTAL ESTIMATED SETTLEMENT (inches)	**8.1**

[1] Surcharge pressure assumes weight of solid waste of 70 pcf

SETTLEMENT CALCULATIONS

CMS LANDFILL

CABARRUS COUNTY, NORTH CAROLINA

Bunnell-Lammons Engineering, Inc. Project No. J09-6452-01

April 2009

Subsurface Layer (feet - feet)	Soil Type	Standard Penetration Resistance N-Value (bpf)	Layer Thickness (feet)	Total Soil Unit Weight (pcf)	Effective Soil Unit Weight (pcf)	Surcharge Pressure[1] (psf)	Soil Modulus (ksf)	Layer Settlement (inches)
CELL 2J WEST SUMP (using boring P-73)								
582-574	Very Dense silty SAND	71	8	130	130	8,140	1370	0.6
574-560	Hard sandy SILT	36	14	120	58	8,140	870	1.6
560-555	Very Dense silty SAND	50	5	130	68	8,140	1080	0.5
555-549	PWR	100	6	140	78	8,140	1710	0.3
Total Thickness of Compressible Material			33	Feet				
							TOTAL ESTIMATED SETTLEMENT (inches)	**3.0**
CELL 2J WEST MIDPOINT FLOOR (using boring P-73)								
584-581	Fill	NA	3	110	120	3,800	240	0.6
581-573	Very Dense silty SAND	71	8	130	130	3,800	1370	0.3
573-554	Hard sandy SILT	39	19	120	58	3,800	920	0.9
554-548	PWR	100	6	140	78	3,800	1710	0.2
Total Thickness of Compressible Material			36	Feet				
							TOTAL ESTIMATED SETTLEMENT (inches)	**2.0**
CELL 2J WEST UPPER FLOOR (using boring P-74)								
586-578	Fill	NA	8	110	110	11,360	240	4.5
578-568	PWR	100	10	140	140	11,360	1710	0.8
Total Thickness of Compressible Material			90	Feet				
							TOTAL ESTIMATED SETTLEMENT (inches)	**5.3**

[1] Surcharge pressure assumes weight of solid waste of 70 pcf

SETTLEMENT CALCULATIONS

CMS LANDFILL

CABARRUS COUNTY, NORTH CAROLINA

Bunnell-Lammons Engineering, Inc. Project No. J09-6452-01

April 2009

Subsurface Layer (feet - feet)	Soil Type	Standard Penetration Resistance N-Value (bpf)	Layer Thickness (feet)	Total Soil Unit Weight (pcf)	Effective Soil Unit Weight (pcf)	Surcharge Pressure[1] (psf)	Soil Modulus (ksf)	Layer Settlement (inches)
CELL 2K EAST SUMP (using boring P-59)								
580-571	Stiff clayey SILT	9	9	120	120	2,145	350	0.7
571-550	PWR	100	21	140	78	2,145	1710	0.3
Total Thickness of Compressible Material			30	Feet				
						TOTAL ESTIMATED SETTLEMENT (inches)		**1.0**
CELL 2K EAST MIDPOINT FLOOR (using boring P-61)								
585-580	Stiff clayey SILT	14	7	120	120	7,471	240	2.6
580-575	Stiff SILT	7	5	120	120	7,471	300	1.5
575-564	PWR	100	11	140	78	7,471	1710	0.6
Total Thickness of Compressible Material			23	Feet				
						TOTAL ESTIMATED SETTLEMENT (inches)		**4.7**
CELL 2K EAST UPPER FLOOR (using boring P-62)								
589-583	Fill	NA	6	110	110	10,170	240	3.1
583-575	Stiff sandy CLAY	10	8	120	120	10,170	370	2.6
575-555	Dense silty SAND	30	20	120	58	10,170	770	3.2
Total Thickness of Compressible Material			80	Feet				
						TOTAL ESTIMATED SETTLEMENT (inches)		**8.9**

[1] Surcharge pressure assumes weight of solid waste of 70 pcf

SETTLEMENT CALCULATIONS

CMS LANDFILL
CABARRUS COUNTY, NORTH CAROLINA
Bunnell-Lammons Engineering, Inc. Project No. J09-6452-01

April 2009

Subsurface Layer (feet - feet)	Soil Type	Standard Penetration Resistance N-Value (bpf)	Layer Thickness (feet)	Total Soil Unit Weight (pcf)	Effective Soil Unit Weight (pcf)	Surcharge Pressure[1] (psf)	Soil Modulus (ksf)	Layer Settlement (inches)
CELL 2K WEST LOW POINT (using boring P-115)								
584-579	Fill	NA	5	110	110	1,980	240	0.5
579-567	Firm silty SAND	11	12	120	120	1,980	400	0.7
571-567	Dense silty SAND	30	4	130	130	1,980	770	0.1
567-550	PWR	100	17	140	68	1,980	1710	0.2
Total Thickness of Compressible Material			38	Feet				
							TOTAL ESTIMATED SETTLEMENT (inches)	**1.5**
CELL 2K WEST MIDPOINT FLOOR (using boring P-67)								
586-566	Stiff silty CLAY	10	20	120	120	5,177	370	3.4
566-545	Very Stiff sandy SILT	20	21	120	58	5,177	590	2.2
Total Thickness of Compressible Material			41	Feet				
							TOTAL ESTIMATED SETTLEMENT (inches)	**5.6**
CELL 2K WEST UPPER FLOOR (using boring P-62)								
589-583	Fill	NA	6	110	110	10,170	240	3.1
583-575	Stiff sandy CLAY	10	8	120	120	10,170	370	2.6
575-555	Dense silty SAND	30	20	120	58	10,170	770	3.2
Total Thickness of Compressible Material			116	Feet				
							TOTAL ESTIMATED SETTLEMENT (inches)	**8.9**

[1] Surcharge pressure assumes weight of solid waste of 70 pcf

SETTLEMENT CALCULATIONS

CMS LANDFILL
CABARRUS COUNTY, NORTH CAROLINA
Bunnell-Lammons Engineering, Inc. Project No. J09-6452-01

April 2009

Subsurface Layer (feet - feet)	Soil Type	Standard Penetration Resistance N-Value (bpf)	Layer Thickness (feet)	Total Soil Unit Weight (pcf)	Effective Soil Unit Weight (pcf)	Surcharge Pressure[1] (psf)	Soil Modulus (ksf)	Layer Settlement (inches)
CELL 2M SUMP (using boring P-60)								
584-569	Fill	NA	15	110	110	1,840	240	1.4
569-556	Very Firm clayey SAND	28	13	120	120	1,840	740	0.4
556-545	PWR	100	11	140	78	1,840	1710	0.1
Total Thickness of Compressible Material			39	Feet				
TOTAL ESTIMATED SETTLEMENT (inches)								**1.9**
CELL 2M MIDPOINT FLOOR (using boring P-34)								
585-577	Fill	NA	8	110	110	4,423	240	1.8
577-569	Very Stiff silty CLAY	20	8	120	58	4,423	590	0.7
569-560	PWR	100	9	140	78	4,423	1710	0.3
Total Thickness of Compressible Material			25	Feet				
TOTAL ESTIMATED SETTLEMENT (inches)								**2.8**
CELL 2M UPPER FLOOR (using boring P-91)								
588-579	Fill	NA	9	110	110	2,120	240	1.0
579-556	Very Stiff sandy SILT	19	23	120	120	2,120	570	1.0
556-550	Dense silty SAND	39	6	130	68	2,120	920	0.2
550-545	PWR	100	5	140	78	2,120	1710	0.1
Total Thickness of Compressible Material			93	Feet				
TOTAL ESTIMATED SETTLEMENT (inches)								**2.3**

[1] Surcharge pressure assumes weight of solid waste of 70 pcf

GROUNDWATER SEPARATION

CMS LANDFILL

CABARRUS COUNTY, NORTH CAROLINA

BLE Project No. J09-6452-01

April 2009

Reference Point	Geomembrane (FML) Elevation Feet	Estimated Settlement at FML Feet	Clay Liner Subgrade Elevation (FML-2.0 Ft) Feet	Groundwater Elevation[1] Feet	Groundwater Separation with Bottom of Clay Liner Feet
Cell 2I					
Sump	574	0.08	572	567	4.9
Midpoint	588	0.98	586	576	9.0
Upper	592	0.15	590	578	11.9
Cell 2J East					
Low Point	580	0.27	578	566	11.7
Midpoint	583	0.38	581	569	11.6
Upper	586	0.68	584	573	10.3
Cell 2J West					
Sump	582	0.25	580	570	9.8
Midpoint	584	0.17	582	575	6.8
Upper	586	0.44	584	575	8.6
Cell 2K East					
Sump	580	0.08	578	567	10.9
Midpoint	585	0.39	583	577	5.6
Upper	589	0.74	587	580	6.3
Cell 2K West					
Low Point	584	0.13	582	565	16.9
Midpoint	586	0.47	584	573	10.5
Upper	589	0.74	587	580	6.3
Cell 2M					
Low Point	584	0.16	582	565	16.8
Midpoint	585	0.23	583	569	13.8
Upper	588	0.19	586	569	16.8

1 Data from Sheet No. 4 of Design Hydrogeologic Report by David Garrett & Associates report dated August 2008

BEDROCK SEPARATION

CMS LANDFILL

CABARRUS COUNTY, NORTH CAROLINA

BLE Project No. J09-6452-01

April 2009

Reference Point	Geomembrane (FML) Elevation Feet	Estimated Settlement at FML Feet	Clay Liner Subgrade Elevation (FML-2.0 Ft) Feet	Bedrock Elevation[1] Feet	Bedrock Separation with Bottom of Clay Liner Feet
Cell 2I					
Sump	574	0.08	572	558	13.9
Midpoint	588	0.98	586	563	22.0
Upper	592	0.15	590	563	26.9
Cell 2J East					
Low Point	580	0.27	578	555	22.7
Midpoint	583	0.38	581	562	18.6
Upper	586	0.68	584	566	17.3
Cell 2J West					
Sump	582	0.25	580	548	31.8
Midpoint	584	0.17	582	555	26.8
Upper	586	0.44	584	562	21.6
Cell 2K East					
Sump	580	0.08	578	545	32.9
Midpoint	585	0.39	583	560	22.6
Upper	589	0.74	587	558	28.3
Cell 2K West					
Low Point	584	0.13	582	551	30.9
Midpoint	586	0.47	584	550	33.5
Upper	589	0.74	587	558	28.3
Cell 2M					
Low Point	584	0.16	582	540	41.8
Midpoint	585	0.23	583	560	22.8
Upper	588	0.19	586	550	35.8

1 Data from Sheet No. 6 of Design Hydrogeologic Report by David Garrett & Associates report dated August 2008

IX. CLOSURE & POST-CLOSURE CARE

CLOSURE / POST-CLOSURE PLAN

CHARLOTTE MOTOR SPEEDWAY LANDFILL V
PHASE 3 PERMIT TO CONSTRUCT
CITY OF CONCORD, NORTH CAROLINA

FOR

REPUBLIC SERVICES OF SOUTH CAROLINA, LLC

MAY 2009

NORTH CAROLINA PROFESSIONAL SEAL 16146 ENGINEER WILLIAM F. HODGES 4/30/09

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CLOSURE / POST-CLOSURE PLAN
CHARLOTTE MOTOR SPEEDWAY LANDFILL V – PHASE 3

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CLOSURE / POST-CLOSURE PLAN
CHARLOTTE MOTOR SPEEDWAY LANDFILL V – PHASE 3
CELLS 2I, 2J, 2K & 2M

SECTION 1.0 - CLOSURE PLAN

Sections .1627 and .1629 of the North Carolina Solid Waste Section of Environmental and Natural Resources (NC DENR), Solid Waste Regulations requires that a closure plan be included in the permit application that details the activities that will be performed to satisfy the requirements of Sections .1627 and .1629. All municipal solid waste landfill (MSWLF) owners/operators shall prepare a closure plan that describes the steps necessary to partially close a MSWLF at any point during its active life as well as the steps necessary to facilitate final closure. Partial closure refers to the closure of a landfill phase, while final closure is the closure of the entire landfill. In providing this information, the closure plan will assist Charlotte Motor Speedway Landfill V towards achieving the goals of closure implementation, which are: to prevent exposure of the disposed solid waste, minimize leachate generation, and control the emission of landfill gas in order to protect human health and the environment. Specifically, this closure plan establishes: design criteria for the final cover system, a description of the landfill gas collection system, a closure sequence and construction schedule, construction costs, and other important information relating to closure.

In accordance with Sections .1627 and .1629, the Charlotte Motor Speedway Landfill V shall notify the Solid Waste Section that this closure plan has been prepared and placed in the operating record prior to permit issuance. The closure plan shall be reviewed and updated if any changes occur at the facility that require a deviation from the approved closure plan.

1.1 FINAL COVER SYSTEM

The final cover system has been designed in accordance with Section .1627(c) to minimize storm water infiltration into the landfill and to resist erosive forces. The final cover system consists of an erosion layer, protective soil layer, drainage layer and a barrier layer. The multi-layered final cover system will provide permeability less than or equal to the permeability of the bottom liner system of the proposed landfill.

The final cover system will consist of the following layers (listed from top to bottom) for the landfill cap (areas with a proposed 5 percent slope):

- A 6-inch **Erosion (Vegetative Soil) Layer** consisting of soil capable of supporting native plant growth and designed to maintain vegetative growth over the landfill;
- An 18-inch **Protective Soil Layer** to prevent damage due to freezing or puncture to the Drainage and Barrier Layers;
- A **Drainage Layer** consisting of double-sided heat-bonded geocomposite. The geocomposite is designed to horizontally drain storm water that has percolated through the Erosion and Protective Soil Layers in order to prevent the build-up of water over the Barrier Layer (thus minimizing infiltration); and

- A **Barrier Layer** consisting of a 40-mil Textured Linear Low Density Polyethylene (LLDPE) geomembrane placed over an 18-inch layer of compacted soil with a maximum hydraulic conductivity of 1 x 10-5 cm/sec. The compacted soil layer (1 x 10-5 cm/sec) is not proposed for the side slopes.

Due to the highly elastic nature of the LLDPE membrane, the final cover system will accommodate the differential settlement anticipated to occur during the post-closure period. In accordance with Section .1627(c), the post settlement surface slopes will be no less than five (5) percent to promote positive drainage across the cover system surface and at a maximum slope not greater than thirty three (33) percent (pre-settlement) to facilitate construction and prevent erosion.

Based on an evaluation using the "HELP" model analysis, leachate generation and / or infiltration of rainfall into the waste mass is not affected when the barrier soil liner component is omitted on the side slopes. Therefore, the barrier soil layer will not be installed on the side slope areas for landfill closure. The 40-mil LLDPE liner will rest on top of a minimum 12-inch layer of foundation / fill soils placed above waste. The potential to accumulate hydraulic head on the liner system is not likely on the side slopes. Infiltration of rainfall through the protective cover will follow a preferred path through the geocomposite down slope to an edge drain.

1.2 ESTIMATE OF LARGEST PARTIAL CLOSURE

Section .1628.b requires that the closure plan include an estimate of the largest area of the MSWLF unit ever requiring a final cover at any time during the active life of the facility. The largest area of Charlotte Motor Speedway Landfill V requiring closure at any time will be 226.25 acres including the proposed Lateral Expansions.

1.3 ESTIMATE OF MAXIMUM WASTE INVENTORY ON SITE

The maximum amount of waste that is expected to be landfilled at the Charlotte Motor Speedway Landfill V under this plan consisting of Phase 2, 3, 4 and 5 was calculated using AutoCAD Release 2009 by comparing the top of operational/protective cover grades with the proposed final cover elevations. The total available airspace, tonnage and subsequent time frames are listed below. These reported quantities are subject to change based on potential future expansions beyond the scope of this submittal.

	AC	Gross Airspace (CY)	Final Cover (CY)	Net Airspace (CY)
Phase 2 Exp.	41.7	6,450,000	235,465	5,827,535
Phase 3				
Cell No. 2I	16.3	2,366,773	56,551	2,310,222
Cell No. 2J	15.9	2,449,935	52,991	2,396,944
Cell No. 2K	15.5	2,950,460	56,797	2,893,663
Cell No. 2M	6.7	1,327,912	59,209	1,268,703
Phase 4	6.8	3,275,000	169,400	3,105,600
Phase 5	19.0	3,836,000	112,930	3,723,070

Based on the available airspace listed above and the waste volumes listed in Section 2.2 of the Facility Plan, anticipated operating capacity of each Cell / Phase operating 285 days per year is listed below:

	Years *	Tons
Phase 2 Exp.	**2.7**	**4,639,800**
Phase 3		
Cell No. 2I	**1.1**	**1,848,178**
Cell No. 2J	**1.1**	**1,917,555**
Cell No. 2K	**1.3**	**2,314,930**
Cell No. 2M	**0.6**	**1,014,962**
Phase 4	**1.3**	**2,382,600**
Phase 5	**1.6**	**2,758,800**

*Life of each cell has been adjusted to reflect approximate volumes of daily and intermediate cover.

Therefore, based on current waste stream under contract, the anticipated remaining operating capacity for Charlotte Motor Speedway Landfill V would be on the order of 14 years disposing of approximately 16.9 million tons. Based on the uncertainty of municipalities and private haulers awarding contracts, the remaining operating capacity may extend up to 30 years.

1.4 LANDFILL CLOSURE SEQUENCE

The landfill facility will be developed such that one cell will be in operation while another cell is being constructed. Closure activities will be initiated in phases according to the filling sequence shown on the Phasing Plans in the Facility Plan and will be coordinated with the erosion and sedimentation control plan designed for the facility. Partial closure will occur after a landfill phase has reached the proposed closure grades indicated on the Plans. Partial closure will continue until all of the proposed phases are brought to final grade. At that time, final closure of the entire facility will begin. The steps for implementing the closure process are described in the following subsections. The procedure applies to both partial closure and final closure.

1.4.1 DETERMINATION OF CLOSURE AREA

Charlotte Motor Speedway Landfill V will determine the location and acreage of areas to be closed. Closure procedures should not be implemented until an adequate area of the landfill has reached final grade. An estimate of landfill area that has reached final grade should be determined periodically based on annual topographic surveys performed at the site.

1.4.2 NOTIFICATION OF INTENT TO CLOSE

In accordance with Section .1627(c)(4) prior to beginning closure of each MSWLF unit, Charlotte Motor Speedway Landfill V will notify the Solid Waste Section that a notice of intent to close the unit has been placed in the operating record.

1.4.3 DEVELOPMENT OF CLOSURE SCHEDULE

When an area has reached final grades, Charlotte Motor Speedway Landfill V shall initiate the closure process no later than 30 days after the final receipt of waste. This will be dependent upon inclement weather and seasonal encumbrances for proposed construction. However, if the area has not reached permitted final grades and there is reasonable likelihood that additional waste will be received, then closure activities must begin no later than one year after the most recent receipt of wastes. The Solid Waste Section may grant extensions beyond the one-year deadline for beginning closure if Charlotte Motor Speedway Landfill V demonstrates the area has additional capacity and the facility has implemented measures to protect human health and the environment.

Charlotte Motor Speedway Landfill V shall complete all closure activities of each MSWLF unit in accordance with the closure plan within one hundred eighty (180) days following the beginning of closure as specified in section .1627(c). Extensions of the closure period may be granted by the Solid Waste Section if Charlotte Motor Speedway Landfill V demonstrates that closure will, of necessity, take longer than one hundred eighty (180) days and the facility has implemented procedures to prevent threats to human health and the environment from the unclosed MSWLF unit.

1.4.4 FINAL COVER CONSTRUCTION

The final cover system at the Charlotte Motor Speedway Landfill V facility shall be constructed in accordance with the requirements of the CQA/CQC Plan, Technical Specifications, and Engineering Drawings, incorporated by reference as part of this Closure Plan.

1.4.5 CERTIFICATION OF CLOSURE CONSTRUCTION

In accordance with Section .1627(c)(7), following closure of each MSWLF unit, Charlotte Motor Speedway Landfill V shall notify the Solid Waste Section that a certification, signed by the project engineer, a North Carolina registered professional engineer, verifying that closure has been completed in accordance with the closure plan, has been placed in the operating record.

1.4.6 RECORDATION OF DEED

In accordance with Section .1627(c)(9), following closure of all MSWLF units, Charlotte Motor Speedway Landfill V shall record a notation on the deed to the landfill facility property, or some other instrument that is normally examined during title search, and notify the Solid Waste Section that the notation has been recorded and a copy has been placed in the operating record. The notation on the deed shall, in perpetuity, notify any potential purchaser of the property that the land has been used as a landfill facility and that its future use is restricted under Section .1627(c)(8), to the planned post-closure property uses presented in the post-closure plan. If all waste is removed from the facility,

Charlotte Motor Speedway Landfill V may request permission from the Solid Waste Section to remove the notation from the deed as specified in Section .1627(c)(9).

1.5 GAS RECOVERY SYSTEM

Charlotte Motor Speedway Landfill V currently utilizes a gas recovery system for the operating and non-active Cells at the Facility. The gas recovery facility operates by creating a vacuum through a network of collection pipes and gas extraction wells throughout areas of the landfill that have achieved final waste grades or will not receive waste for a substantial time period. This gas recovery system reduces the concentration and quantity of gases within the landfill to deter the migration of gases off-site. The collected gas is used as fuel for a turbine to generate electricity.

This gas recovery system reduces the uplift pressure for a composite liner system placed as a cap on the landfill Cells. The system is expanded to areas within the landfill as final grades are achieved. This system will expand to the Phase 2, Phase 3, Phase 4 and Phase 5 as final grades are achieved. Design of the gas extraction system is an on-going activity as technology and methodologies improve and change. The design and installation of future expansions of the gas extraction system shall meet or exceed the minimum requirements set forth by the Solid Waste Section in accordance with the approved NSPS GCCS Design Plan.

1.6 LEACHATE SURFACE IMPOUNDMENT

After leachate collection has ceased at the Charlotte Motor Speedway Landfill V facility, a closure plan for the leachate surface impoundment shall be submitted to the Solid Waste Section. Closure activities shall be dependent of investigative results of possible contamination underlying the surface impoundment. The leachate surface impoundment, all residues, contaminated system components including pretreatment equipment and contaminated soils (if applicable) shall be removed and disposed of properly or closed out in accordance with North Carolina Solid Waste Management Rule 15A NCAC 13B, Rule .1680. Closure activities shall be completed within 180 days following the termination of leachate collection operations.

If there is no evidence of potential contamination from within the surface impoundment footprint, the base liner system shall be perforated for drainage and the impoundment will be backfilled with clean soil.

1.7 FINANCIAL ASSURANCE

Financial assurance will be updated annually as portions of the landfill are closed and new Cells are activated. With the addition of the Phase 3 cells, the total acreage requiring closure at one time is now 226.25 acres. A copy of the updated Closure Cost Estimate is in Appendix 1 of this Plan.

In accordance with Section .1628, Charlotte Motor Speedway Landfill V may increase the closure cost estimate and the amount of financial assurance provided if changes to the closure plan or MSWLF unit conditions increase the maximum cost of closure at any time during the remaining active life. Charlotte Motor Speedway Landfill V may reduce the closure cost estimate and the amount of financial assurance provided under .1628 if the cost estimate exceeds the

maximum cost of closure at any time during the remaining life of the MSWLF unit. Charlotte Motor Speedway Landfill V shall notify the Solid Waste Section that the justification for the reduction of the closure cost estimate and the amount of financial assurance has been placed in the operating record.

In accordance with Section .1628, Charlotte Motor Speedway Landfill V shall establish financial assurance for closure of the MSWLF unit. The facility shall provide continuous coverage for closure until released from financial assurance requirements by demonstrating compliance with .1627(c).

SECION 2.0 - POST CLOSURE CARE PLAN

Sections .1627 and .1629 of the North Carolina Solid Waste Section of Environmental and Natural Resources (NC DENR), Solid Waste Regulations requires that all municipal solid waste landfill (MSWLF) owners/operators prepare a post-closure plan to be included in the final permit application that details the activities that will be performed to satisfy the requirements of Sections .1627 and .1629. The purpose of the plan is to provide the necessary information for preserving the integrity of the landfill facility during the post-closure period. This post-closure plan specifically addresses maintenance activities for the final cover, landfill gas collection and monitoring systems, leachate collection and conveyance systems, groundwater monitoring wells, and erosion and sedimentation control system to be installed at the Charlotte Motor Speedway Landfill V, Phase 2 and Phase 3. This plan also addresses certification and financial assurance requirements.

Post-closure care will begin immediately following final closure of the landfill and continue for a period of 30 years. The post-closure care period may be decreased from the minimum time period of 30 years specified in the regulations if Charlotte Motor Speedway Landfill V can demonstrate that the facility poses no threat to human health or the environment. However, the Solid Waste Section reserves the right to increase the post-closure care period if it is deemed necessary to protect human health and the environment.

2.1 MAINTENANCE AND MONITORING

Following final closure of each MSWLF unit, Charlotte Motor Speedway Landfill V shall conduct post-closure care for a minimum of thirty (30) years, except as provided under section .1627(d)(2). At a minimum, post-closure care shall consist of the activities as detailed below.

2.1.1 FINAL COVER SYSTEM

Inspection of the final cover system will take place quarterly. The inspection will consist of a field reconnaissance of the entire final cover system. Items of concern to be noted by the inspector include, but are not limited to: signs of erosion (ruts, sediment deposits, etc.), patches of distressed or dead vegetation, animal burrows, settlement and/or ponded water, upheaving, stained soil due to leachate seeps and/or flowing leachate, cracks in the cover, damaged gas wells and tree saplings (especially species with tap roots). Following each inspection, a summary report of the condition of the final cover and the items requiring repair or maintenance shall be recorded on an inspection form and filed in the

post-closure log book for the facility. Areas that require further attention should be photographed and delineated on a map of the facility and attached to the inspection report. Since post-closure inspection personnel will most likely change during the post-closure period, the post-closure log book should be kept in a standardized format as part of the operating record of the facility so that new inspection personnel may easily review the results of past post-closure inspections of the site.

Action should be taken immediately to address any items of concern identified during the inspection. Obvious repair items should be performed under the supervision of the post-closure maintenance manager. If an item of concern requires further investigation to determine a course of action, the Engineer responsible for closure design should be contacted for consultation.

Maintenance required for the final cover is minimal. The vegetative cover should be mowed at least once a year to suppress weed and brush growth. If vegetative cover is not adequate in any particular area, fertilizer should be applied and the area re-seeded in order to re-establish vegetation. Insecticides may be used to eliminate insect populations that are detrimental to the vegetation. Animal burrows and eroded or depressed areas should be filled in with compacted soil and reseeded.

2.1.2 LEACHATE COLLECTION SYSTEM

In accordance with Section .1627(d)(l)(B), post-closure maintenance shall include maintaining and operating the leachate collection system in accordance with the requirements in Section .1627(d)(l)(B), if applicable. The Solid Waste Section may allow the Charlotte Motor Speedway Landfill V to stop managing leachate if the facility demonstrates to the Solid Waste Section's satisfaction that leachate no longer poses a threat to human health and the environment.

Inspection of the accessible items of the leachate collection system (i.e. manholes, and pump stations) will be made on a quarterly basis. Inspection of the collection lines will be performed concurrent with the annual cleaning service.

The pump stations and flow meter vault (if applicable) shall be inspected each quarter by a qualified inspector who is knowledgeable in the construction and operation of pump stations and flow meters. The inspector is responsible for manually operating each pump to ensure that they are working properly. The high and low level alarms shall be checked at this time, and the overall condition of the wiring and support structures shall also be inspected. The wetwell (if any exists) shall be drained so that inspection of the walls and floor can be performed. The flow meter calibration shall be checked (and scheduled for recalibration as required) quarterly and flow meter measurements shall be recorded and placed in the post-closure logbook. A summary report of the condition of the pump stations and metering facilities shall be recorded in the post-closure log book, including photographs of any items of concern.

The manholes shall be inspected for damage on a quarterly basis. The protruding portion of each manhole should be checked for damage and the cap should be checked for proper operation.

All leachate collection and conveyance system piping will be pressure cleaned and flushed as needed to remove the build-up of biological growth and sediments that may impede the flow of leachate.

If problems with the leachate collection system are discovered, or abnormally high or low flows are recorded from the pump station, assessment and/or repairs shall begin immediately.

The pump stations wet well and control floats shall be flushed clean of grease and debris build-ups on an annual basis. Each pump shall be hoisted to the surface for a visual inspection every 12 to 14 months or in accordance with the manufacturer's specifications.

The pump control panel shall be fully inspected at the same time, to ensure proper alarm operations, reset functions, and normal operations performance. Run time readings shall be recorded for each pump.

2.1.3 GROUNDWATER MONITORING WELLS

Inspection of the groundwater monitoring wells will take place semi-annually during sampling events. The inspection will consist of verifying the condition of the monitoring wells to ensure that they are providing representative samples of the groundwater being collected. The inspector should note the following:

1) The total depth of the well should be recorded every time a water sample is collected or a water level reading is taken to determine if sediment has accumulated at the bottom. If sediment build-up has occurred, the sediment shall be removed by pumping or bailing.
2) If turbid samples are collected from a well, redevelopment of the well will be performed.
3) The aboveground protective casing shall be inspected for damage. The protective casing shall be of good structural integrity and free of any cracks or corrosion. The lockable cover and lock shall also be inspected at this time.
4) The surface seals shall be inspected for settling and cracking. If the seal is damaged in any way, the seal shall be replaced.
5) The well casing and cap shall be inspected. The casing and cap shall be of good structural integrity and free of any cracks or corrosion. Any debris shall be removed from around the cap to prevent it from entering the well.

The condition of the groundwater monitoring system shall be recorded on the inspection form and filed in the post-closure logbook following each sampling event. Monitoring of the groundwater wells shall be conducted as described in the groundwater monitoring plan.

2.1.4 LANDFILL GAS MONITORING AND CONTROLS

Inspection of the landfill gas monitoring and control system shall take place at least quarterly. The inspection shall consist of verifying the condition and operation of the gas extraction wells and monitoring probes. The full depth of all wells and monitoring probes shall be checked for blockage that may be caused by settlement or cracks in the casing. At least once a year, all wells and probes shall be tested with an air pump to ensure they are free-flowing. The summary of each inspection of the landfill gas monitoring and control system should be recorded in the post-closure log book along with photographs of any items of concern. Testing of the monitoring probes and on-site buildings shall be conducted as described in the Operations Plan.

If any wells or probes are determined to be inoperable, they should be flushed and pressure cleaned. If all attempts to repair a well or probe are unsuccessful, a replacement will be installed.

2.1.5 UNDERDRAIN MONITORING

Underdrain water quality monitoring for the underdrains will continue to be monitored after closure as required by the Solid Waste Section.

2.1.6 SURFACE WATER MONITORING

Surface water monitoring of the Rocky River shall continue after closure as required by the Solid Waste Section. Surface water monitoring and analytical testing will occur in concert with groundwater sampling and analysis. Storm water sampling in accordance with NPDES requirements for closed landfills shall also continue in accordance with NPDES General Permit.

2.2 INDIVIDUAL RESPONSIBLE FOR POST-CLOSURE MAINTENANCE

The Site Manager (currently Mr. Brad Green) of Charlotte Motor Speedway Landfill V will be responsible for operations and maintenance of the site during the post-closure period. The Site Manager can be reached at the following address:

Mr. Brad Green
General Manager
Republic Services of South Carolina, LLC
Charlotte Motor Speedway Landfill
5105 Morehead Road
Concord, NC 28027
(704) 782-2004

Over the course of closure and post-closure period, the individual serving as Site Manager will change. The Solid Waste Section shall be informed of the individual serving as the Site Manager for Charlotte Motor Speedway Landfill V as personnel changes occur.

2.3 PLANNED USE FOLLOWING CLOSURE

Post-closure use of the property shall not disturb the integrity of the final cover, liner, or any other components of the containment system, or the function of the monitoring systems. The Solid Waste Section may approve any disturbance of these systems if the owner or operator demonstrates that disturbance of the final cover, liner or other component of the containment system, including any removal of waste, will not increase the potential threat to human health or the environment.

There are no planned uses for the landfill site after closure. The property will continue to be owned and maintained by Republic Services of South Carolina, LLC, with public access prohibited. If at some later date, the Owner wishes to propose alternative end uses for the facility, this plan will be revised accordingly.

2.4 NOTIFICATION

Charlotte Motor Speedway Landfill V shall notify the Solid Waste Section that a post-closure plan has been prepared and placed in the operating record prior to permit issuance. The post-closure plan shall be updated if any changes occur at the facility that require a deviation from the approved post-closure plan.

2.5 CERTIFICATION OF POST-CLOSURE

Following completion of the post-closure care period for each MSWLF unit, Charlotte Motor Speedway Landfill V shall notify the Solid Waste Section that a certification, signed by an independent registered professional engineer, verifying that post-closure care has been completed in accordance with the post-closure plan, has been placed in the operating record.

2.6 FINANCIAL ASSURANCE

A detailed cost estimate for post-closure care is included in Appendix 1 of this Plan. This estimate has been placed in the operating record. The cost estimate is based on 30 years of post-closure care of the entire facility. Each year, the estimate will be adjusted for inflation and to reflect any changes to the post-closure plan.

APPENDIX

APPENDIX 1 COST ESTIMATE FOR CLOSURE / POST-CLOSURE

REPUBLIC SERVICES OF SOUTH CAROLINA, LLC
CHARLOTTE MOTOR SPEEDWAY LANDFILL V
CITY OF CONCORD, NORTH CAROLINA

CLOSURE AND POST-CLOSURE CARE COST ESTIMATE
CELLS 1A-1B, 2A THROUGH 2I, 2J, 2K & 2M

EXECUTIVE SUMMARY

ACTIVE AREA REQUIRING CLOSURE	*158.5* ACRES
ACTIVE AREA REQUIRING LFG SYSTEM CONSTRUCTION	*158.5* ACRES

CLOSURE COST ESTIMATE TOTAL	$ 2,615,879.00
POST-CLOSURE CARE COST ESTIMATE TOTAL	$ 2,730,000.00
CORRECTIVE ACTION TOTAL	$ 103,983.00
TOTAL ESTIMATE	$ 5,449,862.00

CHARLOTTE MOTOR SPEEDWAY LANDFILL V
CITY OF CONCORD, NORTH CAROLINA

CLOSURE CARE COST ESTIMATE

GENERAL

Largest Area: Cells No. 2I, 2J, 2K, & 2M (54.25 acres) = 2,363,130 s.f.

CLOSURE CARE COST ESTIMATE

1	6" Topsoil													
	2,363,130	s.f.	x	0.5	ft.	÷	27	ft^3/cy	=	43,762	c.y.	@	$2.60	=	$113,781.20
	(soil cost $0.50/ c.y. - Haul Cost $1.80 / c.y. - Placement Cost $0.30 / c.y.)														
2	18" Cover Soil													
	2,363,130	s.f.	x	1.5	ft.	÷	27	ft^3/cy	=	131,285	c.y.	@	$2.60	=	$341,341.00
	(soil cost $0.25 / c.y. - Haul Cost $1.00 / c.y. - Placement Cost $0.30 / c.y.)														
3	18" Infiltration Layer (1×10^{-5} cm/sec)													
	339,690	s.f.	x	1.5	ft.	÷	27	ft^3/cy	=	18,872	c.y.	@	$3.55	=	$66,995.60
	(soil cost $0.75 / c.y. - Haul Cost $2.00 / c.y. - Placement Cost $0.80 / c.y.)														
4	Drainage Layer (Geofabric Geonet)													
		Material								2,363,130	s.f.	@	$0.34	=	$803,464.20
		Labor								2,363,130	s.f.	@	$0.06	=	$141,787.80
5	FML													
		Material & Installation								2,363,130	s.f.	@	$0.34	=	$803,464.20
6	Seed													
			55	ac	x	70	#/ac		=	3,850	#	@	$3.50	=	$13,475.00
7	Fertilizer													
			0.75	tons/ac	x	55	ac		=	41	tons	@	$200.00	=	$8,250.00
8	Lime													
			1	ton/ac	x	55	ac		=	55	tons	@	$40.00	=	$2,200.00
9	Mulch													
										55	ac	@	$100.00	=	$5,500.00
10	Labor for Seeding, Fertilizing, Liming & Mulching													
										55	ac	@	$200.00	=	$11,000.00
11	Silt Fence													
										2,000	l.f.	@	$3.00	=	$6,000.00
12	Final Disposal of Waste & Cleanup													
										225	tons	@	$30.00	=	$6,750.00
13	Downdrain Construction													
										3,958	l.f.	@	$15.00	=	$59,370.00
14	Additional Sediment and Erosion Control Construction													
										1	L.S.	@	$2,000.00	=	$2,000.00
15	Sediment Basin Cleanout													
										5,000	c.y.	@	$2.50	=	$12,500.00
16	Leachate Tank, Containment System & Pumping Station Alarm System													
										1	L.S.	@	$4,000.00	=	$4,000.00
17	Waste Limit Survey													
										1	L.S.	@	$4,000.00	=	$4,000.00
18	Engineering and Closure Certification													
										70	ac	@	$3,000.00	=	$210,000.00
													TOTAL CLOSURE COST		**$2,615,879.00**

CHARLOTTE MOTOR SPEEDWAY LANDFILL V
CITY OF CONCORD, NORTH CAROLINA
POST-CLOSURE CARE COST ESTIMATE

1	Water Monitoring & Statisitcs									
	(Includes Appendix I sampling, analysis & reporting for 2 events per year.)									
	Groundwater	43	wells	@	1	event/yr	@	$1,200.00	=	$51,600.00
	Surface Water	4	locations	@	1	event/yr	@	$800.00	=	$3,200.00
2	Methane Gas Monitoring									
					4	events/yr	@	$500.00	=	$2,000.00
	Sediment & Erosion Control,									
3	Including Inspections, Repairs to Cap, Slope & Vegetation									
					1	L.S.	@	$5,500.00	=	$5,500.00
4	Sediment Basin Cleanout									
					1,000	C.Y.	@	$3.00	=	$3,000.00
5	Leachate Collection Treatment & Analysis (Average over 30 years)									
					1	L.S.	@	$18,000.00	=	$18,000.00
6	Alarm System Monitoring									
					1	L.S.	@	$500.00	=	$500.00
7	Engineering Inspections									
					4	yr	@	$1,000.00	=	$4,000.00
8	Air Emissions Testing									
					1	yr	@	$2,000.00	=	$2,000.00
	ANNUAL POST-CLOSURE CARE COST									**$89,800.00**
9	Leachate System Decommissioning (one-time cost)									
					2	Ea.	@	$18,000.00	=	$36,000.00
	30 Year Post-Closure Care Cost									**$2,730,000.00**

CORRECTIVE ACTION
REMEDIATION COST ESTIMATE
CLOSURE/POST-CLOSURE PLAN
CMS LANDFILL V
CITY OF CONCORD, NORTH CAROLINA

ASSUMPTION: Leachate break out on a side slope

Cubic Yards of contamintated soil:	300 CY
No. of Assessment Monitoring Wells to be added:	2
No. of Monitoring Events:	2
No. of Occurances (assumed):	3

1	WELL INSTALLATION					
	2	wells	@	$2,575.00	=	$5,150.00
2	EXCAVATION OF CONTAMINATED SOIL WITH ON-SITE PLACEMENT					
	300	CY	@	$3.12	=	$936.00
3	REPLACEMENT OF EXCAVATED SOIL (BACKFILL AND COMPACT)					
	300	CY	@	$3.55	=	$1,065.00
4	ENGINEERING / DOCUMENTATION OF REPAIRS					
			Lump Sum		=	$5,000.00
5	GEOSYNTHETIC CONTRACTOR					
			Mobilization and Repair of Liner			$15,450.00
6	GROUNDWATER SAMPLING					
	2	events	@	$1,030.00	=	$2,060.00
7	GROUNDWATER ASSESSMENT REPORT/STATISTICAL ANALYSIS					
			Lump Sum		=	$5,000.00
			SUBTOTAL PER OCCURANCE			**$34,661.00**
			COST TO MANAGE 3 OCCURANCES IN 30 YEARS			**$103,983.00**

X. ENGINEERING PLANS

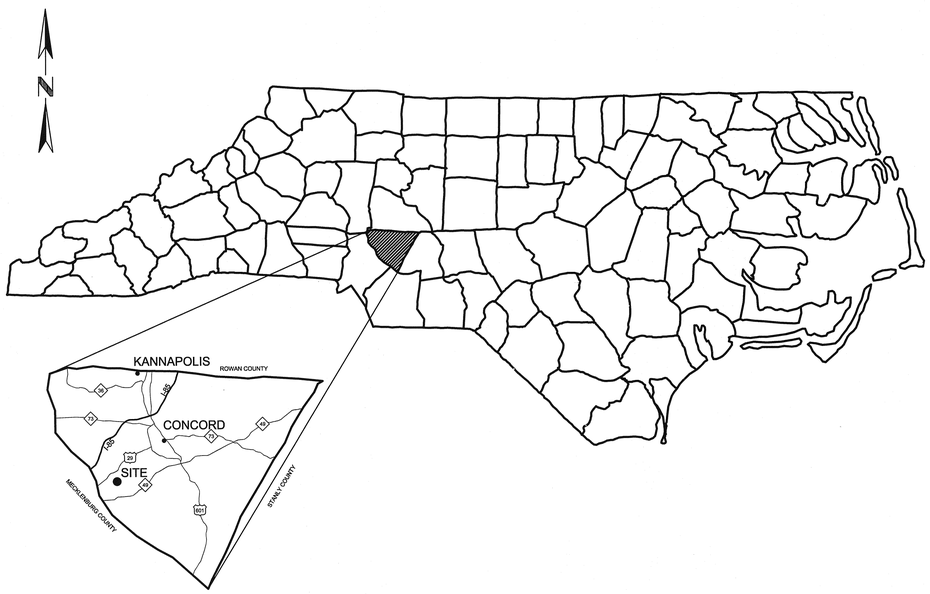
PHASE 3 ENGINEERING PLANS
CHARLOTTE MOTOR SPEEDWAY LANDFILL V

FOR

REPUBLIC SERVICES OF SOUTH CAROLINA, LLC

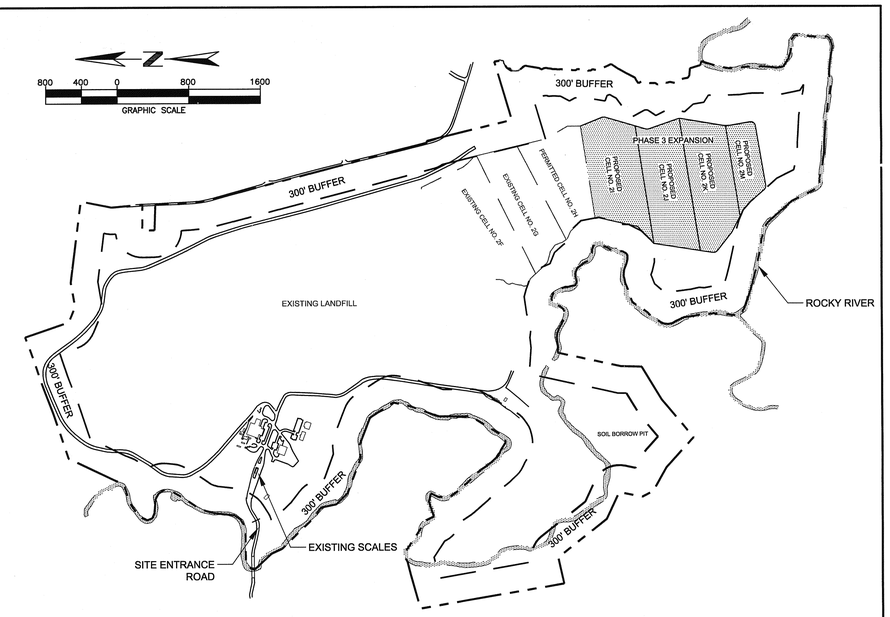
CABARRUS COUNTY, NORTH CAROLINA

APRIL, 2009



CABARRUS COUNTY, NORTH CAROLINA

N.T.S



CHARLOTTE MOTOR SPEEDWAY LANDFILL V
SITE PLAN

SCALE: 1" = 800'

REVISION HISTORY

DATE	SHEET NO.

NORTH CAROLINA PROFESSIONAL SEAL 32249 ENGINEER K. MATTHEW CHEEK 4/30/09

HODGES, HARBIN, NEWBERRY
& TRIBBLE, INC.
NC Corp. License No. C-0813
484 MULBERRY STREET, SUITE 265 - MACON, GEORGIA 31201
P.O. BOX 974 - MACON, GEORGIA 31202
(478) 743-7175

NORTH CAROLINA PROFESSIONAL SEAL 16148 ENGINEER WILLIAM F. HODGES 4/30/09

OWNER AND OPERATOR

REPUBLIC SERVICES OF SOUTH CAROLINA, LLC
5105 MOREHEAD ROAD
CONCORD, NC 28027
PHONE: (704) 782-2004

CMS V-P3-TS
4-30-09

EXISTING

- PROPERTY LINE
- UNDISTURBED PROPERTY BUFFER
- STREAM AND WETLAND BUFFER
- EDGE OF CELL
- 2' CONTOUR — 102
- 2' CONTOUR (DASHED)
- 10' CONTOUR — 100
- 10' CONTOUR (DASHED)
- UNPAVED ROAD
- PAVED ROAD
- STORM DRAINAGE PIPE
- MANHOLE
- FLOODPLAIN
- JURISDICTIONAL WETLAND
- HEADWALL
- OVERFLOW STRUCTURE
- BUILDING
- TREE LINE
- PIEZOMETER — PZ-1
- GROUNDWATER MONITORING WELL — MW-19
- METHANE MONITORING PROBE — MMW-16
- METHANE MONITORING BAR HOLE PUNCH — MM-10
- SURFACE WATER MONITORING POINT — SW-3
- BENCHMARK
- OUTLET PROTECTION
- SANITARY SEWER — SN — SN — SN

PROPOSED

- EDGE OF CELL
- 2' CONTOUR — 102
- 10' CONTOUR — 100
- SPOT ELEVATION — 100.50
- STORM DRAINAGE PIPE
- HEADWALL
- OVERFLOW STRUCTURE
- SOLID LEACHATE PIPE — L — L — L
- PERFORATED LEACHATE PIPE — L — L — L — L — L
- LEACHATE CLEAN OUT — LCO
- LEACHATE SUMP
- DITCH CENTERLINE / SIDESLOPE BERM
- DOWNDRAIN PIPE AND RISER — 1 INLET EL. 500 — 2 INLET EL. 480
- SINGLE ROW SILT FENCE — X
- DOUBLE ROW SILT FENCE — XX
- OUTLET PROTECTION
- SEDIMENT TRAP

INDEX TO DRAWINGS

SHEET NO.	DESCRIPTION
-	TITLE SHEET
1	INDEX TO DRAWINGS AND LEGEND
2	BOUNDARY SURVEY
3	EXISTING TOPOGRAPHIC CONDITIONS
4	TOP OF SOIL LINER/INFRASTRUCTURE GRADING PLAN
5	LEACHATE COLLECTION PLAN
6	FINAL GRADING PLAN
7	FINAL DRAINAGE PLAN
8	EROSION CONTROL PLAN
9	LEACHATE COLLECTION LINE PROFILES - CELLS NO. 2I & 2J
10	LEACHATE COLLECTION LINE PROFILES - CELLS NO. 2K & 2M
11	LANDFILL CROSS SECTIONS A & B
12	SEQUENCE OF FILL - CELL NO. 2I
13	SEQUENCE OF FILL - CELL NO. 2J
14	SEQUENCE OF FILL - CELL NO. 2K
15	SEQUENCE OF FILL - CELL NO. 2M
16	SEQUENCE OF FILL - FINAL GRADING PLAN
17-20	MISCELLANEOUS DETAILS

NORTH CAROLINA PROFESSIONAL SEAL 32249 ENGINEER K. MATTHEW CHEEK 9/30/09

NORTH CAROLINA PROFESSIONAL SEAL 16746 ENGINEER WILLIAM F. HODGES

INDEX TO DRAWINGS AND LEGEND

PHASE 3 ENGINEERING PLANS
CHARLOTTE MOTOR SPEEDWAY LANDFILL V
FOR
REPUBLIC SERVICES OF SOUTH CAROLINA, LLC
CABARRUS COUNTY, NORTH CAROLINA

HODGES, HARBIN, NEWBERRY & TRIBBLE, INC.
CONSULTING ENGINEERS
(478) 743-7175
(478) 743-1703(FAX)
NC Corp. License No. C-0813
484 MULBERRY ST. - STE. 265
MACON, GEORGIA 31201

PROJ. NO.	6703-351-01	DWG. CMS_V-P3-NT	EDIT 4-30-09
SCALE	NOT TO SCALE	SHEET 1 OF 20	
DATE	APRIL, 2009		

COMPILED PLAT FOR :

BFI WASTE SYSTEMS OF NORTH AMERICA, INC.

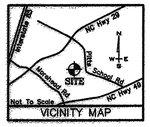
Originally Four Tracts of the CMS Development Corporation Property along Rocky River and Pitts School Road (Deed Book 618 Page 204)
And a Portion of the Evelyn H. Furr Property located along the West side of Loop Run (Deed Book 4328 Page 353)
In the City of Concord, Township No. 2, Cabarrus County, North Carolina
For further reference see Deed Book 2218 Page 291 for Articles of Merger; Deed Book 786 Page 91 for Solid Waste Permit No. 13-04 dated April 2, 1991; and Deed Book 3619 Page 150 for Municipal Solid Waste Landfill Facility Permit No. 13-04 dated January 16, 2002.
This Plat compiled by Thomas J. Fields, PLS-2906, in December 2009

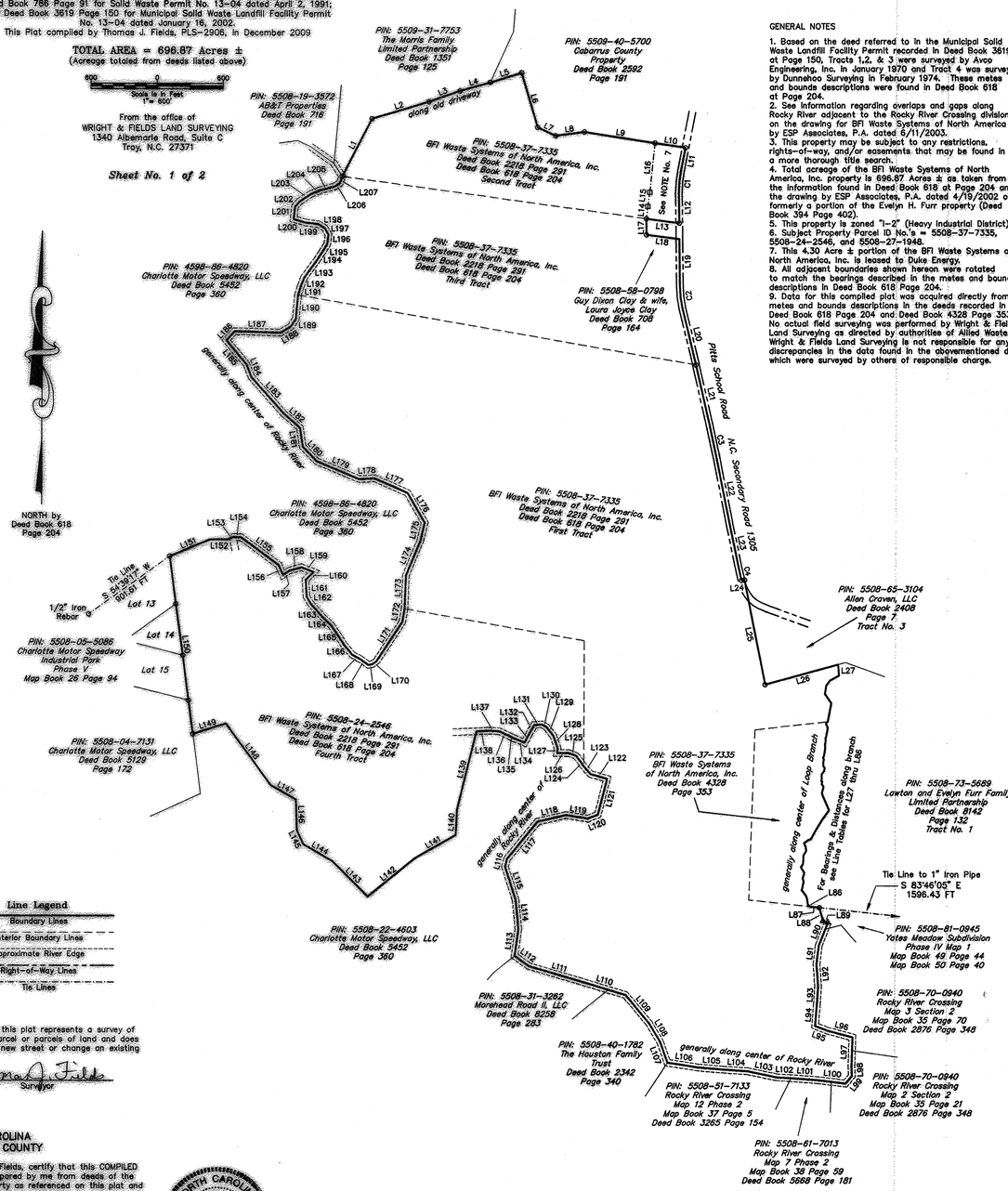
TOTAL AREA = 696.87 Acres ±
(Acreage totaled from deeds listed above)

600 0 600
Scale is in Feet
1" = 600'

From the office of
WRIGHT & FIELDS LAND SURVEYING
1340 Albemarle Road, Suite C
Troy, N.C. 27371

Sheet No. 1 of 2





Line Legend

- Boundary Lines
- Interior Boundary Lines
- Approximate River Edge
- Right-of-Way Lines
- Tie Lines

I certify that this plat represents a survey of an existing parcel or parcels of land and does not create a new street or change an existing street.

Thomas J. Fields
Surveyor

NORTH CAROLINA
CABARRUS COUNTY

I, Thomas J. Fields, certify that this COMPILED PLAT was prepared by me from deeds of the subject property as referenced on this plat and is in all respects correct to the best of my knowledge and belief. The ratio of precision for this drawing is inadjustable due to each tract being surveyed by different surveyors and at different dates as noted on this plat. This plat is prepared according to G.S. 47-30 as amended. Witness my original signature and official stamp this the 22nd day of December.

Thomas J. Fields
SURVEYOR PLS-2906

NORTH CAROLINA PROFESSIONAL SEAL L-2906 LAND SURVEYOR THOMAS JEFFREY FIELDS

Symbol Legend

- o ..... denotes Iron Rods, Iron Pipes, Iron Rebars, spikes, etc.
- ♣ ..... denotes various trees located as property corners.
- ▣ ..... denotes concrete monuments.

I certify that the plat shown hereon is not within the Watershed Protection District or complies with the Watershed Protection District for Cabarrus County and is approved for recordation in the office of the Register of Deeds for Cabarrus County, North Carolina.

Date — Watershed Administrator
Cabarrus Co., N.C.

CABARRUS COUNTY, NORTH CAROLINA

Filed for registration on the_____day of
_____ at_____o'clock_____M,
and registered in Book No._____Page_____.

Register of Deeds
or Deputy

GENERAL NOTES

1. Based on the deed referred to in the Municipal Solid Waste Landfill Facility Permit recorded in Deed Book 3619 at Page 150, Tracts 1,2, & 3 were surveyed by Avco Engineering, Inc. in January 1970 and Tract 4 was surveyed by Dunnehoo Surveying in February 1974. These metes and bounds descriptions were found in Deed Book 618 at Page 204.
2. See information regarding overlaps and gaps along Rocky River adjacent to the Rocky River Crossing division on the drawing for BFI Waste Systems of North America by ESP Associates, P.A. dated 6/11/2003.
3. This property may be subject to any restrictions, rights-of-way, and/or easements that may be found in a more thorough title search.
4. Total acreage of the BFI Waste Systems of North America, Inc. property is 696.87 Acres ± as taken from the information found in Deed Book 618 at Page 204 and the drawing by ESP Associates, P.A. dated 4/19/2002 of formerly a portion of the Evelyn H. Furr property (Deed Book 394 Page 402).
5. This property is zoned "I-2" (Heavy Industrial District).
6. Subject Property Parcel ID No.'s = 5508-37-7335, 5509-24-2546, and 5508-27-1948.
7. This 4.30 Acre ± portion of the BFI Waste Systems of North America, Inc. is leased to Duke Energy.
8. All adjacent boundaries shown hereon were rotated to match the bearings described in the metes and bounds descriptions in Deed Book 618 Page 204.
9. Data for this compiled plat was acquired directly from metes and bounds descriptions in the deeds recorded in Deed Book 618 Page 204 and Deed Book 4328 Page 353. No actual field surveying was performed by Wright & Fields Land Surveying as directed by authorities of Allied Waste, Inc. Wright & Fields Land Surveying is not responsible for any discrepancies in the data found in the abovementioned deeds which were surveyed by others of responsible charge.

State of North Carolina
County of Cabarrus

I, _____, Review Officer of Cabarrus County, certify that the map or plat to which this certification is affixed, meets all statutory requirements for recording.

Date — Review Officer

Job No. 2009-178

DATA SHEET FOR :

BFI WASTE SYSTEMS OF NORTH AMERICA, INC.

Line and Curve Tables for the perimeter of the property along Rocky River and Pitts School Road
In the City of Concord, Township No. 2, Cabarrus County, North Carolina
This Plat compiled by Thomas J. Fields, PLS-2906, in December 2009

TOTAL AREA = 696.87 Acres ±
(Acreage totaled from deeds listed above)

From the office of
WRIGHT & FIELDS LAND SURVEYING
1340 Albemarle Road, Suite C
Troy, N.C. 27371

Sheet No. 2 of 2

LINE TABLE		
LINE	BEARING	DISTANCE
L1	N 27°28'09" E	587.90 FT
L2	N 73°24'08" E	539.11 FT
L3	N 70°53'23" E	299.90 FT
L4	N 74°18'31" E	285.47 FT
L5	N 72°54'38" E	297.83 FT
L6	S 16°28'40" E	512.67 FT
L7	S 65°23'19" E	181.20 FT
L8	N 82°20'56" E	263.00 FT
L9	S 81°09'30" E	648.53 FT
L10	S 81°09'30" E	279.99 FT
L11	S 10°52'30" W	218.08 FT
L12	S 00°35'00" E	270.44 FT
L13	N 82°12'35" W	302.40 FT
L14	S 07°17'06" W	111.49 FT
L15	S 07°54'43" W	129.26 FT
L16	S 06°02'45" W	448.69 FT
L17	S 00°35'00" E	145.71 FT
L18	S 82°12'35" E	302.40 FT
L19	S 00°35'00" E	426.48 FT
L20	S 13°43'00" E	524.83 FT
L21	S 12°56'30" E	570.11 FT
L22	S 11°25'30" E	580.36 FT
L23	S 11°50'00" E	417.37 FT
L24	N 85°40'43" E	28.14 FT
L25	S 11°21'37" E	961.50 FT
L26	N 74°46'04" E	686.36 FT
L27	S 04°55'17" E	100.69 FT
L28	S 61°43'30" W	93.86 FT
L29	S 36°27'00" W	56.98 FT
L30	S 09°18'34" W	76.44 FT
L31	S 35°39'57" E	101.93 FT
L32	S 11°23'44" W	170.12 FT
L33	S 54°51'06" W	16.16 FT
L34	S 04°18'13" E	20.03 FT
L35	S 42°26'31" E	7.00 FT
L36	S 19°56'16" E	20.65 FT
L37	S 03°21'41" W	21.23 FT
L38	S 14°03'45" W	28.21 FT
L39	S 06°37'52" W	7.21 FT
L40	S 06°37'52" W	20.56 FT
L41	S 23°55'37" W	15.62 FT
L42	S 01°20'56" E	16.88 FT
L43	S 01°19'46" E	15.30 FT
L44	S 12°51'56" W	18.67 FT
L45	S 06°35'04" W	14.84 FT
L46	S 03°54'56" E	27.10 FT
L47	S 06°55'06" E	32.80 FT
L48	S 11°00'37" W	30.00 FT
L49	S 09°00'33" W	17.73 FT
L50	S 29°53'02" W	13.05 FT
L51	S 26°18'49" E	17.50 FT
L52	S 09°19'47" W	30.86 FT
L53	S 00°11'49" E	29.19 FT
L54	S 37°19'47" E	21.41 FT
L55	S 14°20'40" W	27.46 FT
L56	S 36°29'17" W	33.51 FT
L57	S 02°08'01" W	21.87 FT
L58	S 03°29'32" E	23.59 FT
L59	S 11°13'07" W	19.20 FT
L60	S 65°58'43" E	8.79 FT
L61	S 08°36'11" W	24.45 FT
L62	S 36°07'49" E	26.32 FT
L63	S 13°22'11" W	56.67 FT
L64	S 10°29'30" E	23.14 FT
L65	S 23°48'55" E	75.06 FT
L66	S 23°19'47" E	70.70 FT
L67	S 35°07'22" W	102.93 FT
L68	S 31°23'51" W	107.84 FT
L69	S 29°12'54" W	95.60 FT

LINE TABLE		
LINE	BEARING	DISTANCE
L70	S 66°17'11" W	33.93 FT
L71	S 55°25'24" W	40.08 FT
L72	S 25°40'51" E	35.19 FT
L73	S 08°41'18" E	36.87 FT
L74	S 30°59'22" W	48.85 FT
L75	S 01°39'20" W	77.74 FT
L76	S 35°28'13" W	32.68 FT
L77	S 24°09'59" E	19.56 FT
L78	S 33°27'50" E	39.83 FT
L79	S 14°51'31" W	52.58 FT
L80	S 14°04'26" E	34.38 FT
L81	S 12°15'21" W	77.44 FT
L82	S 39°14'49" E	57.64 FT
L83	S 19°30'55" E	31.11 FT
L84	S 09°19'39" E	28.02 FT
L85	S 07°16'19" E	27.97 FT
L86	S 54°32'59" E	31.20 FT
L87	S 83°46'05" E	80.83 FT
L88	S 15°32'21" E	122.89 FT
L89	S 72°07'58" E	46.22 FT
L90	S 21°20'24" W	225.05 FT
L91	S 06°26'09" W	169.64 FT
L92	S 04°18'03" E	199.02 FT
L93	S 03°26'47" W	158.70 FT
L94	S 04°25'09" W	201.09 FT
L95	S 68°43'22" E	117.21 FT
L96	S 75°12'15" E	237.09 FT
L97	S 01°36'15" W	257.42 FT
L98	S 02°28'49" E	87.72 FT
L99	S 39°15'24" W	89.64 FT
L100	N 83°16'14" W	261.60 FT
L101	N 85°35'20" W	241.42 FT
L102	N 87°20'12" W	123.94 FT
L103	N 78°22'53" W	272.67 FT
L104	N 86°27'05" W	219.90 FT
L105	N 85°05'15" W	234.26 FT
L106	N 81°14'28" W	277.35 FT
L107	N 19°58'58" W	196.75 FT
L108	N 30°59'27" W	196.43 FT
L109	N 40°07'36" W	336.28 FT
L110	N 73°24'33" W	436.25 FT
L111	N 73°57'49" W	476.11 FT
L112	N 54°28'09" W	163.57 FT
L113	N 07°49'59" E	247.07 FT
L114	N 05°47'56" W	262.75 FT
L115	N 17°56'42" W	314.85 FT
L116	N 14°12'06" E	70.80 FT
L117	N 39°32'30" E	436.11 FT
L118	N 76°49'56" E	263.47 FT
L119	S 80°57'52" E	202.23 FT
L120	N 68°07'10" E	97.11 FT
L121	N 14°15'44" E	335.00 FT
L122	N 74°26'57" W	154.51 FT
L123	N 41°46'38" W	108.32 FT
L124	N 31°12'05" W	27.45 FT
L125	N 69°48'20" W	71.02 FT
L126	N 89°45'17" W	105.78 FT
L127	N 07°24'20" E	43.23 FT
L128	N 19°14'57" W	118.19 FT
L129	N 38°30'26" W	102.61 FT
L130	N 60°52'24" W	48.03 FT
L131	S 86°28'05" W	69.67 FT
L132	S 29°24'10" W	103.71 FT
L133	S 27°28'12" W	80.06 FT
L134	N 67°55'19" W	103.75 FT
L135	N 63°27'49" W	39.42 FT
L136	N 64°46'50" W	109.66 FT
L137	N 88°26'07" W	100.01 FT
L138	S 87°46'01" W	107.21 FT

LINE TABLE		
LINE	BEARING	DISTANCE
L139	S 13°52'55" W	725.77 FT
L140	S 02°58'39" W	231.15 FT
L141	S 60°27'22" W	426.73 FT
L142	S 51°00'44" W	550.15 FT
L143	N 45°02'27" W	449.97 FT
L144	N 59°58'34" W	304.67 FT
L145	N 25°25'14" W	140.22 FT
L146	N 01°35'00" W	276.37 FT
L147	N 60°42'41" W	262.05 FT
L148	N 36°31'04" W	692.95 FT
L149	S 72°11'25" W	313.58 FT
L150	N 07°31'13" W	1619.28 FT
L151	N 67°41'20" E	396.00 FT
L152	N 88°59'24" E	170.20 FT
L153	N 61°56'13" E	42.77 FT
L154	S 87°57'35" E	72.75 FT
L155	S 53°50'40" E	422.28 FT
L156	S 23°53'32" E	97.63 FT
L157	N 55°19'53" E	69.35 FT
L158	N 74°55'27" E	114.96 FT
L159	S 69°14'32" E	118.05 FT
L160	S 45°45'17" W	100.94 FT
L161	S 03°53'26" E	152.69 FT
L162	S 30°15'15" E	73.67 FT
L163	S 42°24'49" E	175.35 FT
L164	S 46°00'32" E	99.99 FT
L165	S 32°57'42" E	203.96 FT
L166	S 40°14'26" E	117.18 FT
L167	S 61°52'33" E	77.41 FT
L168	S 54°52'46" E	93.76 FT
L169	N 79°47'19" E	35.09 FT
L170	N 55°26'53" E	46.09 FT
L171	N 33°40'04" E	425.70 FT
L172	N 10°10'28" E	121.53 FT
L173	N 02°08'48" E	301.67 FT
L174	N 22°39'00" E	337.95 FT
L175	N 13°22'12" E	166.38 FT
L176	N 30°09'00" W	309.03 FT
L177	N 66°14'43" W	325.99 FT
L178	S 87°12'00" W	142.27 FT
L179	N 67°11'44" W	418.59 FT
L180	N 43°49'47" W	180.69 FT
L181	N 08°38'24" W	171.71 FT
L182	N 49°11'39" W	193.49 FT
L183	N 41°42'37" W	445.78 FT
L184	N 22°04'03" W	125.25 FT
L185	N 40°06'20" W	279.56 FT
L186	N 43°19'36" E	109.16 FT
L187	S 88°22'53" E	415.00 FT
L188	N 59°30'28" E	107.69 FT
L189	N 33°44'51" E	82.77 FT
L190	N 04°51'18" E	216.91 FT
L191	N 16°52'02" E	80.26 FT
L192	N 21°26'29" E	86.11 FT
L193	N 36°11'20" E	197.01 FT
L194	N 33°40'33" E	77.44 FT
L195	N 32°30'16" E	93.78 FT
L196	N 07°16'08" E	88.98 FT
L197	N 29°53'50" W	65.87 FT
L198	N 57°36'10" W	67.85 FT
L199	N 83°22'43" W	113.22 FT
L200	N 74°00'59" W	117.14 FT
L201	N 06°18'53" E	112.46 FT
L202	N 41°23'37" E	63.70 FT
L203	N 56°20'44" E	123.21 FT
L204	N 68°14'57" E	83.57 FT
L205	N 74°38'15" E	139.98 FT
L206	N 58°07'28" E	55.02 FT
L207	N 19°29'02" E	66.25 FT

CURVE TABLE				
CURVE	CHORD BEARING	CHORD	RADIUS	ARC
C1	S 05°08'45" W	199.00 FT	996.74 FT	199.33 FT
C2	S 07°09'00" E	198.68 FT	868.70 FT	199.12 FT
C3	S 12°11'00" E	299.97 FT	11332.57 FT	299.98 FT
C4	S 12°59'01" E	119.04 FT	2964.64 FT	119.05 FT

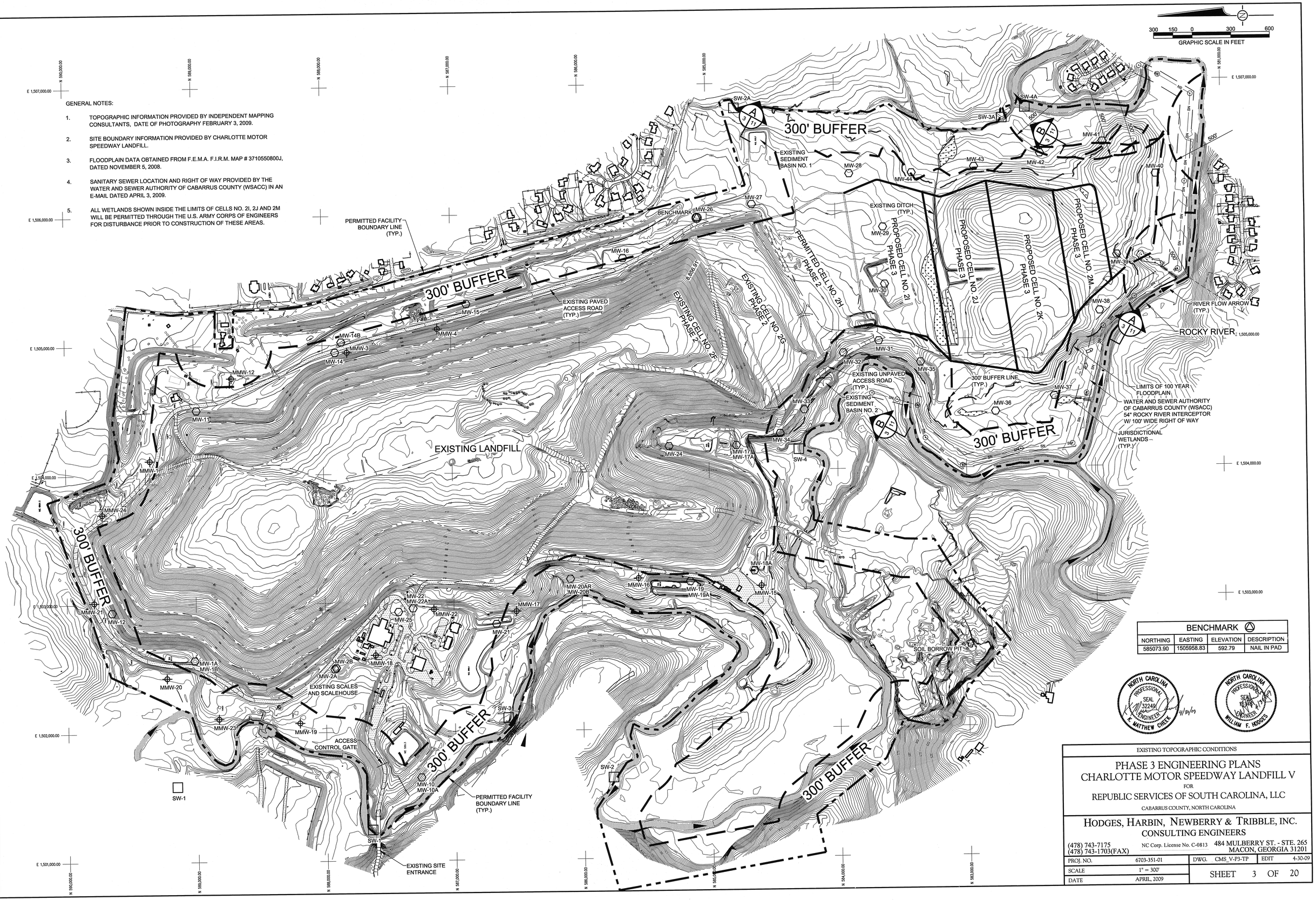
NORTH CAROLINA PROFESSIONAL SEAL L-2906 LAND SURVEYOR THOMAS JEFFREY FIELDS

Thomas J. Fields

Job No. 2009-178

GENERAL NOTES:

1. TOPOGRAPHIC INFORMATION PROVIDED BY INDEPENDENT MAPPING CONSULTANTS, DATE OF PHOTOGRAPHY FEBRUARY 3, 2009.
2. SITE BOUNDARY INFORMATION PROVIDED BY CHARLOTTE MOTOR SPEEDWAY LANDFILL.
3. FLOODPLAIN DATA OBTAINED FROM F.E.M.A. F.I.R.M. MAP # 3710550800J, DATED NOVEMBER 5, 2008.
4. SANITARY SEWER LOCATION AND RIGHT OF WAY PROVIDED BY THE WATER AND SEWER AUTHORITY OF CABARRUS COUNTY (WSACC) IN AN E-MAIL DATED APRIL 3, 2009.
5. ALL WETLANDS SHOWN INSIDE THE LIMITS OF CELLS NO. 2I, 2J AND 2M WILL BE PERMITTED THROUGH THE U.S. ARMY CORPS OF ENGINEERS FOR DISTURBANCE PRIOR TO CONSTRUCTION OF THESE AREAS.



BENCHMARK			
NORTHING	EASTING	ELEVATION	DESCRIPTION
585073.90	1505958.83	592.79	NAIL IN PAD

NORTH CAROLINA PROFESSIONAL SEAL 32249 ENGINEER K. MATTHEW CHEEK 4/30/09

NORTH CAROLINA PROFESSIONAL SEAL 16346 ENGINEER WILLIAM F. HODGES

EXISTING TOPOGRAPHIC CONDITIONS

PHASE 3 ENGINEERING PLANS
CHARLOTTE MOTOR SPEEDWAY LANDFILL V

FOR

REPUBLIC SERVICES OF SOUTH CAROLINA, LLC

CABARRUS COUNTY, NORTH CAROLINA

HODGES, HARBIN, NEWBERRY & TRIBBLE, INC.
CONSULTING ENGINEERS

(478) 743-7175
(478) 743-1703(FAX)
NC Corp. License No. C-0813
484 MULBERRY ST. - STE. 265
MACON, GEORGIA 31201

PROJ. NO.	6703-351-01	DWG. CMS_V-P3-TP	EDIT 4-30-09
SCALE	1" = 300'	SHEET 3 OF 20	
DATE	APRIL, 2009		

GENERAL NOTES:

1. TOPOGRAPHIC INFORMATION PROVIDED BY INDEPENDENT MAPPING CONSULTANTS, DATE OF PHOTOGRAPHY FEBRUARY 3, 2009.
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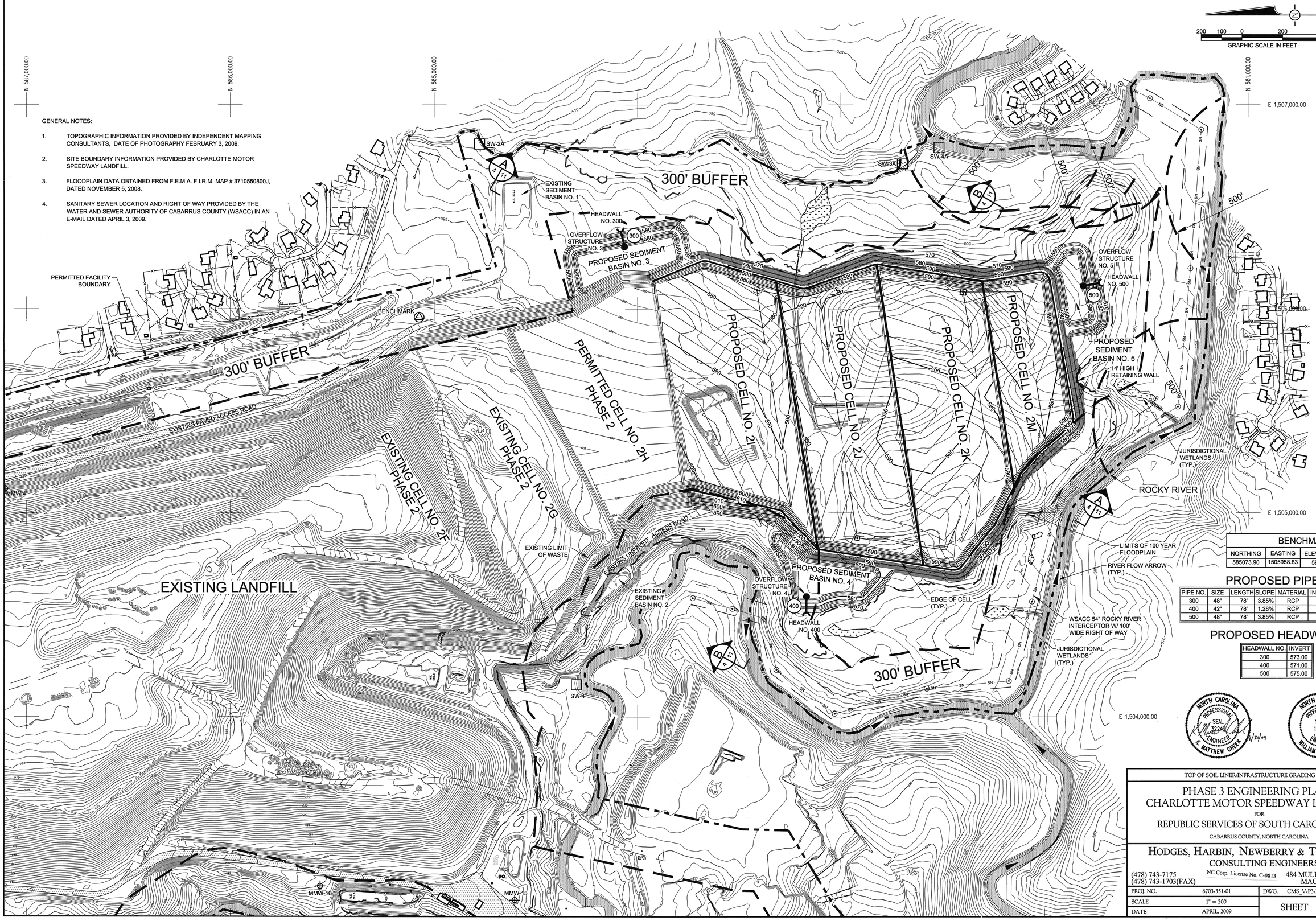

BENCHMARK

NORTHING	EASTING	ELEVATION	DESCRIPTION
585073.90	1505958.83	592.79	NAIL IN PAD

PROPOSED PIPES

PIPE NO.	SIZE	LENGTH	SLOPE	MATERIAL	INLET INV.	OUTLET INV.
300	48"	78'	3.85%	RCP	576.00	573.00
400	42"	78'	1.28%	RCP	572.00	571.00
500	48"	78'	3.85%	RCP	578.00	575.00

PROPOSED HEADWALLS

HEADWALL NO.	INVERT
300	573.00
400	571.00
500	575.00

NORTH CAROLINA PROFESSIONAL SEAL 32249 ENGINEER K. MATTHEW CHEEK 4/30/09

NORTH CAROLINA PROFESSIONAL SEAL 16146 ENGINEER WILLIAM F. HODGES 4/30/09

TOP OF SOIL LINER/INFRASTRUCTURE GRADING PLAN

PHASE 3 ENGINEERING PLANS
CHARLOTTE MOTOR SPEEDWAY LANDFILL V

FOR

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484 MULBERRY ST. - STE. 265
MACON, GEORGIA 31201

PROJ. NO.	6703-351-01	DWG.	CMS_V-P3-IG	EDIT	4-30-09
SCALE	1" = 200'	SHEET 4 OF 20			
DATE	APRIL, 2009				

GENERAL NOTES:

1. TOPOGRAPHIC INFORMATION PROVIDED BY INDEPENDENT MAPPING CONSULTANTS, DATE OF PHOTOGRAPHY FEBRUARY 3, 2009.
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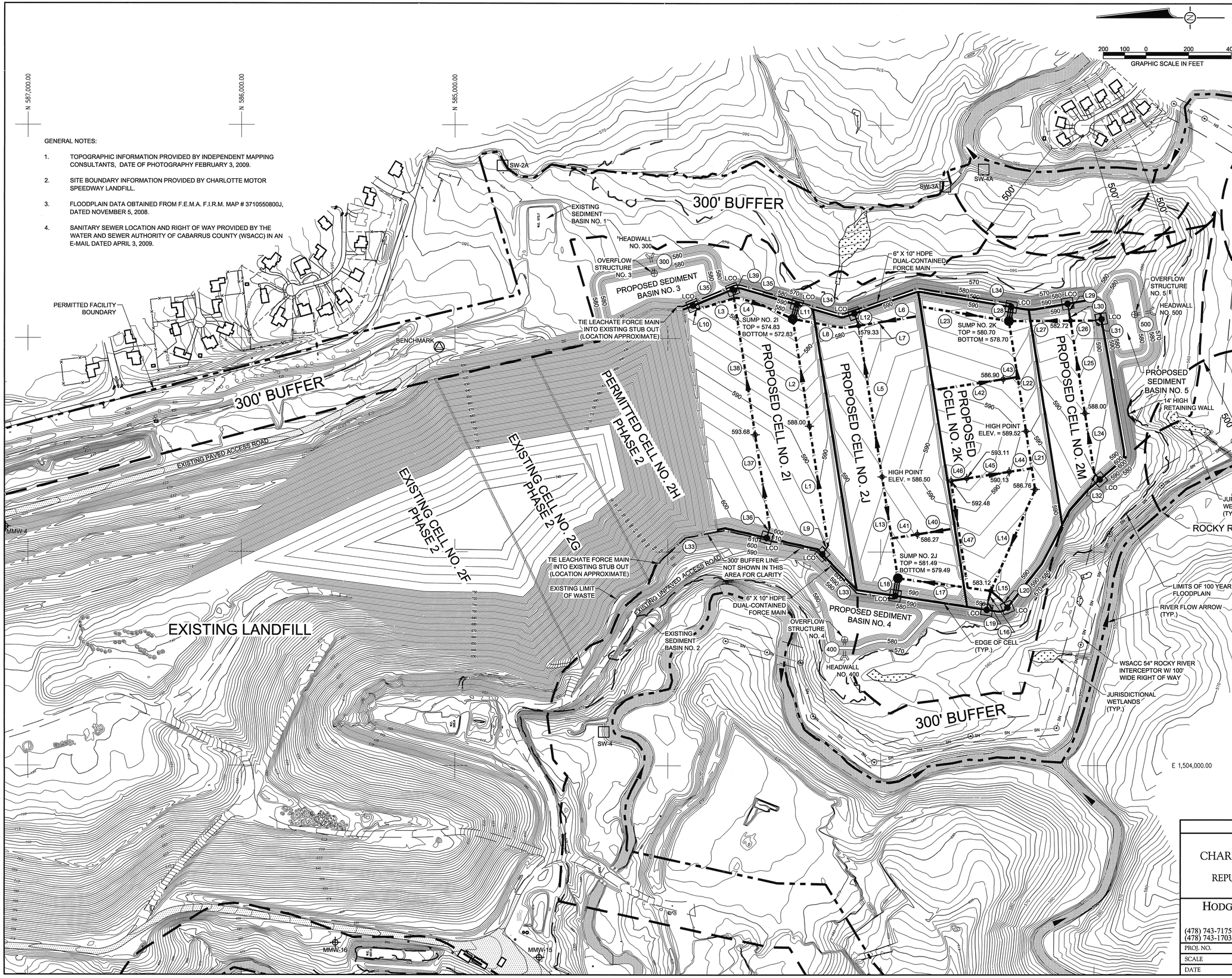

HDPE LEACHATE PIPING					
PIPE NO.	SOLID				PERFORATED
	3" X 6"	6" X 10"	8"	24"	8"
L1	-	-	-	-	568' @ 0.70%
L2	-	-	-	-	509' @ 2.50%
L3	-	-	-	-	159' @ 2.51%
L4	-	-	-	-	315' @ 1.24%
L5	-	-	-	-	717' @ 1.00%
L6	-	-	-	-	149' @ 1.16%
L7	-	-	-	-	123' @ 0.54%
L8	-	-	-	-	313' @ 1.16%
L9	-	-	48'	-	-
L10	-	-	28'	-	-
L11	85'	-	70'	2 - 70'	-
L12	-	-	61'	-	-
L13	-	-	-	-	482' @ 1.00%
L14	-	-	-	-	520' @ 0.70%
L15	-	-	-	-	70' @ 1.69%
L16	-	-	-	-	47' @ 1.87%
L17	-	-	-	-	440' @ 0.70%
L18	100'	-	84'	2 - 84'	-
L19	-	-	45'	-	-
L20	-	-	41'	-	-
L21	-	-	-	-	276' @ 1.00%
L22	-	-	-	-	523' @ 1.60%
L23	-	-	-	-	408' @ 0.70%
L24	-	-	-	-	283' @ 0.70%
L25	-	-	-	-	440' @ 1.12%
L26	-	-	-	-	103' @ 2.26%
L27	-	-	-	-	289' @ 0.70%
L28	82'	-	67'	2 - 67'	-
L29	-	-	45'	-	-
L30	-	-	-	-	36' @ 1.86%
L31	-	-	42'	-	-
L32	-	-	39'	-	-
L33	-	*1255'	-	-	-
L34	-	1037'	-	-	-
L35	-	*597'	-	-	-
L36	-	-	-	48'	-
L37	-	-	-	-	443' @ 0.70%
L38	-	-	-	-	647' @ 2.50%
L39	-	-	-	42'	-
L40	-	-	-	-	157' @ 0.88%
L41	-	-	-	-	122' @ 2.20%
L42	-	-	-	-	311' @ 1.00%
L43	-	-	-	-	68' @ 2.20%
L44	-	-	-	-	107' @ 2.20%
L45	-	-	-	-	202' @ 1.48%
L46	-	-	-	-	74' @ 0.85%
L47	-	-	-	-	508' @ 2.00%

*PIPE LENGTHS FOR PIPES L33 & L35 ARE APPROXIMATE. PIPES SHALL TIE IN TO EXISTING LEACHATE FORCE MAIN.

LEACHATE SUMP		
SUMP NO.	TOP ELEV.	INV. ELEV.
2I	574.83	572.83
2J	581.49	579.49
2K	580.70	578.70

BENCHMARK			
NORTHING	EASTING	ELEVATION	DESCRIPTION
585073.90	1505958.83	592.79	NAIL IN PAD

NORTH CAROLINA PROFESSIONAL SEAL 032249 ENGINEER K. MATTHEW CHECK 11/20/09

NORTH CAROLINA PROFESSIONAL SEAL 16 ENGINEER WILLIAM F. HODGES 4/30/09

LEACHATE COLLECTION PLAN

PHASE 3 ENGINEERING PLANS
CHARLOTTE MOTOR SPEEDWAY LANDFILL V

FOR

REPUBLIC SERVICES OF SOUTH CAROLINA, LLC

CABARRUS COUNTY, NORTH CAROLINA

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484 MULBERRY ST. - STE. 265
MACON, GEORGIA 31201

PROJ. NO.	6703-351-01	DWG.	CMS_V-P3-L	EDIT	4-30-09
SCALE	1" = 200'	SHEET 5 OF 20			
DATE	APRIL, 2009				

GENERAL NOTES:

1. TOPOGRAPHIC INFORMATION PROVIDED BY INDEPENDENT MAPPING CONSULTANTS, DATE OF PHOTOGRAPHY FEBRUARY 3, 2009.
2. SITE BOUNDARY INFORMATION PROVIDED BY CHARLOTTE MOTOR SPEEDWAY LANDFILL.
3. FLOODPLAIN DATA OBTAINED FROM F.E.M.A. F.I.R.M. MAP # 3710550800J, DATED NOVEMBER 5, 2008.
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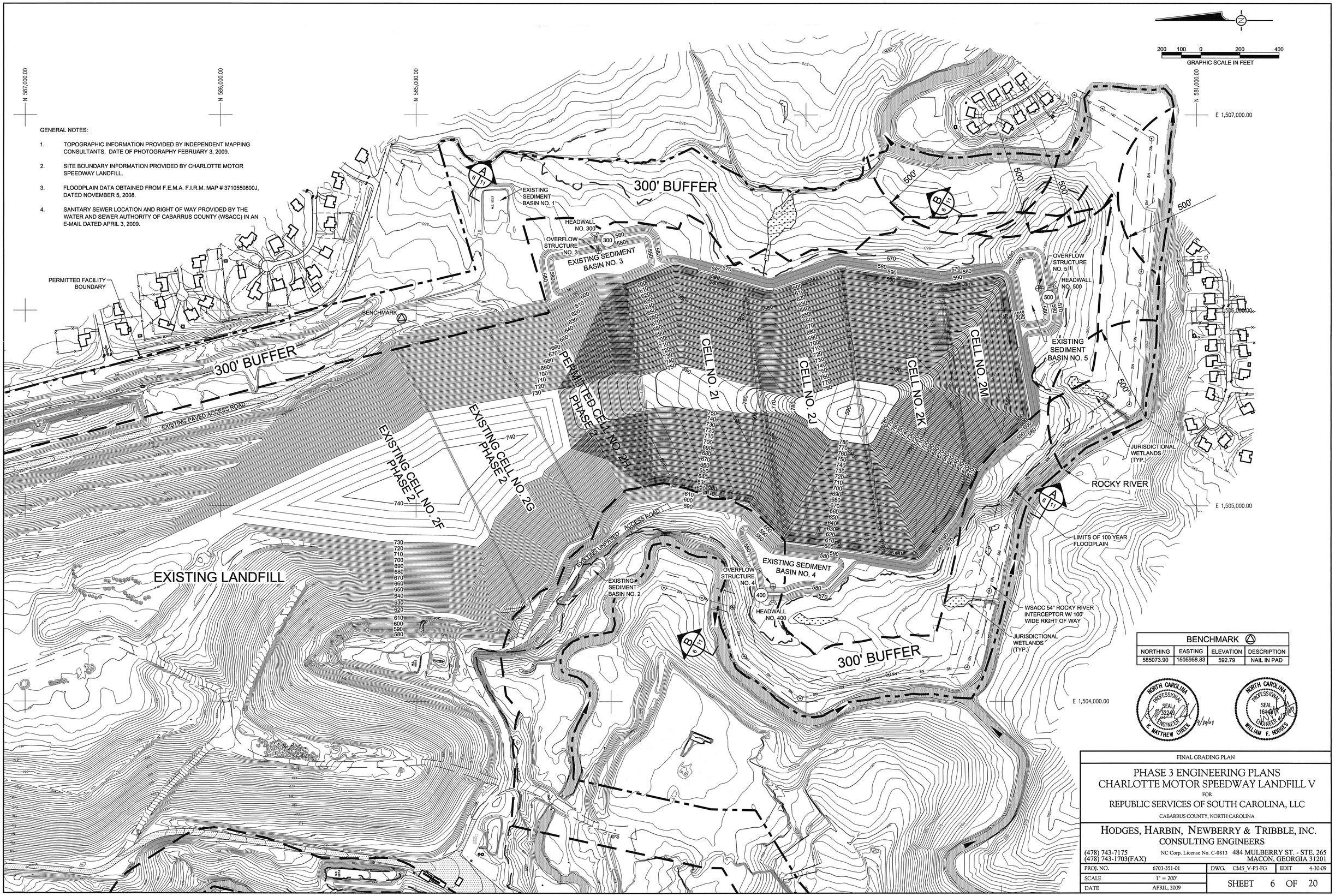

BENCHMARK			
NORTHING	EASTING	ELEVATION	DESCRIPTION
585073.90	1505958.83	592.79	NAIL IN PAD

NORTH CAROLINA PROFESSIONAL SEAL 32249 ENGINEER K. MATTHEW CHECK 11/24/09

NORTH CAROLINA PROFESSIONAL SEAL 16400 ENGINEER WILLIAM F. HODGES 4-30-09

FINAL GRADING PLAN

PHASE 3 ENGINEERING PLANS
CHARLOTTE MOTOR SPEEDWAY LANDFILL V

FOR

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484 MULBERRY ST. - STE. 265
MACON, GEORGIA 31201

PROJ. NO.	6703-351-01	DWG. CMS_V-P3-FG	EDIT 4-30-09
SCALE	1" = 200'	SHEET 6 OF 20	
DATE	APRIL, 2009		

GENERAL NOTES:

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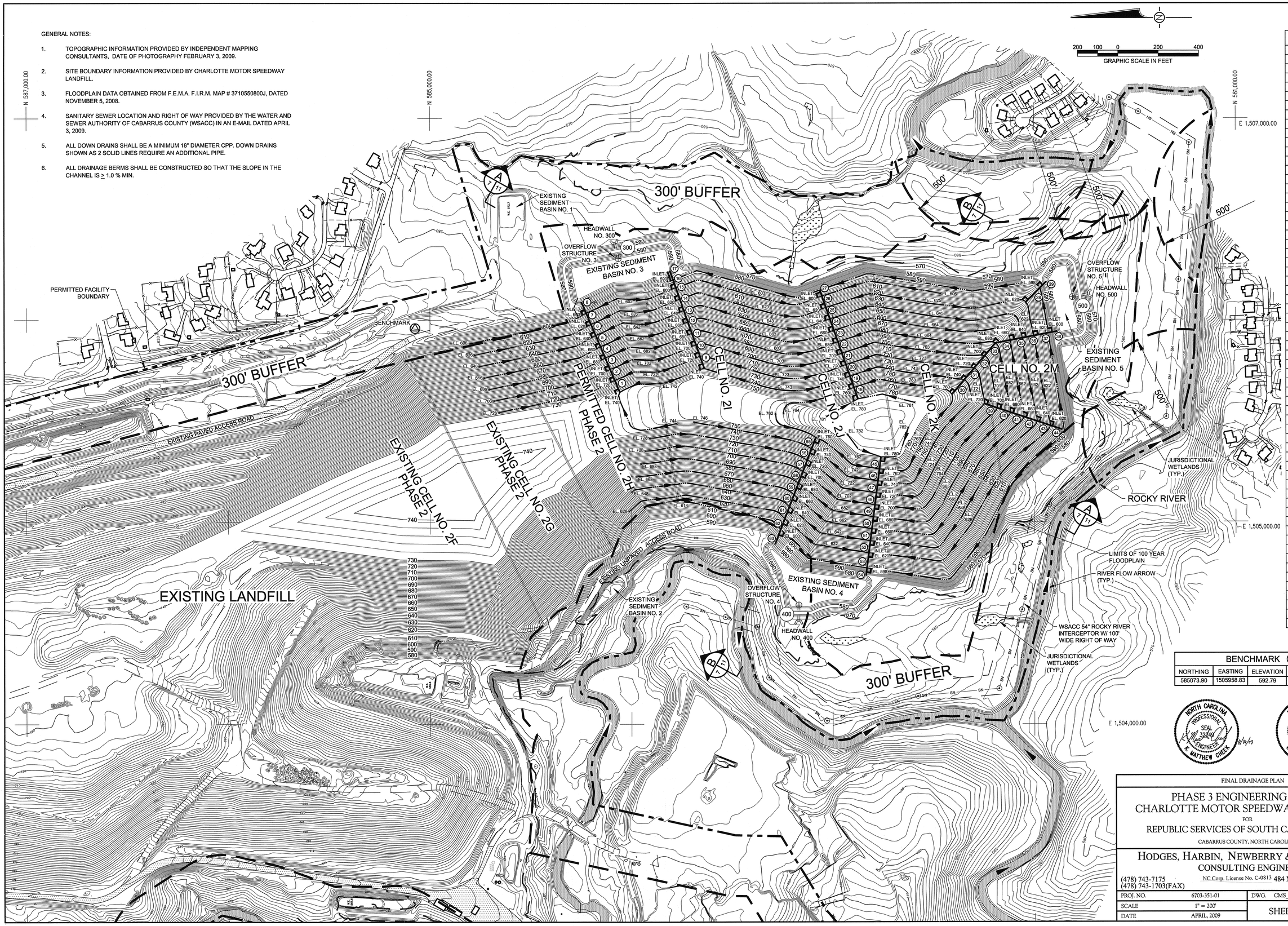
5. ALL DOWN DRAINS SHALL BE A MINIMUM 18" DIAMETER CPP. DOWN DRAINS SHOWN AS 2 SOLID LINES REQUIRE AN ADDITIONAL PIPE.
6. ALL DRAINAGE BERMS SHALL BE CONSTRUCTED SO THAT THE SLOPE IN THE CHANNEL IS ≥ 1.0 % MIN.



DOWNDRAIN STRUCTURES

DOWNDRAIN NO.	SIZE OF DOWNDRAIN
1	18"
2	18"
3	18"
4	18"
5	24"
6	24"
7	24"
8	24"
9	18"
10	18"
11	18"
12	18"
13	18"
14	18"
15	24"
16	24"
17	2 - 24"
18	18"
19	18"
20	18"
21	18"
22	18"
23	18"
24	24"
25	24"
26	24"
27	24"
28	18"
29	18"
30	18"
31	18"
32	18"
33	18"
34	18"
35	18"
36	18"
37	24"
38	24"
39	18"
40	18"
41	18"
42	18"
43	18"
44	18"
45	18"
46	18"
47	18"
48	18"
49	18"
50	18"
51	18"
52	24"
53	24"
54	24"
55	18"
56	18"
57	18"
58	18"
59	18"
60	24"
61	24"
62	24"
62	24"

BENCHMARK

NORTHING	EASTING	ELEVATION	DESCRIPTION
585073.90	1505958.83	592.79	NAIL IN PAD

NORTH CAROLINA PROFESSIONAL SEAL 32249 ENGINEER K. MATTHEW CHEEK 11/30/09

NORTH CAROLINA PROFESSIONAL SEAL 16278 ENGINEER WILLIAM F. HODGES 4/30/09

FINAL DRAINAGE PLAN

PHASE 3 ENGINEERING PLANS
CHARLOTTE MOTOR SPEEDWAY LANDFILL V

FOR

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CABARRUS COUNTY, NORTH CAROLINA

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MACON, GEORGIA 31201

PROJ. NO.	6703-351-01	DWG. CMS_V-P3-FD	EDIT 4-30-09
SCALE	1" = 200'	SHEET 7 OF 20	
DATE	APRIL, 2009		

GENERAL NOTES:

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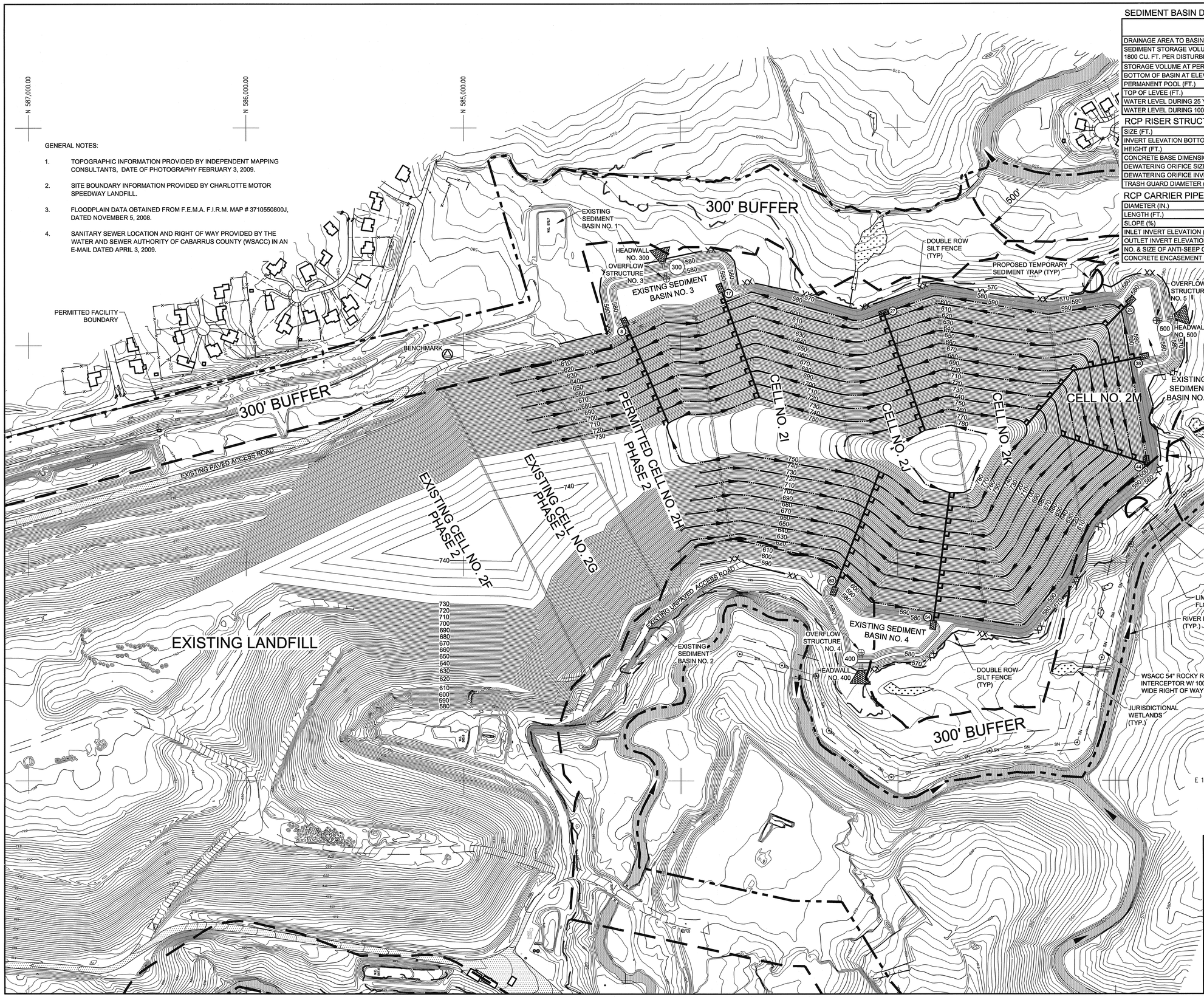


SEDIMENT BASIN DATA

	SED BASIN NO. 3	SED BASIN NO. 4	SED BASIN NO. 5
DRAINAGE AREA TO BASIN (ACRES)	35.1	28.0	14.9
SEDIMENT STORAGE VOLUME REQUIRED AT 1800 CU. FT. PER DISTURBED ACRE (CU. FT.)	63,180	50,400	26,820
STORAGE VOLUME AT PERM. POOL LEVEL (CU. FT)	203,479	187,438	97,092
BOTTOM OF BASIN AT ELEVATION (FT.)	574.00	572.00	576.00
PERMANENT POOL (FT.)	577.00	575.00	579.00
TOP OF LEVEE (FT.)	584.00	580.00	586.00
WATER LEVEL DURING 25 YEAR STORM (FT.)	580.32	577.49	582.18
WATER LEVEL DURING 100 YEAR STORM (FT.)	581.14	577.85	582.60

RCP RISER STRUCTURE

SIZE (FT.)	5' x 5' BOX	5' x 5' BOX	5' x 5' BOX
INVERT ELEVATION BOTTOM OF RISER (FT.)	576.00	572.00	578.00
HEIGHT (FT.)	5.00	5.50	5.00
CONCRETE BASE DIMENSIONS LxWxH (FT.)	10' x 10' x 2'	10' x 10' x 2'	10' x 10' x 2'
DEWATERING ORIFICE SIZE (IN.)	1 - 4"(H) x 16"(W)	1 - 4"(H) x 18"(W)	1 - 4"(H) x 10"(W)
DEWATERING ORIFICE INVERT ELEVATION (FT.)	577.00	575.00	579.00
TRASH GUARD DIAMETER (IN.)	#8 BAR - 8" OCEW	#8 BAR - 8" OCEW	#8 BAR - 8" OCEW

RCP CARRIER PIPE

DIAMETER (IN.)	48	42	48
LENGTH (FT.)	78	78	78
SLOPE (%)	3.85	1.28	3.85
INLET INVERT ELEVATION (FT.)	576.00	572.00	578.00
OUTLET INVERT ELEVATION (FT.)	573.00	571.00	575.00
NO. & SIZE OF ANTI-SEEP COLLARS (FT.)	2 - 8' x 8'	2 - 7' x 7'	2 - 8' x 8'
CONCRETE ENCASEMENT OF CARRIER PIPE (FT.)	5'(W) x 3.5'(H) x 23'(L)	5'(W) x 3.5'(H) x 23'(L)	5'(W) x 3.5'(H) x 23'(L)

EROSION CONTROL DEVICES

X — SILT FENCE

XX — DOUBLE ROW SILT FENCE

W2 / L / W1 — RIP-RAP OUTLET PROTECTION

PIPE NO.	MIN. RIP-RAP SIZE	LENGTH(L)	W1	W2
300	12"	28'	12'	40'
400	12"	22'	10.5'	32.5'
500	12"	26'	12'	38'
DD 8	12"	25'	6'	31'
DD 17	12"	24'	8'	32'
DD 27	12"	26'	17'	17'
DD 29	6"	10'	4.5'	14.5'
DD 38	15"	28'	6'	34'
DD 44	9"	20'	13.5'	13.5'
DD 54	12"	23'	6'	29'
DD 63	15"	28'	6'	34'

* DD = DOWNDRAIN PIPE NUMBER REQUIRING OUTLET PROTECTION

BENCHMARK

NORTHING	EASTING	ELEVATION	DESCRIPTION
585073.90	1505958.83	592.79	NAIL IN PAD

NORTH CAROLINA PROFESSIONAL SEAL 32248 ENGINEER K. MATTHEW CHEEK 4/30/09

NORTH CAROLINA PROFESSIONAL SEAL 19761 ENGINEER WILLIAM F. HODGES 4/30/09

EROSION CONTROL PLAN

PHASE 3 ENGINEERING PLANS
CHARLOTTE MOTOR SPEEDWAY LANDFILL V

FOR

REPUBLIC SERVICES OF SOUTH CAROLINA, LLC

CABARRUS COUNTY, NORTH CAROLINA

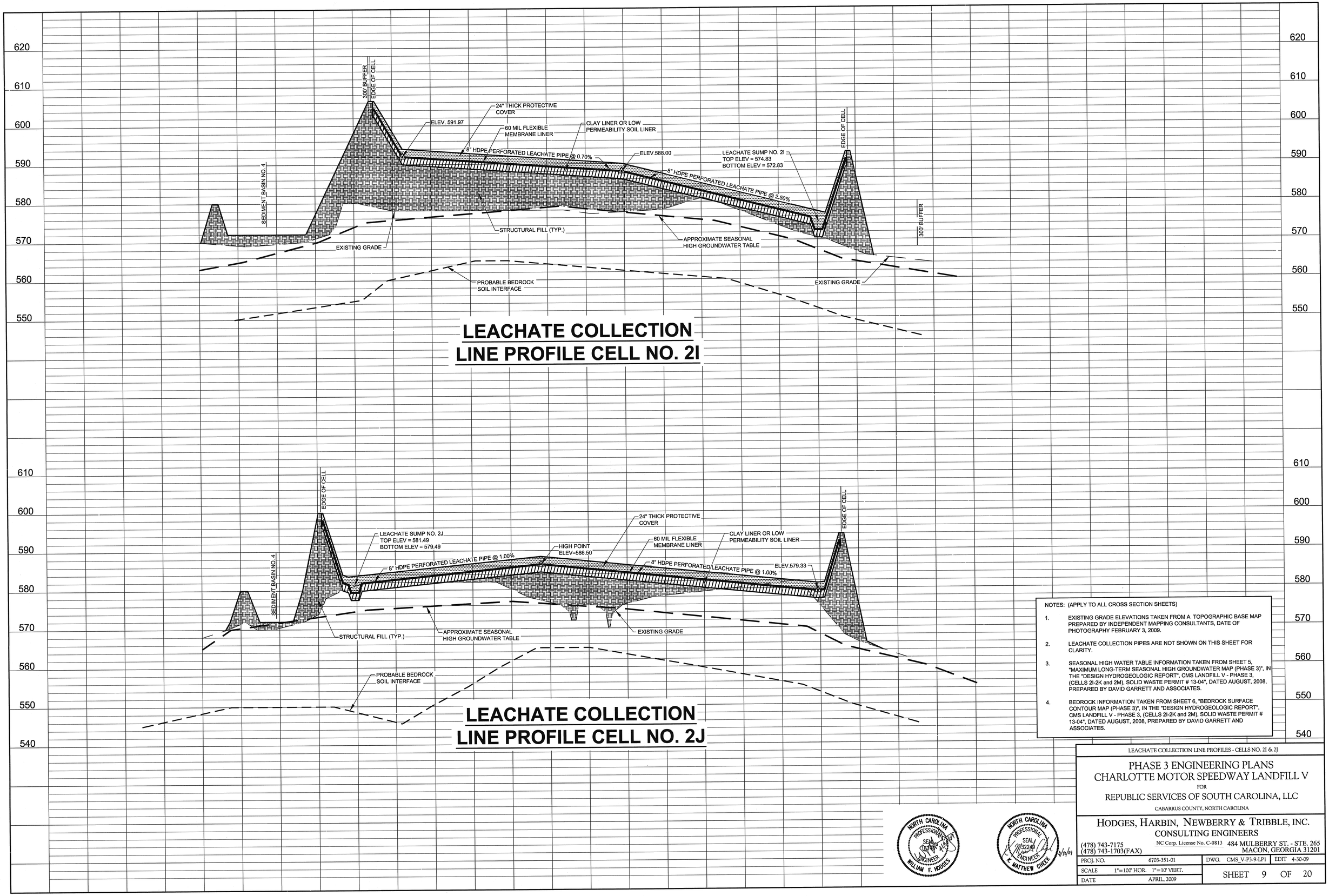
HODGES, HARBIN, NEWBERRY & TRIBBLE, INC.
CONSULTING ENGINEERS

(478) 743-7175
(478) 743-1703(FAX)

NC Corp. License No. C-0813

484 MULBERRY ST. - STE. 265
MACON, GEORGIA 31201

PROJ. NO.	6703-351-01	DWG. CMS_V-P3-EC	EDIT 4-30-09
SCALE	1" = 200'	SHEET 8 OF 20	
DATE	APRIL, 2009		



NOTES: (APPLY TO ALL CROSS SECTION SHEETS)

1. EXISTING GRADE ELEVATIONS TAKEN FROM A TOPOGRAPHIC BASE MAP PREPARED BY INDEPENDENT MAPPING CONSULTANTS, DATE OF PHOTOGRAPHY FEBRUARY 3, 2009.
2. LEACHATE COLLECTION PIPES ARE NOT SHOWN ON THIS SHEET FOR CLARITY.
3. SEASONAL HIGH WATER TABLE INFORMATION TAKEN FROM SHEET 5, "MAXIMUM LONG-TERM SEASONAL HIGH GROUNDWATER MAP (PHASE 3)", IN THE "DESIGN HYDROGEOLOGIC REPORT", CMS LANDFILL V - PHASE 3, (CELLS 2I-2K and 2M), SOLID WASTE PERMIT # 13-04", DATED AUGUST, 2008, PREPARED BY DAVID GARRETT AND ASSOCIATES.
4. BEDROCK INFORMATION TAKEN FROM SHEET 6, "BEDROCK SURFACE CONTOUR MAP (PHASE 3)", IN THE "DESIGN HYDROGEOLOGIC REPORT", CMS LANDFILL V - PHASE 3, (CELLS 2I-2K and 2M), SOLID WASTE PERMIT # 13-04", DATED AUGUST, 2008, PREPARED BY DAVID GARRETT AND ASSOCIATES.

LEACHATE COLLECTION LINE PROFILES - CELLS NO. 2I & 2J

PHASE 3 ENGINEERING PLANS
CHARLOTTE MOTOR SPEEDWAY LANDFILL V
FOR
REPUBLIC SERVICES OF SOUTH CAROLINA, LLC
CABARRUS COUNTY, NORTH CAROLINA

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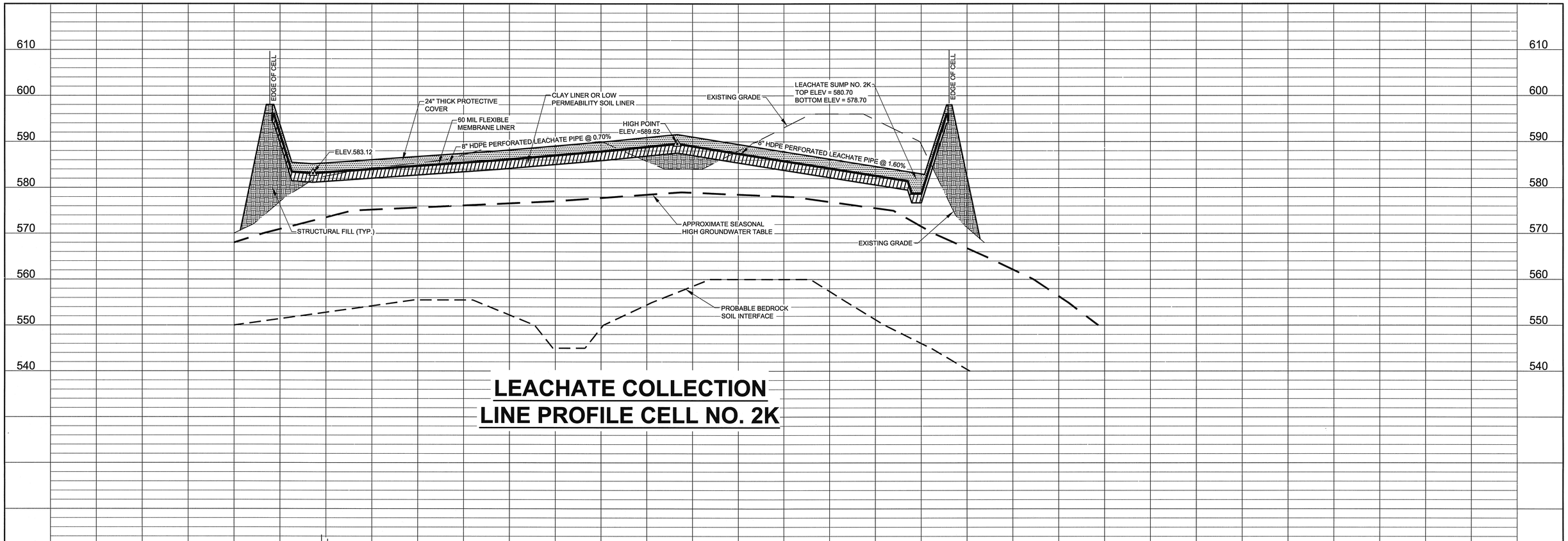
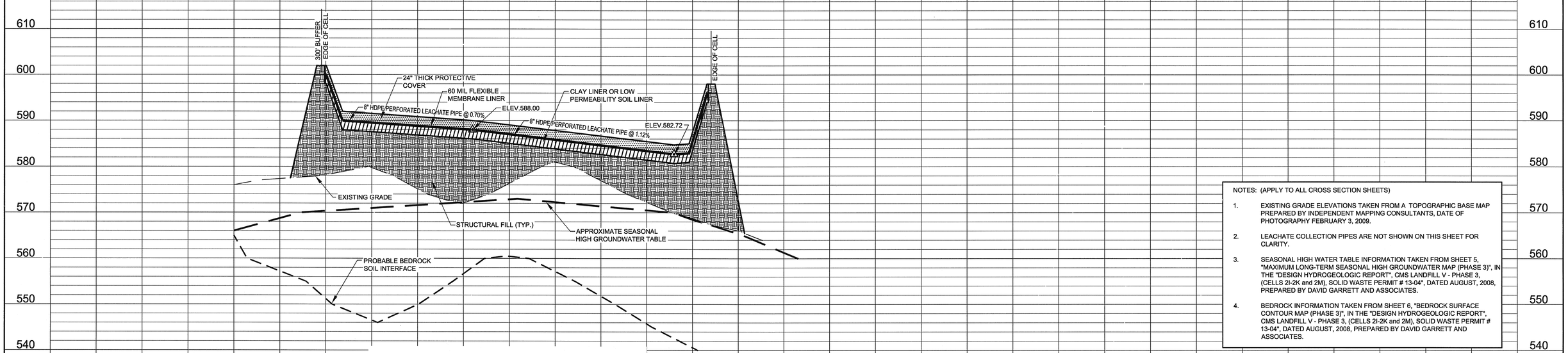
484 MULBERRY ST. - STE. 265
MACON, GEORGIA 31201

PROJ. NO.	6703-351-01	DWG. CMS_V-P3-9-LP1	EDIT 4-30-09
SCALE	1"=100' HOR. 1"=10' VERT.	SHEET 9 OF 20	
DATE	APRIL, 2009		



LEACHATE COLLECTION LINE PROFILE CELL NO. 2K



LEACHATE COLLECTION LINE PROFILE CELL NO. 2M

NOTES: (APPLY TO ALL CROSS SECTION SHEETS)

1. EXISTING GRADE ELEVATIONS TAKEN FROM A TOPOGRAPHIC BASE MAP PREPARED BY INDEPENDENT MAPPING CONSULTANTS, DATE OF PHOTOGRAPHY FEBRUARY 3, 2009.
2. LEACHATE COLLECTION PIPES ARE NOT SHOWN ON THIS SHEET FOR CLARITY.
3. SEASONAL HIGH WATER TABLE INFORMATION TAKEN FROM SHEET 5, "MAXIMUM LONG-TERM SEASONAL HIGH GROUNDWATER MAP (PHASE 3)", IN THE "DESIGN HYDROGEOLOGIC REPORT", CMS LANDFILL V - PHASE 3, (CELLS 2I-2K and 2M), SOLID WASTE PERMIT # 13-04", DATED AUGUST, 2008, PREPARED BY DAVID GARRETT AND ASSOCIATES.
4. BEDROCK INFORMATION TAKEN FROM SHEET 6, "BEDROCK SURFACE CONTOUR MAP (PHASE 3)", IN THE "DESIGN HYDROGEOLOGIC REPORT", CMS LANDFILL V - PHASE 3, (CELLS 2I-2K and 2M), SOLID WASTE PERMIT # 13-04", DATED AUGUST, 2008, PREPARED BY DAVID GARRETT AND ASSOCIATES.

LEACHATE COLLECTION LINE PROFILES - CELLS NO. 2K & 2M

PHASE 3 ENGINEERING PLANS
CHARLOTTE MOTOR SPEEDWAY LANDFILL V
FOR
REPUBLIC SERVICES OF SOUTH CAROLINA, LLC
CABARRUS COUNTY, NORTH CAROLINA

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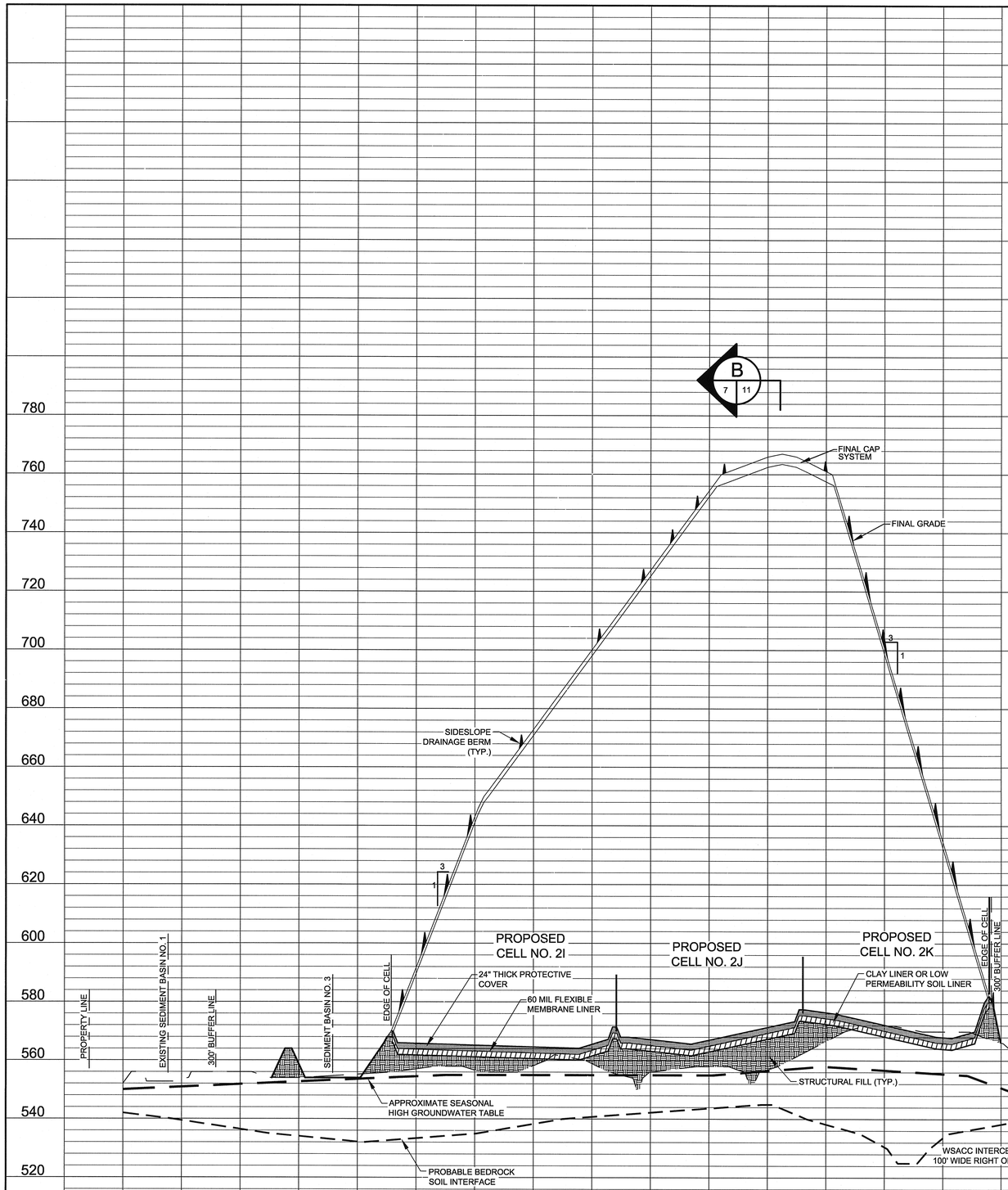
NC Corp. License No. C-0813
484 MULBERRY ST. - STE. 265
MACON, GEORGIA 31201

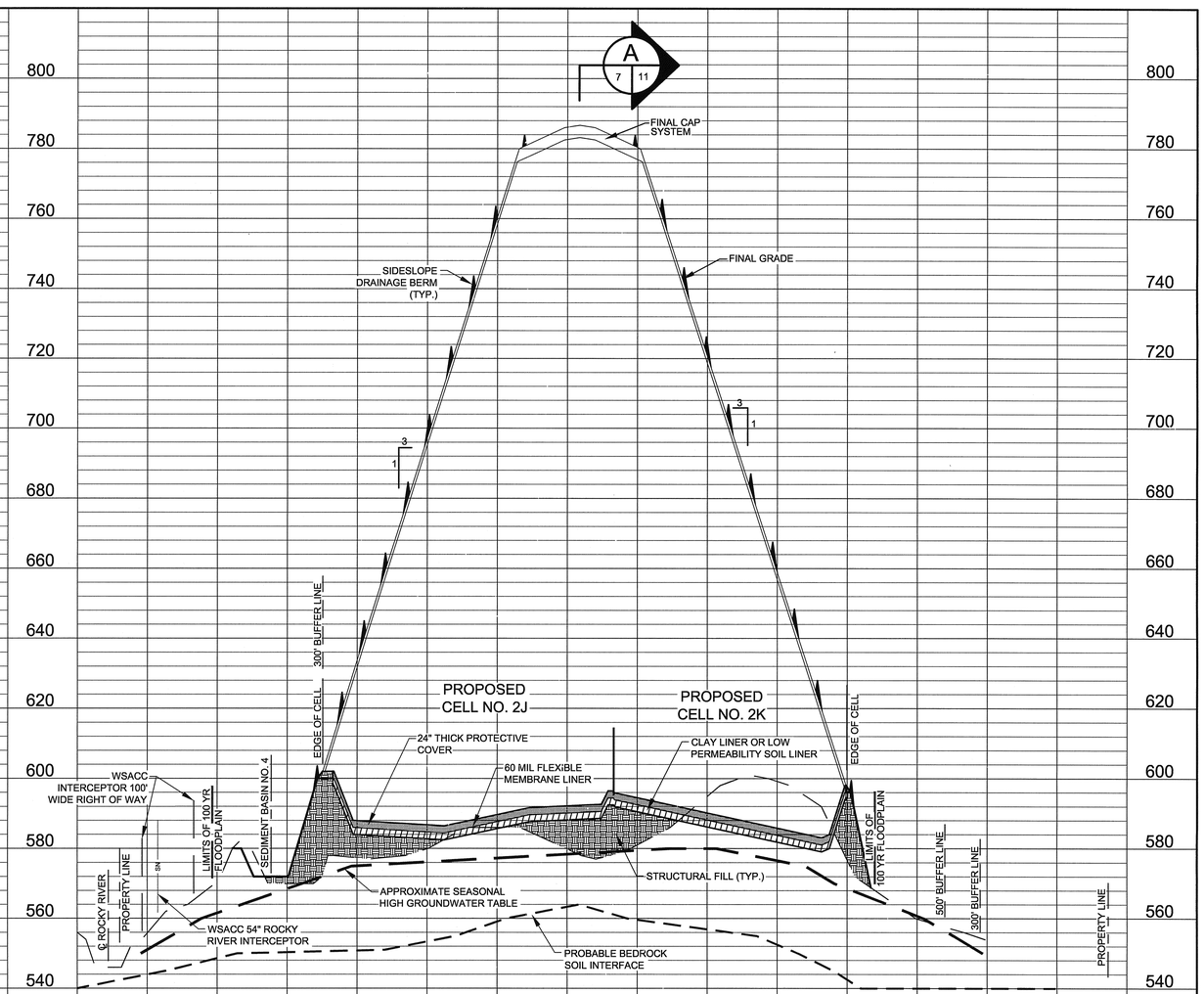
NORTH CAROLINA PROFESSIONAL SEAL 16044 ENGINEER WILLIAM F. HODGES

NORTH CAROLINA PROFESSIONAL SEAL 32249 ENGINEER K. MATTHEW CHEEK 11/9/09

PROJ. NO.	6703-351-01	DWG. CMS_V-P3-10-LP2	EDIT 4-30-09
SCALE	1"=100' HOR. 1"=10' VERT.	SHEET 10 OF 20	
DATE	APRIL, 2009		



CROSS SECTION A



CROSS SECTION B

NOTES: (APPLY TO ALL CROSS SECTION SHEETS)

1. EXISTING GRADE ELEVATIONS TAKEN FROM A TOPOGRAPHIC BASE MAP PREPARED BY INDEPENDENT MAPPING CONSULTANTS, DATE OF PHOTOGRAPHY FEBRUARY 3, 2009.
2. LEACHATE COLLECTION PIPES ARE NOT SHOWN ON THIS SHEET FOR CLARITY.
3. SEASONAL HIGH WATER TABLE INFORMATION TAKEN FROM SHEET 5, "MAXIMUM LONG-TERM SEASONAL HIGH GROUNDWATER MAP (PHASE 3)", IN THE "DESIGN HYDROGEOLOGIC REPORT", CMS LANDFILL V - PHASE 3, (CELLS 2I-2K and 2M), SOLID WASTE PERMIT # 13-04", DATED AUGUST, 2008, PREPARED BY DAVID GARRETT AND ASSOCIATES.
4. BEDROCK INFORMATION TAKEN FROM SHEET 6, "BEDROCK SURFACE CONTOUR MAP (PHASE 3)", IN THE "DESIGN HYDROGEOLOGIC REPORT", CMS LANDFILL V - PHASE 3, (CELLS 2I-2K and 2M), SOLID WASTE PERMIT # 13-04", DATED AUGUST, 2008, PREPARED BY DAVID GARRETT AND ASSOCIATES.

NORTH CAROLINA PROFESSIONAL SEAL 16048 ENGINEER WILLIAM F. HODGES 4/30/09

NORTH CAROLINA PROFESSIONAL SEAL 32249 ENGINEER K. MATTHEW CHEEK 11/20/09

LANDFILL CROSS SECTIONS A & B

PHASE 3 ENGINEERING PLANS
CHARLOTTE MOTOR SPEEDWAY LANDFILL V
FOR
REPUBLIC SERVICES OF SOUTH CAROLINA, LLC
CABARRUS COUNTY, NORTH CAROLINA

HODGES, HARBIN, NEWBERRY & TRIBBLE, INC.
CONSULTING ENGINEERS
NC Corp. License No. C-0813
(478) 743-7175
(478) 743-1703(FAX)
484 MULBERRY ST. - STE. 265
MACON, GEORGIA 31201

PROJ. NO.	6703-351-01	DWG. CMS_V-P3-XSAB	EDIT 4-30-09
SCALE	1"=200' HOR. 1"=20' VERT.	SHEET 11 OF 20	
DATE	APRIL, 2009		

GENERAL NOTES:

1. TOPOGRAPHIC INFORMATION PROVIDED BY INDEPENDENT MAPPING CONSULTANTS, DATE OF PHOTOGRAPHY FEBRUARY 3, 2009.
2. SITE BOUNDARY INFORMATION PROVIDED BY CHARLOTTE MOTOR SPEEDWAY LANDFILL.
3. FLOODPLAIN DATA OBTAINED FROM F.E.M.A. F.I.R.M. MAP # 3710550800J, DATED NOVEMBER 5, 2008.
4. SANITARY SEWER LOCATION AND RIGHT OF WAY PROVIDED BY THE WATER AND SEWER AUTHORITY OF CABARRUS COUNTY (WSACC) IN AN E-MAIL DATED APRIL 3, 2009.

BENCHMARK			
NORTHING	EASTING	ELEVATION	DESCRIPTION
585073.90	1505958.83	592.79	NAIL IN PAD

PROPOSED PIPES

PIPE NO.	SIZE	LENGTH	SLOPE	MATERIAL	INLET INV.	OUTLET INV.
300	48"	78'	3.85%	RCP	576.00	573.00
400	42"	78'	1.28%	RCP	572.00	571.00

PROPOSED HEADWALLS

HEADWALL NO.	INVERT
300	573.00
400	571.00

NORTH CAROLINA PROFESSIONAL SEAL 32249 ENGINEER K. MATTHEW CHEEK 4/30/09

NORTH CAROLINA PROFESSIONAL SEAL 16146 ENGINEER WILLIAM F. HODGES

SEQUENCE OF FILL - CELL NO. 2I

PHASE 3 ENGINEERING PLANS
CHARLOTTE MOTOR SPEEDWAY LANDFILL V

FOR

REPUBLIC SERVICES OF SOUTH CAROLINA, LLC

CABARRUS COUNTY, NORTH CAROLINA

HODGES, HARBIN, NEWBERRY & TRIBBLE, INC.
CONSULTING ENGINEERS
NC Corp. License No. C-0813
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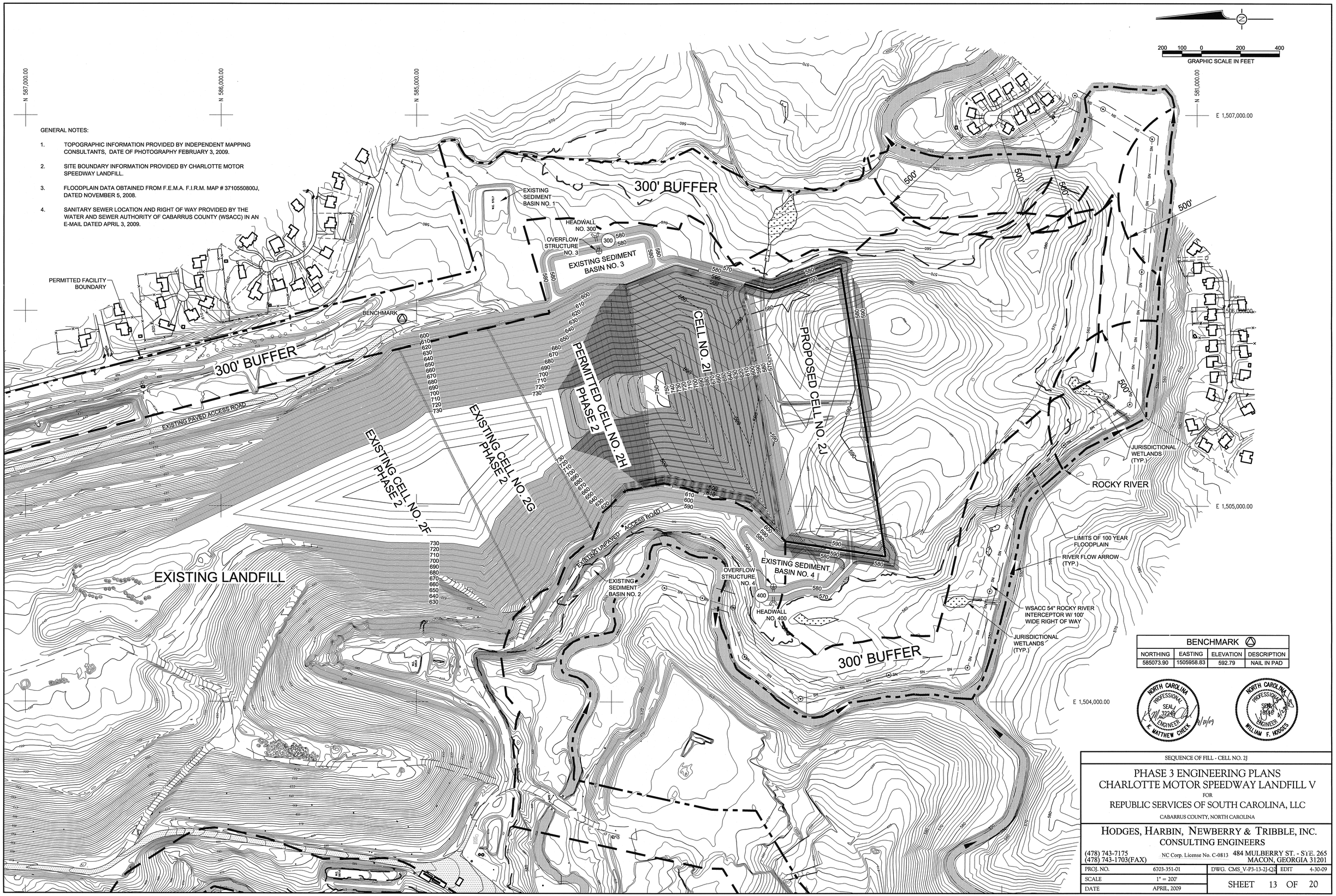
484 MULBERRY ST. - STE. 265
MACON, GEORGIA 31201

PROJ. NO.	6703-351-01	DWG. CMS_V-P3-12-2I-QI	EDIT 4-30-09
SCALE	1" = 200'	SHEET 12 OF 20	
DATE	APRIL, 2009		

GENERAL NOTES:

1. TOPOGRAPHIC INFORMATION PROVIDED BY INDEPENDENT MAPPING CONSULTANTS, DATE OF PHOTOGRAPHY FEBRUARY 3, 2009.
2. SITE BOUNDARY INFORMATION PROVIDED BY CHARLOTTE MOTOR SPEEDWAY LANDFILL.
3. FLOODPLAIN DATA OBTAINED FROM F.E.M.A. F.I.R.M. MAP # 3710550800J, DATED NOVEMBER 5, 2008.
4. SANITARY SEWER LOCATION AND RIGHT OF WAY PROVIDED BY THE WATER AND SEWER AUTHORITY OF CABARRUS COUNTY (WSACC) IN AN E-MAIL DATED APRIL 3, 2009.



BENCHMARK			
NORTHING	EASTING	ELEVATION	DESCRIPTION
585073.90	1505958.83	592.79	NAIL IN PAD

NORTH CAROLINA PROFESSIONAL SEAL 32249 ENGINEER K. MATTHEW CHEEK 4/30/09

NORTH CAROLINA PROFESSIONAL SEAL 16146 ENGINEER WILLIAM F. HODGES 4/28/09

SEQUENCE OF FILL - CELL NO. 2J

PHASE 3 ENGINEERING PLANS
CHARLOTTE MOTOR SPEEDWAY LANDFILL V

FOR

REPUBLIC SERVICES OF SOUTH CAROLINA, LLC

CABARRUS COUNTY, NORTH CAROLINA

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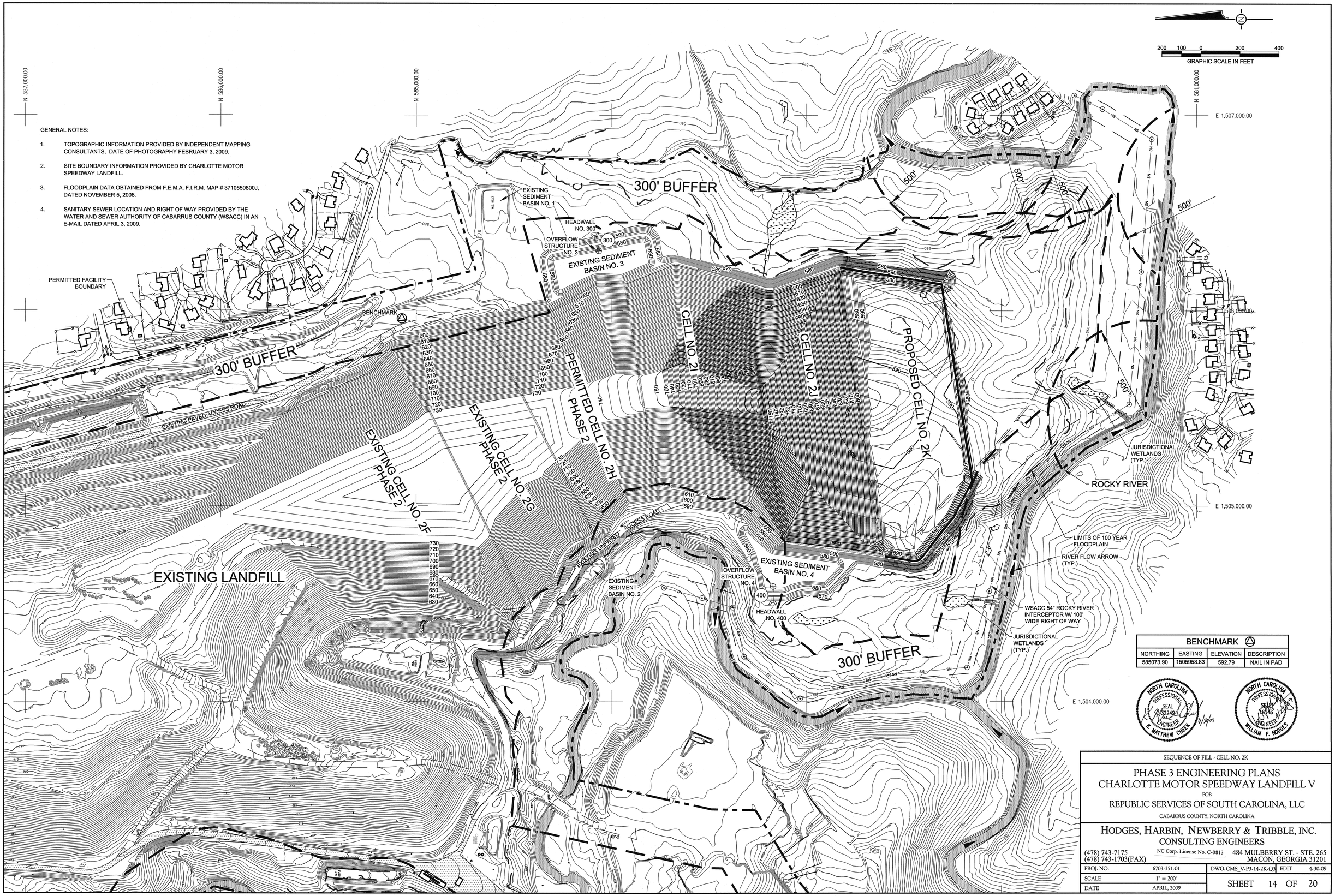
NC Corp. License No. C-0813
484 MULBERRY ST. - STE. 265
MACON, GEORGIA 31201

PROJ. NO.	6703-351-01	DWG. CMS_V-P3-13-2J-Q2	EDIT 4-30-09
SCALE	1" = 200'	SHEET 13 OF 20	
DATE	APRIL, 2009		

GENERAL NOTES:

1. TOPOGRAPHIC INFORMATION PROVIDED BY INDEPENDENT MAPPING CONSULTANTS, DATE OF PHOTOGRAPHY FEBRUARY 3, 2009.
2. SITE BOUNDARY INFORMATION PROVIDED BY CHARLOTTE MOTOR SPEEDWAY LANDFILL.
3. FLOODPLAIN DATA OBTAINED FROM F.E.M.A. F.I.R.M. MAP # 3710550800J, DATED NOVEMBER 5, 2008.
4. SANITARY SEWER LOCATION AND RIGHT OF WAY PROVIDED BY THE WATER AND SEWER AUTHORITY OF CABARRUS COUNTY (WSACC) IN AN E-MAIL DATED APRIL 3, 2009.



BENCHMARK			
NORTHING	EASTING	ELEVATION	DESCRIPTION
585073.90	1505958.83	592.79	NAIL IN PAD

NORTH CAROLINA PROFESSIONAL SEAL 52249 ENGINEER K. MATTHEW CHEEK 4/30/09

NORTH CAROLINA PROFESSIONAL SEAL 18146 ENGINEER WILLIAM F. HODGES 4/30/09

SEQUENCE OF FILL - CELL NO. 2K

PHASE 3 ENGINEERING PLANS
CHARLOTTE MOTOR SPEEDWAY LANDFILL V

FOR

REPUBLIC SERVICES OF SOUTH CAROLINA, LLC

CABARRUS COUNTY, NORTH CAROLINA

HODGES, HARBIN, NEWBERRY & TRIBBLE, INC.
CONSULTING ENGINEERS

(478) 743-7175
(478) 743-1703(FAX)

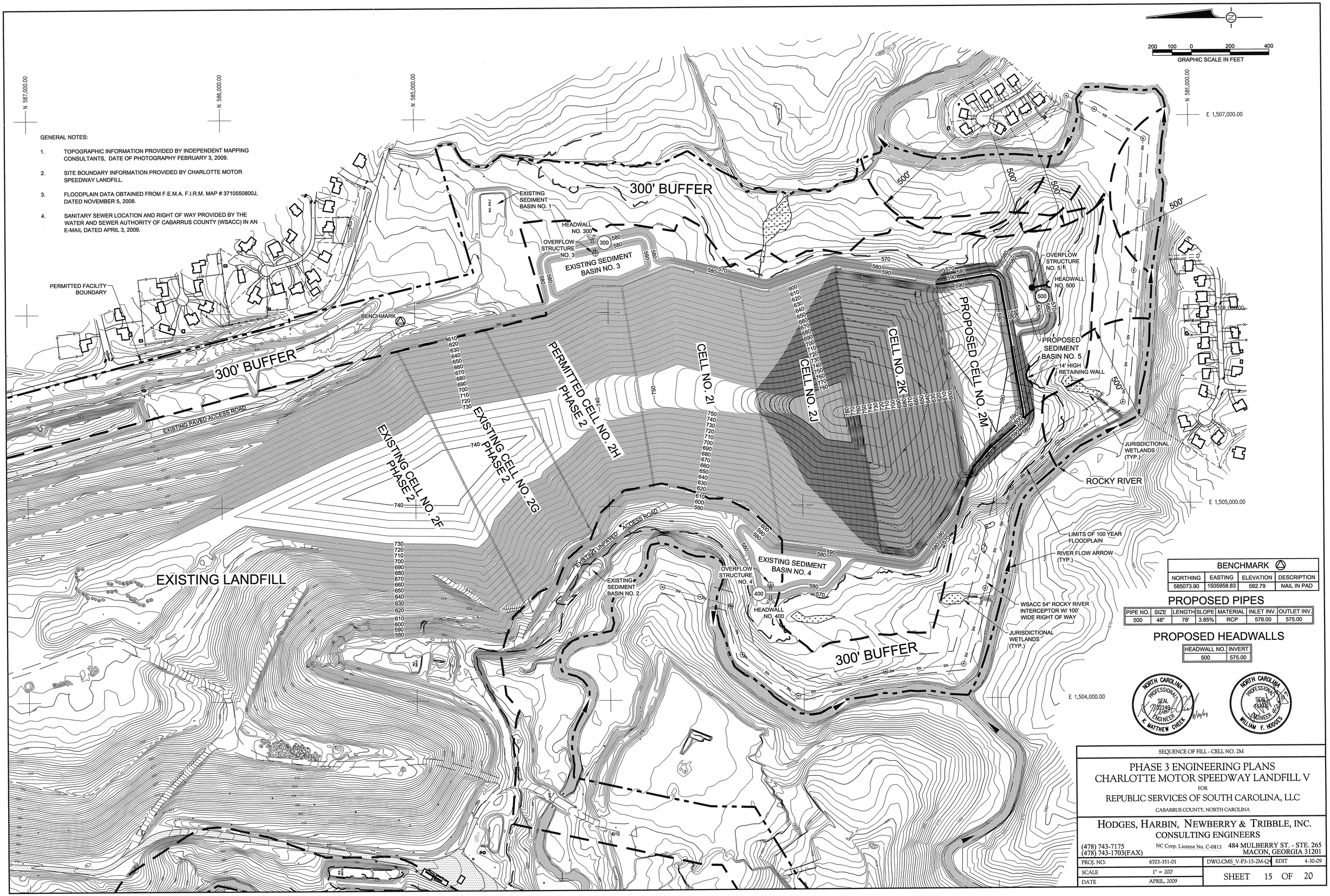
NC Corp. License No. C-0813

484 MULBERRY ST. - STE. 265
MACON, GEORGIA 31201

PROJ. NO.	6703-351-01	DWG.CMS_V-P3-14-2K-Q3	EDIT 4-30-09
SCALE	1" = 200'	SHEET 14 OF 20	
DATE	APRIL, 2009		

GENERAL NOTES:

1. TOPOGRAPHIC INFORMATION PROVIDED BY INDEPENDENT MAPPING CONSULTANTS, DATE OF PHOTOGRAPHY FEBRUARY 3, 2009.
2. SITE BOUNDARY INFORMATION PROVIDED BY CHARLOTTE MOTOR SPEEDWAY LANDFILL.
3. FLOODPLAIN DATA OBTAINED FROM F.E.M.A. F.I.R.M. MAP # 3710550800J, DATED NOVEMBER 5, 2008.
4. SANITARY SEWER LOCATION AND RIGHT OF WAY PROVIDED BY THE WATER AND SEWER AUTHORITY OF CABARRUS COUNTY (WSACC) IN AN E-MAIL DATED APRIL 3, 2009.



BENCHMARK			
NORTHING	EASTING	ELEVATION	DESCRIPTION
585073.90	1505958.83	592.79	NAIL IN PAD

PROPOSED PIPES

PIPE NO.	SIZE	LENGTH	SLOPE	MATERIAL	INLET INV.	OUTLET INV.
500	48"	78'	3.85%	RCP	578.00	575.00

PROPOSED HEADWALLS

HEADWALL NO.	INVERT
500	575.00

NORTH CAROLINA PROFESSIONAL SEAL 32249 ENGINEER K. MATTHEW CHEEK 4/30/09

NORTH CAROLINA PROFESSIONAL SEAL 16346 ENGINEER WILLIAM F. HODGES

SEQUENCE OF FILL - CELL NO. 2M

PHASE 3 ENGINEERING PLANS
CHARLOTTE MOTOR SPEEDWAY LANDFILL V

FOR

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CABARRUS COUNTY, NORTH CAROLINA

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NC Corp. License No. C-0813
484 MULBERRY ST. - STE. 265
MACON, GEORGIA 31201

PROJ. NO.	6703-351-01	DWG.CMS_V-P3-15-2M-Q4	EDIT 4-30-09
SCALE	1" = 200'	SHEET 15 OF 20	
DATE	APRIL, 2009		

GENERAL NOTES:

1. TOPOGRAPHIC INFORMATION PROVIDED BY INDEPENDENT MAPPING CONSULTANTS, DATE OF PHOTOGRAPHY FEBRUARY 3, 2009.
2. SITE BOUNDARY INFORMATION PROVIDED BY CHARLOTTE MOTOR SPEEDWAY LANDFILL.
3. FLOODPLAIN DATA OBTAINED FROM F.E.M.A. F.I.R.M. MAP # 3710550800J, DATED NOVEMBER 5, 2008.
4. SANITARY SEWER LOCATION AND RIGHT OF WAY PROVIDED BY THE WATER AND SEWER AUTHORITY OF CABARRUS COUNTY (WSACC) IN AN E-MAIL DATED APRIL 3, 2009.

BENCHMARK			
NORTHING	EASTING	ELEVATION	DESCRIPTION
585073.90	1505958.83	592.79	NAIL IN PAD

NORTH CAROLINA PROFESSIONAL SEAL 32240 ENGINEER K. MATTHEW CHECK 11/19/09

NORTH CAROLINA PROFESSIONAL SEAL 19146 ENGINEER WILLIAM F. HODGES

SEQUENCE OF FILL - FINAL GRADING PLAN

PHASE 3 ENGINEERING PLANS
CHARLOTTE MOTOR SPEEDWAY LANDFILL V

FOR

REPUBLIC SERVICES OF SOUTH CAROLINA, LLC

CABARRUS COUNTY, NORTH CAROLINA

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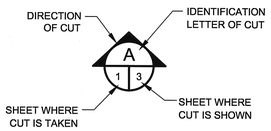
CONSULTING ENGINEERS
NC Corp. License No. C-0813
(478) 743-7175
(478) 743-1703(FAX)
484 MULBERRY ST. - STE. 265
MACON, GEORGIA 31201

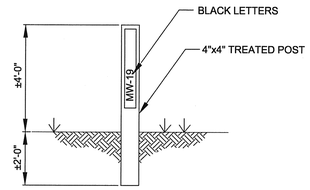
PROJ. NO.	6703-351-01	DWG. CMS_V-P3-16-QF	EDIT 4-30-09
SCALE	1" = 200'	SHEET 16 OF 20	
DATE	APRIL, 2009		

1



EXAMPLE - SECTION SYMBOL

2

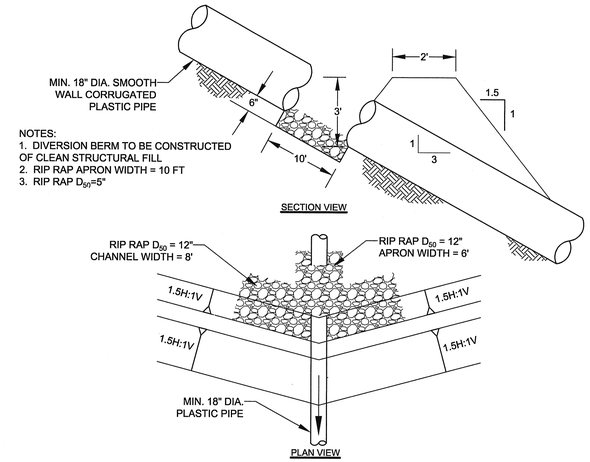


MW = GROUNDWATER MONITORING WELL
EDGE OF CELL
EDGE OF LINER
LEACHATE CLEANOUT

NOTE: OTHER MARKER DESIGNS MAY BE UTILIZED AT THE OPERATOR'S DISCRETION.

MARKER POST

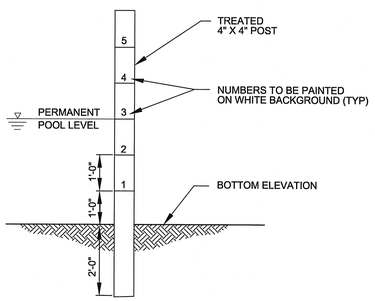
3



NOTES:
1. DIVERSION BERM TO BE CONSTRUCTED OF CLEAN STRUCTURAL FILL
2. RIP RAP APRON WIDTH = 10 FT
3. RIP RAP D_{50}=5"

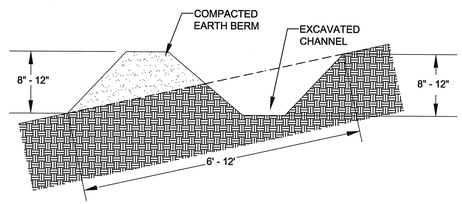
SIDESLOPE DRAINAGE BERM AND DOWNDRAIN PIPE CONNECTION

4



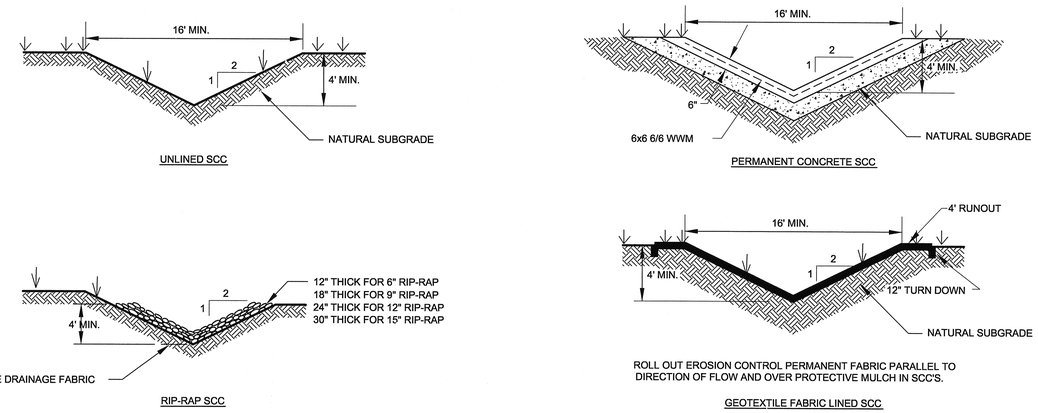
SILT GAGE

5



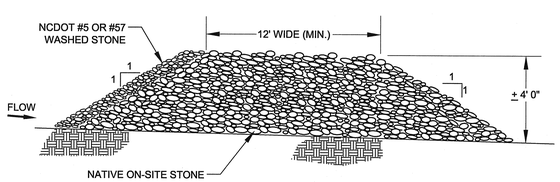
DIVERSION BERM
(AS NEEDED)

6



STORMWATER CONVEYANCE CHANNEL SECTIONS

7



ROCK FILTER DAM CROSS SECTION

8

NO DETAIL

9

NO DETAIL

MISCELLANEOUS DETAILS

PHASE 3 ENGINEERING PLANS
CHARLOTTE MOTOR SPEEDWAY LANDFILL V
FOR
REPUBLIC SERVICES OF SOUTH CAROLINA, LLC
CABARRUS COUNTY, NORTH CAROLINA

HODGES, HARBIN, NEWBERRY & TRIBBLE, INC.
CONSULTING ENGINEERS
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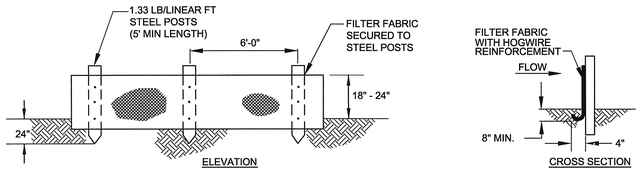
NC Corp. License No. C-0813
484 MULBERRY ST. - STE. 265
MACON, GEORGIA 31201

PROJ. NO.	6703-351-01	DWG. CMS_V-P3-17-D1	EDIT 4-30-09
SCALE	NOT TO SCALE	SHEET 17 OF 20	
DATE	APRIL, 2009		

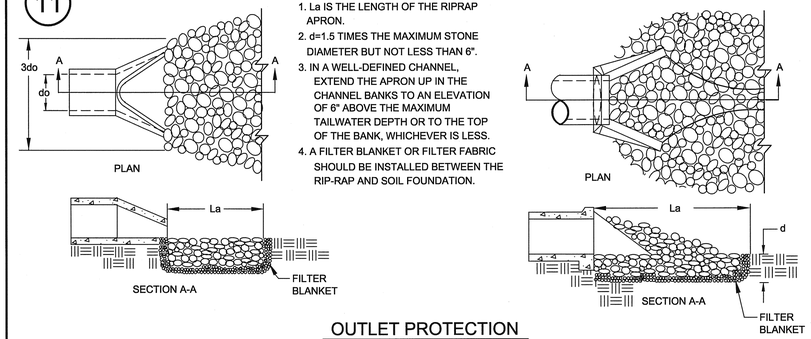
10



NOTES:
1. FLOWS MAY NECESSITATE THE PLACEMENT OF HAY BALES IN FRONT OF FILTER FABRIC.
2. FABRIC SHALL BE ATTACHED IN ACCORDANCE WITH THE NORTH CAROLINA "EROSION AND SEDIMENT CONTROL PLANNING AND DESIGN MANUAL."
3. USE 36" D.O.T. APPROVED FABRIC.
4. USE STEEL POSTS ONLY.

SILT FENCE

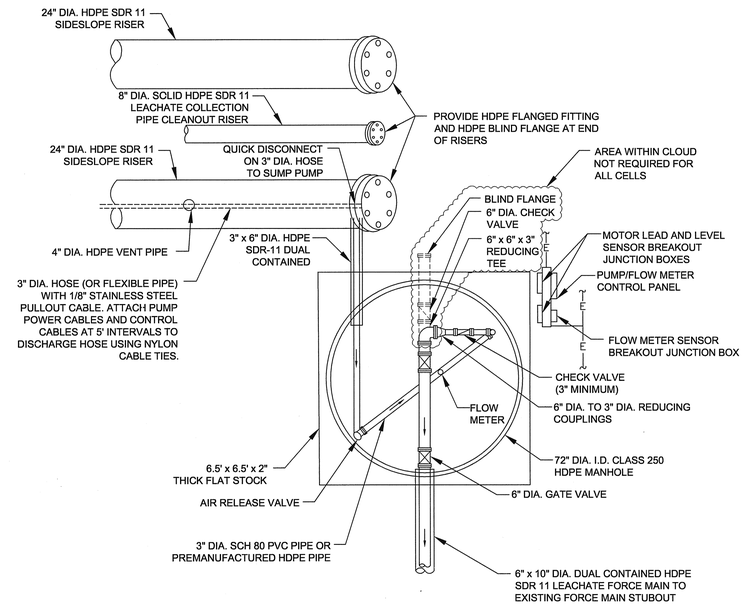
11



NOTES:
1. La IS THE LENGTH OF THE RIPRAP APRON.
2. d=1.5 TIMES THE MAXIMUM STONE DIAMETER BUT NOT LESS THAN 6".
3. IN A WELL-DEFINED CHANNEL, EXTEND THE APRON UP IN THE CHANNEL BANKS TO AN ELEVATION OF 6" ABOVE THE MAXIMUM TAILWATER DEPTH OR TO THE TOP OF THE BANK, WHICHEVER IS LESS.
4. A FILTER BLANKET OR FILTER FABRIC SHOULD BE INSTALLED BETWEEN THE RIP-RAP AND SOIL FOUNDATION.

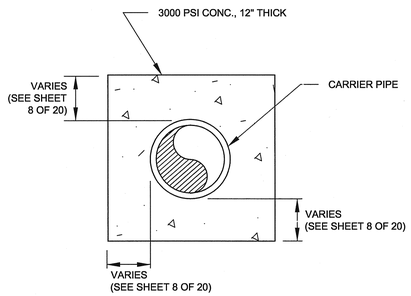
OUTLET PROTECTION

12



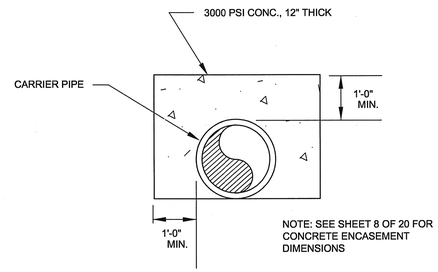
LEACHATE RISER VAULT PLAN VIEW
(PLAN VIEW)

13



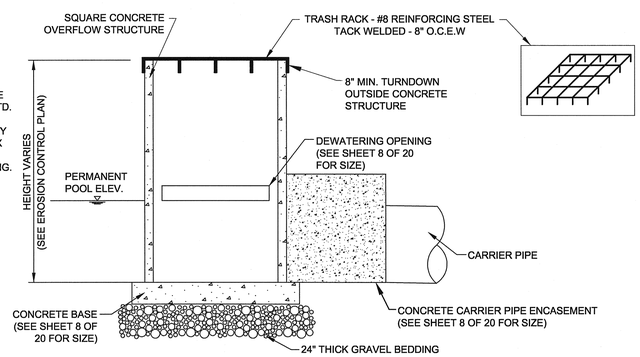
CARRIER PIPE
ANTI-SEEPAGE COLLAR

14



CARRIER PIPE
CONCRETE ENCASEMENT

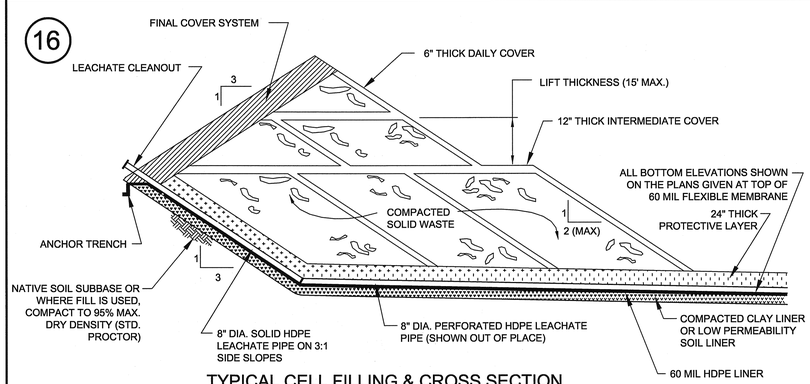
15



NOTES:
1. ALL FILL MATERIAL SHALL BE COMPACTED TO MIN. 95% STD. PROCTOR DENSITY.
2. OVERFLOW STRUCTURE MAY BE PRECAST CONCRETE BOX WITH MANUFACTURERS RECOMMENDED REINFORCING.

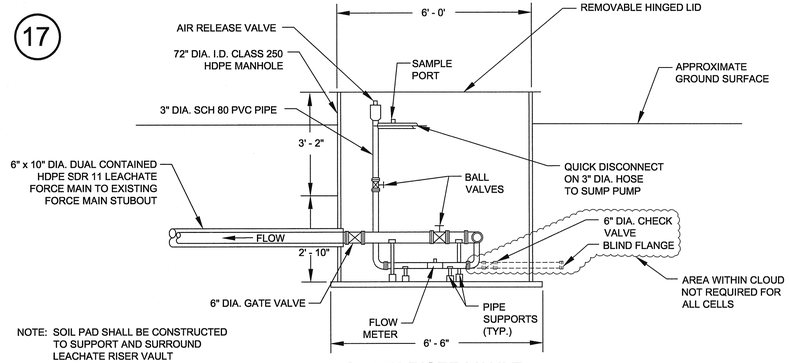
OVERFLOW STRUCTURE

16



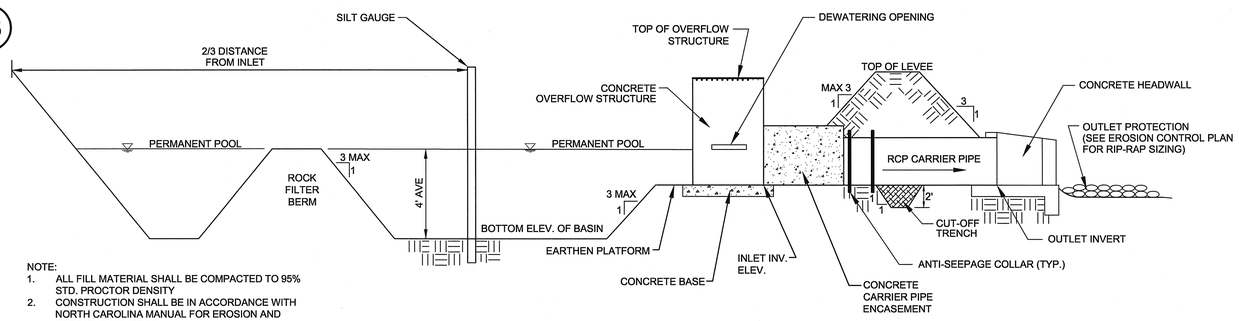
TYPICAL CELL FILLING & CROSS SECTION

17



LEACHATE RISER VAULT
(SECTION VIEW)

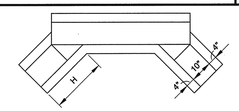
18



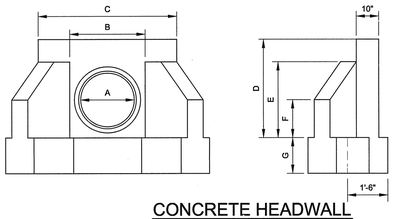
NOTE:
1. ALL FILL MATERIAL SHALL BE COMPACTED TO 95% STD. PROCTOR DENSITY
2. CONSTRUCTION SHALL BE IN ACCORDANCE WITH NORTH CAROLINA MANUAL FOR EROSION AND SEDIMENT CONTROL.
3. SEE SEDIMENT BASIN DATA CHARTS ON EROSION CONTROL PLAN FOR ADDITIONAL INFORMATION.

SEDIMENT BASIN

19



"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"
12"	1'-8"	4'-0"	2'-6"	1'-8"	1'-2"	1'-3"	1'-7"
15"	2'-0"	4'-4"	2'-10"	2'-0"	1'-3"	1'-3"	1'-7"
18"	2'-4"	4'-8"	3'-2"	2'-4"	1'-4"	1'-3"	1'-7"
24"	2'-10"	5'-2"	3'-8"	2'-10"	1'-5"	1'-4"	2'-1"
30"	3'-6"	5'-10"	4'-4"	3'-6"	1'-9"	1'-6"	2'-5"
36"	4'-0"	6'-4"	4'-10"	4'-0"	2'-0"	1'-8"	2'-11"
42"	4'-6"	6'-10"	5'-4"	4'-6"	2'-3"	2'-0"	3'-6"
48"	5'-2"	7'-6"	6'-0"	5'-2"	2'-6"	2'-0"	4'-0"
54"	5'-9"	8'-1"	6'-7"	5'-9"	2'-9"	2'-0"	4'-6"
60"	6'-4"	8'-8"	7'-2"	6'-4"	3'-0"	2'-2"	5'-0"



NOTES:
1. PRECAST CONSTRUCTION SHALL MEET THE REQUIREMENTS OF THE NC. D.O.T. AND ASTM C-478.
2. REINFORCING STEEL SHALL BE A MINIMUM OF #4 @ 6" O.C.E.W.
3. FOR TWIN PIPES, DOUBLE DIMENSIONS "B" AND "C."

CONCRETE HEADWALL

NORTH CAROLINA PROFESSIONAL SEAL 22249 ENGINEER K. MATTHEW CREER 4/30/09

NORTH CAROLINA PROFESSIONAL SEAL 16780 ENGINEER WILLIAM F. HODGES 4/30/09

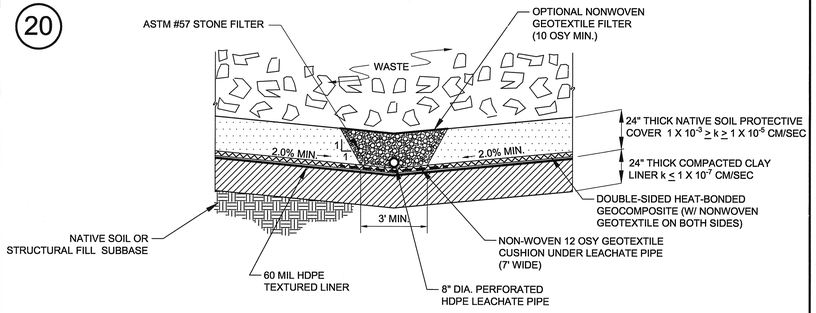
MISCELLANEOUS DETAILS

PHASE 3 ENGINEERING PLANS
CHARLOTTE MOTOR SPEEDWAY LANDFILL V
FOR
REPUBLIC SERVICES OF SOUTH CAROLINA, LLC
CABARRUS COUNTY, NORTH CAROLINA

HODGES, HARBIN, NEWBERRY & TRIBBLE, INC.
CONSULTING ENGINEERS
(478) 743-7175
(478) 743-1703(FAX)
NC Corp. License No. C-0813
484 MULBERRY ST. - STE. 265
MACON, GEORGIA 31201

PROJ. NO.	6703-351-01	DWG. CMS_V-P3-18-D2	EDIT 4-30-09
SCALE	NOT TO SCALE	SHEET 18 OF 20	
DATE	APRIL, 2009		

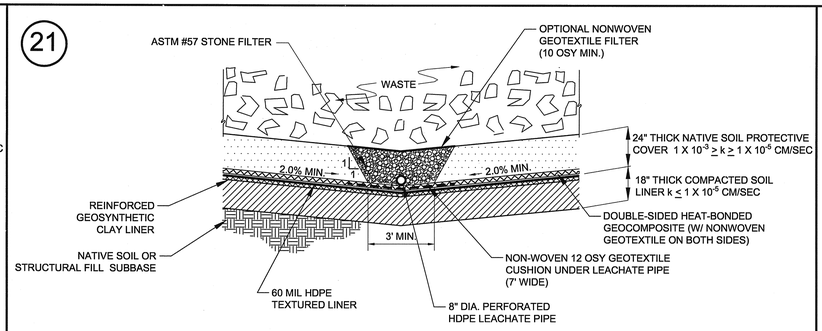
20



LEACHATE COLLECTION PIPE WITH BASE LINER SYSTEM

(SECTION LOOKING UP THE CELL)

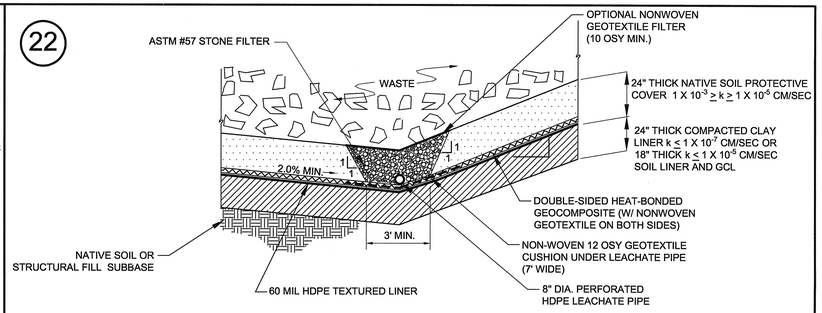
21



LEACHATE COLLECTION PIPE WITH ALTERNATE BASE LINER SYSTEM

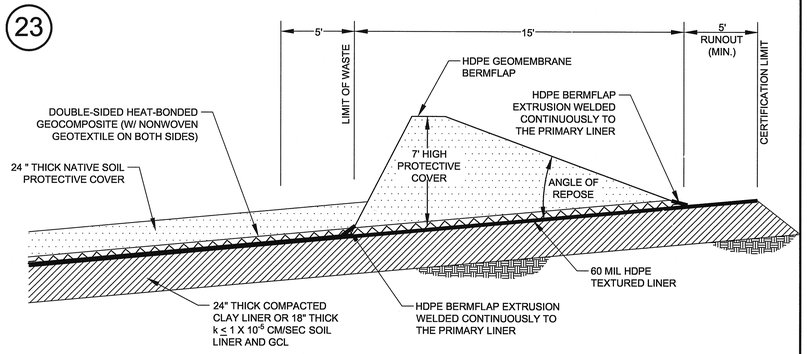
(SECTION LOOKING UP THE CELL)

22



LEACHATE COLLECTION PIPE AT TOE OF PERIMETER SLOPE (WITH BASE LINER SYSTEM)

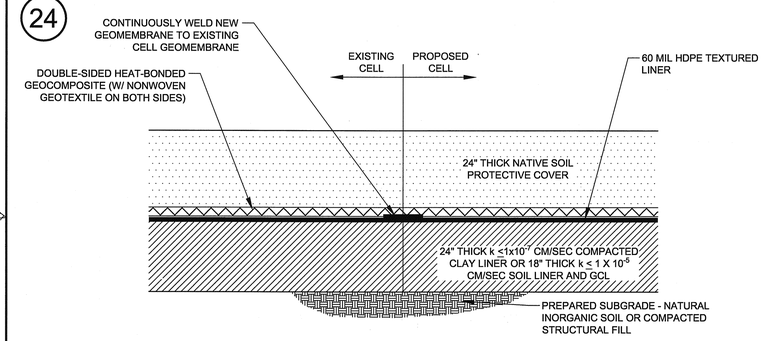
23



TEMPORARY BERM BETWEEN CELLS

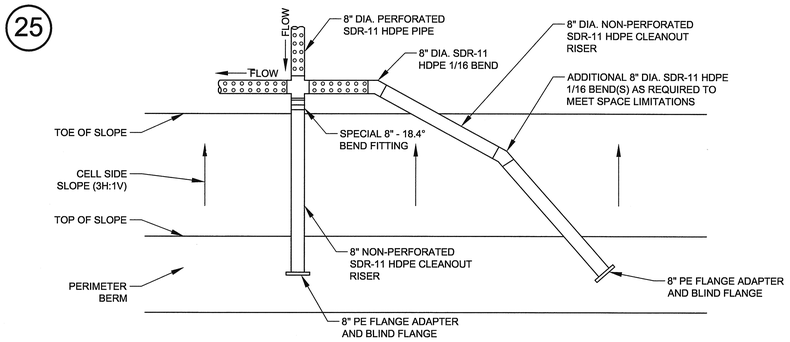
(IF REQUIRED)

24



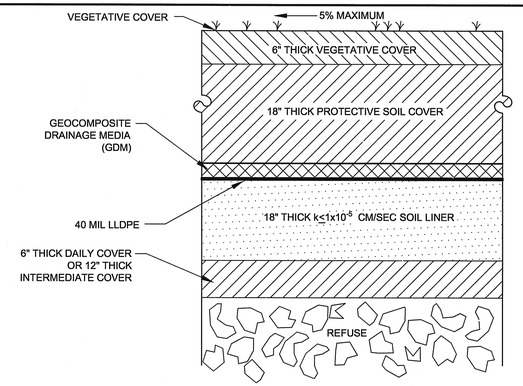
LINER SYSTEM TIE-IN WITH ADJACENT CELL (WITH BASE LINER SYSTEM)

25

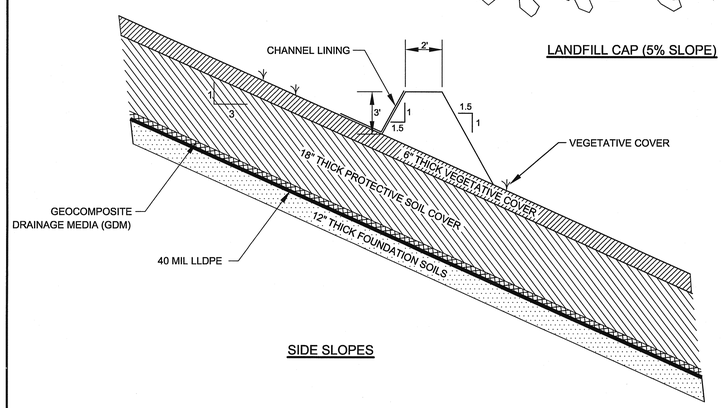


LEACHATE COLLECTION PIPES - CLEANOUT RISERS

26



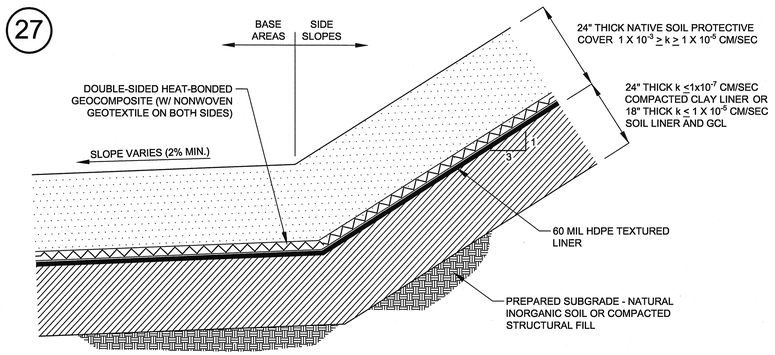
LANDFILL CAP (5% SLOPE)



SIDE SLOPES

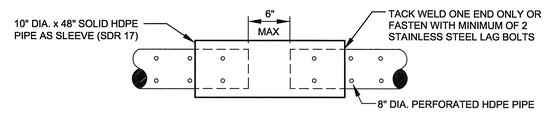
FINAL CLOSURE SECTION

27

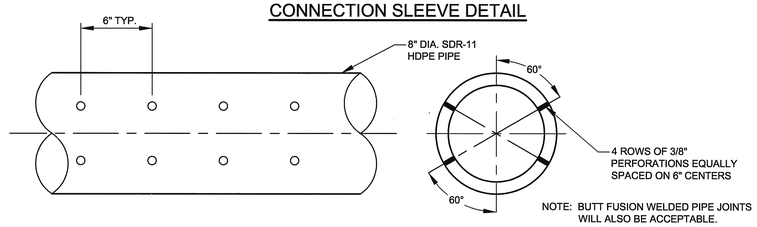


BASE LINER WITH 24" COMPACTED SOIL LINER

28

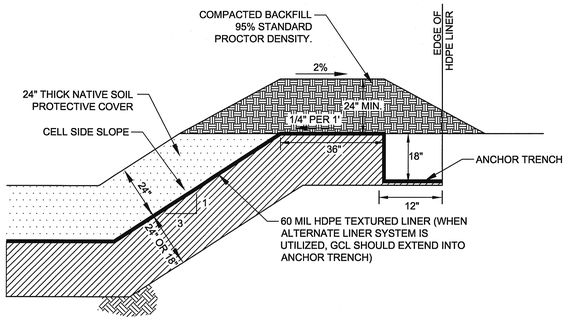


CONNECTION SLEEVE DETAIL



8" DIA. PERFORATED HDPE PIPE (SDR 11)

29



FML ANCHOR TRENCH

NORTH CAROLINA PROFESSIONAL SEAL 32249 ENGINEER J. MATTHEW CHEEK 4/30/09

NORTH CAROLINA PROFESSIONAL SEAL 16141 ENGINEER WILLIAM F. HODGES 4/30/09

MISCELLANEOUS DETAILS

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CABARRUS COUNTY, NORTH CAROLINA

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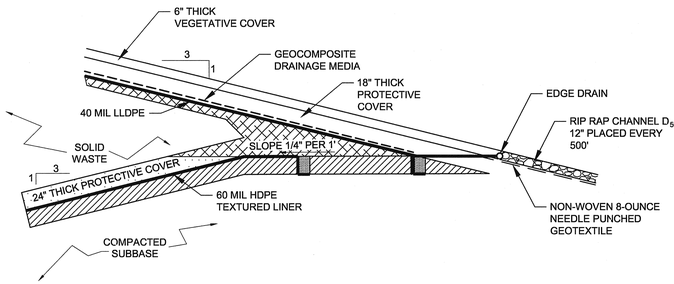
MACON, GEORGIA 31201

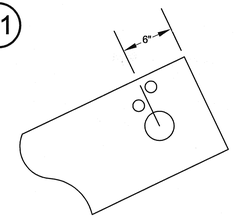
PROJ. NO.	6703-351-01	DWG. CMS_V-P3-19-D3	EDIT 4-30-09
SCALE	NOT TO SCALE	SHEET 19 OF 20	
DATE	APRIL, 2009		

30



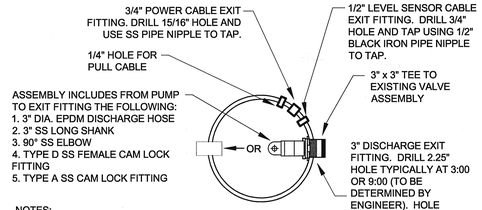
FINAL CLOSURE SECTION AT ANCHOR TRENCH

31



NOTE:
1. EXIT FITTINGS SHOULD BE PLACED APPROXIMATELY 6" BELOW THE TOP OF THE RISER AND 10" MAX. TO ALLOW REACH TO FITTINGS.

SIDE VIEW

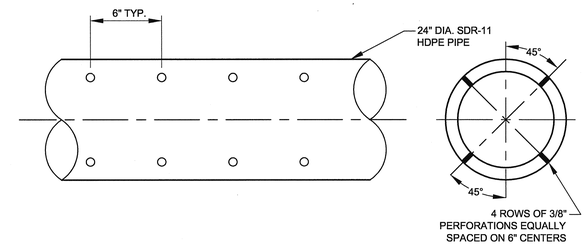


NOTES:
1. DRILL HOLE TO CORRECT SIZE AT DESIRED LOCATION.
2. THREAD EXIT NIPPLE INTO DRILLED HOLE. HOLD AT NON-THREADED BOSS AREA OR ATTACH END CAP TO TURN. EXTEND INTO RISER APPROXIMATELY 2.5".
3. ATTACH MALE CAM AND GROOVE FITTING-USE THREAD PASTE.
4. BACK UP NIPPLE UNTIL SHOULDER OF CAM AND GROOVE FITTING IS AGAINST INSIDE OF RISER PIPE WALL.
5. POSITION CABLE EXIT FITTINGS AS REQUIRED-TYPICALLY ABOVE THE DISCHARGE EXIT FITTING.
6. ALL FITTINGS TO BE EITHER HDPE OR STAINLESS STEEL (SS).
7. ALL BOLD ITEMS IN THIS DETAIL TO BE STAINLESS STEEL.
8. THE 24" DIA. RISER PIPE SHALL BE CLEANED OF ALL HDPE PIPE SHAVINGS ONCE DRILLING IS COMPLETE. ALL SHAVINGS SHALL BE REMOVED FROM INSIDE THE PIPE PRIOR TO PLACING THE SYSTEM INTO OPERATION.

INTO 24" RISER VIEW

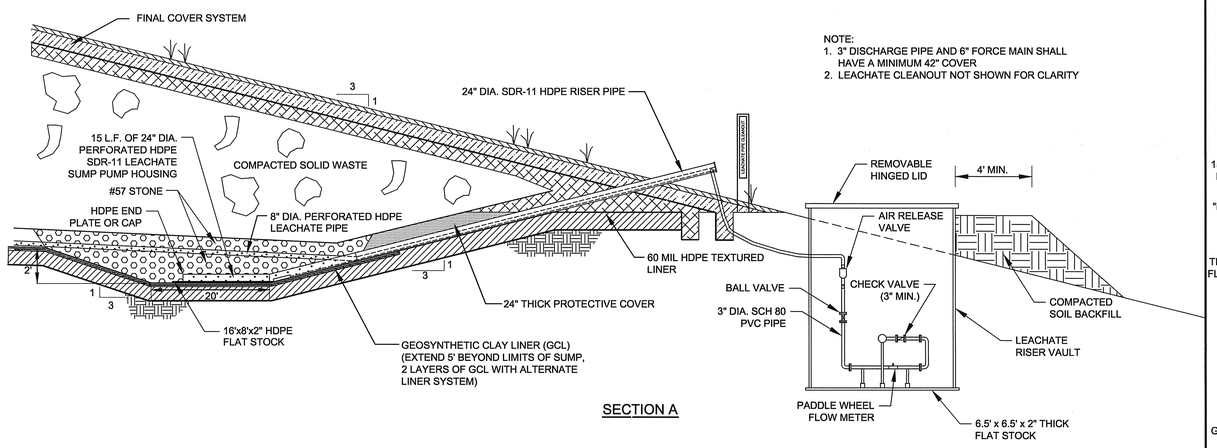
24" RISER SIDE EXIT
(SECONDARY CONTAINMENT NOT SHOWN FOR CLARITY)

32



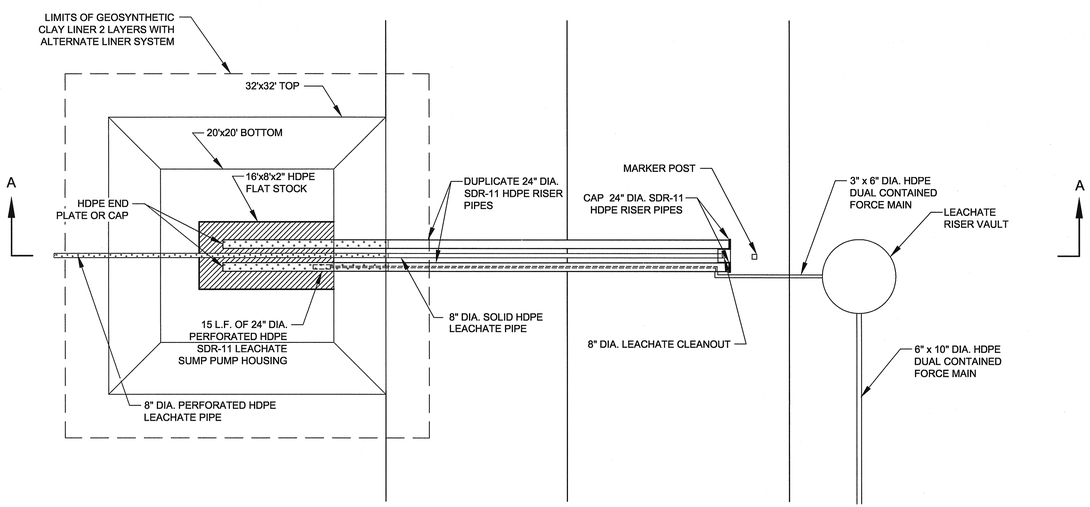
24" DIA. SDR-11 HDPE PERFORATED SUMP HOUSING DETAIL

33



NOTE:
1. 3" DISCHARGE PIPE AND 6" FORCE MAIN SHALL HAVE A MINIMUM 42" COVER
2. LEACHATE CLEANOUT NOT SHOWN FOR CLARITY

SECTION A

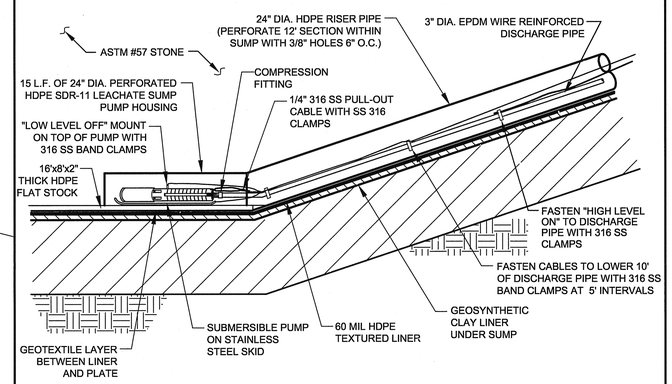


PLAN VIEW

NOTE: ENTIRE SUMP SHALL BE FILLED WITH ASTM #57 GRAVEL

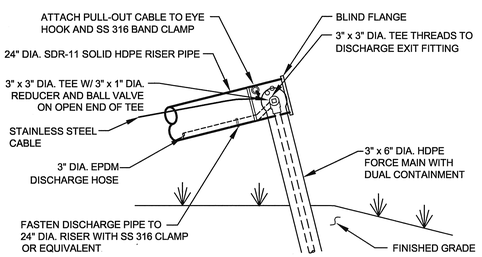
LEACHATE SUMP ASSEMBLY

34



LEACHATE SUMP PUMP

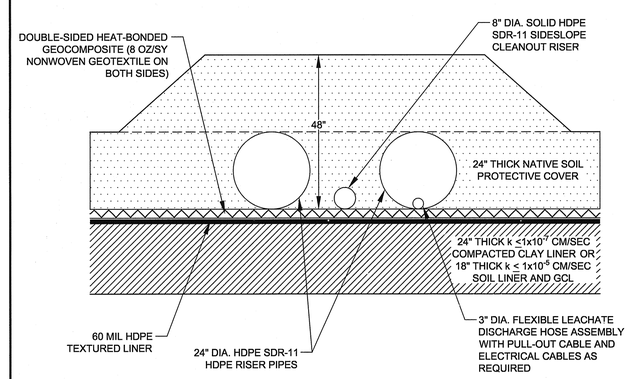
35



NOTE:
WRAP DISCHARGE PIPE AND FITTINGS WITH INSULATION AND HEAT TAPE.

FORCE MAIN FITTINGS

36



LEACHATE SIDESLOPE RISER SECTION

MISCELLANEOUS DETAILS

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PROJ. NO.	6703-351-01	DWG. CMS_V-P3-20-D4	EDIT 4-30-09
SCALE	NOT TO SCALE	SHEET 20 OF 20	
DATE	APRIL, 2009		

XI. CORRESPONDENCE

XI. CORRESPONDENCE

NCDENR

STATE OF NORTH CAROLINA
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF WASTE MANAGEMENT

MUNICIPAL SOLID WASTE FACILITY PERMIT
PERMIT NO. 13-04

BFI WASTE SYSTEMS OF NORTH AMERICA, INC.,
a wholly owned subsidiary of Allied Waste Industries, Inc.
is hereby issued a

PERMIT to OPERATE
the
CHARLOTTE MOTOR SPEEDWAY LANDFILL V
Cell 2G

located at Morehead Road, Concord, Cabarrus County, North Carolina, in accordance with Article 9, Chapter 130A, 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 and described by the legal description found in the approved application.

Edward F. Mussler III, P.E.
cn=Edward F. Mussler III, P. E., c=US, o=Division of Waste Management, ou=Solid Waste Section, email=ed.mussler@ncmail.net
I have reviewed this document and am approving this document
2008.10.07 11:14:24 -04'00'

Edward F. Mussler, III, P.E.,
Permitting Branch Supervisor
Solid Waste Section

ATTACHMENT 3

PERMITTING HISTORY

Permit Type	Date Issued
Original Issue (PTC)	April 1, 1991
Original Issue (PTO)	August 22,1992
Amendment 1 (Cell B)	September 16, 1993
Permit Renewal (Facility Plan& 2A-2E)	April 25, 1995
Transition Plan Approval (Cell 1A)	May 23, 1996
Amendment 2 (PTC) Vertical Expansion	December 17, 2001
Amendment 3 (PTO) Vertical. Expansion/Cell 2L	August 21, 2002
Amendment 4 (PTC) 2F, 2G, & 2H	July 14, 2006
Amendment 5 (PTO) 2F	July 12, 2007
Amendment 6 (PTO) 2G	October 7, 2008

Part I List of Documents for the Approved Facility Plan

Documents 1-10 listed in previous permits.

11. *Permit Modification Application, Facility, Engineering and Erosion Control Drawings, and CQA and Operations Plans for the Charlotte Motor Speedway Landfill V, NCDENR Permit No. 1304 Concord, North Carolina.* Prepared by: ESP Associates and Almes & Associates, Inc. Prepared for: BFI Waste Systems of North America, Inc. May 7, 2004. As amended through December 6, 2005, NCDENR hydro comments and responses by ESP Associates Inc., and NCDENR Engineering comments answered by BFI Waste Systems of North America Inc. and ESP Associates Inc. through March 16, 2006.

    a. Site Suitability Update for BFI Waste Systems of North America, Inc, CMS Landfill V – Lateral Expansion Phase 2 Expansion (Cells 2F, 2G & 2H) and Phases 3, 4, & 5. Prepared by: ESP Associates, P.A. Prepared for: BFI Waste Systems of North America, Inc. May 6, 2004.

    b. Revised Plans for NCDENR – Division of Solid Waste Management, Hydrogeologic Comments prepared by Almes & Associates, Inc., and ESP Associates, P.A., December 20, 2005.

    c. Response to Comments prepared by ESP Associates, P.A., November 2005

    d. Revised Plan Sheets for Application to Construct. Prepared by: ESP Associates, P.A. December 20, 2005.

12. Certified Copy of Franchise Ordinance from Benne C. Hutson of Helms Mulliss Wicker with attached "An Ordinance Renewing A Nonexclusive Franchise to BFI of North America, Inc." from the City of Concord dated February 10, 2005.

13. *Final Certification Report, Construction Quality Assurance Services, Volumes I and II, Cell 2F Construction, Charlotte Motor Speedway Landfill V.* Prepared for: Allied Waste. Prepared by: ACC of North Carolina, LLC. May 2007.

14. *Final Certification Report, Construction Quality Assurance Services, Cell 2G Construction, Soil Component Construction, Charlotte Motor Speedway Landfill V, Cabarrus County, North Carolina.* Prepared for: Allied Waste. Prepared by: ACC of North Carolina, LLC. July 22, 2008.

15. *Final Certification Report, Construction Quality Assurance Services, Cell 2G Construction, Geosynthetic Component Construction, Charlotte Motor Speedway Landfill V, Cabarrus County, North Carolina.* Prepared for: Allied Waste. Prepared by: ACC of North Carolina, LLC. August 19, 2008.

Part II Construction and Demolition Landfill Conditions
(NOT APPLICABLE)

Part III Land Clearing and Inert Debris Landfill Conditions
(NOT APPLICABLE)

Part IV Yard Waste Conditions
(NOT APPLICABLE)

Part V Miscellaneous Treatment and Processing Facilities Conditions
(NOT APPLICABLE)

- End of Section-

ATTACHMENT 4
CONDITIONS OF PERMIT TO OPERATE

Part I General Facility Conditions

1. This permit shall expire July 12, 2012. Pursuant to 15A NCAC 13B .0201(e), no later than March 12, 2012, the permittee must submit an application for amendment or modification to the permit for review to the North Carolina Department of Environment and Natural Resources (Department), Division of Waste Management (Division), Solid Waste Section (Section). The application must be prepared in accordance with 15A NCAC 13B .1600, as applicable.

2. The person(s) to whom this permit is issued ("permittee") are the owner(s) and operator(s) of the solid waste management facility.

3. (Intentionally Blank)

4. (Intentionally Blank).

5. By receiving waste at this facility the permittee shall be considered to have accepted the terms and conditions of this permit.

6. Operation of this solid waste management facility must be in accordance with the Solid Waste Management Rules, 15A NCAC 13B, Article 9 of the Chapter 130A of the North Carolina General Statutes (NCGS 130A-290, et seq.), the conditions contained in this permit; and the approved plan. Should the approved plan and the rules conflict, the Solid Waste Management Rules shall take precedence unless specifically addressed by permit condition.

7. This permit is issued based on the documents submitted in support of the permit application for the facility including those identified in Attachment 1 and Attachment 3, "List of Documents for Approved Plan," which constitutes the approved plan for the facility. Where discrepancies exist, the most recent submittals and the Conditions of Permit shall govern.

8. This permit may be transferred only with the approval of the Section and through the issuance of a new or substantially amended permit in accordance with applicable statutes and rules. In accordance with NCGS 130A-295.2(g) the permittee shall notify the Section thirty (30) days prior to any significant change in the identity or business structure of either the owner or the operator, including but not limited to a proposed transfer of ownership of the facility or a change in the parent company of the owner or operator of the facility.

9. The permittee is responsible for obtaining all permits and approvals necessary for the development of this project including approval from appropriate agencies for a General or Individual NPDES

Stormwater Discharge Permit. Issuance of this permit does not remove the permittee's responsibilities for compliance with any other local, state or federal rule, regulation or statute.

10. Additional conditions and revision of the approved documents or changes during the operation of the landfill require approval by the North Carolina Solid Waste Section.

11. On or before August 1 annually, the Permittee shall report the amount of tons waste received at this facility and disposed of in the landfill units to the Solid Waste Section and to all counties from which waste was accepted on forms prescribed by the Section. This annual report shall include the following information:

    a. The reporting period shall be for the previous year beginning July 1 and ending June 30.

    b. The annual report shall list the amount of waste received and landfilled in tons and be compiled:

        i) On a monthly basis,
        ii) By county, city or transfer station of origin,
        iii) By specific waste type,
        iv) By disposal location within the facility, and
        v) By diversion to alternative management facilities.

    c. A measurement of the volume utilized in the MSW cells shall be performed during the second quarter of the calendar year. The date and volume, in cubic yards, shall be included in the report.

    d. The completed report shall be forwarded to the Regional Waste Management Specialist for the facility. A copy of the completed report shall be forwarded to the County Manager of each county from which waste was received.

    e. The facility shall maintain records for all solid waste materials accepted as alternative cover material and used as alternate daily cover. The records shall include: the date of receipt, weight of material, general description of the material, identity of the generator and transporter, and county of origin. Such records shall be made available to the Section upon request.

12. Ground water quality at this facility is subject to the "Classifications and Water Quality Standards Applicable to the Groundwater of North Carolina", 15A NCAC 2L. This includes, but is not limited to, provisions for detection monitoring, assessment, and corrective action.

Part II Municipal Solid Waste Landfill Conditions

Specific Conditions

13. The facility is approved for a total gross capacity of approximately 61,531,035 cubic yards including development of the constructed Cell 2G and to be constructed 2H; Phases 3, 4 and 5; and the existing permitted landfill in accordance with the Division approved plans.

14. Landfilling operation is approved in accordance with the Solid Waste Management Rules, approved plan and these permit conditions for Cell 2G. This Permit only authorizes the operation Cell 2G for MSW disposal consisting of 14 acres.

15. A Permit to Construct remains in effect for Cell 2H. Operation of Cell 2H may not commence until application is made for and a Permit to Operate is issued for the specific use of this cell.

16. Franchise and Site Suitability approval is in effect for Phases 3, 4 and 5 for approximately 15,386,000 cubic yards of capacity. However, application for a Permit to Construct is required prior to the initiation of construction activities for those phases.

17. The dimensions of Cells 2G and 2H are as follows:

Cell	Acres	Gross Capacity		Approximate Service Years
		Cubic Yards	Tons*	
2G	14.0	2,223,947	1,779,158	1.2
2H	13.5	1,777,450	1,421,960	1.0
Totals	27.5	4,001,397	3,201,118	2.2

**Based on 0.8 tons per cubic yard as presented on page 5, Section 3.0 of the approved Permit Modification application dated May 2004 with approved amendments.*

18. This permit approves operation of Cell 2G consistent with the final contours as shown on Drawing No. FC-7 contained in the "Permit Modification Application" revision date December 2005.

19. This landfill is permitted to receive solid waste generated within the City of Concord, Cabarrus County, the State of North Carolina, and the following counties in the State of South Carolina: Cherokee, York, Lancaster, Chesterfield and Chester and serve the associated populations except as may be prohibited by North Carolina General Statutes Article 9 of Chapter 130A and rules adopted by the Commission for Health Services.

20. The franchise issued for this facility by the City of Concord provides for an average annual disposal rate of 120,000 tons per month not to exceed a maximum of 140,000 tons per month.

Monitoring and Reporting

21. Groundwater monitoring at this unit must be performed in compliance with the appropriate requirements of 15A NCAC 13B .1630 through .1637 and the approved monitoring plan.

22. A readily accessible unobstructed path shall be cleared and maintained so that four-wheel drive vehicles may access monitoring well locations at all times.

23. A field log book that details all development, sampling, repair, and all other pertinent activities associated with each monitoring well and all sampling activities associated with each surface water and leachate sampling location shall be kept as part of the permanent facility record.

24. Records of all groundwater, surface water and leachate analytical data shall be kept as part of the permanent facility record.

25. Reports of the analytical data for each water quality sampling event shall be submitted to the Section within 60 days of the respective sampling event. Analytical data shall be submitted in a manner prescribed by the Section.

26. The four independent samples that comprise the initial baseline sampling event shall be collected from each groundwater monitoring well and the report shall be submitted to the Section within six months after issuance of the Permit to Operate.

27. Untreated leachate shall be sampled and analyzed at least semi-annually concurrently with the ground and surface water sampling. The leachate shall be analyzed for all Appendix I constituents, pH, specific conductance, BOD, COD, sulfates, nitrates, and phosphates. Test results shall be submitted to the Section along with ground and surface water test results. In the event leachate is recirculated, additional leachate sampling may be required.

Operational Conditions

28. The landfill unit shall conform to all operating requirements described in the approved plans, 15A NCAC 13B .1626, and the conditions specified herein.

29. The use of alternative daily cover requires approval, prior to implementation, by the Solid Waste Section. Requests for alternative daily cover approval must include a plan detailing the comprehensive use and a demonstration of the effectiveness of the alternative daily cover. The plan shall be developed according to Section guidelines. Plans that are approved by the Section will be incorporated into and made a part of the permit.

    a. The use of automobile shedder fluff mixed with soil, petroleum contaminated soil, tarps and foundry sand as alternate daily cover is approved when used as per the approved demonstration project reports.

30. The use of leachate recirculation as a leachate management tool requires written approval by the Solid Waste Section prior to implementation.

    b. Requests for leachate recirculation approval must include a comprehensive management plan developed according to Section guidelines and be consistent with the approved operation plan.

c. Plans, which are approved by the Section, will be incorporated into, and made a part of, the approved documents found in Attachment 3.

d. If approved, only leachate originating from the unit shall be recirculated in the unit and the unit must comply with the design requirements contained in Solid Waste Rule 15A NCAC 13B .1624.

31. The landfill facility is permitted to co-dispose of wastewater treatment sludge generated within the facility's approved service area, and subject to the terms and procedures of the approved plan.

32. Closure or partial closure of any MSWLF unit shall be in accordance with the Closure Plans described in the approved plans and 15A NCAC 13B .1629. Final Closure Plans shall be submitted to the Division at least 90 days prior to implementation. Closure and Post-closure plans, including financial instruments shall be updated annually pursuant to 15A NCAC 13 B .1628.

33. Waste boundary posts will be installed marking the edge of the waste footprint.

- End of Section -

Part III Construction and Demolition Debris Unit
(NOT APPLICABLE)

Part IV Land Clearing and Inert Debris Unit
(NOT APPLICABLE)

Part V Yard Waste Unit
(NOT APPLICABLE)

Part VI Miscellaneous Treatment and Processing Unit
(NOT APPLICABLE)

- End of Section

NCDENR
North Carolina Department of Environment and Natural Resources
Division of Waste Management

Beverly Eaves Perdue
Governor

Dexter R. Matthews
Director

Dee Freeman
Secretary

March 31, 2009

David Garrett, P.G., P.E.
David Garrett & Associates
5105 Harbour Towne Drive
Raleigh, NC 27604

RE: Application for Permit to Construct, Expansion
CMS Landfill V-Phase 3 (Cells 2I, 2J, 2K, 2M), MSW Landfill
Additional Information Request – Design Hydrogeologic Report
Permit No. 13-04
Document No. 7121

Dear Mr. Garrett:

The above referenced Design Hydrogeologic Report for the proposed expansion Phase 3 (Cells 2I-2K and 2M) of CMS Landfill V-Phase 3, MSW Landfill has been submitted by David Garrett & Associates, on behalf BFI Waste Systems of North America, Inc.; Charlotte Motor Speedway (CMS) MSW Landfill V-Phase 3, in Cabarrus County. There are several items in the Hydrogeologic Report that require clarification and/or revision before the hydrogeologic review can be completed. Please respond to the following questions and comments:

Design Hydrogeologic Report – August 29, 2008
Contents –
Lists of Tables
Table 1B – Test Pit Data
Section 3.4.1 – Test Pits

Page 3-8 under Section 3.4.1 (Test Pits) states in-part: "A summary of soils data collected from the test pits is presented in Table 1B. Table 1B could not be located in the Hydrogeologic Report; please submit the table.

Design Hydrogeologic Report – August 29, 2008
Section 1.0 Introduction
Sheet No's. 2, 3, 9

Section 1.0, Page 1-2 states in-part: *"The poor drainage within the "saddle" area gave rise to the tentative identification of a small wetlands area within the central portion of Phase 3. A recent delineation has been performed (in 2008) by a qualified consultant (Carolina Ecosystems), which confirmed the presence of wetlands, perhaps smaller than originally mapped by a previous consultant, but as of this writing the US Army Corps of Engineers has yet to make a final determination of the size of the wetlands impact....." "That determination will be pursued while this work is under review by NC DENR Division of Waste Management. Revisions to this report will be made once the Corps has made those determinations".*

The maps provided in the report delineate areas of wetlands east of proposed cells 2I and 2J, outside of the proposed footprints. As stated above small areas of possible wetlands maybe located within the central portion of Phase 3, but are not delineated on the maps provided. <u>As stated above, keep the Division of Waste Management (Solid Waste Section) updated on the US Army Corps of Engineer's wetland determination.</u>

Design Hydrogeologic Report – August 29, 2008
Section 3.0 – Hydrogeologic Investigation
Section 3.2.3 – Springs, Seeps, and Ground Water Discharge Features
Appendix F – Water Quality Monitoring Plan
Section 1.3 – New Monitoring Location Criteria
Table 1 – Monitoring Well and Surface Water Sampling Location Data
Sheet No's. 3,4,5,6, and 9

Section 3.2.3, Page 3-3 states in-part the following: *"No perennial streams were noted in the Phase 3 area, but there are man-made drainage ditches present. The central "saddle" (within Phase 3) drains via the ditches toward the seasonal spring, which drains via a small intermittent stream within the Furr tract to an unnamed tributary east of the study area. This stream, in turn, drains to the Rocky River".*

Perhaps a shallow screened monitor well should be located near this preferential flow area between proposed groundwater monitoring wells, MW-43 and MW-44. <u>Further open discussion for location of this well and other proposed groundwater monitoring wells is suggested to determine final location of proposed wells</u>.

Section 1.3, page 2 of the Water Quality Monitoring Plan (Appendix F) states in-part: *"Based on a review of the site topography and hydrogeologic conditions. A monitoring network for Phase 3 should +consist of ten (10) new well locations (MW-35 – MW-44)."* Table 1, Page 19 of the Monitoring Plan is titled "Phase II Monitoring wells" and lists the wells as proposed wells. Other sections of the report (i.e. the statement mentioned above) and maps (i.e. Sheet No. 9) refer to the new phase, as "Phase 3". Please revise accordingly.

Design Hydrogeologic Report – August 29, 2008
Section 3.0 – Hydrogeologic Investigation
Section 3.6.2 – Long-Term Water Levels
Appendix D – NOAA and NURE Data
Appendix E – Slug Test Data and Permeability Calculations
F – Water Quality Monitoring Plan

Page 3-15, second, third, and fourth paragraph of Section 3.6.2 refers to Appendix E, pertaining to climatic data. The correlating Appendix is probably Appendix D, instead of E. Please revise accordingly.

Design Hydrogeologic Report – August 29, 2008
Appendix C – Geotechnical Laboratory Data

This data is missing in the Report; please submit accordingly.

Design Hydrogeologic Report – August 29, 2008
Appendix E – Slug Test Data and Permeability Calculations

This data is missing in the Report; please submit accordingly.

Design Hydrogeologic Report
Appendix F – Water Quality Monitoring Plan

According to recent groundwater sampling data, some of the existing groundwater monitoring wells at the facility are designated as assessment monitoring wells. The wells are MW-12, MW-14, MW-18A, MW-19, MW-19A, and MW-20B. The Water Quality Plan listed in Appendix F does not list these wells for Appendix II monitoring; therefore, please modify the text and associated tables to reflect this.

Please update the Water Quality plan accordingly to include recent Solid Waste Section guidelines. The guidelines are located at the Solid Waste Section's web site, under the subcategory "Environmental Monitoring". The web link address to this portion of the Solid Waste Section's main page is:
http://www.wastenotnc.org/swhome/enviro_monitoring.asp

Pertinent guidelines to include in the monitoring plan are:

"Groundwater, Surface Water, and Soil Sampling for Landfills"
"Leachate Sampling and Analysis"
"Solid Waste Environmental Monitoring Data Form"
"Electronic Data Deliverable (EDD) Template"
"October 2007 Memo"
"October 2006 Memo"
"Addendum to the October 2006 Memo"

==========

Please note the comments and questions raised above and provide additional information and revisions as needed. If you have any questions or wish to schedule a meeting to discuss the items referenced in this letter, please call me at 919-508-8524.

Sincerely,

Brian Wootton

Brian Wootton
Hydrogeologist
Solid Waste Section

cc:	Mike Gurley, Env. Manager	BFI Waste Systems of NA, Inc.
	Ed Mussler, P.E.	Solid Waste Section
	John Murray, P.E.	Solid Waste Section

ESP Associates, P.A.
engineering • surveying • planning

December 13, 2004

State of North Carolina
Department of Environment and
Natural Resources
Division of Waste Management
401 Oberlin Road
Raleigh, North Carolina 27605

ATTENTION: Ms. Sheri Coghill

Reference: **EROSION AND SEDIMENTATION CONTROL PLAN LETTER OF APPROVAL**
CMS LANDFILL V, CELLS 2F – 2H
Concord, North Carolina

Ms. Coghill:

ESP Associates, P.A. (ESP) has received the Erosion and Sedimentation Control Approval Letter for the referenced project issued on December 8, 2004 by Cabarrus County, North Carolina. A copy of the approval letter is attached for inclusion with our Application for Permit Modification dated May 2004.

If you should have any questions or require additional information concerning this submittal, please contact me at (704) 504-1015.

Sincerely,

ESP Associates, P.A.

David W. Wasiela, P.E.
Project Engineer
N.C. Registration No. 20770

Cc: Mr. Mike Gurley – BFI

Attch: Letter of Approval from Cabarrus County

P.O. Box 7030, Charlotte, NC 28241, (704) 583-4949 Fax (704) 583-4950
www.espassociates.com

Commerce Department
Environmental Protection Division

RECEIVED

DEC 1 0 2004

ESP ASSOCIATES, P.A.

December 8, 2004

Mr. Mike Gurley
BFI Waste System of North America Inc.
5105 Morehead Road
Concord NC 28027

Environmental Protection Division
RE: LETTER OF APPROVAL
(For Sites with Disturbed Area Exceeding Five (5) Acres)
Project Name: CMS Landfill V Phases 2 and 3
Location: Pitt School Road
Submitted By: ESP Associates P.A.
Date Received: December 1, 2004
New Submittal:_____ Revision: X
River Basin: Yadkin

Dear Mr. Gurley:

This office has reviewed the subject erosion and sedimentation control plan. We find the plan to be acceptable and hereby issue this letter of approval.

Please be advised that Cabarrus County Soil Erosion & Sedimentation Control Ordinance (Sec. 17[c]) and Title 15 NCAC 4B.0017(a) requires that a copy of the approved erosion control plan be on file at the job site. You should consider this letter to give the Notice required by the Ordinance (Sec. 19) and G.S. 113A-61(d) of our right of periodic inspection to insure compliance with the approved plan. Please note self inspection of erosion and sedimentation control measures are required for land disturbing activities five (5) or more acres disturbed. Ordinance (Sec. 19[f]). **Activities indicated on approved plans not completed within eighteen (18) months of the date of approval shall be deemed null and void.**

Cabarrus County Soil Erosion & Sedimentation Control Ordinance and North Carolina's Sedimentation Pollution Control Program is performance oriented, requiring protection of the natural resources and adjoining properties. If following the commencement of this project it is determined that the erosion and sedimentation control plan is inadequate to meet the requirements of the Ordinance (Sections 1 thru 23) and the Sedimentation Pollution Control Act of 1973 (North Carolina General Statute 113A-51 thru 66), this

office may require revisions to the plan and implementation of the revisions to insure compliance with the Ordinance and the Act.

> "The land-disturbing activity described in this plan may be subject to the approval of other Local, State or Federal agencies. This could include the Division of Water Quality under storm water or water quality regulations, the U.S. Army Corps of Engineers under Article 404 jurisdiction, county, city or town agencies under other local ordinances, or other approvals that may be required. This approval cannot supersede any other permit or approval."

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 a starting date for this project.

Also note that the Ordinance (Sec. 19[g]) indicates a certificate of occupancy will not be issued if the tract is deemed to be in violation of this ordinance.

Your cooperation is appreciated, and we look forward to working with you on this project.

Sincerely,

F.A. "Tony" Johnson, Jr., CPESC
Erosion Control Specialist

FAJ/apg
cc: Inspection Dept.
ESP Associates P.A.

CERTIFICATE OF PLAN APPROVAL

The posting of this certificate certifies that an erosion and sedimentation control plan has been approved for this project by Development Services, Cabarrus County, North Carolina in accordance with Cabarrus County Soil Erosion and Sedimentation Control Ordinance, Sec. 6 (a), Sec. 7 (d), Sec. 17 (a) and North Carolina General Statue, 113A - 57 (4) and 113A - 54 (d) and with 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 Cabarrus County Soil Erosion and Sedimentation Control Ordinance Sec. 7 (c) and the North Carolina Administrative Code, Title 15A, Chapter 4B.0027 (b).

CMS LANDFILL V PH. 2 + 3

Project Name and Location

12/8/04

Date of Plan Approval

Erosion Control Specialist

ESP Associates, P.A.
engineering • surveying • planning

July 28, 2004

Cabarrus County
Office of Development Services
Post Office Box 707
Concord, North Carolina 28026-0707

Attention: Mr. F.A. "Tony" Johnson, Jr.
Erosion Control Specialist

Reference: **EROSION AND SEDIMENTATION CONTROL PLAN**
RESPONSE TO COMMENTS DATED JULY 6, 2004
CMS LANDFILL V, LATERAL EXPANSIONS
Concord, North Carolina
ESP Job No. E3-RC23

Mr. Johnson:

On behalf of BFI Waste Systems of North America, Inc. (BFI), ESP Associates, P.A. (ESP) is submitting with this letter revised erosion and sedimentation control plans and supporting calculations for your review and approval. The plans have been revised pursuant to the list of comments received from Cabarrus County Developmental Services, Soil Erosion and Sediment Control dated July 6, 2004. A copy of the comments is attached for reference.

Review Fee

After discussing the proposed plan with Mr. Tony Johnson, we understand that the previously permitted area must be reviewed again due to the revisions to proposed grades. Therefore, we are submitting a revised Financial Responsibility Ownership Form and additional fee of $1,320.00.

Northwest Corner

A sediment trap has been proposed to control sediment runoff in the northwest corner of the site. Design calculations are attached with this submittal and the location and construction details for the sediment trap are included on the revised plans (attached).

Construction Entrance

As stated in previous submittals, the proposed development is adjacent to an existing landfill that will receive surplus excavated for proposed development. Borrow areas for fill soils are on-site

P.O. Box 7030, Charlotte, NC 28241, (704) 583-4949 Fax (704) 583-4950
www.espassociates.com

and are previously permitted. Landfill roads are washed on a regular basis to deter build up of mud and dust. A construction entrance is not necessary for the on-going operations and on-going construction at this facility (Reference ESP submittal of July 1, 2002, Revised Erosion and Sedimentation Control Plan, CMS Landfill V, Cells 2F – 2G, approved by Cabarrus County).

Stabilization of Fill and Slopes

Notes have been revised on the detail sheet to require stabilization of fill areas and slopes in 15 days in lieu of 30.

Construction Sequence

The construction sequence on the detail sheet has been revised to include a pre-construction meeting and an inspection by Cabarrus County Erosion Control following installation of erosion & sedimentation control devices.

Settling Efficiency

Settling Efficiency for sediment basins and sediment traps has been added onto the details.

A copy of the calculations and associated plans are attached within this submittal. If you should have any questions or require additional information concerning this project, please contact me at (704) 504-1015.

Sincerely,

ESP Associates, P.A.

David W. Wasiela, P.E.
Project Engineer
N.C. Registration No. 20770

7-28-04

cc: Mr. Tony Johnson – Cabarrus County (1)
Mr. Mike Gurley – BFI Waste Systems of North America, Inc. (1)

Attch: Comments dated July 6, 2004
Financial Responsibility / Ownership Form
Fee
Calculations
Revised Erosion Control Plans

Commerce Department
Environmental Protection Division

RECEIVED

ESP ASSOCIATES, P.A.

July 6, 2004

Mr. Mike Gurley
BFI Waste System of North Carolina
5105 Morehead Road
Concord NC 28027

Dear Mr.Gurley:

This office has received a soil erosion and sediment control plan for the project listed on page two which was submitted as required by the Cabarrus County Soil Erosion and Sedimentation Control Ordinance and by the North Carolina Sedimentation Pollution Control Act (G.S. 113A-57).

Please be advised that the Ordinance the Act requires that all persons disturbing an area of one or more acres of land must obtain approval of a soil erosion control plan prior to the commencement of the land-disturbing activity. The Ordinance and the Act further states that this plan must be filed a minimum of thirty (30) days prior to the activity and the approving authority must approve or disapprove the submitted plan within thirty (30) days of receipt. Failure of the approving authority to approve or disapprove the submitted plan within the thirty (30) day period will be deemed approval of the plan if the submitted plan is complete. Commencement or continuation of a land-disturbing activity under the jurisdiction of this Ordinance and the Act prior to the approval of an erosion and sediment control plan is a violation of the Ordinance and the Act.

We have performed a preliminary review of your submitted plan and have determined that additional information will be necessary before a final review can be completed. Enclosed is a checklist of items that must be submitted before we can complete the review process. Failure to provide the additional information may result in disapproval of your plan.

If you have questions please do not hesitate to contact this office. Your cooperation in this matter is appreciated and we look forward to working with you on this project.

Sincerely,

F.A. "Tony" Johnson, Jr., CPESC
Erosion Control Specialist

Project Name: CMS Landfill V phases 2 and 3
Location: Pitt School Road
Submitted By: ESP Associates P.A.
Date Received by Environmental Protection: June 23, 2004

cc: ESP Associates P.A.
FAJ/apg

Soil Erosion and Sedimentation Control
Development Services

DATE: July 6, 2004
PROJECT NAME: CMS Landfill V Phases 2 and 3

North Carolina

EROSION AND SEDIMENTATION CONTROL PLAN CHECKLIST

To expedite the approval process, a cursory review of your submitted Erosion Control Plan has been made and has shown the need for additional information as specified below. To meet our review schedule, any additional information should be received by this Office no later than **July 13, 2004**. Failure to meet this schedule may result in disapproval of your plan.

1. Please submit the fee for the total denuded area shown on the erosion control plan. (136.6 acres) Also revise FRO form accordingly.
2. Please provide adequate sedimentation and erosion control measures for all the proposed denuded area. (Northwest corner of the site drains away from SB-1 and SB-2.)
3. Please provide adequate construction entrance to enter/exit the site.
4. Please revise notes on detail sheet to indicate that slopes and fills are to be stabilized within 15 working days and not 30 as shown on the erosion control plan.
5. Please revise construction sequence to indicate that a pre-construction meeting should take place prior to start of construction. Also note in construction sequence that once erosion control measures have been installed that the site should be inspected by Cabarrus County Erosion Control prior to mass grading.
6. Please revise the sediment basin and sediment trap design to provide adequate settling efficiency by designing the traps to have a surface area (A=Q*0.01) as indicated in the North Carolina design manual or verify that the existing designs provide adequate surface area.
7. A revised plan (2 sets) should be submitted to us with the above items changed.

Reviewed by: Thomas A. Smith

cc: ESP Associates, P.A.
WSIC