Fac/Perm/Co ID #	Date	Doc ID#
29-06	11/16/10	12223

Permit Amendment Application

Davidson County C&D Landfill - Phases 3 & 4
Davidson County, North Carolina

Received
APR 2009
Waste Management

Prepared For:

Davidson County Integrated Solid Waste Management
1242 Old Highway 29
Thomasville, North Carolina 27360

Prepared By:

RICHARDSON SMITH GARDNER
& ASSOCIATES
ENGINEERING & GEOLOGICAL
SERVICES
14 N. BOYLAN AVENUE
RALEIGH, NORTH CAROLINA 27603

April 2009

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April 2009

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PERMIT AMENDMENT APPLICATION

Davidson County C&D Landfill - Phases 3 & 4
Davidson County, North Carolina

Prepared for:
Davidson County Integrated Solid Waste Management Department
Thomasville, North Carolina

RSG Project No. DAVDCO-08-5

NORTH CAROLINA LICENSED SEAL 1369 GEOLOGIST JOAN A. SMYTH

4/16/09

Joan A. Smyth, P.G.
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DAVIDSON COUNTY
DAVIDSON COUNTY C&D LANDFILL - PHASES 3 & 4

PERMIT AMENDMENT APPLICATION

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ATTACHMENT B	TECHNICAL SPECIFICATIONS *(15A NCAC 13B.0539)*
ATTACHMENT C	CONSTRUCTION QUALITY ASSURANCE MANUAL *(15A NCAC 13B.0541)*
ATTACHMENT D	OPERATIONS MANUAL *(15A NCAC 13B.0542)*
ATTACHMENT E	CLOSURE AND POST-CLOSURE PLAN *(15A NCAC 13B.0543)*
ATTACHMENT F	EROSION AND SEDIMENTATION CONTROL PLAN *(15A NCAC 13B.0540 and 15A NCAC 4)*
ATTACHMENT G	PERMIT AMENDMENT DRAWINGS *(15A NCAC 13B.0537, .0539, .0540, .0542, and .0543, and 15A NCAC 4)*
ATTACHMENT H	DESIGN HYDROGEOLOGIC REPORT *(15A NCAC 13B.0538)*

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EXECUTIVE SUMMARY

GENERAL

The following is a Permit Amendment Application submitted on behalf of Davidson County for construction of the Phases 3 and 4 of the County's construction and demolition debris (C&D) Landfill. Phase 3 is a vertical expansion of the existing Phases 1 and 2. Phase 4 is a lateral expansion of the landfill and it is the intent of Davidson County to proceed with construction of this unit as soon as possible.

This submittal focuses on the engineering design of Phases 3 and 4 and follows the Site Application Report prepared by Richardson Smith Gardner & Associates, Inc. (RSG) (formerly G.N. Richardson & Associates, Inc.) dated May 1999. As noted above, the proposed Phase 3 is a vertical expansion of existing Phases 1 and 2. The proposed Phase 4 will occupy approximately 1.7 acres to the south of the existing Phases 1 and 2 and is the final phase of the C&D landfill. At the projected gate rate of 12,500 tons/year, Phases 3 and 4 have been designed for approximately 3.0 years of disposal volume.

Phase 4 has been designed to have a minimum of 4 feet of soil between base grades and underlying bedrock and groundwater. This separation has been verified by a drilling program as discussed in the Design Hydrogeologic Report (**Attachment H**).

REGULATORY REFERENCES

This submittal has been prepared in accordance with the requirements of the North Carolina Solid Waste Management Rules (15A NCAC 13B.500 et. seq.) and the North Carolina Sedimentation Control Rules (15A NCAC 4) which are enforced by the Division of Waste Management (DWM) and the Division of Land Quality, respectively, of the North Carolina Department of Environment and Natural Resources. Included in this document are the following attachments:

Facility and Engineering Plan;
Technical Specifications;
Construction Quality Assurance (CQA) Manual;
Operations Manual;
Closure and Post-Closure Plan;
Erosion and Sedimentation Control Plan;
Permit Amendment Drawings; and
Design Hydrogeologic Report.

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ATTACHMENT
A

Facility And Engineering Plan

Davidson County C&D Landfill - Phases 3 & 4
Lexington, North Carolina

Prepared for:
Davidson County Integrated Solid Waste Management
Lexington, North Carolina

March 2009

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Engineering and Geological Services
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DAVIDSON COUNTY
DAVIDSON COUNTY C&D LANDFILL - PHASES 3 & 4

FACILITY AND ENGINEERING PLAN

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2.0 Earthwork Quantities
3.0 Slope Stability Evaluation

DAVIDSON COUNTY
C&D LANDFILL - PHASES 3 & 4

FACILITY AND ENGINEERING PLAN

1.0 OVERVIEW

This section presents a plan for Phases 3 & 4 of Davidson County's construction and demolition (C&D) debris landfill.

2.0 FACILITY SERVICES AND WASTE STREAM

2.1 Facility Services

Currently, the following activities or services are provided at the Davidson County Landfill facility:

- Scales and scale house facilities
- Administrative offices and maintenance building
- Subtitle D MSW landfill
- C&D landfill
- White goods scrap metal and tires handling area
- Convenience center
- Household hazardous waste (HHW) facility
- Recycling building.

2.2 Types of Waste

The Davidson County Landfill facility accepts mixed MSW originating from residential, commercial, and industrial sources, C&D waste, white goods, and tires. MSW wastes and C&D wastes are routed to the on-site Subtitle D and C&D landfill units, respectively, for proper disposal. Other wastes are handled as described below.

2.3 Disposal Rate

The Davidson County facility currently accepts about 12,500 tons per year of C&D waste, which is currently disposed of within the C&D landfill unit. This amounts to an average of about 45 tons per day based upon 280 days of operation per year. Actual daily amounts of C&D are expected to vary considerably.

2.4 Service Area

The landfill serves Davidson County.

2.5 Procedures for Waste Segregation

Wastes are segregated at the scales. Operators at the scalehouse are trained to classify and segregate the waste stream. White goods are routed to an on-site processing area. C&D wastes will be directed toward the C&D landfill.

Employees at the landfill are trained in the safety procedures for the handling and detection of illegal waste. The screening of unacceptable waste is done through the random checking of incoming loads by a County employee at the scalehouse and at the tipping area. When unacceptable waste is detected at the scalehouse, the load is rejected and not permitted into the landfill. If hazardous waste is found at the tipping area, identification of the truck or persons is made (if possible) and documented, then the hazardous waste is identified and placed in a hazardous waste container and taken to a designated hazardous waste staging area for proper disposal. When this occurs, the event is reported to the appropriate authorities.

2.6 Equipment Requirements

The County will maintain on-site equipment required to perform the necessary landfill activities. Periodic maintenance of all landfilling equipment, and minor and major repair work will be performed at designated maintenance zones outside of the landfill.

3.0 LANDFILL CAPACITY

3.1 Total Operating Capacity and Life Expectancy

Drawing S3 (Site Development Plan - Final Cover Grades), identifies the final configuration for Phases 1-4 of the C&D landfill. The top elevation of the final grades is at approximately 766 feet. The exterior side slopes will have a maximum slope of 4H to 1V.

The estimated total gross operating capacity, net capacity (accounts for periodic and final cover), disposal area, and life expectancy for Phases 1-4 are shown in **Table 1**.

3.2 In-Place Ratio of Waste to Soil and Compaction Factor

The capacities obtained above were based on a 10 percent periodic cover ratio and a compaction factor of 1,100 pounds per cubic yard (0.55 tons/cy). The assumed periodic cover ratio is typical for C&D landfills. The assumed compaction factor is based on the average value for the site determined in annual survey.

4.0 AVAILABLE SOIL RESOURCES AND REQUIRED SOIL QUANTITIES

The soils required to construct the proposed landfill will be removed from on-site borrow sources. The soils removed during excavation of Phases 1-4 may be used for structural fill and

general fill.

4.1 Earthwork Quantities

The anticipated quantity of soil to be excavated to achieve base grades and the anticipated quantity to be required as structural fill for foundation soils and berms is shown in **Table 2**.

4.2 Periodic Cover

Assuming the previously mentioned periodic cover ratio of 10 percent, the estimated quantity of soil that will be required for use as periodic cover during C&D landfill operations is shown in **Table 2**.

4.3 Final Cover System

On the basis of the 1.5 foot thick compacted soil barrier and 1.5 foot thick vegetative soil layer components of the C&D landfill final cover, the estimated in-place volume required is shown in **Table 2**.

4.4 Soil Summary

The above soil quantities are summarized in **Table 2**. Note that, based on the conceptual base and final cover grades shown on **Drawings S2 and S3**, respectively, long-term there is a soil deficit of on-site soil which will be needed from on or off-site borrow sources outside of the C&D landfill footprint.

5.0 FACILITY DESIGN CRITERIA

The Davidson County C&D landfill is designed and operates in accordance with Section .0542 of the North Carolina Administrative Code, Title 15A, Chapter 13, Subchapter 13B including the following requirements.

5.1 Horizontal Separation Requirements

The horizontal separation requirement between the disposal boundary (edge of waste) and the property lines is a more than 50 feet (as required for existing facilities) (for Phase 4, the minimum buffer exceeds 150 feet), the minimum buffer between private residences and wells and the disposal boundary is 500 feet, and the minimum buffer between any surface water (stream, river, creek) and the disposal boundary is 50 feet.

5.2 Vertical Separation Requirements

The landfill subgrade elevations have been designed to meet the minimum requirement of four feet above the seasonal high groundwater table and bedrock.

6.0 CONTAINMENT AND ENVIRONMENTAL CONTROL SYSTEMS

Technical specifications and a project construction quality assurance (CQA) manual for the following materials can be found in **Attachments B and C**, respectively.

6.1 Landfill Subgrade and Perimeter Berms

The subgrade elevations will be achieved by excavation or placement of compacted structural fill (embankment). During excavation, a determination of unsuitable soils (i.e. soils which are too soft, wet, or organic) will be made. Where unsuitable soils are found, the soils will be undercut and backfilled with structural fill.

In addition to providing the liner foundation in fill areas, structural fill will be used for berm and roadway construction. Structural fill will consist of on-site soils removed during excavation of Phase 4 or imported borrow soils, except that no CH, OL, or OH soils will be allowed.

6.2 Final Cover System

The components of the final cover system will consist of the following components (top-down):

Regulatory Final Cover System (.0543 (c) (1)):

- An 18-inch thick vegetative soil layer; and
- an 18-inch thick soil liner with a permeability of no more than 1×10^{-5} cm/sec ("compacted soil barrier").

The final cover system will be placed on prepared intermediate cover at a maximum slope of 4H:1V. Top slopes will be approximately 8%. A landfill gas (LFG) control system and surface water control devices will also be incorporated into the final cover. The final cover surface will be vegetated upon completion of the final cover installation according to the project seeding specifications.

6.3 Erosion and Sedimentation Control

The Erosion and Sedimentation Control structures provided will be designed and maintained to manage the run-off generated by the 24-hour, 25-year storm event, and conform to the requirements of the Sedimentation Pollution Control Law (15A, NCAC, 4).

A detailed discussion of site erosion and sedimentation control can be found in the Project Erosion and Sedimentation Control Plan (**Attachment F**).

6.4 Landfill Gas Control

Landfill gas control will consist of passive wells / vents as shown on **Drawing S5**.

6.5 Access and Roadways

Site operations will provide for all-weather access to active areas.

7.0 SLOPE STABILITY

The slope stability of the waste mass is addressed in **Appendix A**. The results of the slope stability analysis indicates that the proposed C&D landfill configuration is stable.

TABLE 1
SUMMARY OF LANDFILL CAPACITY AND LIFE EXPECTANCY

Phase	Area (Ac.)	Operating Capacity (CY)		Life Expectancy[2]
		Gross (CY)	Net (CY/Tons)	
Capacity Used				
1/2	3.0	123,528	117,352 CY 64,625 Tons	-----
Capacity Remaining				
1/2	3.0	85,085	67,037 CY 36,870 Tons	3.0 Years[1]
3	2.1	26,760	15,766 CY 8,671 Tons	0.7 Years
4	2.3	67,434	52,567 CY 28,912 Tons	2.3 Years
Total:	6.7	302,807	252,722 CY 139,078 Tons	6.0 Years

Notes:
1. The remaining capacity and life expectancy for Phases 1 and 2 is from April 30, 2008.
2. Life expectancy for all units is based on 12,500 tons of waste disposed per year.

TABLE 2
SOIL SUMMARY

Material	Quantity (CY)			
	Phase 1 & 2	Phase 3[1]	Phase 4	Total
Excavation	-----	-----	6,224	6,224
Structural Fill	-----	-----	(5,114)	(5,114)
Periodic Cover	(3,528)	(830)	(2,767)	(7,125)
Compacted Soil Barrier	(7,260)	(5,082)	(6,050)	(18,392)
Vegetative Soil Layer	(7,260)	(5,082)	(6,050)	(18,392)
Total:	(18,048)	(10,994)	(14,867)	(43,909)

Notes:
1. Note that Phase 3 is a vertical expansion area.

DAVIDSON COUNTY
DAVIDSON COUNTY C&D LANDFILL - PHASES 3 & 4

FACILITY AND ENGINEERING PLAN
APPENDIX A: LANDFILL DESIGN CALCULATIONS

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3.0 Slope Stability Evaluation

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DAVIDSON COUNTY
DAVIDSON COUNTY C&D LANDFILL - PHASES 3 & 4

FACILITY AND ENGINEERING PLAN
APPENDIX A: LANDFILL DESIGN CALCULATIONS

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1.0 Capacity Evaluation
2.0 Earthwork Quantities
3.0 Slope Stability Evaluation

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PROJECT Davidson County C&D Landfill - Phases 3 & 4

SUBJECT Capacity Evaluation (Density & Life Calcs.)

JOB NO. Davidson 08-5
DATE 3/24/2009
COMPUTED BY KBS
CHECKED BY PLS

Objective To determine the capacity of landfill units. Also, to estimate the expected life of the landfill unit(s) given the proposed contours and the anticipated waste loading rate(s). As part of the evaluation, an evaluation or estimate of waste density will be required based on the known or assumed percentage of periodic cover soil.

Analysis The volume(s) will be calculated by using AutoCAD. Alternatively, the volume(s) will be calculated by taking cross sections of the landfill, using a planimeter to measure the area of the cross sections, and using the average end area method.

CAPACITY LF DENSITY & LIFE.WPD

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SHEET: 2/6
JOB #: DAVDCO-08-5
DATE: 3/9/09
BY: PKS
CHKD BY:

Davidson County C&D Landfill - Phases 1 & 2
Capacity Evaluation - Filling Rate & Density Calculations

Density and Filling Rate Calculations:

Start Date	Period of Interest End Date	Total Time (years)	Volume Filled (cy)	Quantity of Waste Disposed (tons)	Waste Filling Rate* (lbs/cy)	Periodic Cover Assumed %	Periodic Cover Volume (cy)	Waste Volume (cy)	Waste Density** (lbs/cy)
12/4/2001	4/5/2005	3.34	55,944	31,271	**1,118**	5	2,797	53,147	**1,177**
4/6/2005	5/13/2006	1.10	17,738	9,284	**1,047**	5	887	16,851	**1,102**
5/14/2006	5/7/2007	0.98	25,133	12,279	**977**	5	1,257	23,876	**1,029**
5/8/2007	4/30/2008	0.98	24,713	11,791	**954**	5	1,236	23,477	**1,004**
		Total Volume =	123,528	64,625			6,176	117,352	
								Avg. =	**1,115**

Notes:
*Waste Filling Rate = (Tons of Waste Disposed)/(Volume Filled).
**Waste Density = (Tons of Waste Disposed)/(Volume Filled - Volume of Periodic Cover).

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SHEET: 3 /6
JOB #: DAVDCO-08-5
DATE: 3/9/09
BY: PKS
CHKD BY:

Davidson County Landfill
Capacity Evaluation - C&D - Phases 1 & 2

Waste & Periodic Cover Parameters:

Waste Density (pcy) =	1,100	(From Filling Rate and Density Calcs.)
Waste Density (tcy) =	0.55	
Percentage of Periodic Cover =	5	

Volume Calculations:

Volume From AutoCAD (cy) =	85,085	(Compared to April 30, 2008 Topo.)
(= Gross Volume Remaining)		

Net (Waste) Capacity:

Adjustment For Other Layers:

	Area of Final Cover (Ac.) =	3.0
1.5 feet	Vegetative Soil Layer =	(7,260) cy
1.5 feet	Compacted Soil Barrier =	(7,260) cy
	Sum =	(14,520) cy
	Volume of Waste and Periodic Cover (cy) =	70,565
	Volume of Periodic Cover (cy) =	(3,528)
	Net (Waste) Capacity (cy) =	67,037
	Net (Waste) Capacity (tons) =	36,870

Life Expectancy Calculations:

Start Time	End Time	Tons Disposed	Total Tons	Remainder	
2008.33	2009	8,375	8,375	28,495	
2009	2011	25,000	33,375	3,495	Based on 12,500 Tons/Year
2011	2011.28	3,495	36,870	0	

Landfill Life Expectancy (years) = 3.0 April 2011

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SHEET: 4 / 6
JOB #: DAVDCO-08-5
DATE: 3/18/09
BY: KBS
CHKD BY: PKS

Davidson County Landfill
Capacity Evaluation - C&D - Phase 3

Waste & Periodic Cover Parameters:

Waste Density (pcy) =	1,100	(From Filling Rate and Density Calcs.)
Waste Density (tcy) =	0.55	
Percentage of Periodic Cover =	5	

Waste Loading Parameters:

Annual Tonnage =	12,500

Volume Calculations:

Volume From AutoCAD (cy) =	26,760
(= Gross Volume Remaining)	

Net (Waste) Capacity:

Adjustment For Other Layers:

	Area of Final Cover (Ac.) =	2.1
1.5 feet	Vegetative Soil Layer =	(5,082) cy
1.5 feet	Compacted Soil Barrier =	(5,082) cy
	Sum =	(10,164) cy
	Volume of Waste and Periodic Cover (cy) =	16,596
	Volume of Periodic Cover (cy) =	(830)
	Net (Waste) Capacity (cy) =	15,766
	Net (Waste) Capacity (tons) =	8,671
	Landfill Life Expectancy (years) =	0.7

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SHEET: 5 16
JOB #: DAVDCO-08-5
DATE: 3/18/09
BY: KBS
CHKD BY: PKS

Davidson County Landfill
Capacity Evaluation - C&D - Phase 4

Waste & Periodic Cover Parameters:

Waste Density (pcy) =	1,100	(From Filling Rate and Density Calcs.)
Waste Density (tcy) =	0.55	
Percentage of Periodic Cover =	5	

Waste Loading Parameters:

Annual Tonnage =	12,500

Volume Calculations:

Volume From AutoCAD (cy) =	67,434
(= Gross Volume Remaining)	

Net (Waste) Capacity:

Adjustment For Other Layers:

	Area of Final Cover (Ac.) =	2.5
1.5 feet	Vegetative Soil Layer =	(6,050) cy
1.5 feet	Compacted Soil Barrier =	(6,050) cy
	Sum =	(12,100) cy
	Volume of Waste and Periodic Cover (cy) =	55,334
	Volume of Periodic Cover (cy) =	(2,767)
	Net (Waste) Capacity (cy) =	52,567
	Net (Waste) Capacity (tons) =	28,912
	Landfill Life Expectancy (years) =	2.3

Davidson County C&D Landfill
Phase 4
3/13/2009

Phase 4 Subgrade Cut/Fill

version	date	time	surfBase	surfCompare	volCut	volFill	volNet
1	3/13/2009	14-40-56	TOPO 043008	SGRD_BERM	6,224.39	5,113.96	(1,110.43)
1	3/13/2009	14-40-56	PHASE 1-2_FCVR	PHASE 1-3_FCVR	0.52	26,760.99	26,760.48
1	3/13/2009	14-40-56	PHASE 1-3_FCVR SGRD PASTE	FCVR	253.55	67,687.96	67,434.42

Phase 4 Volume

Phase 3 Volume

phase 1 = 80,692 cy

phase 2 = 137,463 cy

phase 3 = 26,760 cy

phase 4 = 67,434 cy

6/6

PROJECT Davidson County C&D Landfill - Phases 3 & 4	SHEET 1 OF 2
	JOB NO. Davidson 08-5
	DATE 3/24/2009
SUBJECT Earthwork Quantities	COMPUTED BY KBS
	CHECKED BY

Objective To determine the earthwork and related material quantities associated with the construction and operation of the landfill.

Analysis The volumes of each material will be calculated by taking design thicknesses and/or cross sections and multiplying by design areas and/or lengths. Areas and lengths are determined using AutoCAD, a planimeter, and/or direct measurement.

EARTHWORK.WPD

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SHEET: 2/2
JOB #: DAVDCO-08-5
DATE: 4/2/09
BY: KBS
CHKD BY:

Davidson County Landfill
Earthwork Quantities

Phases 1 & 2:

Periodic Cover Soil Volumes:
Volume of Periodic Cover (cy) = 3,528 **(User Input - From Capacity Evaluation)**

Compacted Soil Barrier (CSB) Volume:
Volume of VSL (cy) = 7,260 **(User Input - From Capacity Evaluation)**

Vegetative Soil Layer (VSL) Volume:
Volume of VSL (cy) = 7,260 **(User Input - From Capacity Evaluation)**

Phase 3:

Periodic Cover Soil Volumes:
Volume of Periodic Cover (cy) = 830 **(User Input - From Capacity Evaluation)**

Compacted Soil Barrier (CSB) Volume:
Volume of VSL (cy) = 5,082 **(User Input - From Capacity Evaluation)**

Vegetative Soil Layer (VSL) Volume:
Volume of VSL (cy) = 5,082 **(User Input - From Capacity Evaluation)**

Phase 4:

Subgrade Cut and Fill Volumes:
Volume of Cut (cy) = 6,224 **(From AutoCAD - See Attached)**
Volume of Fill (cy) = 5,114 **(From AutoCAD - See Attached)**

Periodic Cover Soil Volumes:
Volume of Periodic Cover (cy) = 2,767 **(User Input - From Capacity Evaluation)**

Compacted Soil Barrier (CSB) Volume:
Volume of VSL (cy) = 6,050 **(User Input - From Capacity Evaluation)**

Vegetative Soil Layer (VSL) Volume:
Volume of VSL (cy) = 6,050 **(User Input - From Capacity Evaluation)**

Slope Stability Evaluation

The slope stability analyses for the Davidson County Landfill – Phases 3 & 4 were evaluated using the computer program STABL5M, a computer program developed by Purdue University. Both block (translational) and circular (rotational) failures are analyzed for deep failures. The block failure surfaces were assumed to pass along the landfill subgrade and through the waste mass. The circular failure surfaces were assumed to pass through the underlying soil layers and/or through the waste mass. EPA guidance (EPA/600/R-95/051) requires that the landfill have minimum factors of safety against slope failures of 1.5 statically and 1.0 dynamically.

Slope stability analysis was performed for Section-AA shown in **attached** figure. A summary of results for the STABL5M studies is presented in **Table 1** for both static and dynamic loadings. The material properties assumed in the slope stability analyses are presented in **Table 2**. Material properties for subgrade and waste used in these analyses are same as were used in the analyses conducted as part of the, "**Permit to Construct Application for Phase 2**" by G.N.Richardson & Associates, September 2005.

These analyses resulted in minimum factors of safety of 3.3 for static loading condition and 2.5 for dynamic (seismic) loading conditions. Both factors of safety are satisfactory and exceed EPA guidelines.

Table 1: Summary of Slope Stability Analyses

CROSS SECTION	FAILURE SURFACES	FACTOR OF SAFETY	
		STATIC	DYNAMIC
AA	Block Along Liner	3.84	3.01
AA	Circular	3.26	2.47

Table 2: Material Properties Assumed in Slope Stability Analyses

MATERIAL TYPE	UNIT WEIGHT (pcf)	COHESION, C (pcf)	PHI, Φ (degree)
Subgrade	100	200	25
Waste	75	500	25
Bed Rock	120	0	40

Figure - 1A

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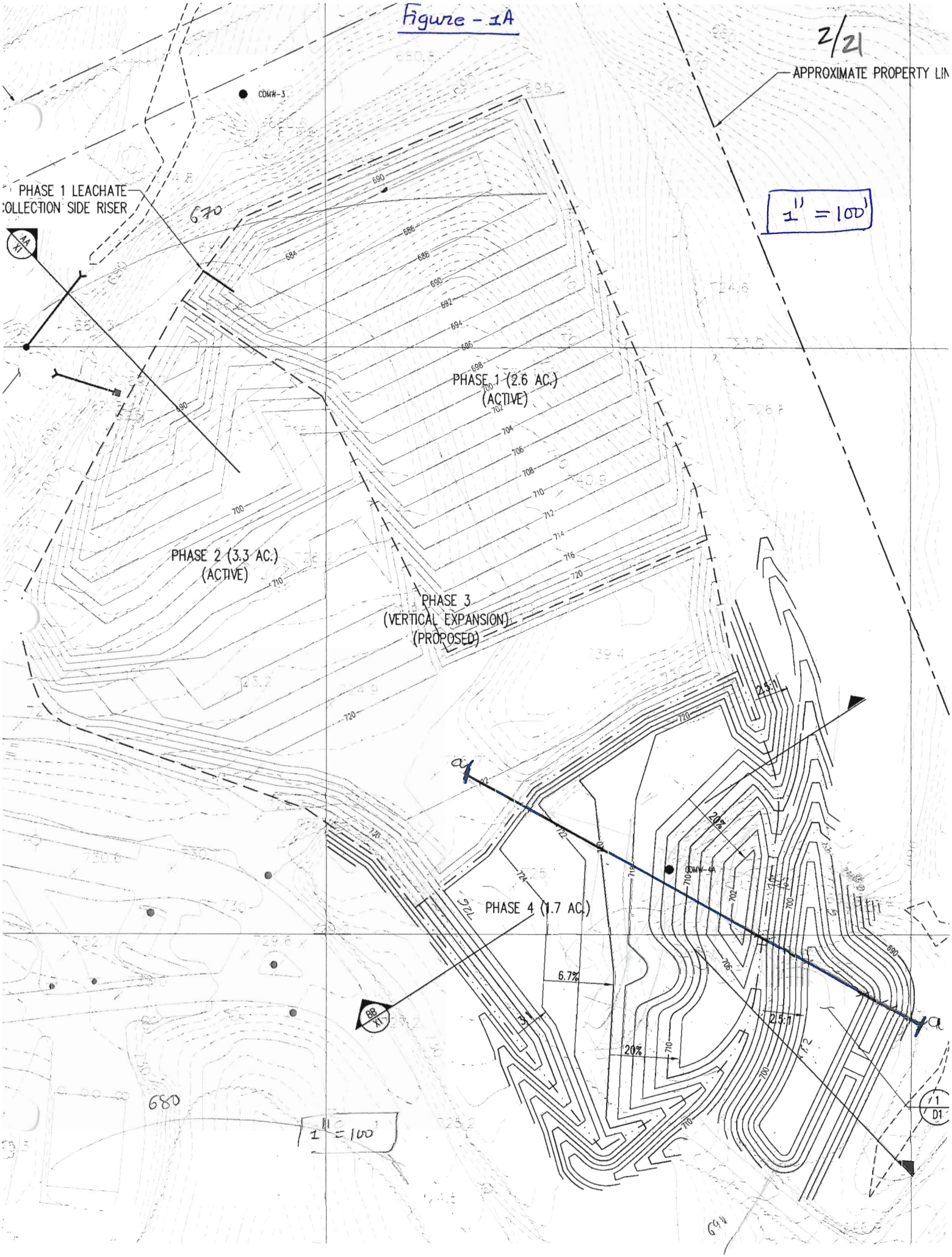

Figure - 1B

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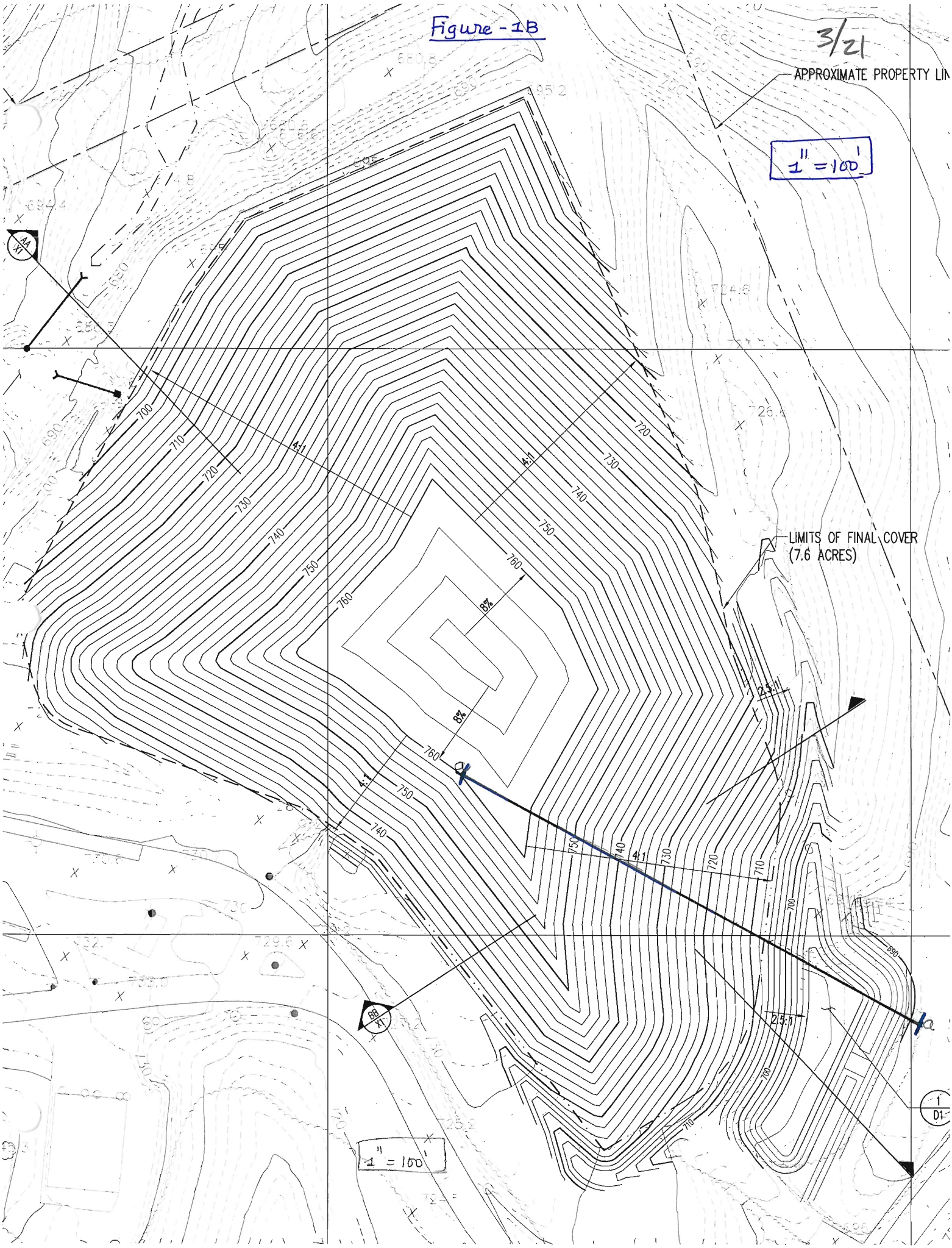
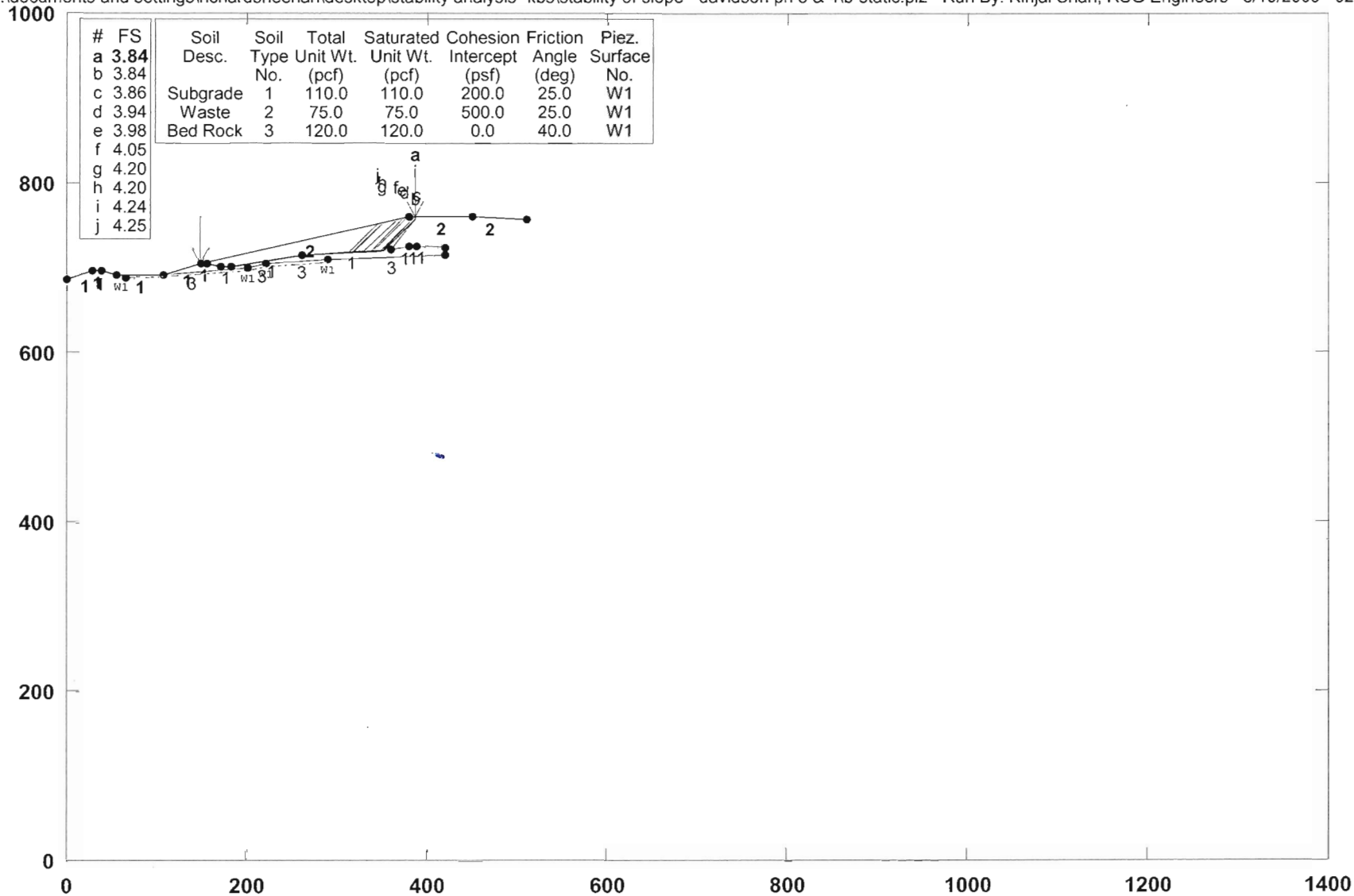


Davidson County Landfill - Phases 3 & 4 Block Analysis - Static

c:\documents and settings\richardsheehan\desktop\stability analysis -kbs\stability of slope - davidson ph 3 & 4\b-static.pl2 Run By: Kinjal Shah, RSG Engineers 3/19/2009 02:56PM

#	FS
a	**3.84**
b	3.84
c	3.86
d	3.94
e	3.98
f	4.05
g	4.20
h	4.20
i	4.24
j	4.25

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Subgrade	1	110.0	110.0	200.0	25.0	W1
Waste	2	75.0	75.0	500.0	25.0	W1
Bed Rock	3	120.0	120.0	0.0	40.0	W1



STABL6H FSmin=3.84

Safety Factors Are Calculated By The Modified Janbu Method

STED

4/21

5/21

**** STABL6H ****
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 3/19/2009
Time of Run: 02:56PM
Run By: Kinjal Shah, RSG Engineers
Input Data Filename: C:b-static.in
Output Filename: C:b-static.OUT
Plotted Output Filename: C:b-static.PLT
PROBLEM DESCRIPTION Davidson County Landfill - Phases 3 & 4
Block Analysis - Static

BOUNDARY COORDINATES
8 Top Boundaries
20 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	688.00	28.00	698.00	1
2	28.00	698.00	38.00	698.00	1
3	38.00	698.00	55.00	692.00	1
4	55.00	692.00	107.00	692.00	1
5	107.00	692.00	148.00	706.00	1
6	148.00	706.00	380.00	760.00	2
7	380.00	760.00	450.00	760.00	2
8	450.00	760.00	510.00	758.00	2
9	148.00	706.00	155.00	706.00	1
10	155.00	706.00	170.00	702.00	1
11	170.00	702.00	182.00	702.00	1
12	182.00	702.00	260.00	716.00	1
13	260.00	716.00	360.00	722.00	1
14	360.00	722.00	380.00	726.00	1
15	380.00	726.00	388.00	726.00	1
16	388.00	726.00	420.00	724.00	1
17	65.00	689.00	200.00	700.00	3
18	200.00	700.00	220.00	705.00	3
19	220.00	705.00	290.00	710.00	3
20	290.00	710.00	420.00	715.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	110.0	110.0	200.0	25.0	.00	.0	1
2	75.0	75.0	500.0	25.0	.00	.0	1
3	120.0	120.0	.0	40.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	60.00	688.00
2	200.00	698.00
3	220.00	703.00
4	290.00	708.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.
30 Trial Surfaces Have Been Generated.
6 Boxes Specified For Generation Of Central Block Base
Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 50.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	148.00	706.00	148.00	706.00	.00
2	155.00	706.00	155.00	706.00	.00

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3	170.00	702.00	170.00	702.00	.00
4	182.00	702.00	182.00	702.00	.00
5	260.00	716.00	260.00	716.00	.00
6	260.01	716.00	360.00	722.00	.00

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Janbu Method * *
Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.00	706.00
2	155.00	706.00
3	170.00	702.00
4	182.00	702.00
5	260.00	716.00
6	350.82	721.45
7	385.99	756.99
8	386.96	760.00

*** 3.839 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.00	706.00
2	155.00	706.00
3	170.00	702.00
4	182.00	702.00
5	260.00	716.00
6	347.32	721.24
7	382.68	756.60
8	386.03	760.00

*** 3.840 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.00	706.00
2	155.00	706.00
3	170.00	702.00
4	182.00	702.00
5	260.00	716.00
6	358.65	721.92
7	388.04	760.00

*** 3.862 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.00	706.00
2	155.00	706.00
3	170.00	702.00
4	182.00	702.00
5	260.00	716.00
6	340.00	720.80
7	374.30	757.19
8	375.11	758.86

*** 3.942 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.00	706.00
2	155.00	706.00
3	170.00	702.00
4	182.00	702.00
5	260.00	716.00
6	336.92	720.62
7	371.64	756.60
8	371.94	758.12

*** 3.979 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.00	706.00
2	155.00	706.00
3	170.00	702.00
4	182.00	702.00
5	260.00	716.00
6	330.19	720.21
7	364.03	756.28

*** 4.048 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.00	706.00
2	155.00	706.00
3	170.00	702.00
4	182.00	702.00
5	260.00	716.00
6	317.30	719.44
7	349.29	752.85

*** 4.197 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.00	706.00
2	155.00	706.00
3	170.00	702.00
4	182.00	702.00
5	260.00	716.00
6	315.64	719.34
7	348.95	752.77

*** 4.204 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.00	706.00
2	155.00	706.00
3	170.00	702.00
4	182.00	702.00
5	260.00	716.00
6	349.20	721.35
7	383.41	757.82
8	385.56	760.00

*** 4.243 ***

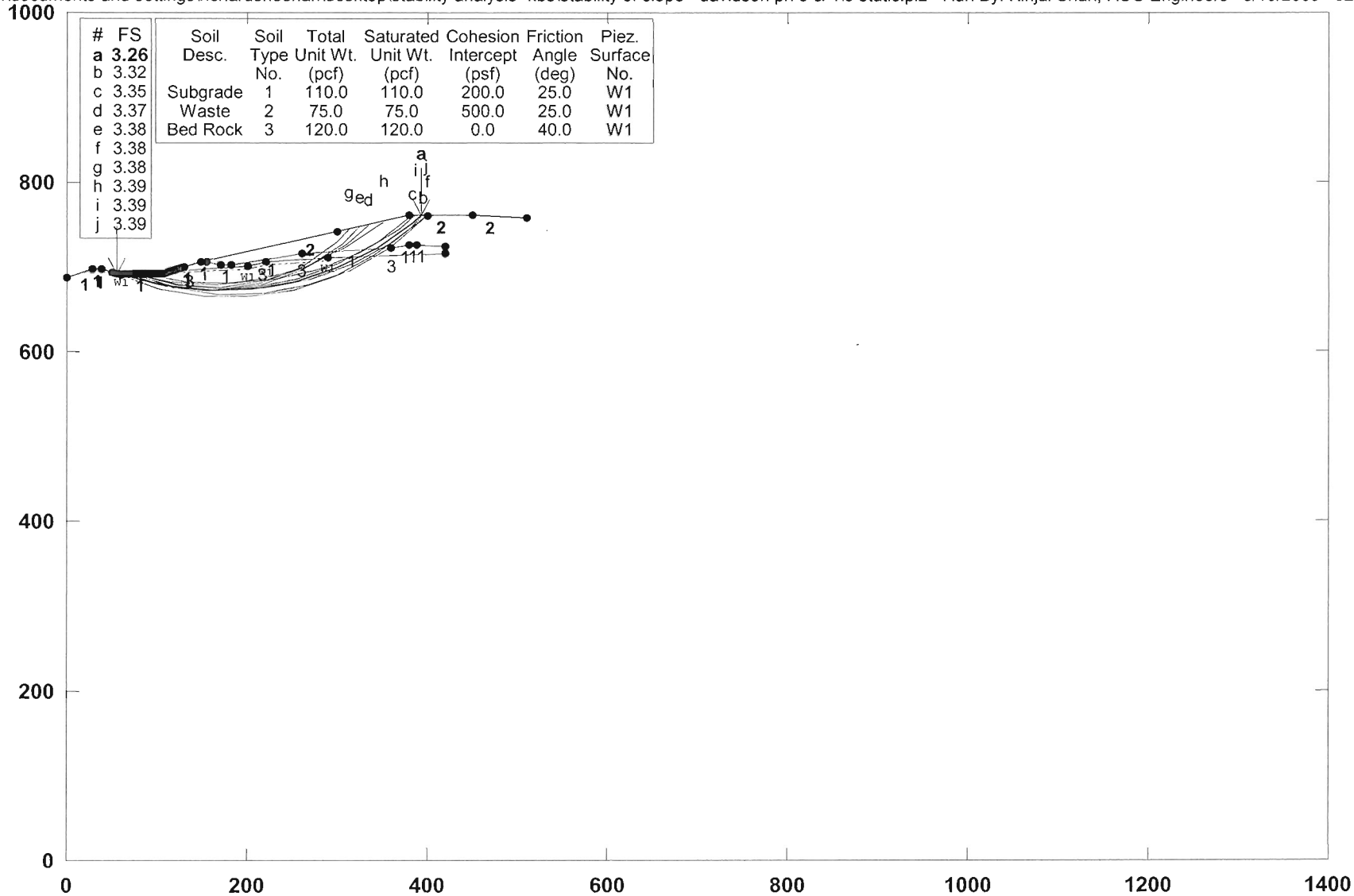
Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.00	706.00
2	155.00	706.00
3	170.00	702.00
4	182.00	702.00
5	260.00	716.00
6	312.17	719.13
7	344.26	751.68

*** 4.254 ***

Davidson County Landfill - Phases 3 & 4 Circular Failure – STATIC

c:\documents and settings\richardsheehan\desktop\stability analysis -kbs\stability of slope - davidson ph 3 & 4\c-static.pl2 Run By: Kinjal Shah, RSG Engineers 3/19/2009 02:42PM



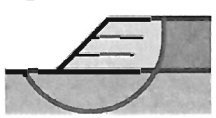
#	FS
a	**3.26**
b	3.32
c	3.35
d	3.37
e	3.38
f	3.38
g	3.38
h	3.39
i	3.39
j	3.39

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Subgrade	1	110.0	110.0	200.0	25.0	W1
Waste	2	75.0	75.0	500.0	25.0	W1
Bed Rock	3	120.0	120.0	0.0	40.0	W1

STABL6H FSmin=3.26

Safety Factors Are Calculated By The Modified Bishop Method

STED



8/21

**** STABL6H ****
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 3/19/2009
Time of Run: 02:42PM
Run By: Kinjal Shah, RSG Engineers
Input Data Filename: C:c-static.in
Output Filename: C:c-static.OUT
Plotted Output Filename: C:c-static.PLT
PROBLEM DESCRIPTION Davidson County Landfill - Phases 3 & 4
Circular Failure

BOUNDARY COORDINATES
8 Top Boundaries
20 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	688.00	28.00	698.00	1
2	28.00	698.00	38.00	698.00	1
3	38.00	698.00	55.00	692.00	1
4	55.00	692.00	107.00	692.00	1
5	107.00	692.00	148.00	706.00	1
6	148.00	706.00	380.00	760.00	2
7	380.00	760.00	450.00	760.00	2
8	450.00	760.00	510.00	758.00	2
9	148.00	706.00	155.00	706.00	1
10	155.00	706.00	170.00	702.00	1
11	170.00	702.00	182.00	702.00	1
12	182.00	702.00	260.00	716.00	1
13	260.00	716.00	360.00	722.00	1
14	360.00	722.00	380.00	726.00	1
15	380.00	726.00	388.00	726.00	1
16	388.00	726.00	420.00	724.00	1
17	60.00	690.00	200.00	700.00	3
18	200.00	700.00	220.00	705.00	3
19	220.00	705.00	290.00	710.00	3
20	290.00	710.00	420.00	715.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	110.0	110.0	200.0	25.0	.00	.0	1
2	75.0	75.0	500.0	25.0	.00	.0	1
3	120.0	120.0	.0	40.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	60.00	690.00
2	200.00	698.00
3	220.00	703.00
4	290.00	708.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
300 Trial Surfaces Have Been Generated.
10 Surfaces Initiate From Each Of 30 Points Equally Spaced
Along The Ground Surface Between X = 50.00 ft.
and X = 130.00 ft.
Each Surface Terminates Between X = 300.00 ft.
and X = 400.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
50.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.52	692.00
2	103.67	678.54
3	153.30	672.49
4	203.28	673.97
5	252.47	682.96
6	299.74	699.25
7	344.02	722.47
8	384.30	752.09
9	392.22	760.00

Circle Center At X = 168.5 ; Y = 1003.4 and Radius, 331.2
*** 3.263 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.52	692.00
2	102.38	674.55
3	151.53	665.41
4	201.53	664.85
5	250.88	672.89
6	298.12	689.28
7	341.84	713.54
8	380.74	744.95
9	393.91	760.00

Circle Center At X = 179.8 ; Y = 954.1 and Radius, 290.0
*** 3.316 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	58.28	692.00
2	106.44	678.57
3	156.13	672.98
4	206.07	675.37
5	254.99	685.67
6	301.66	703.64
7	344.86	728.80
8	382.89	760.00

Circle Center At X = 166.2 ; Y = 985.9 and Radius, 313.1
*** 3.353 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	72.07	692.00
2	120.36	679.02
3	170.27	676.02
4	219.76	683.10
5	266.82	699.99
6	309.53	725.99
7	334.77	749.47

Circle Center At X = 160.1 ; Y = 923.3 and Radius, 247.5
*** 3.373 ***

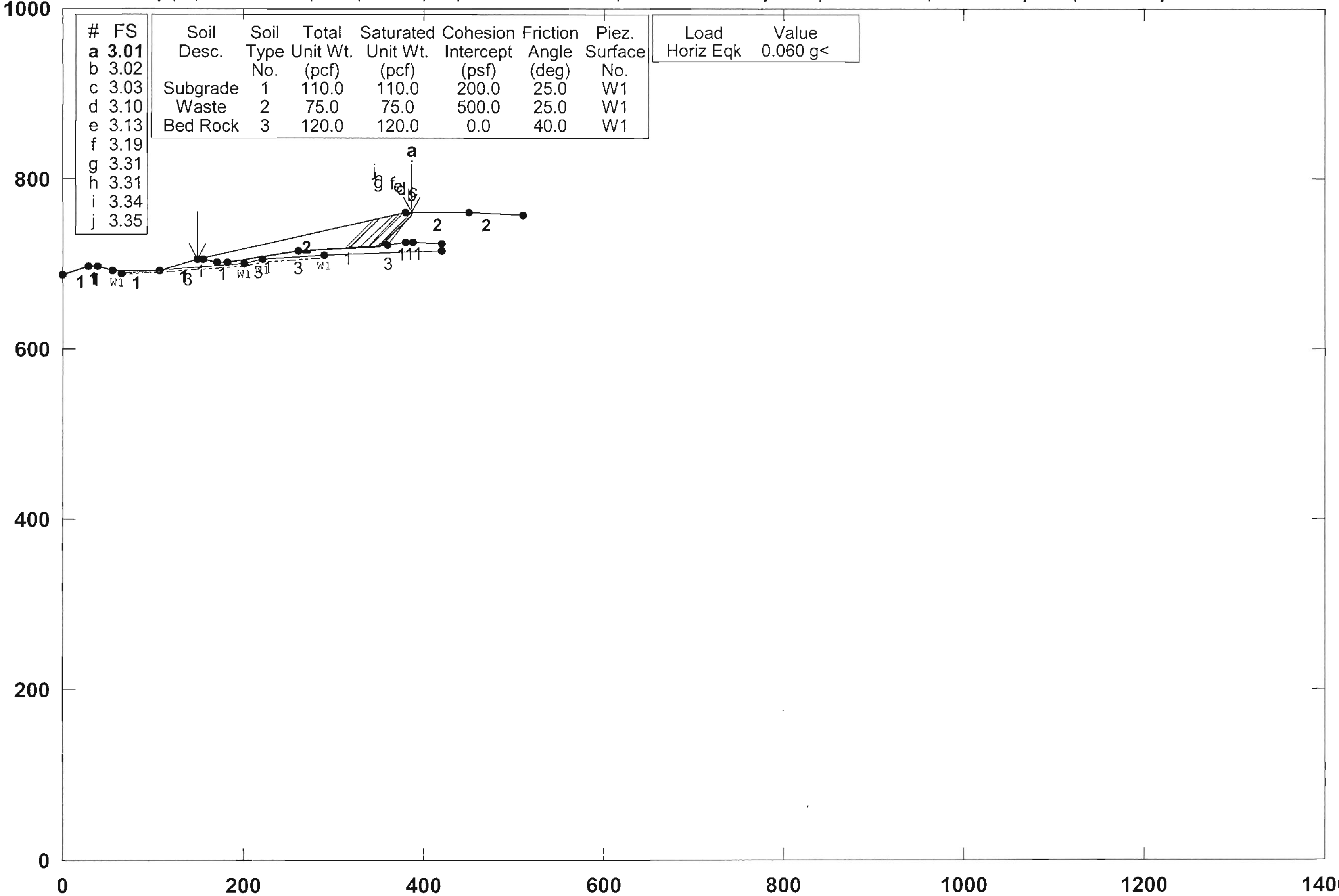
Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	69.31	692.00
2	116.88	676.60
3	166.69	672.27
4	216.20	679.25
5	262.88	697.18
6	304.33	725.13
7	324.91	747.18

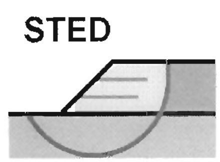
```
Circle Center At X =  160.8 ; Y =  893.3  and Radius,  221.1
      ***     3.376   ***
Failure Surface Specified By  8 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1          74.83       692.00
    2         123.08       678.88
    3         172.79       673.50
    4         222.72       675.99
    5         271.65       686.28
    6         318.36       704.13
    7         361.69       729.08
    8         399.90       760.00
Circle Center At X =  182.0 ; Y =  990.9  and Radius,  317.6
      ***     3.378   ***
Failure Surface Specified By  7 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1          66.55       692.00
    2         114.01       676.25
    3         163.84       672.19
    4         213.22       680.06
    5         259.33       699.40
    6         299.54       729.11
    7         312.13       744.20
Circle Center At X =  155.8 ; Y =  881.6  and Radius,  209.5
      ***     3.384   ***
Failure Surface Specified By  8 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1          66.55       692.00
    2         115.42       681.40
    3         165.36       679.11
    4         214.99       685.19
    5         262.91       699.48
    6         307.76       721.56
    7         348.30       750.83
    8         350.59       753.15
Circle Center At X =  154.0 ; Y =  977.2  and Radius,  298.3
      ***     3.387   ***
Failure Surface Specified By  8 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1          83.10       692.00
    2         132.13       682.16
    3         182.07       679.84
    4         231.79       685.11
    5         280.15       697.84
    6         326.02       717.73
    7         368.36       744.33
    8         386.49       760.00
Circle Center At X =  172.3 ; Y = 1009.4  and Radius,  329.7
      ***     3.390   ***
Failure Surface Specified By  9 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1          72.07       692.00
    2         119.29       675.57
    3         168.66       667.66
    4         218.66       668.52
    5         267.73       678.11
    6         314.36       696.15
    7         357.12       722.06
    8         394.68       755.07
    9         398.62       760.00
Circle Center At X =  188.8 ; Y =  951.5  and Radius,  284.5
      ***     3.391   ***
```

Davidson County Landfill - Phases 3 & 4 Block Analysis -Dynamic

h:\projects\davidson county (nc)\davdco-08-5 (c&dlf ph 3 & 4)\nc permit amendment - phase 3 & 4\stability of slope - davidson ph 3 & 4\b-dynami.pl2 Run By: Username 3/20/2009 11:05AM



STABL6H FSmin=3.01
Safety Factors Are Calculated By The Modified Janbu Method



12/21

**** STABL6H ****
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 3/20/2009
Time of Run: 11:05AM
Run By: Username
Input Data Filename: h:b-dynami.in
Output Filename: h:b-dynami.OUT
Plotted Output Filename: h:b-dynami.PLT
PROBLEM DESCRIPTION Davidson County Landfill - Phases 3 & 4
Block Analysis -Dynamic

BOUNDARY COORDINATES
8 Top Boundaries
20 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	688.00	28.00	698.00	1
2	28.00	698.00	38.00	698.00	1
3	38.00	698.00	55.00	692.00	1
4	55.00	692.00	107.00	692.00	1
5	107.00	692.00	148.00	706.00	1
6	148.00	706.00	380.00	760.00	2
7	380.00	760.00	450.00	760.00	2

8	450.00	760.00	510.00	758.00	2
9	148.00	706.00	155.00	706.00	1
10	155.00	706.00	170.00	702.00	1
11	170.00	702.00	182.00	702.00	1
12	182.00	702.00	260.00	716.00	1
13	260.00	716.00	360.00	722.00	1
14	360.00	722.00	380.00	726.00	1
15	380.00	726.00	388.00	726.00	1
16	388.00	726.00	420.00	724.00	1
17	65.00	689.00	200.00	700.00	3
18	200.00	700.00	220.00	705.00	3
19	220.00	705.00	290.00	710.00	3
20	290.00	710.00	420.00	715.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	110.0	110.0	200.0	25.0	.00	.0	1
2	75.0	75.0	500.0	25.0	.00	.0	1
3	120.0	120.0	.0	40.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	60.00	688.00
2	200.00	698.00
3	220.00	703.00
4	290.00	708.00

A Horizontal Earthquake Loading Coefficient
Of .060 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 psf
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Sliding Block Surfaces, Has Been
Specified.
30 Trial Surfaces Have Been Generated.
6 Boxes Specified For Generation Of Central Block Base
Length Of Line Segments For Active And Passive Portions Of
Sliding Block Is 50.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	148.00	706.00	148.00	706.00	.00
2	155.00	706.00	155.00	706.00	.00
3	170.00	702.00	170.00	702.00	.00
4	182.00	702.00	182.00	702.00	.00
5	260.00	716.00	260.00	716.00	.00
6	260.01	716.00	360.00	722.00	.00

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Janbu Method * *
Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.00	706.00
2	155.00	706.00
3	170.00	702.00
4	182.00	702.00
5	260.00	716.00
6	350.82	721.45
7	385.99	756.99
8	386.96	760.00

*** 3.014 ***
Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.00	706.00
2	155.00	706.00
3	170.00	702.00
4	182.00	702.00
5	260.00	716.00
6	347.32	721.24
7	382.68	756.60
8	386.03	760.00

*** 3.020 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.00	706.00
2	155.00	706.00
3	170.00	702.00
4	182.00	702.00
5	260.00	716.00
6	358.65	721.92
7	388.04	760.00

*** 3.029 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.00	706.00
2	155.00	706.00
3	170.00	702.00
4	182.00	702.00
5	260.00	716.00
6	340.00	720.80
7	374.30	757.19
8	375.11	758.86

*** 3.102 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.00	706.00
2	155.00	706.00
3	170.00	702.00
4	182.00	702.00
5	260.00	716.00
6	336.92	720.62
7	371.64	756.60
8	371.94	758.12

*** 3.130 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.00	706.00
2	155.00	706.00
3	170.00	702.00
4	182.00	702.00
5	260.00	716.00
6	330.19	720.21
7	364.03	756.28

*** 3.187 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.00	706.00
2	155.00	706.00
3	170.00	702.00
4	182.00	702.00
5	260.00	716.00
6	317.30	719.44
7	349.29	752.85

```
      ***     3.306   ***
Failure Surface Specified By  7 Coordinate Points
  Point       X-Surf      Y-Surf
   No.         (ft)        (ft)
    1        148.00      706.00
    2        155.00      706.00
    3        170.00      702.00
    4        182.00      702.00
    5        260.00      716.00
    6        315.64      719.34
    7        348.95      752.77
      ***     3.312   ***
Failure Surface Specified By  8 Coordinate Points
  Point       X-Surf      Y-Surf
   No.         (ft)        (ft)
    1        148.00      706.00
    2        155.00      706.00
    3        170.00      702.00
    4        182.00      702.00
    5        260.00      716.00
    6        349.20      721.35
    7        383.41      757.82
    8        385.56      760.00
      ***     3.341   ***
Failure Surface Specified By  7 Coordinate Points
  Point       X-Surf      Y-Surf
   No.         (ft)        (ft)
    1        148.00      706.00
    2        155.00      706.00
    3        170.00      702.00
    4        182.00      702.00
    5        260.00      716.00
    6        312.17      719.13
    7        344.26      751.68
      ***     3.352   ***
```

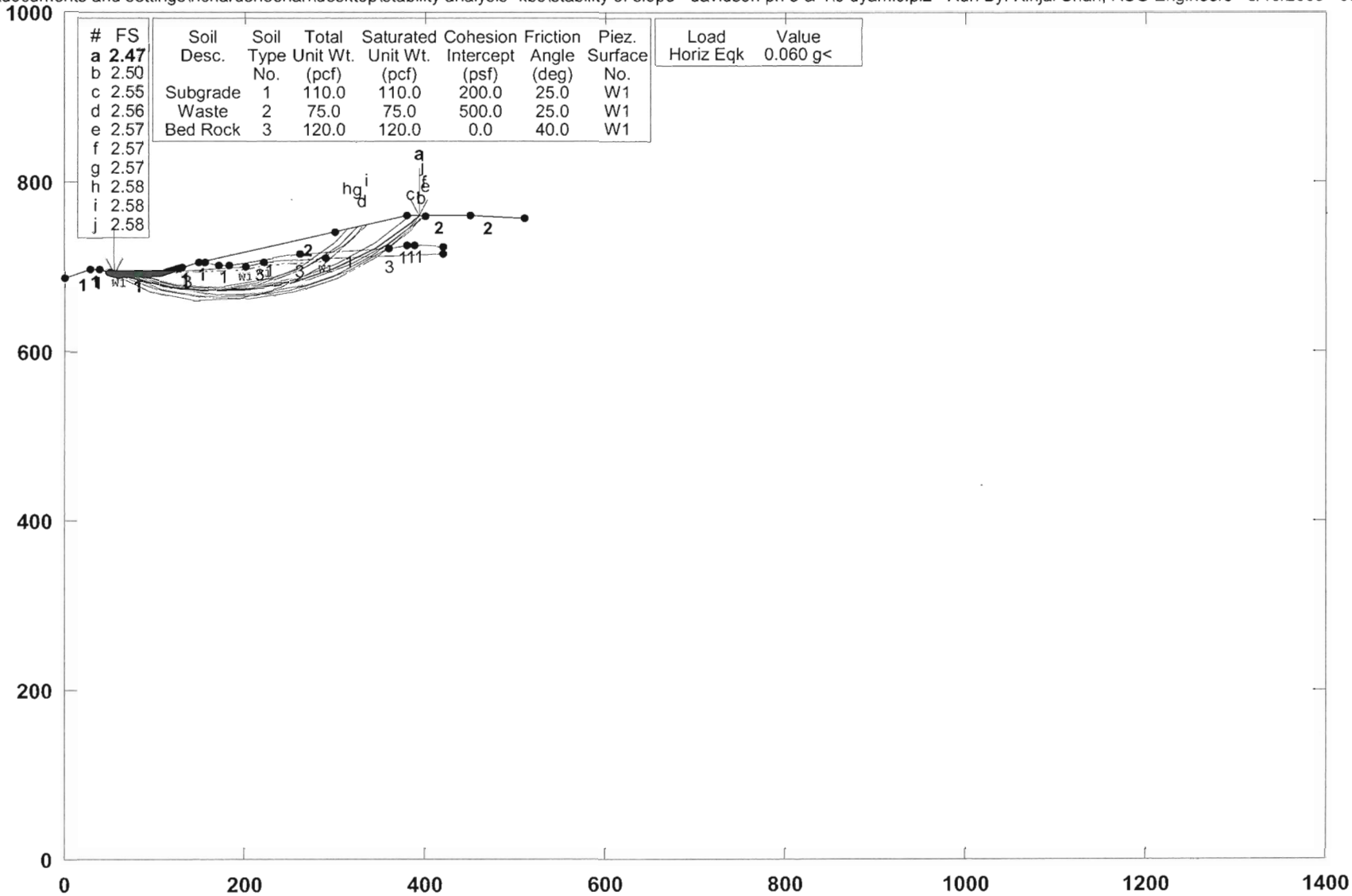
Davidson County Landfill - Phases 3 & 4 Circular Failure -Dynamic

c:\documents and settings\richardsheehan\desktop\stability analysis -kbs\stability of slope - davidson ph 3 & 4\c-dyamic.pl2 Run By: Kinjal Shah, RSG Engineers 3/19/2009 03:03PM

#	FS
a	2.47
b	2.50
c	2.55
d	2.56
e	2.57
f	2.57
g	2.57
h	2.58
i	2.58
j	2.58

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Subgrade	1	110.0	110.0	200.0	25.0	W1
Waste	2	75.0	75.0	500.0	25.0	W1
Bed Rock	3	120.0	120.0	0.0	40.0	W1

Load	Value
Horiz Eqk	0.060 g<



STABL6H FSmin=2.47

Safety Factors Are Calculated By The Modified Bishop Method

STED

17/21

```
                    ** STABL6H  **
                          by
                  Purdue University
              --Slope Stability Analysis--
           Simplified Janbu, Simplified Bishop
              or Spencer`s Method of Slices
Run Date:                  3/19/2009
Time of Run:               03:03PM
Run By:                    Kinjal Shah, RSG Engineers
Input Data Filename:       C:c-dyamic.in
Output Filename:           C:c-dyamic.OUT
Plotted Output Filename:   C:c-dyamic.PLT
PROBLEM DESCRIPTION   Davidson County Landfill - Phases 3 & 4
                        Circular Failure -Dynamic
BOUNDARY COORDINATES
    8 Top   Boundaries
   20 Total Boundaries
```

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	688.00	28.00	698.00	1
2	28.00	698.00	38.00	698.00	1
3	38.00	698.00	55.00	692.00	1
4	55.00	692.00	107.00	692.00	1
5	107.00	692.00	148.00	706.00	1
6	148.00	706.00	380.00	760.00	2
7	380.00	760.00	450.00	760.00	2
8	450.00	760.00	510.00	758.00	2
9	148.00	706.00	155.00	706.00	1
10	155.00	706.00	170.00	702.00	1
11	170.00	702.00	182.00	702.00	1
12	182.00	702.00	260.00	716.00	1
13	260.00	716.00	360.00	722.00	1
14	360.00	722.00	380.00	726.00	1
15	380.00	726.00	388.00	726.00	1
16	388.00	726.00	420.00	724.00	1
17	60.00	690.00	200.00	700.00	3
18	200.00	700.00	220.00	705.00	3
19	220.00	705.00	290.00	710.00	3
20	290.00	710.00	420.00	715.00	3

```
ISOTROPIC SOIL PARAMETERS
  3 Type(s) of Soil
```

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	110.0	110.0	200.0	25.0	.00	.0	1
2	75.0	75.0	500.0	25.0	.00	.0	1
3	120.0	120.0	.0	40.0	.00	.0	1

```
1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water =  62.40
Piezometric Surface No.  1 Specified by  4 Coordinate Points
```

Point No.	X-Water (ft)	Y-Water (ft)
1	60.00	690.00
2	200.00	698.00
3	220.00	703.00
4	290.00	708.00

```
A Horizontal Earthquake Loading Coefficient
Of .060 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure =     .0 psf
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
300 Trial Surfaces Have Been Generated.
 10 Surfaces Initiate From Each Of 30 Points Equally Spaced
Along The Ground Surface Between  X =  50.00 ft.
                              and  X = 130.00 ft.
```

```
Each Surface Terminates Between   X = 300.00 ft.
                            and   X = 400.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is  Y =    .00 ft.
50.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
      Failure Surfaces Examined.  They Are Ordered - Most Critical
      First.
      * * Safety Factors Are Calculated By The Modified Bishop Method * *
      Failure Surface Specified By  9 Coordinate Points
        Point       X-Surf       Y-Surf
         No.         (ft)         (ft)
          1          55.52       692.00
          2         103.67       678.54
          3         153.30       672.49
          4         203.28       673.97
          5         252.47       682.96
          6         299.74       699.25
          7         344.02       722.47
          8         384.30       752.09
          9         392.22       760.00
      Circle Center At X =  168.5 ; Y = 1003.4  and Radius,  331.2
            ***     2.472   ***
      Failure Surface Specified By  9 Coordinate Points
        Point       X-Surf       Y-Surf
         No.         (ft)         (ft)
          1          55.52       692.00
          2         102.38       674.55
          3         151.53       665.41
          4         201.53       664.85
          5         250.88       672.89
          6         298.12       689.28
          7         341.84       713.54
          8         380.74       744.95
          9         393.91       760.00
      Circle Center At X =  179.8 ; Y =  954.1  and Radius,  290.0
            ***     2.500   ***
      Failure Surface Specified By  8 Coordinate Points
        Point       X-Surf       Y-Surf
         No.         (ft)         (ft)
          1          58.28       692.00
          2         106.44       678.57
          3         156.13       672.98
          4         206.07       675.37
          5         254.99       685.67
          6         301.66       703.64
          7         344.86       728.80
          8         382.89       760.00
      Circle Center At X =  166.2 ; Y =  985.9  and Radius,  313.1
            ***     2.550   ***
      Failure Surface Specified By  8 Coordinate Points
        Point       X-Surf       Y-Surf
         No.         (ft)         (ft)
          1          50.00       693.76
          2          94.60       671.15
          3         143.38       660.18
          4         193.36       661.52
          5         241.48       675.09
          6         284.81       700.05
          7         320.67       734.89
          8         328.80       748.08
      Circle Center At X =  163.0 ; Y =  861.4  and Radius,  202.1
            ***     2.564   ***
      Failure Surface Specified By  8 Coordinate Points
        Point       X-Surf       Y-Surf
         No.         (ft)         (ft)
          1          74.83       692.00
```

```
    2        123.08      678.88
    3        172.79      673.50
    4        222.72      675.99
    5        271.65      686.28
    6        318.36      704.13
    7        361.69      729.08
    8        399.90      760.00
Circle Center At X =  182.0 ; Y =  990.9  and Radius,  317.6
      ***     2.572   ***
Failure Surface Specified By  9 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1         72.07      692.00
    2        119.29      675.57
    3        168.66      667.66
    4        218.66      668.52
    5        267.73      678.11
    6        314.36      696.15
    7        357.12      722.06
    8        394.68      755.07
    9        398.62      760.00
Circle Center At X =  188.8 ; Y =  951.5  and Radius,  284.5
      ***     2.573   ***
Failure Surface Specified By  7 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1         69.31      692.00
    2        116.88      676.60
    3        166.69      672.27
    4        216.20      679.25
    5        262.88      697.18
    6        304.33      725.13
    7        324.91      747.18
Circle Center At X =  160.8 ; Y =  893.3  and Radius,  221.1
      ***     2.574   ***
Failure Surface Specified By  7 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1         66.55      692.00
    2        114.01      676.25
    3        163.84      672.19
    4        213.22      680.06
    5        259.33      699.40
    6        299.54      729.11
    7        312.13      744.20
Circle Center At X =  155.8 ; Y =  881.6  and Radius,  209.5
      ***     2.577   ***
Failure Surface Specified By  7 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1         72.07      692.00
    2        120.36      679.02
    3        170.27      676.02
    4        219.76      683.10
    5        266.82      699.99
    6        309.53      725.99
    7        334.77      749.47
Circle Center At X =  160.1 ; Y =  923.3  and Radius,  247.5
      ***     2.579   ***
Failure Surface Specified By  9 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1         61.03      692.00
    2        107.37      673.21
    3        156.34      663.10
    4        206.33      662.03
    5        255.69      670.00
```

```
    6        302.79      686.78
    7        346.08      711.80
    8        384.13      744.23
    9        396.96      760.00
Circle Center At X =  187.3 ; Y =  936.7  and Radius,  275.3
      ***     2.582   ***
```

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ATTACHMENT
B

Technical Specifications

Davidson County C&D Landfill
Lexington, North Carolina

Prepared for:

Davidson County Integrated Solid Waste Management
Lexington, North Carolina

March 2009

RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services
14 N. Boylan Avenue
Raleigh, North Carolina 27603

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DAVIDSON COUNTY
DAVIDSON COUNTY C&D LANDFILL

TECHNICAL SPECIFICATIONS

TABLE OF CONTENTS

Section No.	Specification
02110	Site Preparation
02222	Excavation
02223	Embankment
02240	Geotextiles
02250	Soil Liner
02258	Vegetative Soil Layer
02270	Erosion and Sedimentation Control
02271	Rip Rap
02275	Rolled Erosion Control Products
02930	Revegetation

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SECTION 02110

SITE PREPARATION

Site Preparation: Site Preparation includes clearing, grubbing, and stripping operations which precede the proposed construction.

A. DESCRIPTION

1. General:

a. The Contractor shall furnish all labor, material, and equipment to complete Site Preparation in accordance with the Contract Drawings and these Specifications.

b. Principal items of work include:

1. Notifying all authorities owning utility lines running to or on the property. Protect and maintain all utility lines to remain and cap those that are not required in accordance with instructions of the Utility Companies, and all other authorities having jurisdiction.

2. Clearing the site within the clearing limits, including removal of grass, brush, shrubs, trees, loose debris, and other encumbrances except for trees to remain.

3. Boxing and protecting all areas to be preserved.

4. Removing all topsoil from designated areas and stockpiling on site where directed by the Engineer for future use.

5. Disposing from the site all debris resulting from work under this Section.

2. Related Work:

Related Contract Work is described in the following sections of the Specifications:

Work	Section
Excavation	02222
Embankment	02223

B. MATERIALS Not Used.

C. SUBMITTALS Not Used.

D. CONSTRUCTION

1. Clearing of the Site:

a. Clearing limits, as shown on the Contract Drawings, shall be established by the Contractor's Surveyor. Once established, the clearing limits shall be inspected and approved by the Engineer prior to clearing the affected areas.

b. Before removal of topsoil, and start of excavation and grading operations, the areas within the clearing limits shown on the Contract Drawings shall be cleared and grubbed.

c. Clearing shall consist of cutting, removal, and satisfactory disposal of all trees, fallen timber, brush, bushes, rubbish, fencing, and other perishable and objectionable material.

Should it become necessary to remove a tree, bush, brush, or other plants outside the clearing limits, the Contractor shall do so only after permission has been granted by the Engineer.

d. Excavation resulting from the removal of trees, roots, and the like shall be filled with suitable material, as approved by the Engineer, and thoroughly compacted per the requirements contained in Section 02223, Embankment, of these Specifications.

e. In temporary construction easement locations, only those trees and shrubs shall be removed which are in actual interference with excavation or grading work under this Contract, and removal shall be subject to approval by the Engineer. However, the Engineer reserves the right to order additional trees and shrubs removed at no additional cost to the Owner, if such, in his opinion, they are too close to the work to be maintained or have become damaged due to the Contractor's operations.

2. Stripping and Stockpiling Existing Topsoil:

a. Existing topsoil and sod on the site within areas designated on the Contract Drawings shall be stripped to whatever depth it may occur, and stored in locations directed by the Engineer.

b. The topsoil shall be free of stones, roots, brush, rubbish, or other unsuitable materials before stockpiling.

c. Care shall be taken not to contaminate the stockpiled topsoil with any unsuitable materials.

3. Grubbing:

a. Grubbing shall consist of the removal and disposal of all stumps, roots, logs, sticks, and other perishable materials to a depth of at least 6 inches below ground surfaces.

b. Large stumps located in areas to be excavated may be removed during grading operations, subject to the approval of the Engineer.

4. Disposal of Cleared and Grubbed Material:

All trees, stumps, roots, and bushes shall be disposed of by burning (Only if allowed by the Owner and local zoning) or shall be removed from the site and disposed of by the Contractor. The Contractor shall receive written authorization from the Owner prior to burning. Any material other than plant growth shall not be burned. On-site and off-site disposal areas are subject to approval by the Engineer. Ashes and residue from burning operations shall be removed from the site and disposed of by the Contractor. The Contractor shall also obtain all of the required permits for his burning operations, as applicable.

END OF SECTION

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SECTION 02222

EXCAVATION

Excavation: Excavation includes excavating, sealing, hauling, scraping, undercutting, removal of accumulated surface water or ground water, stockpiling, and all necessary and incidental items as required for bringing the landfill and related structures to the specified lines and grades.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment required to complete Excavation of the project area in accordance with the Contract Drawings and these Specifications, except as noted below:

a. Clearing and grubbing and removal of topsoil is addressed in Section 02110, Site Preparation, of these Specifications.

2. Related Work:

Related Contract Work is described in the following sections of the Specifications:

Work	Section
Site Preparation	02110
Embankment	02223
Erosion and Sedimentation Control	02270
CQA Manual	Attached

3. Quality Assurance:

Quality Assurance during Excavation will be provided by the Owner as described in the accompanying Project CQA Manual.

4. Definitions:

a. Excavation: shall consist of the removal and satisfactory disposal and/or stockpiling of materials located with the limits of construction including widening cuts and shaping of slopes necessary for the preparation of roadbeds, landfill slope areas, cutting of any ditches, channels, waterways, entrances, and other work incidental thereto.

b. Borrow: shall consist of approved on-site material required for the construction of embankments/fills or for other portions of the work.

c. Select Borrow: shall consist of approved off-site material required for the construction of embankments/fills, roadway subgrade, backfilling, or for other portions of the work as shown on Contract Drawings or in these Specifications. The Contractor shall make his own arrangements for obtaining select borrow and pay all costs involved.

d. Unsuitable Material: is any in-place or excavated material which contains undesirable materials, or is in a state which is not appropriate; in the opinion of the CQA Engineer, for the intended use or support of planned structures, embankment, or excavation. This may include but not be limited to organic material, waste/refuse, soft, or wet material not meeting required specifications, etc.

e. Unsuitable Materials Excavation (Overexcavation): shall consist of the removal and satisfactory disposal of all unsuitable material located within the limits of construction. Where excavation to the finished grade section shown results in a subgrade or slopes of unsuitable material, the Contractor shall overexcavate such material to below the grade shown on the Contract Drawings or as directed by the Engineer and CQA Engineer.

B. MATERIALS

Excavation shall include the removal of all soil, weathered rock, boulders, conduits, pipe, and all other obstacles encountered and shown on the Contract Drawings or specified herein.

C. SUBMITTALS

The Contractor shall submit the following to the CQA Engineer before approval is given to proceed:

1. Plans of open cut excavations showing side slopes and limits of the excavation at grade.

2. List of disposal site(s) for waste and unsuitable materials.

3. Descriptive information on Excavation equipment to be used.

D. CONSTRUCTION

1. The Contractor shall conduct Excavation activities in such a manner that erosion of disturbed areas and off site sedimentation is absolutely minimized as outlined in Section 02270, Erosion and Sedimentation Control, of these Specifications.

2. The Contractor shall excavate to the lines and grades shown on the Contract Drawings and stockpile all suitable excavated materials. As the excavation is made, the materials will be examined and identified to the CQA Engineer.

   The Contractor will perform all surveys necessary to establish and verify lines and grades for all Excavation, including pipe excavations, soil overexcavation, and anchor trenches.

3. Stockpiling:

   The Contractor shall stockpile the materials in appropriate stockpiles as approved by the CQA Engineer. The Contractor shall use equipment and methods as necessary to maintain the moisture content of soils stockpiled (excluding topsoil) at or near their optimum moisture content.

   Stockpiles shall be properly sloped and the surfaces sealed by the Contractor at the end of each working day, or during the day in the event of heavy rain, to the satisfaction of the Engineer.

4. The Contractor shall protect all existing facilities and structures including, but not limited to, existing utilities, monitoring wells, signs, grade stakes, etc. during the grading and stockpiling operations.

5. All excavations shall be made in the dry and in such a manner and to such widths as will give ample room for properly constructing and inspecting the structures and/or piping they are to contain and for such sheeting, timbering, pumping, and drainage as may be required.

6. The Contractor shall be responsible for the control of all surface and subsurface water when necessary.

7. Excavation slopes shall be flat enough to avoid sloughs and slides that will cause disturbance of the subgrade or damage of adjacent areas. Slides and overbreaks which occur due to negligence, carelessness, or improper construction techniques on the part of the Contractor shall be removed and disposed of by the Contractor as directed by the Engineer at no additional cost to the Owner.

8. The intersection of slopes with natural ground surfaces, including the beginning and ending of cut slopes, shall be uniformly rounded. All protruding roots and other vegetation shall be removed from slopes.

9. The bottom of all excavations for structures and pipes shall be examined by the CQA Engineer for bearing value and the presence of unsuitable material. If, in the opinion of the CQA Engineer, additional Excavation is required due to the low bearing value of the subgrade material, or if the in-place materials are soft, yielding, pumping and wet, the Contractor shall remove such material to the required width and depth and replace it with thoroughly compacted structural fill, or material directed by the CQA Engineer. No payment will be made for subgrade disturbance caused by inadequate Dewatering or improper construction methods.

10. Any areas excavated below design subgrade elevations by the Contractor, unless directed by the CQA Engineer, shall be brought back to design elevations at no cost to the Owner. The Contractor shall place and compact such material in accordance with Section 02223, Embankment, of these Specifications.

11. The Contractor shall dispose of excess or unsuitable excavation materials on-site at location(s) approved by the Owner.

12. The Contractor shall properly level-off bottoms of all excavations. Proof-rolling shall be conducted with appropriate equipment.

13. Upon reaching subgrade elevations shown in excavation areas, the Contractor shall scarify subgrade soils to a minimum depth of 6" and obtain the CQA Engineer's approval of quality. If unsuitable materials are encountered at the subgrade elevation, perform additional excavations as approved by the CQA Engineer to remove unsuitable materials.

14. <u>Overexcavation and Backfill:</u>

    Where subgrade materials are determined to be unsuitable, such materials shall be removed by the Contractor to the lengths, widths and depths approved by the CQA Engineer and backfilled with suitable material in accordance with Section 02223, Embankment, of these Specifications unless further excavation or earthwork is required. No additional payment will be made for such excavation and backfill 1 foot or less than the finished subgrade. Unsuitable material excavation greater than 1 foot beneath the finished subgrade shall be made on a unit price basis for excavation and backfill, only as approved by the Engineer and CQA Engineer prior to the work. Unit price for overexcavation and backfill greater than 1 foot in depth shall include disposal of unsuitable materials.

15. All cuts shall be brought to the grade and cross section shown on the Contract Drawings, or established by the Engineer, prior to final inspection.

16. The Contractor shall protect finished lines and grades of completed excavation against excessive erosion, damage from trafficking, or other causes and shall repair any damage at no additional cost to the Owner.

17. Trench Excavation:

    a. All pipe Excavation and trenching shall be done in strict accordance with these Specifications, all applicable parts of the OSHA Regulations, 29 CFR 1926, Subpart P, and other applicable regulations. In the event of any conflicts in this information, safe working conditions as established by the appropriate OSHA guidelines shall govern.

    b. The minimum trench widths shall be as indicated on the Contract Drawings. Enlargements of the trench shall be made as needed to give ample space for operations at pipe joints. The width of the trench shall be limited to the maximum dimensions shown on the Contract Drawings, except where a wider trench is needed for the installation of and work within sheeting and bracing.

    c. Except where otherwise specified, excavation slopes shall be flat enough to avoid slides which will cause disturbance of the subgrade, damage to adjacent areas, or endanger the lives or safety of persons in the vicinity.

    d. Hand excavation shall be employed wherever, in the opinion of the Engineer, it is necessary for the protection of existing utilities, poles, trees, pavements, obstructions, or structures.

    e. No greater length of trench in any location shall be left open, in advance of pipe laying, than shall be authorized or directed by the Engineer and, in general, such length shall be limited to approximately one hundred (100) feet.

    f. Pipe Bedding: All pipe bedding shall be as shown on the Contract Drawings, unless otherwise specified herein.

18. Sheeting and Bracing:

    a. The Contractor shall furnish, place, and maintain such sheeting and bracing which may be required to support sides of Excavation or to protect pipes and structures from possible damage and to provide safe working conditions in accordance with current OSHA requirements. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, he may order additional supports put in at the sole expense of the Contractor. The Contractor shall be responsible for the adequacy of all sheeting and bracing used and for all damage resulting

from sheeting and bracing failure or from placing, maintaining, and removing it.

b. The Contractor shall exercise caution in the installation and removal of sheeting to insure that excessive or unusual loadings are not transmitted to any new or existing structure. The Contractor shall promptly repair at his expense any and all damage that can be reasonably attributed to sheeting installation or removal.

c. All sheeting and bracing shall be removed upon completion of the work.

19. If grading operations are suspended for any reason whatsoever, partially completed cut and fill slopes shall be brought to the required slope and the work of seeding and mulching or other required erosion and sedimentation control operations shall be performed at the Contractor's sole expense.

END OF SECTION

SECTION 02223

EMBANKMENT

Embankment: Embankment is the on-site compacted fill that provides the foundation and the berms for the containment area, the subgrade for some access roadways and structures, and backfill around structures and piping.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment to complete Embankment including borrowing, hauling, screening, discing, drying, compaction, control of surface and subsurface water, final grading, sealing, and all necessary and incidental items as detailed or required to complete the Embankment, all in accordance with the Contract Drawings and these Specifications.

2. Related Work:

Related Contract Work is described in the following sections of the Specifications:

Work	Section
Excavation	02222
Erosion and Sedimentation Control	02270
CQA Manual	Attached

3. Reference Standards:

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 D 698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3).
ASTM D 1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
ASTM D 2167	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.

ASTM D 2216	Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
ASTM D 2488	Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).
ASTM D 2937	Standard Test Method for Density of Soil in Place by the Drive Cylinder Method.
ASTM D 2974	Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils.
ASTM D 4643	Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method.
ASTM D 4959	Standard Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating Method.
ASTM D 6938	Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

4. Quality Assurance:

Quality Assurance during placement of Embankment will be provided by the Owner as described in the accompanying Project CQA Manual.

5. Definitions:

a Embankment: Shall include construction of all site earthwork including roadways, subgrade, perimeter berm embankments, including preparation of the areas upon which materials are to be placed. Embankment may also be referred to as structural and/or controlled fill. All Embankment materials may be either (off-site) Select Borrow or (on-site) Borrow unless otherwise noted on Contract Drawings or specified by the Engineer.

b. Prepared Subgrade: The ground surface after clearing, grubbing, stripping, excavation, scarification, and/or compaction, and/or proof rolling to the satisfaction of the CQA Engineer.

c. Well-Graded: A mixture of particle sizes that has no specific concentration or lack thereof of one or more sizes. Well-graded does not define any numerical value that must be placed on the coefficient of uniformity, coefficient of curvature, or other specific grain size

distribution parameters. Well-graded is used to define a material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids.

d. Unclassified Fill: The nature of materials to be used is not identified or described herein but must be approved by the Engineer prior to use.

B. MATERIALS

1. Embankment materials shall consist of clean well-graded natural soil classified as SW, SM, SM-SC, SC, ML, CL-ML, or CL (ASTM D 2488) containing no topsoil or other deleterious material. Other material classifications may be approved by the Engineer.

2. Stones or rock fragments shall not exceed one half the maximum lift thickness as compacted in any dimension. Isolated rocks shall be a maximum of 24-inches in any dimension.

C. SUBMITTALS

The Contractor shall submit the following to the CQA Engineer before approval is given to proceed:

1. Descriptive information on compaction equipment to be used for construction of Embankment.

2. Descriptive information on the location and source of any off-site borrow material to be used for Embankment, where applicable. Information shall include Standard Proctor curves (ASTM D698) for each borrow material.

D. CONSTRUCTION

1. The Contractor shall conduct Embankment activities in such a manner that erosion of disturbed areas and off-site sedimentation is absolutely minimized as outlined in Section 02270, Erosion and Sedimentation Control, of these Specifications.

2. All placement and compaction of Embankment shall be performed only when the CQA Engineer is informed by the Contractor of intent to perform such work.

3. Embankment shall be placed and compacted to the lines and grades shown on the Contract Drawings. Placement of Embankment outside the construction limits shall occur only as directed and approved by the Engineer.

The Contractor will perform all surveys necessary to establish and verify lines and grades for all Embankment.

4. The Contractor shall protect all existing facilities including, but not limited to, utilities and monitoring wells.

5. Subgrade Preparation:

   a. The CQA Engineer shall inspect the exposed subgrade prior to placement of Embankment to assure that all rocks, topsoil, vegetation, roots, debris, or other deleterious materials have been removed.

   b. Prior to placement of Embankment, the exposed subgrade shall be proofrolled using a static smooth-drum roller, loaded tandem axle dump truck, or other suitable equipment in the presence of the CQA Engineer. Any soft or unsuitable materials revealed before or during the in-place compaction shall be removed as directed by the CQA Engineer and replaced with suitable Embankment.

6. Surfaces on which Embankment is to be placed, shall be scarified or stepped in a manner which will permit bonding of the Embankment with the existing surface.

7. The Contractor shall be responsible for preparing the materials for the Embankment, including but not limited to, in-place drying or wetting of the soil necessary to achieve the compaction criteria of these Specifications.

8. The Contractor shall be responsible for the control of all surface and subsurface water when necessary.

9. Embankment materials shall be placed in a manner permitting drainage and in continuous, approximately horizontal layers.

10. Compaction Requirements:

    a. The Contractor shall compact Embankment in accordance with the requirements shown in Table 1 of this section. If Embankment does not meet the specified requirements, the Contractor shall rework the material, as may be necessary and continue compaction to achieve these requirements, or remove and replace the material to achieve the specified requirements, at Contractor's expense.

    b. Each lift shall be compacted prior to placement of succeeding lifts. In confined areas, mechanical equipment, suitable for small areas and capable of achieving the density requirements, shall be required.

c. Lift compaction shall be performed with an appropriately heavy, properly ballasted, penetrating-foot or smooth-drum vibratory compactor depending on soil type. Compaction equipment shall be subject to approval by the CQA Engineer.

11. Embankment that becomes excessively eroded, soft, or otherwise unsuitable shall be removed or repaired by the Contractor as directed by the CQA Engineer, at no cost to the Owner.

12. The exposed surface of Embankment shall be rolled with a smooth-drum roller at the end of each work day to protect from adverse weather conditions.

13. Where Embankment is to be placed and compacted on slopes that are steeper than 3:1, the subgrade shall be benched to a minimum depth of 6 inches and the Embankment shall be placed in horizontal lifts.

14. Backfilling for Structures and Piping:

a. All structures, including manholes and pipes shall be backfilled with Embankment as shown in the Contract Drawings and as described in these Specifications.

b. Where sheeting is used, the Contractor shall take all reasonable measures to prevent loss of support beneath and adjacent to pipes and existing structures when sheeting is removed. If significant volumes of soil cannot be prevented from clinging to the extracted sheets, the voids shall be continuously backfilled as rapidly as possible. The Contractor shall thereafter limit the depth below subgrade that sheeting will be driven in similar soil conditions or employ other appropriate means to prevent loss of support.

c. When backfilling around structures, do not backfill until concrete has sufficiently cured (as determined by the CQA Engineer) and is properly supported. Place backfill in a manner to avoid displacement or damage of structures.

TABLE 1: REQUIRED EMBANKMENT PROPERTIES

ITEM	Required % Standard Proctor (ASTM D698)[2]	Required Moisture Content[3]	Maximum Lift Thickness (Compacted) (inches)
Embankment	95	As Required for Compaction	8
Embankment Beneath Structures and Roads[1]	98		8
Backfill Around Structures	95		8
Backfill in Pipe Trenches	95		6
Unclassified Fill	N/A	N/A	N/A

Notes:

1. Embankment beneath structures shall be considered to include a zone 10 feet out from the foundation of the structure extending down to the natural ground on a 45° slope. Embankment beneath roads shall be considered to include all embankment placed within 2 vertical feet of the final wearing surface and shall also include shoulders.
2. Determine field density using ASTM D 6938, ASTM D 1556, ASTM D 2167, or ASTM D 2937.
3. Determine field moisture content using ASTM D 6938, ASTM D 2216, ASTM D 4643, or ASTM D 4959.
4. The Engineer may allow exceptions to the above criteria for areas outside of the containment area which are not subject to significant long-term loads.

END OF SECTION

SECTION 02240

GEOTEXTILES

Geotextiles: For the proposed construction, a Type GT-S (Separator/Filter) Geotextile is specified. The Type GT-S Geotextile will be placed in some erosion control and drainage applications.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment to complete installation of Geotextiles including all necessary and incidental items as detailed or required for the Contractor to complete the installation in accordance with the Contract Drawings and these Specifications, except as noted below:

a. Geotextiles used as a Silt Fence is covered under Section 02270, Erosion and Sedimentation Control, of these Specifications.

2. Related Work:

Related Contract Work is described in the following sections of the Specifications:

Work	Section
Erosion and Sedimentation Control	02270

3. Reference Standards:

The latest revision of the following standards of the American Society of Testing and Materials (ASTM) and the American Association of State Highway and Transportation Officials (AASHTO) are hereby made a part of these specifications.

ASTM D 3786	Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method.
ASTM D 4355	Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).

ASTM D 4491	Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
ASTM D 4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
ASTM D 4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
ASTM D 4751	Standard Test Method for Determining Apparent Opening Size of a Geotextile.
ASTM D 4833	Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
ASTM D 5261	Standard Test Method for Measuring Mass per Unit Area of Geotextiles.
AASHTO M 288	Standard Specification for Geotextiles.

B. MATERIALS

1. General:

The materials supplied under these Specifications shall consist of new, first-quality products designed and manufactured specifically for the purpose of this work, which shall have been satisfactorily demonstrated, by prior use, to be suitable and durable for such purposes.

Labels on each roll of Geotextile shall identify the length, width, lot and roll numbers, and name of Manufacturer.

2. The Type GT-S Geotextile shall be a nonwoven spunbonded or nonwoven needlepunched synthetic fabric consisting of polyester or polypropylene manufactured in a manner approved by the Engineer. Woven fabrics may be used in certain applications if approved in advance by the Engineer.

3. All Geotextiles shall conform to the properties listed in Table 1 of this section.

C. SUBMITTALS

Prior to the installation of Geotextiles, the Contractor shall submit the following to the CQA Engineer:

1. Mill Certificate and Sample: Prior to shipping to the site, the Contractor shall submit a mill certificate or affidavit signed by a legally authorized official of the Manufacturer for each type of Geotextile attesting that the Geotextiles meet the physical and manufacturing requirements stated in these Specifications. The Contractor shall also submit a sample of each Geotextile to be used. The samples shall be labeled with the product name and be accompanied by the Manufacturer's specifications.

2. Shipping, Handling, and Storage Instructions: The Manufacturer's plan for shipping, handling, and storage shall be submitted for review.

3. Seaming Procedures:

   Submit proposed seaming procedures including proposed method and equipment.

4. Quality Control Certificates: For Geotextiles delivered to the site, quality control certificates, signed by the Manufacturer's quality assurance manager shall be provided which represent every roll of each type of Geotextile supplied. Each certificate shall have the roll identification number(s), test methods, frequency, and test results. At a minimum, the test results and frequency of testing shall be as shown in Table 2 of this section.

5. Furnish copies of the delivery tickets or other approved receipts as evidence for materials received that will be incorporated into the construction.

D. CONSTRUCTION

1. Shipping, Handling, and Storage:

   All Geotextiles shall be shipped, handled, and stored in strict accordance with the Manufacturer's recommendations.

2. Failing CQA Material Control Tests:

   Geotextiles that are rejected upon testing shall be removed from the project site and replaced at Contractor's cost. Sampling and CQA testing of Geotextiles supplied as replacement for rejected material shall be performed by the CQA Engineer at Contractor's cost.

3. Installation:

   a. The surface receiving the Geotextiles shall be prepared to a relatively smooth condition, free of obstructions, standing water, excessive depressions, debris, and very soft, excessively wet, and/or loose pockets of

soil. This surface shall be approved by the CQA Engineer prior to Geotextile placement.

b. Geotextiles shall be placed to the lines and grades shown on the Contract Drawings. At the time of installation, Geotextiles shall be rejected by the CQA Engineer if they have defects, rips, holes, flaws, evidence of deterioration, or other damage.

c. The Geotextiles shall be placed smooth and free of excessive wrinkles.

d. On slopes, Geotextiles shall be anchored at the top and unrolled down the slope. In the presence of wind, all Geotextiles shall be weighted with sandbags or other material as approved by the CQA Engineer. Geotextiles uplifted by wind may be reused upon approval by the CQA Engineer.

4. Seams:

a. All Geotextile seams shall be continuously sewn or heat bonded with methods approved by the Engineer. Overlapping of seams may also be allowed if approved in advance by the Engineer. All seams must be approved by the CQA Engineer.

b. On slopes of 6H:1V or steeper, all seams shall be oriented parallel to (in the direction of) the slope unless otherwise approved by the Engineer.

c. Seams to be sewn shall be sewn using a Type 401 stitch. One or two rows of stitching may be used. Each row of stitching shall consist of 4 to 7 stitches per inch. The minimum distance from the geotextile edge to the stitch line nearest to that edge (seam allowance) shall be 1.5 inches if a Type SSa (prayer or flat) seam is used. The minimum seam allowance for all other seam types shall be 1.0 inches.

d. Seams to be heat bonded shall be bonded using hot plate, hot knife, ultrasonic, or other approved devices.

5. Repair Procedures:

a. Any Geotextile that is torn, punctured, or otherwise damaged shall be repaired or replaced, as directed by the CQA Engineer, by the Contractor at no additional cost to the Owner. The repair shall consist of a patch of the same type of Geotextile placed over the failed areas and shall overlap the existing Geotextile a minimum of 18 inches from any point of the rupture. Patches shall be spot sewn or heat bonded so as not to shift during cover placement.

b. Slopes Flatter Than 6H:1V: Damaged areas of a size exceeding 10 percent of the roll width shall be removed and replaced across the entire roll width with new material. Damaged areas of a size less than 10 percent of the roll width may be patched.

c. Slopes of 6H:1V or Steeper: Geotextile panels which require repair shall be removed and replaced with new material. Replacement material shall be sewn as previously described in this specification.

6. Cover Placement:

Placement of cover over Geotextiles shall be performed in a manner as to ensure that the Geotextiles or underlying materials are not damaged. Cover material shall be placed such that excess tensile stress is not mobilized in the Geotextile.

TABLE 1: REQUIRED GEOTEXTILE PROPERTIES

PROPERTY	TEST METHOD	UNITS	VALUE[1]	
			TYPE GT-S	TYPE GT-C
Geotextile Construction (NW = Nonwoven) (W = Woven)	----------	----------	NW[2] or W[3]	NW[2] Needle-punched
Mass per Unit Area (Unit Weight)	ASTM D 5261	oz/yd^2	N/A	12
Ultraviolet Resistance (500 hrs)	ASTM D 4355	%	70	70
Strength Class[4]	AASHTO M 288	Class	2	1
Tensile Properties:	ASTM D 4632			
Grab Strength		lbs	160 (NW) 250 (W)	205
Grab Elongation		%	$\geq$ 50 (NW) < 50 (W)	$\geq$ 50
Puncture Resistance	ASTM D 4833	lbs	55 (NW) 90 (W)	80
Trapezoidal Tear Strength	ASTM D 4533	lbs	55 (NW) 90 (W)	80
Burst Strength	ASTM D 3786	psi	200 (NW) 400 (W)	255
Apparent Opening Size (AOS)	ASTM D 4751	U.S. Sieve	70+	N/A
Permittivity	ASTM D 4491	sec^{-1}	1.0	N/A

Notes:

1. Minimum Average Roll Value (MARV).
2. Nonwoven geotextiles that have been heat calendered are not acceptable, unless approved by the Engineer in advance.
3. Woven geotextiles shall be approved in advance by the Engineer. Woven geotextiles formed exclusively with slit film fibers are not acceptable.
4. AASHTO M 288 criteria includes the above listed requirements for: Tensile Properties, Puncture Resistance, Trapezoidal Tear Strength, and Burst Strength.

TABLE 2: REQUIRED MANUFACTURER QUALITY CONTROL TESTS

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
Mass per Unit Area (Unit Weight)	ASTM D 5261	200,000 ft^2
Ultraviolet Resistance (500 hrs)	ASTM D 4355	Periodic
Tensile Properties	ASTM D 4632	200,000 ft^2
Burst Strength (Diaphragm Methods)	ASTM D 3786	200,000 ft^2
Apparent Opening Size (AOS)	ASTM D 4751	Periodic
Permittivity	ASTM D 4491	Periodic
Puncture Resistance	ASTM D 4833	200,000 ft^2
Trapezoidal Tear Strength	ASTM D 4533	200,000 ft^2

END OF SECTION

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SECTION 02250

SOIL LINER

Soil Liner: The Soil Liner serves as a hydraulic containment barrier in the final cover system.

A. DESCRIPTION

1. General:

a. The Contractor shall furnish all labor, material, and equipment to complete installation of the Soil Liner including borrowing, hauling, screening, mixing, stockpiling, discing, compacting, drying or wetting, removal of surface water, removal of all previously placed material affected by adverse weather conditions or construction disturbance, final grading and sealing, and all necessary and incidental items as detailed or required to complete the Soil Liner, all in accordance with the Contract Drawings and these Specifications.

b. The Contractor shall provide suitable soil from an on-site or off-site borrow site that meets all requirements outlined in these Specifications for Soil Liner.

Off-site borrow sources shall be approved in advance by the Engineer. The Contractor shall be responsible for all submittals required for Engineer approval of off-site borrow sources.

2. Related Work:

Related Contract Work is described in the following sections of the Specifications:

Work	Section
Vegetative Soil Layer	02258

3. Reference Standards:

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 D 422 Standard Test Method for Particle Size Analysis of Soils.

ASTM D 698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3).
ASTM D 1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
ASTM D 2167	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
ASTM D 2216	Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
ASTM D 2488	Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).
ASTM D 2937	Standard Test Method for Density of Soil in Place by the Drive Cylinder Method.
ASTM D 4318	Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
ASTM D 4643	Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method.
ASTM D 4959	Standard Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating Method.
ASTM D 5084	Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.
ASTM D 6938	Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

4. Quality Assurance:

Quality Assurance during placement of Soil Liner will be provided by the Owner.

B. MATERIALS

All material for Soil Liner shall conform to the requirements shown in Table 1 of this section.

C. SUBMITTALS

The Contractor shall submit the following to the CQA Engineer:

1. Before approval is given to proceed with test fill construction, the Contractor shall submit descriptive information on compaction equipment to be used for construction of the Soil Liner.

2. Off-Site Borrow Sources (If Applicable):

   a. For each off-site borrow source for Soil Liner soils, the Contractor shall provide the following information at least four weeks prior to placement of the Soil Liner:

      (1) The name, location, and owner of proposed borrow site, including a topographic map and location map of the site.

      (2) A certification submitted by an independent Registered Professional Engineer that the proposed borrow site contains a minimum of double the in-place volume of Soil Liner required to complete the work.

      (3) A certification submitted by an independent Registered Professional Engineer that the proposed borrow soils meet the requirements for Soil Liner outlined in these Specifications. Certification shall include the following minimum testing and test frequency:

Test	Min. Number of Tests
Atterberg Limits (ASTM D 4318)	10
Grain Size (with Hydrometer) (ASTM D 422)	10
Standard Proctor (ASTM D 698)	5
Natural Moisture Content (ASTM D 2216)	10
Hydraulic Conductivity (Lab Remolded) (ASTM D 5084)	5

      Testing samples for certification shall be obtained from well distributed locations within the proposed borrow area. All test data shall be submitted with the soil certification.

   b. The Contractor shall be responsible for maintaining quality of the Soil Liner borrow source throughout construction and shall ensure that the borrow soil meets the project criteria outlined in these Specifications. The

Contractor shall cooperate with the CQA Engineer so that the CQA Engineer has unlimited access to the borrow area during construction for the purposes of sampling and testing borrow soil.

c. If the borrow source does not meet the requirements outlined in these Specifications, the Contractor shall be responsible for providing an alternative borrow source at no cost to the Owner.

D. CONSTRUCTION

1. General:

a. All placement and compaction of Soil Liner shall be performed only when the CQA Engineer is informed by the Contractor of intent to perform such work.

b. The Contractor shall place and compact the Soil Liner to the lines and grades shown on the Contract Drawings with the exception that a 0.15 foot overbuild at the Contractor's expense is allowed. Thickness requirements are minimum values. The Contractor will perform all surveys necessary to establish and verify lines and grades for all Soil Liner.

2. Borrow Soils:

a. The Contractor may haul borrow soil to an on-site stockpile area. Unless otherwise allowed by the Engineer, borrow soil cannot be hauled directly to the containment area for placement and compaction unless each load is monitored and approved by the CQA Engineer prior to loading at the borrow site.

b. Any borrow soil not meeting the requirements for Soil Liner shall be rejected and removed from the project site by the Contractor at no cost to the Owner.

3. Test Fill Construction:

The Contractor shall construct a test fill prior to construction of Soil Liner. The test fill shall be at least 20 feet wide by 50 feet long and shall be compacted in lifts to the full design thickness. The Contractor shall use materials and equipment for test fill construction that the Contractor intends to use during construction.

No Soil Liner construction may be performed until the test fill construction is confirmed to be adequate in accordance with the Project CQA Manual.

The Contractor shall amend construction techniques or equipment in order to meet all criteria outlined for Soil Liner in these Specifications at no cost to the Owner.

4. Subgrade Preparation:

a. The CQA Engineer shall inspect the exposed subgrade prior to placement of Soil Liner to assure that all rocks, topsoil, vegetation, roots, debris, or other deleterious materials have been removed.

b. Prior to placement of Soil Liner, the exposed subgrade shall be proofrolled using a static smooth-drum roller, loaded tandem axle dump truck, or other suitable equipment in the presence of the CQA Engineer. Any soft or unsuitable subgrade materials revealed before or during the in-place compaction shall be removed as directed by the CQA Engineer and replaced with Soil Liner.

5. Placement and Compaction:

a. All Soil Liner shall be placed in loose lifts no greater than the height of the feet on compaction equipment to be used. The loose Soil Liner shall be free from clods or rocks which exceed the sizes in Table 1. Where excessive sized clods do occur, the Contractor shall break up the clods using methods approved by the CQA Engineer.

b. Lift compaction shall be performed with an appropriately heavy, properly ballasted, penetrating-foot compactor. Compaction equipment shall be the same as used in the test fill, unless otherwise approved by the Engineer.

Each lift shall be compacted prior to placement of succeeding lifts. The maximum lift thickness shall be as shown in Table 2. In confined areas, mechanical equipment, suitable for small areas and capable of achieving the density requirements, shall be required.

c. The exposed surface of Soil Liner shall be protected from adverse weather conditions or desiccation of the soil. This is commonly done by rolling the surface of the Soil Liner with a smooth-drum roller at the end of each work day. Alternative means of protecting the Soil Liner may be employed by the Contractor.

d. The in-place Soil Liner shall conform to the requirements shown in Table 2 of this section. If Soil Liner does not meet the specified requirements, the Contractor shall rework the material, as may be necessary and continue compaction to achieve these requirements, or remove and replace the material to achieve the specified requirements, at Contractor's expense.

e. Any Soil Liner surface which is smooth, has a moisture content outside of the specified moisture content range, as defined by ASTM D 698, or exhibits evidence of desiccation cracking ½ inch deep or greater, shall be scarified to a depth of 1 to 3 inches and brought to a proper moisture content prior to placement of a subsequent lift. This includes any Soil Liner surface that was previously seal rolled for protection.

f. No Soil Liner shall be placed or compacted when soil temperatures are so low as to produce ice lenses in the Soil Liner borrow soil.

g. Soil Liner placed on side slopes shall be placed and compacted in lifts which are parallel to the slope. Lift criteria shall be as described herein.

h. Locations of control stakes, in-place density tests, thickness checks, or other samples in the Soil Liner shall be patched with compacted Soil Liner or sodium bentonite compacted and hydrated in the holes.

6. Surveying:

After completion of a segment of Soil Liner, but before installation of subsequent layers, the Soil Liner shall be surveyed (by test pit or hand auger) on a 100 foot grid to ensure the minimum specified thickness of Soil Liner has been achieved.

TABLE 1: SOIL LINER MATERIAL REQUIREMENTS

PROPERTY	TEST METHOD	VALUE
Visual Classification	ASTM D 2488	Clean natural fine-grained soil free from organics, debris, or other detrimental material. Soil type as required to achieve the hydraulic conductivity criteria.
Clod Size	-----	Maximum = ¾ inch (or less if required to achieve hydraulic conductivity criteria)
Gradation	ASTM D 422	Max. = 1½ inches
Atterberg Limits	ASTM D 4318	As required based on soil type.
Hydraulic Conductivity (Lab Remolded) (Compacted Soil Barrier)	ASTM D 5084[3]	 $\leq 1 \times 10^{-5}$ cm/s at a density of $\geq$ 95% maximum standard dry density and a moisture content $\geq$ optimum moisture content[4]

TABLE 2: IN-PLACE SOIL LINER REQUIREMENTS

PROPERTY	TEST METHOD	VALUE
Density	ASTM D 6938[1]	≥ 95% maximum standard dry density[4]
Moisture Content	ASTM D 6938[2]	≥ optimum moisture content[4]
Maximum Lift Thickness (Compacted): (Compacted Soil Barrier)	-----	9 inches
Hydraulic Conductivity (Shelby Tube): (Compacted Soil Barrier)	ASTM D 5084[3]	$\leq 1 \times 10^{-5}$ cm/s
Completed Thickness: (Compacted Soil Barrier)	Survey	18 inches minimum

Notes:

1. Optionally use ASTM D 1556, ASTM D 2167, or ASTM D 2937.
2. Optionally use ASTM D 2216, ASTM D 4643, or ASTM D 4959.
3. Maximum effective confining pressure and maximum hydraulic gradient as follows. Backpressure as recommended by ASTM D 5084. Modifications of the maximum hydraulic gradient may be allowed by the Engineer depending on actual hydraulic conductivity values.

Material	Maximum Effective Confining Pressure (psi)	Maximum Hydraulic Gradient
Compacted Soil Barrier ($k \leq 1 \times 10^{-5}$ cm/s)	5	15

4. Or as otherwise determined by remolded samples to achieve hydraulic conductivity criteria.

END OF SECTION

SECTION 02258

VEGETATIVE SOIL LAYER

Vegetative Soil Layer (VSL): The Vegetative Soil Layer (VSL) is placed in the final cover system in order to support permanent vegetative cover.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment to complete installation of the VSL for the landfill cover, including borrowing, hauling, spreading, and final grading and all necessary and incidental items as detailed or required to complete the VSL, all in accordance with the Contract Drawings and these Specifications.

2. Related Work:

Related Contract Work is described in the following sections of the Specifications:

Work	Section
Soil Liner	02250

3. Quality Assurance:

Quality Assurance during placement of Vegetative Soil Layer will be provided by the Owner.

B. MATERIALS

Soil that meets all of the following requirements shall be classified as select soil fill for use in construction of the VSL.

1. Soil materials used in the VSL shall be reasonably free of gypsum, ferrous, and/or calcareous concretions and nodules, refuse, roots, or other deleterious substances.

2. The VSL 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. This material must be capable of supporting growth of vegetative cover.

C. SUBMITTALS

The Contractor shall submit the following to the CQA Engineer:

1. Before approval is given to proceed, the Contractor shall submit descriptive information on placement equipment to be used in construction of the VSL.

D. CONSTRUCTION

1. All placement and compaction of VSL shall be performed only when the CQA Engineer is informed by the Contractor of intent to perform such work.

2. VSL shall be placed as specified below:

   a. The VSL, including topsoil, shall be placed and spread using tracked equipment. The CQA Engineer shall approve the equipment used to place the VSL.

   b. VSL shall be placed and compacted to the lines and grades shown on the Contract Drawings with the exception that a 0.15 foot overbuild at Contractor's expense is allowed. The Contractor will perform all surveys necessary to establish and verify lines and grades for all VSL.

   c. VSL shall be compacted by tracking the final lift with tracked equipment.

3. After the specified thickness has been achieved and verified, the Contractor shall proceed immediately with seeding.

4. Surveying:

   After completion of a segment of VSL, the VSL shall be surveyed (by test pit or hand auger) on a 100 foot grid to ensure the minimum specified thickness of VSL has been achieved.

END OF SECTION

SECTION 02270

EROSION AND SEDIMENTATION CONTROL

Erosion and Sedimentation Control: Erosion and Sedimentation Control is a system of construction and engineered measures (devices, structures, practices, etc.) which act to minimize surface water induced erosion of disturbed areas and the resulting off-site sedimentation.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment to complete installation of and maintain Erosion and Sedimentation Control measures and related work in accordance with the Contract Drawings and these Specifications.

All Erosion and Sedimentation Control work shall be in accordance with the latest edition of the North Carolina Erosion and Sediment Control Planning and Design Manual as well as applicable regulations.

2. Related Work:

Related Contract Work is described in the following sections of the Specifications:

Work	Section
Geotextiles	02240
Rip Rap	02271
Rolled Erosion Control Products	02275
Revegetation	02930

3. Reference Standards:

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 D 3786 — Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method.

ASTM D 4355	Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).
ASTM D 4491	Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
ASTM D 4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
ASTM D 4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
ASTM D 4751	Standard Test Method for Determining Apparent Opening Size of a Geotextile.
ASTM D 4833	Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

B. MATERIALS

1. Permanent Sediment or Detention Basins:

Permanent sediment or detention basins shall be constructed as shown on the Contract Drawings.

2. Permanent Drainage Channels, Diversions, Swales, and Ditches:

Permanent drainage channels, diversions, swales, and ditches shall be constructed as shown on the Contract Drawings.

3. Silt Fence:

Silt fences shall be constructed as shown on the Contract Drawings and as needed, based on the Contractor's discretion and Engineer's approval. The silt fence is a permeable barrier erected within and downgradient of small disturbed areas to capture sediment from sheet flow. It is made of filter fabric buried at the bottom, stretched, and supported by posts and wire mesh backing. Silt fence shall conform to the following properties:

a. Posts: Posts shall be 1.33 lb/linear foot steel (preferred) or wood with a minimum length of 5 feet. Steel posts shall be "U" or "T"-type. Wood posts shall have a minimum diameter of 4-inches.

b. Filter Fabric: Filter fabric shall be a woven geotextile made specifically for sediment control. Filter fabric shall conform to the properties listed in Table 1 of this section.

4. Geotextiles:

Geotextiles shall conform to the requirements of Section 02240, Geotextiles, of these Specifications.

5. Temporary Sediment Traps:

Temporary sediment traps shall be constructed as shown on the Contract Drawings.

6. Filter Berms:

Filter berms shall be constructed as shown on the Contract Drawings.

7. Down Pipes:

Down chutes and pipes shall be constructed as shown on the Contract Drawings.

8. Rip Rap:

Rip Rap shall conform to the requirements of Section 02271, Rip Rap, of these Specifications.

9. Rolled Erosion Control Products (RECPs):

Rolled Erosion Control Products (RECPs) shall conform to the requirements of Section 02275, Rolled Erosion Control Products, of these Specifications.

10. Other Work:

In addition to the Erosion and Sedimentation Control measures shown on the Contract Drawings, the Contractor shall provide adequate means to prevent any sediment from entering any storm drains, drop inlets, ditches, streams, or bodies of water downstream of any area disturbed by construction. Excavation materials shall be placed upstream of any trench or other excavation to prevent sedimentation of off-site areas. In areas where a natural buffer area exists between the work area and the closest stream or water course, this area shall not be disturbed. All paved areas shall be scraped and swept as necessary to prevent the accumulation of dirt and debris. Work associated with this provision shall be considered incidental to the project and no separate payment will be made.

11. Temporary and Permanent Ground Cover:

The Contractor shall provide temporary or permanent ground cover (or other acceptable measure(s)) adequate to restrain erosion on erodible slopes or other areas within 21 calendar days following completion of any phase of grading. The Contractor shall provide permanent ground cover for all disturbed areas within 15 working days or 90 calendar days (whichever is shorter) following the completion of construction.

C. SUBMITTALS

The Contractor shall submit the following to the Engineer:

1. Submit a certification and summary of all required test results, prior to installation, that all Erosion and Sedimentation Control materials manufactured for the project have been produced in accordance with these Specifications.

2. Furnish copies of the delivery tickets or other approved receipts as evidence for materials received that will be incorporated into construction.

D. CONSTRUCTION

1. Establishment of Erosion and Sedimentation Control Measues:

   a. All Erosion and Sedimentation Control measures will be constructed according to the Contract Drawings and these Specifications.

   b. Due to the nature of the work required by this Contract, it is anticipated that the location and nature of the Erosion and Sedimentation Control measures may need to be adjusted on several occasions to reflect the current phase of construction.

   c. Erosion and Sedimentation Control measures shall be established prior to the work in a given area. Where such practice is not feasible, the Erosion and Sedimentation Control measure(s) shall be established immediately following completion of the clearing operation.

   d. The construction schedule adopted by the Contractor will impact the placement and need for specific measures required for the control of erosion. The Contractor shall develop and implement such additional techniques as may be required to minimize erosion and prevent or correct the discharge of sediment outside the limits of construction (unless controlled by other on-site measure(s)).

e. The location and extent of Erosion and Sedimentation Control measures shall be revised at each phase of construction that results in a change in either the quantity or direction of surface runoff from construction areas. All deviations from the control provisions shown on the Contract Drawings shall have the prior approval of the Engineer.

2. Inspection and Maintenance of Erosion and Sedimentation Control Measures:

a. The Contractor shall furnish the labor, material, and equipment required for the inspection and maintenance of all Erosion and Sedimentation Control measures. Maintenance shall be scheduled as required for a particular measure to maintain the removal efficiency and intent of the measure.

b. All Erosion and Sedimentation Control measures shall be inspected at least once every seven calendar days and within 24 hours after any storm event of greater than 0.5 inches of rain per 24 hour period and appropriate maintenance conducted. A rain gauge shall be maintained on the site and a record of the rainfall amounts and dates shall be kept properly.

c. Maintenance shall include, but not be limited to:

(1) The removal and satisfactory disposal of trapped or deposited sediments from basins, traps, barriers, filters, and/or drainage features/devices;

(2) Replacement of filter fabrics used for silt fences upon loss of efficiency; and

(3) Replacement of any other components which are damaged or cannot serve the intended use.

d. The Contractor shall accept and maintain any existing sediments that are included in existing sediment traps or basins that accept or will accept stormwater flow and or sediment accumulation from all areas within the Contractor's limits of construction.

e. Sediments removed from Erosion and Sedimentation Control measures shall be disposed of in locations that will not result in off-site sedimentation as approved by the Engineer.

f. All Erosion and Sedimentation Control measures shall be maintained to the satisfaction of the Engineer until the site has been stabilized.

3. Graded Slopes and Fills:

The angle for graded slopes and fills shall be no greater than the angle that can be retained by vegetated cover or other adequate measures.

4. Finish Grading:

All disturbed areas shall be uniformly graded to the lines, grades, and elevations shown on the Contract Drawings. Finished surfaces shall be reasonably smooth, compacted, and free from irregular surface changes. Unless otherwise specified, the degree of finish shall be that ordinarily obtainable from either blade or scraper operations. Areas shall be finished to a smoothness suitable for application of topsoil.

5. Revegetation:

Revegetation shall conform to the requirements of Section 02930, Revegetation, of these Specifications.

6. Cleanup:

a. The Contractor shall remove from the site all subsoil excavated from his work and all other debris including, but not limited to, branches, paper, and rubbish in all landscape areas, and remove temporary barricades as the work proceeds.

b. All areas shall be kept in a neat, orderly condition at all times. Prior to final acceptance, the Contractor shall clean up the entire landscaped area to the satisfaction of the Engineer.

TABLE 1: REQUIRED SILT FENCE FILTER FABRIC PROPERTIES

PROPERTY	TEST METHOD	UNITS	VALUE[1]
Grab Tensile Strength[2]	ASTM D 4632	lbs	100 x 100
Grab Elongation	ASTM D 4632	%	20 (Max.)
Trapezoidal Tear Strength[2]	ASTM D 4533	lbs	65 x 65
Burst Strength	ASTM D 3786	psi	300
Puncture Resistance	ASTM D 4833	lbs	65
Ultraviolet Resistance (500 hrs)	ASTM D 4355	%	80
Apparent Opening Size (AOS)	ASTM D 4751	U.S. Sieve	30+
Permittivity	ASTM D 4491	sec^{-1}	0.05

Notes:
1. Minimum Average Roll Value (MARV).
2. Values for machine and cross machine direction (MD x XD), respectively.

END OF SECTION

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SECTION 02271

RIP RAP

Rip Rap: This section includes all rip rap aprons and channel protection.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment to complete installation of Rip Rap for protection of earthen slopes against erosion as indicated, including all necessary and incidental items, in accordance with the Contract Drawings and these Specifications.

2. Related Work:

Related Contract Work is described in the following sections of the Specifications:

Work	Section
Geotextiles	02240
Erosion and Sedimentation Control	02270

3. Reference Standards:

The latest revision of the following standards of the North Carolina Department of Transportation (NCDOT) are hereby made a part of these Specifications.

NCDOT Standard Specifications for Roads and Structures.

B. MATERIALS

1. Rip Rap: Rip Rap shall be of the size indicated on the Contract Drawings and shall conform to NCDOT Section 1042, Rip Rap Materials.

2. Geotextiles: Geotextiles shall conform to the requirements outlined in Section 02240, Geotextiles, of these Specifications.

C. SUBMITTALS

The Contractor shall submit the following to the Engineer:

1. Submit a certification and summary of all required test results prior to installation, that all Rip Rap has been produced in accordance with these Specifications.

2. Furnish copies of the delivery tickets or other approved receipts as evidence for materials received that will be incorporated into construction.

D. CONSTRUCTION

1. Surface Preparation:

   a. Trim and dress all areas to conform to the Contract Drawings as indicated with tolerance of 2 inches from theoretical slope lines and grades.

   b. Bring areas that are below allowable minimum tolerance limit to grade by filling with compacted Embankment material similar to adjacent material.

   c. Geotextiles shall be placed as shown on the Contract Drawings and in accordance with Section 02240, Geotextiles, of these Specifications.

   d. Do not place any stone material on the prepared surface prior to inspection and approval to proceed from the Engineer.

2. Placing Rip Rap:

   Rip Rap shall be placed in accordance with NCDOT Section 868, Rip Rap.

END OF SECTION

SECTION 02275

ROLLED EROSION CONTROL PRODUCTS

Rolled Erosion Control Products: Rolled Erosion Control Products (RECPs) include erosion control blankets (ECB), turf reinforcement mats (TRM) placed in channels and on slopes.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment to complete installation of all RECPs in accordance with the Contract Drawings and these Specifications.

2. Related Work:

Related Contract Work is described in the following sections of the Specifications:

Work	Section
Erosion and Sedimentation Control	02270
Revegetation	02930

3. Reference Standards:

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 D 4355	Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).
ASTM D 6475	Standard Test Method for Measuring Mass per Unit Area of Erosion Control Blankets.
ASTM D 6524	Standard Test Method for Measuring the Resiliency of Turf Reinforcement Mats.
ASTM D 6525	Standard Test Method for Measuring Nominal Thickness of Permanent Erosion Control Products.

ASTM D 6566	Standard Test Method for Measuring Mass per Unit Area of Turf Reinforcement Mats.
ASTM D 6818	Standard Test Method for Ultimate Tensile Properties of Turf Reinforcement Mats.

B. MATERIALS

1. General:

The materials supplied under these Specifications shall consist of new, first-quality products designed and manufactured specifically for the purpose of this work, which shall have been satisfactorily demonstrated, by prior use, to be suitable and durable for such purposes.

Labels on each RECP shall identify the length, width, product name, and name of Manufacturer.

2. Erosion Control Blanket (ECB):

ECB shall consist of a machine-produced mat of straw or wood excelsior fiber covered on the top and bottom sides with photodegradable extruded plastic or woven biodegradable nettings and sewn together with degradable thread. ECB shall also conform to the properties listed in Table 1 of this section. ECB shall be S150, as manufactured by North American Green, CURLEX II, as manufactured by American Excelsior Company, LANDLOK S2, as manufactured by Propex Fabrics, or approved equal.

3. Turf Reinforcement Mat (TRM):

TRM shall consist of a dense web of crimped and interlocking polypropylene fibers positioned between two biaxially oriented nets and mechanically bound together by parallel stitching with polypropylene thread. TRM shall be designed to accelerate seedling emergence, exhibit high resiliency, and possess strength and elongation properties to limit stretching in a saturated condition. TRM shall be stabilized against chemical and UV degradation which are normally found in a natural soil environment and shall have no biodegradable components. TRM shall also conform to the properties listed in Table 1 of this section. TRM shall be LANDLOK TRM 435, as manufactured by Propex Fabrics, or approved equal.

4. Anchors: Anchors for RECPs shall consist of machine made staples of No. 8 gauge new steel wire formed into a "U" shape. The size when formed shall be not less that 8 inches in length with a throat of not less than 1 inch in width. Longer anchors may be required for loose soils. Other anchors, such as metal pins or plastic pegs, may also be used if approved in advance by the Engineer.

C. SUBMITTALS

The Contractor shall submit the following to the Engineer:

1. Mill Certificate and Sample: Prior to shipping to the site, the Contractor shall submit a mill certificate or affidavit signed by a legally authorized official of the Manufacturer for each RECP attesting that each RECP meets the physical and manufacturing requirements stated in these Specifications. The Contractor shall also submit a sample of each RECP to be used. The sample shall be labeled with the product name and be accompanied by the Manufacturer's specifications.

2. Shipping, Handling, and Storage Instructions: The Manufacturer's plan for shipping, handling, and storage shall be submitted for review.

3. Installation Guidelines/Instructions: The Manufacturer's guidelines/instructions for installation shall be submitted for review.

4. Furnish copies of delivery tickets or other approved receipts as evidence for materials received that will be incorporated into the construction.

D. CONSTRUCTION

1. Shipping, Handling, and Storage:

   All RECPs shall be shipped, handled, and stored in strict accordance with the Manufacturer's recommendations.

2. Installation - General:

   a. Placing of RECPs shall be done immediately following seeding. Seeding shall be performed in accordance with Section 02930, Revegetation, of these Specifications.

   b. RECPs shall be placed to the lines and grades shown on the Contract Drawings. The earth surface shall be smooth and free from stones, clods, or debris which will prevent the contact of the RECP with the soil. Care shall be taken to preserve the required line, grade, and cross section of the area.

c. RECPs shall be unrolled in the direction of the flow of water and shall be applied without stretching so that it will lie smoothly but loosely on the soil surface.

d. At the time of installation, RECPs shall be rejected, if they have defects, rips, holes, flaws, evidence of deterioration, or other damage.

e. The Engineer may require adjustments in the installation requirements to fit individual conditions.

3. Installation - Channels:

RECPs installed in channels shall be unrolled parallel to the direction of water flow. The first roll shall be centered longitudinally in the channel and anchored with staples. Subsequent rolls shall be installed outward to the edges of the channel and be lapped to allow installation of a common row of anchors. RECP ends shall be overlapped with the upstream ends on top ("shingled"). Refer to the Contract Drawings and/or the Manufacturer's installation guidelines/instructions for installation details.

4. Installation - Slopes:

RECPs installed on slopes shall be oriented in vertical strips and anchored. Subsequent rolls shall be installed outward to the edge(s) of the original roll and be lapped to allow installation of a common row of anchors. RECP ends shall be shingled. Refer to the Contract Drawings and/or the Manufacturer's installation guidelines/instructions for installation details.

5. Maintenance:

Maintenance of RECPs shall be in accordance with Section 02270, Erosion and Sedimentation Control, of these Specifications.

TABLE 1: REQUIRED ROLLED EROSION CONTROL PRODUCT PROPERTIES

PROPERTY	TEST METHOD	UNITS	VALUE[1]
Erosion Control Blanket (ECB)			
Mass per Unit Area	ASTM D 6475	lbs/yd^2	0.5 ± 10% (Straw) 0.7 ± 10% (Excelsior)
Tensile Strength[2]	ASTM D 6818	lbs/ft	75 x 75
Tensile Elongation	ASTM D 6818	%	25
Maximum Permissible Shear Stress (Un-Vegetated)	-----	lb/ft^2	1.75
Functional Longevity	-----	months	12
Turf Reinforcement Mat (TRM)			
Mass per Unit Area	ASTM D 6566	oz/yd^2	8
Thickness	ASTM D 6525	inches	0.35
Tensile Strength[2]	ASTM D 6818	lbs/ft	225 x 175
Tensile Elongation	ASTM D 6818	%	50 (max.)
Resiliency	ASTM D 6524	%	80
UV Resistance (1,000 Hours)	ASTM D 4355	%	80
Maximum Permissible Shear Stress (Long-Term Vegetated)	Large Scale	lb/ft^2	5

Notes:

1. Typical for ECB; Minimum Average Roll Value (MARV) for TRM and HPTRM.
2. Values for machine and cross machine direction (MD x XD), respectively.

END OF SECTION

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SECTION 02930

REVEGETATION

Revegetation: Revegetation includes permanent Revegetation of all site areas disturbed by the Contractor whether inside the Contract Limits or not.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment to complete Revegetation in accordance with the Contract Drawings and these Specifications.

2. Related Work:

Related Contract Work is described in the following sections of the Specifications:

Work	Section
Embankment	02223
Vegetative Soil Layer	02258
Erosion and Sedimentation Control	02270
Rolled Erosion Control Products	02275

3. Warranty:

The Contractor shall be responsible for the satisfactory establishment and growth of a permanent stand of vegetation for a period of one year following the final seeding as judged by the Engineer. During this period, the Contractor shall be responsible for the maintenance items described in Paragraph D.4 (Maintenance) of this Specification.

B. MATERIALS

1. Limestone: Unless otherwise defined by specific soil tests, supply agricultural grade ground limestone conforming to the current "Rules, Regulations, and Standards of the Fertilizer Board of Control."

2. Fertilizer: Unless otherwise defined by specific soil tests, supply commercial fertilizer of 10-10-10 analysis, meeting applicable requirements of State and Federal law. Do not use cyanamic compounds of hydrated lime. Deliver fertilizer in original containers labeled with content analysis.

3. Grass Seed: Supply fresh, clean, new-crop seed as specified in Table 1 of this section. Do not use seed which is wet, moldy, or otherwise damaged. Deliver seed in standard sealed containers labeled with producer's name and seed analysis, and in accord with US Department of Agriculture Rules and Regulations under Federal Seed Act.

4. Mulch: Supply clean, seed-free, threshed straw of oats, wheat, barley, rye, beans, or other locally available mulch material.

   a. Do not use mulch containing a quantity of matured, noxious weed seeds or other species that will be detrimental to seeding, or provide a menace to surrounding land.

   b. Do not use mulch material which is fresh or excessively brittle, or which is decomposed and will smother or retard growth of grass.

5. Binder: Supply emulsified asphalt or synthetic binder.

6. Water: Supply potable, free of substances harmful to growth.

C. SUBMITTALS

The Contractor shall submit the following to the Engineer:

1. Results of soil tests performed and proposed modifications, if any, to the specified requirements.

2. Certificates for each grass seed mixture, stating botanical and common name, percentage by weight, and percentages of purity, germination, and weed seed. Certify that each container of seed delivered is fully labeled in accordance with Federal Seed Act and equals or exceeds specification requirements.

3. Copies of invoices for fertilizer, showing grade furnished and total quantity applied.

D. CONSTRUCTION

1. The Contractor shall establish a smooth, healthy, uniform, close stand of grass from the specified seed. Prior to Revegetation, the Contractor shall adequately test the soils to be revegetated to ensure the adequacy of the specified requirements. Any modifications to these requirements deemed necessary after the review of soil test results, shall be at the Contractor's sole expense. The Engineer will perform the observations to determine when successful Revegetation is achieved.

2. Soil Preparation:

a. Limit preparation to areas which will be planted soon after preparation.

b. Loosen surface to minimum depth of four (4) inches.

c. Remove stones, sticks, roots, rubbish and other extraneous matter over three (3) inches in any dimension.

d. Spread lime uniformly over designated areas at the rate specified in Table 1 of this section.

e. After application of lime, prior to applying fertilizer, loosen areas to be seeded with double disc or other suitable device if soil has become hard or compacted. Correct any surface irregularities in order to prevent pocket or low areas which will allow water to stand.

f. Distribute fertilizer uniformly over areas to be seeded at the rate specified in Table 1 of this section.

(1) Use suitable distributor.

(2) Incorporate fertilizer into soil to depth of a least two (2) inches.

(3) Remove stones or other substances which will interfere with turf development or subsequent mowing.

g. Grade seeded areas to smooth, even surface with loose, uniformly fine texture.

(1) Roll and rake, remove ridges and fill depressions, as required to meet finish grades.

(2) Fine grade just prior to planting.

3. Seeding:

a. Use approved mechanical power driven drills or seeders, mechanical hand seeders, or other approved equipment.

b. Distribute seed evenly over entire area at the rate specified in Table 1 of this section.

c. Stop work when work extends beyond most favorable planting season for species designated, or when satisfactory results cannot be obtained because of drought, high winds, excessive moisture, or other factors.

d. Resume work only when favorable condition develops, or as directed by the Engineer.

e. Lightly rake seed into soil followed by light rolling or cultipacking.

f. Immediately protect seeded areas against erosion by mulching or placing Rolled Erosion Control Products in accordance with Section 02275 of these Specifications, where applicable.

(1) Spread mulch in a continuous blanket at the rate specified in Table 1 of this section.

(2) Immediately following spreading mulch, secure with evenly distributed binder at the rate specified in Table 1 of this section.

4. Maintenance:

The Contractor shall be responsible for maintaining all seeded areas through the end of his warranty period. The Contractor shall provide, at his expense, protection of all seeded areas against damage at all times until acceptance of the work. Maintenance shall include, but not be limited to, the following items:

a. Regrade and revegetate all eroded areas until adequately stabilized by grass.

b. Remulch with new mulch in areas where mulch has been disturbed by wind or maintenance operations sufficiently to nullify its purpose. Anchor as required to prevent displacement.

c. Replant bare areas using same materials specified.

TABLE 1: SEEDING SCHEDULE

MATERIAL	SEED TYPE	APPLICATION RATE[1]
Lime	-----	4,000 lbs/acre
Fertilizer	-----	1,000 lbs/acre
Seed		
Permanent:	Kentucky 31 Tall Fescue	100 lbs/acre
	Sericea Lespedeza[3]	30 lbs/acre
	Kobe Lespedeza	10 lbs/acre
	Seasonal Nurse Crop[2]	See Below
Temporary:	Seasonal Nurse Crop[2]	See Below
Mulch	-----	4,000 - 5,000 lbs/acre
Binder	-----	150 gallons/acre

Notes:

1. Application rates and/or chemical analysis shall be confirmed or established by a soil test(s).
2. Use seasonal nurse crop in accordance with seeding dates as stated below:

May 1 - August 15	10 lbs/acre German Millet or 15 lbs/acre Sudangrass
August 15 - May 1	40 lbs/acre Rye (grain).

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ATTACHMENT
C

Construction Quality Assurance Manual

Davidson County C&D Landfill
Lexington, North Carolina

Prepared for:

Davidson County Integrated Solid Waste Management
Lexington, North Carolina

March 2009

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DAVIDSON COUNTY
DAVIDSON COUNTY C&D LANDFILL

CONSTRUCTION QUALITY ASSURANCE MANUAL

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Appendix A Reference List of Test Methods

SECTION 1.0
GENERAL

1.1 INTRODUCTION

This Construction Quality Assurance (CQA) Manual has been prepared to provide the Owner, (Design) Engineer, and CQA Engineer the means to govern the construction quality and to satisfy landfill certification requirements under current solid waste management regulations.

More specifically, this CQA Manual addresses the construction of the landfill base grades and the final cover system.

The CQA Manual is divided into the following sections:

- Section 1.0 General
- Section 2.0 CQA Documentation
- Section 3.0 Earthwork CQA
- Section 4.0 Soil Liner CQA
- Section 5.0 Final Cover System CQA

1.2 DEFINITIONS RELATING TO CONSTRUCTION QUALITY

1.2.1 Construction Quality Assurance (CQA)

In the context of this Manual, Construction Quality Assurance is defined as a planned and systematic program employed by the Owner to assure conformity of the earthwork, liner, and final cover systems installation with the project drawings and the project specifications. CQA is provided by the CQA Engineer as a representative of the Owner and is independent from the Contractor, and all manufacturers. The CQA program is designed to provide adequate confidence that items or services meet contractual and regulatory requirements and will perform satisfactorily in service.

1.2.2 Construction Quality Control (CQC)

Construction Quality Control refers to actions taken by manufacturers, fabricators, installers, and/or the Contractor to ensure that the materials and the workmanship meet the requirements of the project drawings and the project specifications. The manufacturer's specifications and quality control (QC) requirements are included in this CQA Manual by reference only. A complete updated version of each geosynthetic component manufacturer's QC Plan shall be incorporated as part of the Contractor's CQC Plan.

1.2.3 CQA Certification Document

At the completion of construction, a certification document will be prepared by the CQA Engineer and submitted to State Solid Waste Regulators. The certification report will

include all QC testing performed by the Geosynthetics Manufacturers, all CQC testing performed by the Geosynthetic Installers, and all CQA testing performed by the CQA Engineer.

1.2.4 Discrepancies Between Documents

The Contractor is instructed to bring discrepancies to the attention of the CQA Engineer who shall then notify the Engineer for resolution. The Engineer has the sole authority to determine resolution of discrepancies existing within the Contract Documents (this may also require the approval of State Solid Waste Regulators). Unless otherwise determined by the Engineer, the more stringent requirement shall be the controlling resolution.

1.3 PARTIES TO CONSTRUCTION QUALITY ASSURANCE

1.3.1 Description of the Parties

The parties to Construction Quality Assurance and Quality Control include the Owner, Engineer, Contractor, Geosynthetics Manufacturer, Geosynthetics Installer, CQA Engineer, Geosynthetics CQA Laboratory, and Soils CQA Laboratory.

1.3.1.1 Owner

The Owner is Davidson County, who owns and/or is responsible for the facility.

1.3.1.2 Engineer

The Engineer is responsible for the engineering design, drawings, and project specifications for the landfill. The Engineer is an official representative of the Owner. The Engineer serves as communications coordinator for the project, initiating the meetings outlined in **Section 1.7**. The Engineer will also be responsible for proper resolution of all quality issues that arise during construction. The Engineer is Richardson Smith Gardner & Associates, Inc.

1.3.1.3 Contractor

The Contractor is responsible for the construction of the landfill. The Contractor is responsible for the overall CQC on the project and coordination of submittals to the CQA Engineer. Additional responsibilities of the Contractor are defined by the project specifications.

1.3.1.4 CQA Engineer

The CQA Engineer is a representative of the Owner, is independent from the Contractor, and is responsible for observing, testing, and documenting activities related to the CQA of the earthworks at the site, and the installation of the soil liner,

and final cover systems. The CQA Engineer may make field observations and review submittals for the Engineer and is responsible for notifying the Owner and Engineer of all quality issues that arise during construction. The CQA Engineer is also responsible for issuing a facility certification report, sealed by a Professional Engineer registered in The State of North Carolina. Note that if the Certifying Engineer is with the same firm as the Design Engineer, they must be different individuals.

1.3.1.5 Soils CQA Laboratory

The Soils CQA Laboratory is a party, independent from the Owner, that is responsible for conducting geotechnical tests on conformance samples of soils and aggregates used in structural fills and the liner, and final cover systems. The services of the Soils CQA Laboratory are coordinated by the CQA Engineer and are paid for by the Owner.

1.3.2 Qualifications of the Parties

The following qualifications are required of all parties involved with the manufacture, fabrication, installation, transportation, and CQA of all materials for the landfill. Where applicable, these qualifications must be submitted by the Contractor to the Owner and Engineer for review and approval.

1.3.2.1 Contractor

Qualifications of the Contractor are specific to the construction contract and independent of this CQA Manual.

1.3.2.2 CQA Engineer

The CQA Engineer will act as the Owner's Quality Assurance Representative. The CQA Engineer will perform CQA testing to satisfy the requirements of this CQA Manual and will prepare the CQA certification document. The CQA Engineer will have experience in the CQA aspects of the construction and testing of structural fills and final cover systems, and be familiar with ASTM and other related industry standards. The activities of the CQA Engineer will be performed under the supervision of a Registered Professional Engineer.

1.3.2.3 Soils CQA Laboratory

The Soils CQA Laboratory will have experience in testing structural fills, soil liners, and aggregates, and be familiar with ASTM and other applicable test standards. The Soils CQA Laboratory will be capable of providing test results within 24 hours or a reasonable time after receipt of samples depending on the test(s) to be

conducted, as agreed to at the outset of the project by affected parties, and will maintain that standard throughout the installation.

1.4 SCOPE OF CONSTRUCTION QUALITY ASSURANCE MANUAL

The scope of this CQA Manual includes the CQA of the soils and geosynthetic components of the liner, and final cover systems for the subject facility. The CQA for the selection, evaluation, and placement of the soils is included in the scope.

1.5 UNITS

In this CQA Manual, all properties and dimensions are expressed in U.S. units.

1.6 REFERENCES

The CQA Manual includes references to the most recent version of the test procedures of the American Society of Testing and Materials (ASTM). **Appendix A** contains a list of these procedures.

1.7 CQA MEETINGS

To facilitate the specified degree of quality during installation, clear, open channels of communication are essential. To that end, meetings are critical.

1.7.1 Soil Liner CQA Meeting

Prior to the start of the soil liner system construction a CQA Meeting will be held. This meeting will include all parties then involved, including the Engineer, the CQA Engineer, and the Contractor.

The purpose of this meeting is to begin planning for coordination of tasks, anticipate any problems which might cause difficulties and delays in construction, and, above all, review the CQA Manual to all of the parties involved. It is very important that the rules regarding testing, repair, etc., be known and accepted by all.

This meeting should include all of the activities referenced in the project specifications.

The meeting will be documented by the Engineer and minutes will be transmitted to all parties. The Soil Liner CQA Meeting and the Geosynthetics CQA Meeting may be held as one meeting or separate meetings, depending on the direction of the Engineer.

1.7.2 CQA Progress Meetings

Progress meetings will be held between the Engineer, the CQA Engineer, the Contractor, the Geosynthetic Installation Superintendent(s), and representatives from any other

involved parties at the frequency dictated in the project specifications or, at a minimum, once per month during active construction. These meetings will discuss current progress, planned activities for the next week, and any new business or revisions to the work. The CQA Engineer will log any problems, decisions, or questions arising at this meeting in his daily or periodic reports. Any matter requiring action which is raised in this meeting will be reported to the appropriate parties. These meetings will be documented by the Engineer and minutes will be transmitted to affected parties.

1.7.3 Problem or Work Deficiency Meetings

A special meeting will be held when and if a problem or deficiency is present or likely to occur. At a minimum, the meeting will be attended by the Engineer, the CQA Engineer, the Contractor, and representatives from any other involved parties. The purpose of the meeting is to define and resolve the problem or work deficiency as follows:

- define and discuss the problem or deficiency;
- review alternative solutions; and
- implement an action plan to resolve the problem or deficiency.

The meeting will be documented by the Engineer and minutes will be transmitted to affected parties.

1.8 CONTROL VERSUS RECORD TESTING

1.8.1 Control Testing

In the context of this CQA Manual, Control Tests are those tests performed on a material prior to its actual use in construction to demonstrate that it can meet the requirements of the project plans and specifications. Control Test data may be used by the Engineer as the basis for approving alternative material sources.

1.8.2 Record Testing

Record Tests are those tests performed during the actual placement of a material to demonstrate that its in-place properties meet or exceed the requirements of the project drawings and specifications.

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SECTION 2.0
CQA DOCUMENTATION

2.1 DOCUMENTATION

An effective CQA plan depends largely on recognition of construction activities that should be monitored and on assigning responsibilities for the monitoring of each activity. This is most effectively accomplished and verified by the documentation of quality assurance activities. The CQA Engineer will document that quality assurance requirements have been addressed and satisfied.

The CQA Engineer will provide the Owner and Engineer with his daily and weekly progress reports including signed descriptive remarks, data sheets, and logs to verify that required CQA activities have been carried out. These reports will also identify potential quality assurance problems. The CQA Engineer will also maintain at the job site a complete file of project drawings, reports, project specifications, a CQA Manual, checklists, test procedures, daily logs, and other pertinent documents.

2.2 DAILY CQA REPORT

The CQA Engineer's reporting procedures will include preparation of a daily report which, at a minimum, will include the following information, where applicable:

- a unique identifying sheet number for cross referencing and document control;
- date, project name, location, and other identification;
- data on weather conditions;
- a reduced-scale Site Plan showing all proposed work areas and test locations;
- descriptions and locations of ongoing construction;
- descriptions and specific locations of areas, or units, of work being tested and/or observed and documented;
- locations where tests and samples were taken;
- a summary of test results;
- calibrations or recalibrations of test equipment, and actions taken as a result of recalibration;
- off-site materials received, including quality verification documentation;

- decisions made regarding acceptance of units of work, and/or corrective actions to be taken in instances of substandard quality;
- summaries of pertinent discussions with the Contractor and/or Geosynthetic Installers; and
- the CQA Engineer's signature.

The daily report must be completed at the end of each CQA Engineer's shift, prior to leaving the site. This information will be submitted weekly to and reviewed by the Owner and Engineer.

2.3 CQA PROGRESS REPORTS

The CQA Engineer will prepare a summary progress report each week, or at time intervals established at the pre-construction meeting. As a minimum, this report will include the following information, where applicable:

- a unique identifying sheet number for cross-referencing and document control;
- the date, project name, location, and other information;
- a summary of work activities during the progress reporting period;
- a summary of construction situations, deficiencies, and/or defects occurring during the progress reporting period;
- summary of all test results, failures and retests, and
- signature of the CQA Engineer.

The CQA Engineer's progress reports must summarize the major events that occurred during that week. Critical problems that occur shall be communicated verbally to the Engineer immediately as well as being included in the weekly reports. The CQA Engineer's weekly report must be submitted to the Owner and Engineer no later than the Monday following the week reported.

2.4 CQA PHOTOGRAPHIC REPORTING

Photographs will be taken by the CQA Engineer at regular intervals during the construction process and in all areas deemed critical by the CQA Engineer.

These photographs will serve as a pictorial record of work progress, problems, and mitigation activities. These records will be presented to the Engineer upon completion of the project.

In lieu of photographic documentation, videotaping may be used to record work progress,

problems, and mitigation activities. The Engineer may require that a portion of the documentation be recorded by photographic means in conjunction with videotaping.

2.5 DEFICIENCIES

The Owner and Engineer will be made aware of any significant recurring nonconformance with the project specifications. The Engineer will then determine the cause of the non-conformance and recommend appropriate changes in procedures or specification. When this type of evaluation is made, the results will be documented, and any revision to procedures or project specifications will be approved by the Owner and Engineer.

2.6 DESIGN AND/OR PROJECT TECHNICAL SPECIFICATION CHANGES

Design and/or project specification changes may be required during construction. In such cases, the CQA Engineer will notify the Engineer. The Engineer will then notify the appropriate agency, if necessary.

Design and/or project specification changes will be made only with the written agreement of the Engineer, and will take the form of an addendum to the project specifications. All design changes will include a detail (if necessary) and state which detail it replaces in the plans.

2.7 FINAL CQA REPORT

At the completion of each major construction activity at the landfill unit, the CQA Engineer will certify all required forms, observation logs, field and laboratory testing data sheets including sample location plans, etc. The CQA Engineer will also provide a final report which will certify that the work has been performed in compliance with the plans and project technical specifications, and that the supporting documents provide the necessary information.

The CQA Engineer will also provide summaries of all the data listed above with the report. The Record Drawings will include scale drawings depicting the location of the construction and details pertaining to the extent of construction (e.g., depths, plan dimensions, elevations, soil component thicknesses, etc.). All surveying and base maps required for development of the Record Drawings will be done by the Contractor's Construction Surveyor. These documents will be certified by the Contractor and delivered to the CQA Engineer and included as part of the final CQA (Certification) report.

It may be necessary to prepare interim certifications, as allowed by the regulatory agency to expedite completion and review.

At a minimum, the items shown in **Table 2.1** will be included in the Final CQA Report. Note that some items may not be applicable to all projects.

2.8 STORAGE OF RECORDS

All handwritten data sheet originals, especially those containing signatures, will be stored by the CQA Engineer in a safe repository on site. Other reports may be stored by any standard method which will allow for easy access. All written documents will become property of the Owner.

TABLE 2.1: FINAL CQA REPORT GENERAL OUTLINE

1.0 Introduction
2.0 Project Description
3.0 CQA Program
  3.1 Scope of Services
  3.2 Personnel
4.0 Earthwork CQA
5.0 Final Cover System CQA
6.0 Soil Liner CQA
7.0 Summary and Conclusions
8.0 Project Certification

Appendices

Appendix A Design Clarifications and Modifications
Appendix B Piezometer Abandonment (if applicable)
Appendix C Photographic Documentation
Appendix D CQA Reporting
  D1. CQA Reports
  D2. CQA Meeting Minutes
Appendix E Earthwork CQA Data
  E1. CQA Test Results - Control Tests
  E2. CQA Test Results - Record Tests
Appendix F Soil Liner CQA Data
  F1. CQA Test Results - Control Tests
  F2. CQA Test Results - Record Tests
Appendix G Record Drawings
  G1 Subgrade As-Built
  G2 Soil Liner As-Built
  G3 Final Cover System As-Built

SECTION 3.0
EARTHWORK CQA

3.1 INTRODUCTION

This section of the CQA Manual addresses earthwork (excavation and embankment) and outlines the soils CQA program to be implemented with regard to material approval, subgrade approval, field control and record tests, and resolution of problems.

3.2 EMBANKMENT MATERIAL APPROVAL

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

3.2.1 Control Tests

The procedure for CQA testing during excavation and stockpiling (including existing stockpiles) is outlined below.

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. Appropriate entries will be made in the daily log.

During stockpiling operations, control tests, as shown on **Table 3.1**, will be performed by the CQA Engineer prior to placement of any compacted embankment.

3.3 SUBGRADE APPROVAL

The CQA Engineer will verify that the compacted embankment subgrade is constructed in accordance with the project specifications.

3.4 EARTHWORK CONSTRUCTION

3.4.1 Construction Monitoring

A. Earthwork shall be performed as described in the project specifications.

B. Only soil previously approved by the CQA Engineer (see **Section 3.2**) shall be used in construction of the compacted embankment. Unsuitable material will be removed prior to acceptance by the CQA Engineer.

C. 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.

D. The CQA Engineer will monitor protection of the earthwork during and after construction.

3.4.2 Control Tests

The control tests, as shown on **Table 3.2**, will be performed by the CQA Engineer prior to placement of compacted embankment.

3.4.3 Record Tests

The record tests, as shown on **Table 3.2**, will be performed by the CQA Engineer during placement of compacted embankment.

3.4.3.1 Record Test Failure

Recompaction of the failed area shall be performed and retested until the area meets or exceeds requirements outlined in the specifications.

3.4.4 Judgmental Testing

During construction, the frequency of control and/or record testing may be increased at the discretion of the CQA Engineer when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas will be considered when:

- the rollers slip during rolling operation;
- the lift thickness is greater than specified;
- the fill material is at an improper moisture content;
- fewer than the specified number of roller passes are made;
- dirt-clogged rollers are used to compact the material;
- the rollers may not have used optimum ballast;
- the fill materials differ substantially from those specified; or
- the degree of compaction is doubtful.

3.5 DEFICIENCIES

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

TABLE 3.1: CQA TESTING PROGRAM FOR EMBANKMENT MATERIAL APPROVAL

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
CONTROL TESTS:		
Visual Classification	ASTM D 2488	Each Soil
Moisture-Density Relationship	ASTM D 698	5,000 CY per Each Soil

TABLE 3.2: CQA TESTING PROGRAM FOR COMPACTED EMBANKMENT

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
CONTROL TESTS: (See **Table 3.1**)		
RECORD TESTS:		
Lift Thickness	-----	Each Lift
In-Place Density	ASTM D 6938[1]	20,000 ft^2 per lift & 1 per 500 LF/lift of Berms (< 200 ft. base width)
Moisture Content	ASTM D 6938[2]	20,000 ft^2 per lift & 1 per 500 LF/lift of Berms (< 200 ft. base width)

Notes:

1. Optionally use ASTM D 1556, ASTM D 2167, or ASTM D 2937. For every 10 nuclear density tests perform at least 1 density test by ASTM D 1556, ASTM D 2167, or ASTM D 2937 as a verification of the accuracy of the nuclear testing device.
2. Optionally use ASTM D 2216, ASTM D 4643, or ASTM D 4959. For every 10 nuclear moisture tests perform at least 1 moisture test by ASTM D 2216, ASTM D 4643, or ASTM D 4959 as a verification of the accuracy of the nuclear testing device.

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SECTION 4.0
SOIL LINER CQA

4.1 INTRODUCTION

This information addresses the soil liner component of the final cover system and outlines the soils construction quality assurance (CQA) program to be implemented with regard to material approval, subgrade approval, test fill construction, field and laboratory control and record tests, and resolution of problems.

4.2 SOIL LINER MATERIAL APPROVAL

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

4.2.1 Control Tests

The procedure for CQA testing during excavation and stockpiling (including existing stockpiles) is outlined below.

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. Appropriate entries will be made in the daily log.

During stockpiling operations, control tests, as shown on **Table 1**, will be performed by the CQA Engineer prior to placement of any soil liner material.

4.3 SUBGRADE APPROVAL

The CQA Engineer will verify that the soil liner subgrade is constructed in accordance with the project specifications.

4.4 TEST FILL CONSTRUCTION

A test fill meeting the requirements of the project specifications 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 the soil liner component.

Construction equipment and methods will be reviewed by the CQA Engineer prior to test fill placement.

4.4.1 Control Tests

The control tests, as shown on **Table 2**, will be performed by the CQA Engineer prior to placement of soil liner material in the test fill.

4.4.2 Record Tests

The record tests, as shown on **Table 2**, will be performed by the CQA Engineer during placement of soil liner material in the test fill.

4.4.3 Test Fill Completion

The test fill program is completed when the Contractor has shown that the soil liner constructed using the same construction methods, equipment, and material to be used in construction of the soil liner will satisfy project specifications. No soil liner can be placed until the test fill program is completed.

4.5 SOIL LINER CONSTRUCTION

4.5.1 Construction Monitoring

A. Soil liner shall be placed as described in the applicable section(s) of the project specifications using the construction methods, equipment, and material demonstrated in the test fill construction.

B. Only soil previously approved by the CQA Engineer (see **Section 2.0**) shall be used in construction of the soil liner. Unsuitable material will be removed prior to acceptance by the CQA Engineer.

C. 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.

D. The CQA Engineer will monitor protection of the soil liner during and after construction.

E. The liner surface shall be sprinkled with water as needed to prevent desiccation. Should desiccation occur, the last lift shall be reconstructed in accordance with the project specifications. Standing water should not be present on the soil liner.

F. Frost heave or other damage due to freezing shall require lift reconstruction in accordance with the project specifications.

G. The CQA Engineer will inspect the soil liner and certify that it is in accordance with

the project specifications and approved plans prior to the Contractor beginning installation of overlying geosynthetics.

H. The finished soil liner shall be free of all rock protrusions. All cracks and voids shall be filled and the surface made uniform. This shall be accomplished by final dressing of the soil liner with smooth-drum rollers and hand raking. No rubber tired vehicles are permitted on the final dressed surface unless authorized by the CQA Engineer.

4.5.2 Control Tests

The control tests, as shown on **Table 3**, will be performed by the CQA Engineer prior to placement of soil liner material.

4.5.3 Record Tests

The record tests, as shown on **Table 3** and as described below, will be performed by the CQA Engineer during placement of soil liner material.

A. Each lift will be checked visually for soil clods, rocks, debris, plant materials and other foreign material. Any such material which does not meet specified requirements shall be identified and removed prior to and during the compaction process.

B. The thickness of the loose lift will be measured at random locations after spreading and leveling is completed. Loose lift thickness should not exceed the depth of penetration of the compaction feet.

C. Moisture content will be monitored by the CQA Engineer 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.

Results of testing will be certified within 7 days of soil liner placement.

4.5.3.1 Record Test Failure

The following procedures shall be used in the event of density or hydraulic conductivity test failure:

A. Failed Density Test: Recompaction of the failed area shall be performed and retested until the area meets or exceeds requirements outlined in the specifications.

B. Failed Hydraulic Conductivity Test: The area of failure shall be localized and reconstructed in accordance with the project specifications. This area

will be retested as outlined within the plan by the CQA Engineer. Optionally, at least five replicate samples shall be obtained and tested by the Contractor in the immediate vicinity of the failed test. If all five samples pass, then the initial failing test will be discounted. However, should the replicate samples confirm the failure of the soil liner to meet specifications, the area of failure shall be localized, reconstructed, and retested as described above.

4.5.4 Judgmental Testing

During construction, the frequency of control and/or record testing may be increased at the discretion of the CQA Engineer when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas will be considered when:

- the rollers slip during rolling operation;
- the lift thickness is greater than specified;
- the fill material is at an improper moisture content;
- fewer than the specified number of roller passes are made;
- dirt-clogged rollers are used to compact the material;
- the rollers may not have used optimum ballast;
- the fill materials differ substantially from those specified; or
- the degree of compaction is doubtful.

4.5.5 Perforations In Soil Liner

All holes shall be patched with compacted soil liner or sodium bentonite compacted and hydrated in the holes.

4.6 DEFICIENCIES

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

TABLE 4.1: CQA TESTING PROGRAM FOR SOIL LINER MATERIAL APPROVAL

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
CONTROL TESTS:		
Visual Classification	ASTM D 2488	Each Soil
Moisture Content	ASTM D 2216	2,000 CY per Each Soil
Grain Size Analysis	ASTM D 422	2,000 CY per Each Soil
Atterberg Limits	ASTM D 4318	2,000 CY per Each Soil
Moisture-Density Relationship	ASTM D 698	5,000 CY per Each Soil
Hydraulic Conductivity - Lab Remolded	ASTM D 5084[3]	10,000 CY per Each Soil

TABLE 4.2: CQA TESTING PROGRAM FOR SOIL LINER TEST FILL

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
CONTROL TESTS: (See **Table 1**)		
Moisture-Density Relationship	ASTM D 698[4]	1 per lift
Hydraulic Conductivity - Lab Remolded	ASTM D 5084[3,4]	1 per lift
RECORD TESTS:		
Lift Thickness	-----	Each Lift
Atterberg Limits	ASTM D 4318	1 per lift
Grain Size Analysis	ASTM D 422	1 per lift
In-Place Density	ASTM D 2922[1]	3 per lift
Moisture Content	ASTM D 6938[2]	3 per lift
Hydraulic Conductivity - Undisturbed (Shelby Tube)	ASTM D 6938[3]	1 per lift

TABLE 4.3: CQA TESTING PROGRAM FOR SOIL LINER

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
CONTROL TESTS: (See **Table 1**)		
RECORD TESTS:		
Lift Thickness	-----	Each Lift
In-Place Density	ASTM D 6938[1]	10,000 ft^2 per lift
Moisture Content	ASTM D 6938[2]	10,000 ft^2 per lift
Hydraulic Conductivity - Undisturbed (Shelby Tube)	ASTM D 5084[3]	80,000 ft^2 per lift

Notes:

1. Optionally use ASTM D 1556, ASTM D 2167, or ASTM D 2937. For every 10 nuclear density tests perform at least 1 density test by ASTM D 1556, ASTM D 2167, or ASTM D 2937 as a verification of the accuracy of the nuclear testing device.
2. Optionally use ASTM D 2216, ASTM D 4643, or ASTM D 4959. For every 10 nuclear moisture tests perform at least 1 moisture test by ASTM D 2216, ASTM D 4643, or ASTM D 4959 as a verification of the accuracy of the nuclear testing device.
3. Maximum effective confining pressure and hydraulic gradient as required by the project specifications. Backpressure as recommended by ASTM D 5084.
4. These tests performed on the test fill may count toward the minimum frequencies established in **Table 1**.

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SECTION 5.0
FINAL COVER SYSTEM CQA

5.1 INTRODUCTION

This section of the CQA Manual addresses the landfill gas (LFG) system, drainage aggregate and piping, and the vegetative soil layer of the final cover system. By reference to **Section 4.0** of this CQA Manual, this section also addresses the soil liner that is included in the final cover system. This section outlines the CQA program to be implemented with regard to material approval, construction monitoring, and resolution of problems.

5.2 FINAL COVER SYSTEM MATERIAL APPROVAL

The CQA Engineer shall verify that the following are provided and installed in accordance with the project drawings, specifications, and this CQA Manual.

5.2.1 Corrugated Polyethylene (CPE) Pipe

A. Receipt of Contractor's submittals on CPE pipe.

B. Review of submittals for CPE pipe for conformity to the project specifications.

5.2.2 LFG System Components

A. Receipt of Contractor's submittals on LFG system components.

B. Review of submittals for LFG system components for conformity to the project specifications.

5.2.3 Soil Liner

The CQA program for soil liner is presented in **Section 4.0** of this CQA Manual.

5.2.4 Vegetative Soil Layer

A. Review the proposed source of vegetative soil layer for conformance with the project specifications.

B. Conduct material control tests in accordance with **Table 5.1**.

5.3 FINAL COVER SYSTEM INSTALLATION

The CQA Engineer will monitor and document the construction of all final cover system components for compliance with the project specifications. Monitoring the construction work for the components of the final cover system includes the following:

- verify location and depth of LFG wells;
- verify location of all piping;
- monitoring the placement of the final cover system components.

5.4 DEFICIENCIES

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

TABLE 5.1: CQA TESTING PROGRAM FOR FINAL COVER SYSTEM

COMPONENT	PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
CONTROL TESTS:			
Vegetative Soil Layer:	Visual Classification	ASTM D 2488	Each Load
	Grain Size Analysis	ASTM D 422	5,000 CY
	Atterberg Limits	ASTM D 4318	5,000 CY

Appendix A

Reference List of Test Methods

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DAVIDSON COUNTY C&D LANDFILL
PERMIT AMENDMENT APPLIATION

CQA MANUAL
APPENDIX A: REFERENCE LIST OF TEST METHODS

American Society American Society of Testing and Materials (ASTM):

ASTM C 136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
ASTM D 413	Standard Test Methods for Rubber Property - Adhesion to Flexible Substrate.
ASTM D 422	Standard Test Method for Particle Size Analysis of Soils.
ASTM D 698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3).
ASTM D 792	Standard Test Method for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
ASTM D 1004	Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
ASTM D 1505	Standard Test Method for Density of Plastics by the Density-Gradient Technique.
ASTM D 1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
ASTM D 1603	Standard Test Method for Carbon Black in Olefin Plastics.
ASTM D 2167	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
ASTM D 2216	Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
ASTM D 2434	Standard Test Method for Permeability of Granular Soils (Constant Head).
ASTM D 2488	Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).

ASTM D 2937	Standard Test Method for Density of Soil in Place by the Drive Cylinder Method.
ASTM D 3042	Standard Test Method for Insoluble Residue in Carbonate Aggregates.
ASTM D 4318	Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
ASTM D 4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
ASTM D 4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
ASTM D 4643	Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method.
ASTM D 4716	Standard Test Method for Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products.
ASTM D 4751	Standard Test Method for Determining Apparent Opening Size of a Geotextile.
ASTM D 4833	Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
ASTM D 4959	Standard Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating Method.
ASTM D 5084	Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.
ASTM D 5199	Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.
ASTM D 5596	Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
ASTM D 5641	Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.
ASTM D 5820	Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes.

ASTM D 5887	Standard Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter.
ASTM D 5993	Standard Test Method for Measuring Mass per Unit of Geosynthetic Clay Liners.
ASTM D 5994	Standard Test Method for Measuring Core Thickness of Textured Geomembrane.
ASTM D 6392	Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.
ASTM D 6496	Standard Test Method for Determining Average Bonding Peel Strength Between the Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners.
ASTM D 6693	Standard Test Method for Determining Tensile Properties of Nonreinforced Flexible Polyethylene and Nonreinforced Polypropylene Geomembranes.
ASTM D 6938	Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

Geosynthetic Research Institute (GRI):

GRI GC7	Determination of Adhesion and Bond Strength of Geocomposites.

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ATTACHMENT
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Operations Manual

Davidson County Landfill Facility
Davidson County, North Carolina

Prepared for:
Davidson County Integrated Solid Waste Management
Thomasville, NC

March 2009

RICHARDSON SMITH GARDNER & ASSOCIATES
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DAVIDSON COUNTY
DAVIDSON COUNTY LANDFILL FACILITY

OPERATIONS MANUAL

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SECTION 1.0
GENERAL FACILITY OPERATIONS

1.1 OVERVIEW

This Operations Manual was prepared for operations of the Davidson County Landfill facility (Permit No. 29-06) located near Lexington. This document discusses the operation of the following:

- Phase 1 (Lined Subtitle D MSW Landfill Unit);
- Phase 2 (Lined Subtitle D MSW Landfill Unit);
- C&D Landfill (including mobile home deconstruction area);
- Recycling Center;
- Convenience Center (including white goods and tire handling areas);
- Household Hazardous Waste Collection Facility; and
- Swap Shop.

Refer to **Figure 1** for the location of existing and proposed landfill units and other solid waste management activities.

The information contained herein was prepared to provide landfill personnel with a clear understanding of how the Design Engineer assumed that the completed facility would be operated. While deviations from the operations outlined here may be acceptable, they should be reviewed and approved by the Design Engineer. Please refer to the appropriate permit application for a detailed discussion and calculations for the individual components of each landfill unit, including phasing plans.

1.2 CONTACT INFORMATION

All correspondence and questions concerning the operation of the Davidson County Landfill should be directed to the appropriate County and State personnel listed below. For fire or police emergencies dial 911.

1.2.1 <u>Davidson County</u>

Davidson County Integrated Solid Waste Management Department
1242 Old Highway 29
Thomasville, NC 27360
Phone: (336) 242-2284
Fax: (336) 249-7524

County Solid Waste Director: Charles Brushwood

1.2.2 North Carolina Department of Environment and Natural Resources

North Carolina DENR - Winston-Salem Regional Office (WSRO)
585 Waughtown Street
Winston-Salem, NC 27107
Phone: (336) 771-5000
Fax: (336) 771-4630

North Carolina DENR - Asheville Regional Office (ARO)
2090 US Highway 70
Asheville, NC 28778
Phone: (828) 296-4500
Fax: (828) 299-7043

Division of Waste Management (DWM) - Solid Waste Section:

Western Area Supervisor:	Deborah Aja (ARO)
Waste Management Specialist:	Hugh Jernigan (WSRO)

Division of Land Resources - Land Quality Section:

Regional Engineer:	Matthew Gantt, P.E. (WSRO)

1.3 ACCESS CONTROL

Limiting access to the landfill facility is important for the following reasons:

- Unauthorized and illegal dumping of waste materials is prevented.
- Trespassing, and injury resulting therefrom, is discouraged.
- The risk of vandalism is greatly reduced.

Access to active areas of the landfill will be controlled by a combination of fences and natural barriers, and strictly enforced operating hours. A landfill attendant will be on duty at all times when the facility is open for public use to enforce access restrictions.

1.3.1 Physical Restraints

The site will be accessed by the existing entrance on Davidson County Landfill Road (MSW - Phase 1 & C&D Landfill) and the entrance off of Old Highway 29 (MSW - Phase 2). Scales and a scale house are provided at each entrance. All waste will have been weighed prior to being placed in the landfill. Each entrance will have a gate which will be securely locked during non-operating hours.

1.3.2 Security

Frequent inspections of gates and fences will be performed by landfill personnel. The County will arrange for a random security patrol of the main gate to further discourage trespassing. Evidence of trespassing, vandalism, or illegal operation will be reported to the County Solid Waste Director.

1.4 SIGNAGE

A prominent sign(s) containing the information required by the DWM will be placed at the landfill entrance. This sign(s) will provide information on operating hours, operating procedures, and acceptable wastes. Additional signage will be provided within the landfill complex to distinctly distinguish the roadway to the active landfill unit(s). Service and maintenance roads for use by operations personnel will be clearly marked and barriers (e.g., traffic cones, barrels, etc.) will be provided as required.

1.5 COMMUNICATIONS

Two way radio communication will be maintained between the active landfill unit(s) and the landfill scale house(s) and office. The scale house(s) and office have telephones in case of emergency and for the conduct of day-to-day business. Emergency telephone numbers are displayed in the scale house(s) and office.

1.6 FACILITY OPERATING HOURS

Normal hours of operation will be 7:30 A.M. to 5:00 P.M. Monday to Friday and 7:00 A.M. to 12:00 noon on Saturday. The facility will be closed on Sunday.

The county may elect to modify these hours from time to time.

1.7 FIRE CONTROL

The possibility of fire at the facility must be anticipated in daily operations. Potential fire hazards include both surface conditions and subsurface conditions. Surface conditions include equipment operations and newly placed waste. Subsurface conditions include existing waste previously landfilled.

1.7.1 Fire Triangle

The "triangle" illustrates the rule that in order to ignite and burn, a fire requires three (3) elements: heat, fuel, and oxygen. A fire is prevented or extinguished by "removing" any one of them. A fire naturally occurs when the elements are combined in the right mixture (e.g., more heat needed for igniting some fuels, unless there is concentrated oxygen). These principles

are integral in the prevention and management of potential fire situations.

1.7.2 Equipment Safety

A combination of factory installed fire suppression systems and/or portable fire extinguishers will be operational on all pieces of heavy equipment at all times. Potential fire hazards are created from the build-up of fine, dry dust particles on and around operational motors and control panels. The presence of these build-ups can cause overheating and potential fire if periodic equipment cleaning and maintenance are not practiced. Portable fire extinguishers should be maintained in a state of readiness on each piece of moving equipment and equipment should be cleaned periodically.

1.7.3 Fire Management Strategies

Each fire situation is site specific, however, general strategies for active fire management include the following (in no particular order):

- Accelerated high temperature combustion (displacing fuel);
- Covering of the landfill burn area with soil (reduce oxygen);
- Covering of the burn area with foams (reduce oxygen);
- Flooding the burn area with water (reduce heat);
- Injecting an inert gas such as CO_2 (reduce oxygen); and
- Excavating the burning material (displacing fuel) and then extinguishing it in small controlled areas.

1.7.4 Coordination

A copy of the site Operations Plan will be filed with the local fire department including all contact information for the facility.

1.8 LITTER CONTROL

The vegetative trees/bushes act as a barrier to keep litter contained within the site. Landfill Operators pick up litter within the site daily and respond to weather and heavy wind conditions that may spread litter.

A litter control crew picks up litter around the site and on access roads routinely as required. Wind screens adjacent to active areas will be used as required to control windblown waste.

1.9 SEVERE WEATHER CONDITIONS

Unusual weather conditions can directly affect the operation of the landfill facility. Some of these weather conditions and recommended operational responses are as follows.

1.9.1 Ice Storms

An ice storm can make access to the landfill dangerous, prevent movement or placement of daily cover, and, thus, may require closure of the landfill until the ice is removed or has melted.

1.9.2 Heavy Rains

Exposed soil surfaces can create a muddy situation in some portions of the landfill during rainy periods. The control of drainage and use of crushed stone on unpaved roads should provide all-weather access for the site and promote drainage away from critical areas. In areas where the aggregate surface is washed away or otherwise damaged, new aggregate should be used for repair.

Intense rains can affect newly constructed drainage structures such as swales, diversions, cover soils, and vegetation. After such a rain event, inspection by landfill personnel will be initiated and corrective measures taken to repair any damage found before the next rainfall.

1.9.3 Electrical Storms

The open area of a landfill is susceptible to the hazards of an electrical storm. If necessary, landfilling activities will be temporarily suspended during such an event. To guarantee the safety of all field personnel, refuge will be taken in the on-site buildings or in rubber-tired vehicles.

1.9.4 Windy Conditions

The proposed operational sequence minimizes the occurrence of unsheltered operations relative to prevailing winds. If this is not adequate during a particularly windy period, work will be temporarily shifted to a more sheltered area. When this is done, the previously exposed face will be immediately covered with daily cover.

1.9.5 Violent Storms

In the event of hurricane, tornado, or severe winter storm warning issued by the National Weather Service, landfill operations may be temporarily suspended until the warning is lifted. Daily cover will be placed on exposed waste and buildings and equipment will be properly secured.

1.10 EQUIPMENT REQUIREMENTS

The County will maintain on-site equipment required to perform the necessary landfill activities. Periodic maintenance of all landfilling equipment, and minor and major repair work will be performed at designated maintenance zones outside of the landfill.

1.11 PERSONNEL REQUIREMENTS

At least one member of the landfill supervisory staff will be certified as a Manager of Landfill Operations (MOLO) by the Solid Waste Association of North America (SWANA). Each landfill employee will go through an annual training course (led by supervisory staff) and is certified by SWANA as Landfill Operations personnel. As part of this training, personnel learn to recognize loads which may contain prohibited wastes.

1.12 HEALTH AND SAFETY

All aspects of the landfill facility operations were developed with the health and safety of the operating staff, customers, and neighbors in mind. Prior to commencement of operations of the facility, a member of the operating staff will be designated site safety officer. This individual, together with the facility's management will modify the site safety and emergency response program to remain consistent with National Solid Waste Management Association and Occupational Safety and Health Administration (OSHA) guidance.

Safety equipment provided includes equipment rollover protective cabs, seat belts, audible reverse warning devices, hard hats, safety shoes, and first aid kits. Facility personnel will be encouraged to complete the American Red Cross Basic First Aid Course. Other safety requirements as designated by the Owner will also be implemented.

Facility employees will be routinely trained in health and safety by supervisory staff. All training will be documented. The following are some general recommendations for the health and safety of workers:

1.12.1 Personal Hygiene

The following items are recommended as a minimum of practice:

- Wash hands before eating, drinking, or smoking.
- Wear personal protective equipment as described in **Section 1.12.2.**
- Wash, disinfect, and bandage ANY cut, no matter how small it is. Any break in the skin can become a source of infection.
- Keep fingernails closely trimmed and clean (dirty nails can harbor pathogens).

1.12.2 Personal Protective Equipment

Personal Protective Equipment (PPE) must be evaluated as to the level of protection necessary for particular operating conditions and then made available to facility employees. The list below includes the PPE typically used and/or required in a solid waste management facility workplace.

- Safety shoes with steel toes.
- Noise reduction protection should be used in areas where extended exposure to continuous high decibel levels are expected.

- Disposable rubber latex or chemical resistant gloves for handling and/or sampling of waste materials.
- Dust filter masks.

Following use, PPE's should be disposed of or adequately cleaned, dried, or readied for reuse.

1.12.3 Mechanical Equipment Hazard Prevention

The loaders and other equipment should be operated with care and caution. All safety equipment such as horns, backup alarms, and lights should be functional. A Lockout-Tagout program will be used to identify equipment in need or under repair and insure that operation is "off-limits" prior to maintenance or repair. All operators will be trained in the proper operation of equipment.

1.12.4 Employee Health and Safety

Some general safety rules are:

- Consider safety first when planning and conducting activities.
- Review the equipment O&M Manual prior to attempting repairs/changes.
- Remember the buddy system for repair of mechanical equipment.
- Post emergency contact phone numbers.
- Provide easy and visible access to the Right to Know materials.
- Provide easy and visible access to the first aid kit and fire extinguishers.

1.12.5 Physical Exposure

Facility personnel may come in contact with the fluids, solids, and airborne constituents found at the facility. Routine training should be conducted regarding the individual and collective materials used at the facility and their associated hazards. Training concerning safe work practices around these potential exposures should use equipment and proper disposal procedures.

1.12.6 Material Safety Data Sheets

Material Safety Data Sheets (MSDS) will be collected on every waste (if available) that enters the facility. Information will also be made available for all chemicals stored on site for use by the facility. MSDS sheets shall be stored in a location with all other Right to Know information for the site.

1.13 UTILITIES

Electrical power, water, telephone, and restrooms will be provided at the landfill scale house(s) and office.

1.14 RECORD KEEPING PROGRAM

The County will maintain the following records in an operating record at the landfill:

A. Waste inspection records (see **Section 2.4**);
B. Daily tonnage records - including source of generation;
C. Waste determination records;
D. Quantity, location of disposal, generator, and special handling procedures for all special wastes disposed of at the site;
E. List of generators and haulers that have attempted to dispose of restricted wastes;
F. Employee training procedures and records of training completed;
G. Documentation of mobile home deconstruction (see **Appendix D**)
H. Leachate records (see **Section 3.3.3**);
I. Gas monitoring results and remediation measures as required (see **Section 3.4.2**);
J. All ground water monitoring and surface water quality information (See the current **Water Quality Monitoring Plan**) including:
   1. Monitoring well construction records;
   2. Sampling dates and results;
   3. Statistical analyses; and
   4. Results of inspections, repairs, etc.
K. Annual landfill reports;
L. All closure and post-closure information where applicable;
M. Cost estimates or financial assurance documentation.

The operating record will be kept up to date by the Solid Waste Director or his designee. It will be presented upon request to the DWM for inspection. A copy of this Operations Manual will be kept at the landfill and will be available for use at all times.

SECTION 2.0
WASTE HANDLING OPERATIONS

2.1 OVERVIEW

This section describes the required waste handling operations for the Davidson County Landfill facility. In addition to the MSW and C&D waste disposed of at this facility, the County also processes recyclables, scrap tires, white goods, and household hazardous wastes (HHW). These materials are stored at the landfill facility until there are sufficient quantities for pick up by various recycling contractors.

Note that clean wood waste is not handled at the landfill facility, but instead is directed to TODCO, Inc. a nearby private enterprise which accepts and processes wood waste for reuse as mulch.

2.2 ACCEPTABLE WASTES

2.2.1 MSW Landfill Units

Only the waste as defined by NCGS 130A-290(a)(18a) generated within the approved service area may be disposed of in the MSW landfill units. In addition, the special wastes described in **Section 2.5.4** may also be disposed of in the MSW landfill units.

2.2.2 C&D Landfill Unit

Only the following wastes generated within the approved service area may be disposed of in the C&D landfill unit (Note list is in accordance with existing permit):

- Construction and Demolition Debris: as defined in 15A NCAC 13B.0532(8) means solid waste resulting solely from construction, remodeling, repair, or demolition operations on pavement, buildings, or other structures. C&D waste does not include municipal and industrial wastes that may be generated by the on-going operations at buildings or structures.
- Land Clearing and Inert Debris Landfill: as defined in 15A NCAC 13B.0101(54) means a facility for the disposal of land-clearing waste, concrete, brick, concrete block, uncontaminated soil, gravel and rock, untreated and unpainted wood, and yard trash.
- Land Clearing Waste: as defined in 15A NCAC 13B.0101(53) means solid waste which is generated solely from land-clearing activities, limited to stumps, trees, limbs, brush, grass, and other naturally occurring vegetative material.
- Asphalt: in accordance with NCGS 130A-294(m).
- C&D-Like Waste: wastes that are similar to waste typically found in the land clearing-inert debris and C&D waste streams consisting of: roofing shingle waste from the manufacturer, waste building materials from mobile home/modular home manufacturer, and wooden pallets.
- Other Wastes as Approved by the Solid Waste Section of the Division of Waste

Management.

In addition, waste from the deconstruction of mobile homes described in **Section 2.6** and the special wastes (asbestos only) described in **Section 2.5.4** and may also be disposed of in the C&D landfill unit.

2.3 PROHIBITED WASTES

2.3.1 MSW Landfill Units

The following wastes are prohibited from disposal within the MSW landfill units:

- Whole Scrap Tires
- Used Oil
- White Goods
- Lead Acid Batteries
- Yard Waste
- Construction and Demolition Debris (C&D) (Except when allowed by the County)
- Aluminum Cans

In addition, operating criteria prohibit other materials from disposal within the MSW landfill units. These materials include:

- Hazardous waste as defined by NCGS 130A-290(a)(8), including hazardous waste from conditionally exempt small quantity generators.
- Polychlorinated biphenyls (PCB) wastes as defined in 40 CFR 761 with the exception of trace amounts found in materials such as consumer electronics.
- Bulk or non-containerized liquid wastes unless the waste is household waste other than septic waste and waste oil; or the waste is leachate or gas condensate derived from the MSW landfill unit. A liquid determination will be performed by the paint filter test (see **Appendix A** for apparatus and procedure).
- Containers holding liquid wastes unless the waste is household waste.

2.3.2 C&D Landfill Unit

Only wastes, as defined in **Section 2.2.2** above may be accepted in the C&D landfill unit. No other wastes may be accepted.

2.4 WASTE SCREENING PROGRAMS

In order to assure that prohibited wastes are not entering the landfill facility, screening programs have been implemented at the landfill. Waste received at both the scale house entrance and

waste taken to the working face is inspected by trained personnel. These individuals have been trained to spot indications of suspicious wastes, including: hazardous placarding or markings, liquids, powders or dusts, sludges, bright or unusual colors, drums or commercial size containers, and "chemical" odors. Screening programs for visual and olfactory characteristics of prohibited wastes are an ongoing part of the landfill operation.

2.4.1 Waste Receiving and Inspection

All vehicles must stop at the scale house located at each entrance of the facility and visitors are required to sign-in. All waste transportation vehicles are weighed and the content of the load assessed. The scale attendant(s) requests from the driver of the vehicle a description of the waste it is carrying to ensure that unacceptable waste is not allowed into the landfill. The attendant(s) then visually checks the vehicle as it crosses the scale. Signs informing users of the acceptable and unacceptable types of waste are posted at the scale house. Once passing the scales, the vehicles are routed to the appropriate landfill unit.

Vehicles are randomly selected for screening on a regular basis, depending on personnel available. At least one vehicle per week, but not less than 1% by weight of the waste stream entering the landfill (based on the previous week's total), will be randomly selected by inspection personnel. A random truck number and time will be selected (e.g., the tenth load after 10:00 a.m.) on the day of inspections. However, if something looks suspicious is spotted in any waste load, that load is inspected further.

Vehicles selected for inspection are directed to an area of intermediate cover adjacent to the working face where the vehicle will be unloaded. Waste is carefully spread using suitable equipment. An attendant trained to identify wastes that are unacceptable at the landfill inspects the waste discharged at the screening site. If unacceptable waste is found, including wastes generated from outside of the service area, the load will be isolated and secured by berming off the area. For unacceptable wastes that are non-hazardous, the Solid Waste Director will then notify officials of the DWM (see **Section 1.2.2**) within 24 hours of attempted disposal of any waste the landfill is not permitted to receive in order to determine the proper course of action. For unacceptable wastes that are hazardous, the Hazardous Waste Contingency Plan outlined in **Section 2.4.2** will be followed. The hauler is responsible for removing unacceptable waste from the landfill property.

If no unacceptable waste is found, the load will be pushed to the working face and incorporated into the daily waste cell. All random waste inspections will be documented by landfill staff using the waste screening form provided in **Appendix B**.

In addition to random waste screening described above, waste unloaded on the active face will be inspected by the equipment operators, trained to spot unacceptable wastes, before and during spreading and compaction. Any suspicious looking waste is reported immediately to the designated primary inspector for further evaluation.

2.4.2 Hazardous Waste Contingency Plan

In the event that identifiable hazardous waste or waste of questionable character is detected at the landfill, appropriate equipment, protective gear, personnel, and materials as necessary will be employed to isolate the wastes. The DWM will be notified immediately (see **Section 1.2.2**) that an attempt was made to dispose of hazardous waste at the landfill. If the vehicle attempting disposal of such waste is known, all attempts will be made to prevent that vehicle from leaving the site or, if the vehicle has left the site, immediate notice will be served on the owner of the vehicle that hazardous waste, for which they have responsibility, has been disposed of at the landfill.

The County will assist the DWM as necessary and appropriate in the removal and disposition of the hazardous waste and in the prosecution of responsible parties. If needed, the hazardous waste will be covered with either on-site soils or other tarping material until such time when an appropriate method can be implemented to properly handle the waste. The cost of the removal and disposing of the hazardous waste will be charged to the owner of the vehicle involved. Any vehicle owner or operator who knowingly dumps hazardous waste in the landfill may be barred from using the landfill.

Should an incident where hazardous waste is found at the landfill occur, the event will be documented by landfill staff using the waste screening form provided in **Appendix B**.

Records of information gathered as part of the waste screening programs will be maintained at the landfill site during its active life and as long as required by the County and the DWM.

2.5 WASTE DISPOSAL

2.5.1 Access

Traffic will be clearly directed to the appropriate active access road. For the active lined disposal unit(s), all vehicles entering the unit will use the active ramp to avoid damaging the liner system. Traffic speed on the ramp should be less than 10 MPH. Rutting of gravel roadway surfaces must be repaired by placement of additional gravel on the roadway and not solely by grading the rut. This will maintain the separator geotextile placed below most gravel roadway surfaces.

The location of access roads during waste placement will be determined by operations personnel in order to reflect waste placement strategy.

2.5.2 General Procedures

For each active landfill unit, waste transportation vehicles will arrive at the working face at random intervals. There may be a number of vehicles unloading waste at the same time, while other vehicles are waiting. In order to maintain control over the unloading of waste, a certain number of vehicles will be allowed on the working face at a time. The

actual number will be determined by the truck spotter. This procedure will be used in order to minimize the potential of unloading unacceptable waste and to control disposal activity. Operations at the working face will be conducted in a manner which will encourage the efficient movement of transportation vehicles to and from the working face, and to expedite the unloading of waste.

The approach to the working face will be maintained such that two or more vehicles may safely unload side by side. A vehicle turn-around area large enough to enable vehicles to arrive and turn around safely with reasonable speed will be provided adjacent to the unloading area. The vehicles will back to a vacant area near the working face to unload. Upon completion of the unloading operation, the transportation vehicles will immediately leave the working face area. Personnel will direct traffic necessary to expedite safe movement of vehicles.

Waste unloading at the landfill will be controlled to prevent disposal in locations other than those specified by site management. Such control will also be used to confine the working face to a minimum width, yet allow safe and efficient operations. The width and length of the working face will be maintained as small as practical in order to maintain the appearance of the site, control windblown waste, and minimize the amount of cover required each day. Normally, only one working face will be active on any given day, with all deposited waste in other areas covered by either daily/periodic, intermediate, or final cover, as appropriate.

The procedures for placement and compaction of solid waste include: unloading of vehicles, spreading of waste into 2 foot lifts, and compaction on relatively flat slopes (i.e. 5H:1V max.) using a landfill compactor and a minimum number of three full passes.

Wind screens adjacent to the working face may be used as required to control windblown waste.

The use of portable signs with directional arrows and portable traffic barricades will facilitate the unloading of wastes to the designated disposal locations. These signs and barricades will be placed along the access route to the working face of the landfill or other designated disposal areas which may be established.

2.5.3 MSW Landfill Units

2.5.3.1 Cell Operations and Phasing

Each lined landfill unit is divided into cells. Each cell will be filled in sequence until the entire footprint is covered with waste. Phasing drawings are presented in the appropriate permit application for each landfill unit.

It is advantageous to begin to establish final cover grades along the perimeter berms as soon as is possible. This will allow earlier construction of intermediate or final cover to promote "clean" runoff and to spread out final cover construction

costs.

2.5.3.2 Cell Activation

Before placing waste in a particular area of any cell, that area must be connected to the leachate collection system (LCS) by removing the geosynthetic rain cover (if any) and making any required piping connections such that all liquid collected in that area will flow to the sump. Next, just ahead of waste placement operations, the Type GT-S geotextile placed over the gravel columns is to be cut and removed such that waste will be placed in direct contact with the coarse aggregate.

Once an area has reached its effective capacity, operations will move to the next scheduled area. Prior to placing waste in a new area, it must be connected to the LCS as described above.

2.5.3.3 Placement of Initial Lift

During waste placement operations, the landfill liner system is most vulnerable during the placement of the first lift of waste. The first lift of waste should be comprised of select loads spread on top of the protective cover layer. These select loads must be free of long or large pieces of waste that may push through the protective cover layer and damage the liner system. Workers will be positioned near the working face to check for any waste which could possibly penetrate the protective cover layer. The first lift should be a minimum of four (4) feet thick and provide sufficient area for at least one day's operation without placing other areas of the liner in jeopardy.

The side slopes of the liner system are also vulnerable during placement of the first lift of waste. As with the bottom slopes, the first lift of waste against the side slopes should be comprised of select loads.

In the event that the landfill staff identifies any damage to any part of the landfill's liner system, they should immediately initiate its repair. Additionally, they should document the damage and the repair as a part of the operating record.

2.5.3.4 Equipment Operations Within the Landfill

Both the facility's operational vehicles and waste transportation vehicles must be restricted as follows within the lined landfill:

- Equipment operation directly on the protective cover will be limited to rubber-tired vehicles having a maximum ground contact, i.e., tire pressure, of less than 32 psi.
- A minimum vertical separation of 3 feet will be maintained between the geomembrane liner and all waste transportation vehicles.

- A minimum vertical separation of 5 feet will be maintained between the geomembrane liner and waste compactors.

The operation of vehicles within those portions of the landfill not actively receiving waste should be restricted to activities associated with erosion and sedimentation control.

2.5.4 Special Waste Management

2.5.4.1 Asbestos Management (MSW or C&D Landfill Units)

The County may dispose of asbestos within either the MSW or C&D landfill units. Asbestos will only be accepted if it has been processed and packaged in accordance with State and Federal (40 CFR 61) regulations. Asbestos will arrive at the site in vehicles that contain only the asbestos waste and only after advance notification by the generator.

Once the hauler brings the asbestos to the landfill, the hauler will be directed to the designated asbestos disposal area by operations personnel. The designated disposal area will be prepared by operations personnel by leveling a small area using a dozer or loader. Prior to disposal, the landfill operators will stockpile cover soil near the designated asbestos disposal area. The volume of soil stockpiled will be sufficient to cover the waste and to provide any berms, etc. to maintain temporary separation from other landfill traffic.

Once placed in the prepared area, the asbestos waste will be covered with a minimum of 18 inches of cover soil placed in a single lift. The surface of the cover soil will be compacted and graded using a tracked dozer or loader. The landfill compactor will be prohibited from operating over asbestos disposal areas until at least 18 inches of cover are in-place.

The landfill staff will record the approximate location and elevation of the asbestos waste once cover is in-place. The Solid Waste Director will then review pertinent disposal and location information to assure compliance with regulatory requirements and enter the information into the Operating Record.

Once disposal and recording for asbestos waste is completed, the disposal area may be covered with waste. No excavation into designated asbestos disposal areas will be permitted.

In general, for the lined landfill unit(s), no asbestos will be stored over gravel columns or over sump areas in order to minimize the potential for future disturbance.

2.5.4.2 Sewage Sludge Management (MSW Landfill Units)

Sewage sludge may be accepted for disposal within the MSW landfill units in accordance with Federal and State requirements. Sewage sludge will be co-disposed along with other wastes if the sludge passes the liquids restriction criteria (i.e., the Paint Filter Test) and has an acceptable Toxicity Characteristic Leaching Procedure (TCLP) test. Such testing will be the responsibility of the generator, but landfill staff may conduct spot testing.

In order to minimize the potential for clogging of the leachate collection and removal system, sewage sludge will not be placed within the first lift of waste. Sewage sludge may also be used as a soil conditioner incorporated into the vegetative soil layer of the final cover.

2.5.4.3 Spoiled Food and Animal Waste (MSW Landfill Units)

The disposal of spoiled foods, animal carcasses, and other animal wastes within the MSW landfill units will be handled as follows. The generator of the material must call in advance to the landfill, and a determination will be made as to whether or not the waste will be accepted. If the waste is approved, the generator will present the waste at a predetermined time. An area for disposal will already have been prepared and the waste will be covered immediately.

2.5.5 Daily or Periodic Cover

2.5.5.1 MSW Landfill Units

At the completion of waste placement each day, a 6 inch layer of earthen material or approved alternate daily cover (i.e. tarps, etc.) will be placed over the working face. This daily cover is intended to control vectors, fire, odors, and blowing litter. If the County should desire to use an alternate daily cover, a formal request and an appropriate demonstration will be made to the DWM.

2.5.5.2 C&D Landfill Unit

At the completion of waste placement each week, or sooner if the area of exposed waste exceeds one acre in size, a 6-inch layer of earthen material or other material as approved by the DWM will be placed over the exposed waste. This periodic cover is intended to control vectors, fire, odors, and blowing debris.

2.5.6 Intermediate Cover

A 12 inch layer of soil cover should be placed on all waste surfaces that have not received waste in 30 days but are below final elevation. This intermediate cover should be seeded immediately and graded such that all precipitation run-off is channeled to the surface water systems.

2.5.7 Height Monitoring

Approximately every month, the landfill staff will monitor landfill top and side slope elevations with a level. When such elevations approach design grades, the final top-of-waste grades will be staked to limit over-placement of waste.

2.6 DECONSTRUCTION OF MOBILE HOMES

The deconstruction of mobile homes is handled in an area adjacent to the C&D landfill unit. A description of the process is provided in **Appendix D**.

2.7 RECYCLING CENTER OPERATIONS

The landfill facility's recycling center is used to separate commingled recyclable material from curbside collection programs, as well as source separated recyclables such as cardboard. The facility is equipped with a conveyor system to facilitate hand sorting of materials, bins for storage, and a baler. Cardboard, mixed paper, old newsprint, aluminum, steel cans, and plastic are typically handled at the facility.

2.8 CONVENIENCE CENTER OPERATIONS

The operation of the citizen's convenience center is as follows:

The convenience center is set up with up to eight 40 yard roll-off containers for the collection of MSW (small loads) and recyclables. The County currently typically separately collects aluminum cans, newspaper, cardboard, mixed no. 1 and no. 2 plastics, and brown, green, and clear glass. The convenience center also includes collection facilities for white goods, used tires, waste oil, and batteries.

Within the white goods handling area/building, County personnel remove the freon, as necessary, and load the white goods into three to four large roll-off containers. Typically, every week, the County hauls the full containers to a local salvage yard, where the white goods can be recycled.

Used tires are collected at the convenience center in up to three tire trailers. Once one or more trailers are full, the used tires are taken to a tire recycler for recycling.

A full time attendant looks over the convenience center operations.

2.9 HOUSEHOLD HAZARDOUS WASTE COLLECTION FACILITY OPERATIONS

The household hazardous waste (HHW) collection facility accepts only household hazardous wastes and wastes from conditionally exempt small quantity generators (as determined by County personnel). The facility is designed to handle HHW from the following general categories: 1) yard and garden products; 2) automotive products; 3) paints and solvents; 4) household cleaning products; and 5) miscellaneous HHW. A detailed description of the operation of the HHW collection facility, including procedures for both normal operations and a contingency plan for

emergency situations, is provided in **Appendix E**.

2.10 SWAP SHOP OPERATIONS

The swap shop operates as an exchange program in order to cut down on unnecessary waste disposal. County residents may drop off unwanted usable items or may take items left by others.

SECTION 3.0
ENVIRONMENTAL MANAGEMENT

3.1 OVERVIEW

This section reviews the overall environmental management tasks required for the successful operation of the landfill. Emphasis is given to the supplemental tasks required for the lined landfill units.

3.2 SURFACE WATER CONTROL

As used herein, the definition of "surface water" is water which results from precipitation or site run-on that has not contacted the waste.

Proper control of surface water at the landfill will accomplish the following goals:

- Prevent the run-on of surface water into the lined landfill unit(s) or the active face(s);
- Prevent the run-off of surface water that has come into contact with the waste (i.e. leachate);
- Limit the erosion caused by surface waters;
- Limit sediments carried off-site by surface waters; and
- Maximize the SEPARATION of SURFACE water from LEACHATE.

Separate erosion and sedimentation control plans have been provided for the various landfill units. These plans describe both short and long term engineered features and practices for preventing erosion and controlling sedimentation at this site. The following is a brief discussion of some of these features and practices, focusing more on the landfill units.

3.2.1 Surface Water Run-On Control

The perimeter berms and/or perimeter channels around the landfill unit(s) are designed to prevent the run-on of surface water from adjacent land into the landfill. Additional structures such as diversion berms, channels, down pipes, etc. carry surface water away from the landfill.

3.2.2 Active Face Run-Off Control - MSW Landfill Units

Particular care is required to ensure that surface water coming from the active face, e.g. having potential contact with the waste, is captured by the leachate collection system (LCS). Only run-off from waste surfaces that have received adequate cover is not

considered leachate and should be directed to the stormwater drainage system where practical.

3.2.3 Erosion Control

The serviceability of the landfill relies heavily on soil berms, barrier layers, and agricultural layers that are readily eroded by flowing water. Erosion control provisions incorporated in the landfill include the following:

- The slope of the working face must be no steeper than 5H:1V where practical to limit erosion of the daily/periodic cover.
- Intermediate cover that has been exposed for more than 30 days must be seeded immediately and repaired when erosion features are identified.
- Drainage breaks (diversion berms, rain gutters, etc.) are provided on the final cover to limit the flow length of run-off.
- Water collected by each drainage break is routed to stormwater drainage channels or down pipes so that the run-off volume does not accumulate going down the slope.
- The vegetative soil layer placed over the final cover must be seeded immediately.

Additional erosion control measures have been taken within the drainage channels and at points of stormwater discharge. All final cover should be inspected regularly for erosion damage and promptly repaired.

3.2.4 Sedimentation Control

Stormwater run-off from the landfill unit(s) is conveyed to one of the on site sediment basins and/or traps. These basins and/or traps should be inspected regularly for sediment build-up or erosion damage. The basins and/or traps should be cleaned out when sediment fills the lower half of the basin.

3.2.5 Separation of Stormwater/Leachate - MSW Landfill Units

The stormwater separation system is accomplished by dividing the MSW landfill units into separate cells to reduce the volume of leachate generated and minimize the impoundment of stormwater within the landfill. The separation system allows stormwater in cells which have not yet received waste to be pumped out of the landfill to perimeter drainage features. During activation of a cell, the Owner will connect the cell to the LCS as discussed in **Section 2.5.3.2**.

3.3 LEACHATE MANAGEMENT - MSW LANDFILL UNITS

The leachate management system for the existing and proposed MSW landfill units consists of the LCS, the leachate transmission piping, pumps, valve boxes, valves, the existing leachate storage lagoon (Phase 1), and the leachate storage tanks (Phase 2).

Leachate from each MSW landfill unit is collected in the leachate sumps at the low end(s) of each unit. Leachate collected in each sump is pumped to the leachate storage lagoon (Phase 1) or leachate storage tanks (Phase 2) via a HDPE force main (except for Areas 1 and 3 of Phase 1 which drain via a gravity penetration and HDPE gravity main). From the storage lagoon or tanks, the leachate is pumped into tanker trucks and hauled (or may in the future be pumped via force main) to a local wastewater treatment plant (WWTP). If approved, the County plans to implement leachate recirculation in Phase 2 once enough waste is in place. Planned methods of leachate recirculation are as described in **Appendix C**. Refer to the appropriate permit application for a detailed discussion and details of the leachate management system for each lined landfill unit.

3.3.1 Leachate Collection System (LCS)

A continuous layer of leachate collection media (No. 78 stone) covers the HDPE geomembrane liner to collect leachate draining from the waste. In addition, a large flow capacity network of perforated pipe and gravel drains is constructed within the blanket drain. The LCS is designed to remove inflow from a 25-year 24-hour storm. As such, its capacity is very large compared to that required to accommodate routine leachate generation rates once waste covers the landfill footprint.

The LCS has been designed to minimize the impact of long-term biological clogging as follows:

- Cleanouts are provided on the major perforated leachate collection pipes;
- No geotextiles will be used between the waste and the gravel columns; and
- The use of No. 57 stone around collection pipes allows hydro-washing of the pipe and gravel to remove biological growth.

3.3.1.1 Drainage Aggregate Maintenance

The exposed surface of the gravel columns and the leachate collection media should be inspected monthly and after each large rain storm to check for buildup of sediment on the aggregate. Sediment buildup must be periodically removed carefully with a backhoe. Aggregate that is removed must be replaced with new clean material. Per **Section 2.5.3.2**, the Type GT-S geotextile must be removed just prior to the placement of waste over that portion of gravel column.

3.3.1.2 Collection Pipe Cleanout

Remote camera inspection and flushing (if necessary) of leachate collection piping (portion that can be inspected and cleaned) will be performed every 3 years or earlier if an abnormal reduction in leachate production is observed. If piping is mostly clean at the initial 3 year inspection, the County may petition the DWM to increase the inspection frequency to 5 year intervals.

The locations of the collection system that have sediment or biological growth buildup will be cleaned using high pressure water jetting equipment. The water jetting system should generate greater than 2,000 psi water pressure. Use of the high pressure water jetting equipment should be limited to only those portions of the piping system with buildup.

3.3.1.3 Leachate Removal

As constructed, leachate is collected in sumps at the low points of the landfill and is removed from the landfill via gravity or via a side riser pump and HDPE transmission pipe. The leachate is routed to the leachate storage lagoon (Phase 1) or storage tank (Phase 2) via a gravity or force main or into the leachate recirculation system.

Under normal conditions, the County will remove (via pump and haul) leachate from the Phase 2 primary storage tank (Tank A) at a rate to maintain a typical volume of 200,000 gallons (approximate 20 foot depth), or less, of leachate in the tank. This allows ample volume in the tank to handle the anticipated "surge" event caused by a design storm and minimizes the potential for ponding within the landfill. Additional draw-down of the tanks to a minimum volume of approximately 20,000 gallons (approximate 1 foot depth) will be performed in advance of predicted heavy rainfall (tropical storm, hurricane, etc.). Likewise, the county will routinely remove leachate from the Phase 1 lagoon.

3.3.1.4 Operation and Maintenance of Leachate Pumps and Storage Tanks

Operation and maintenance of leachate pumps and the storage tanks shall be in accordance with the appropriate manufacturer's recommendations. The County Solid Waste Director or his designee will be responsible for following and documenting, as required, these activities.

3.3.2 Leachate Quality Sampling

Semi-annual leachate quality sampling and analysis will be performed during operation of the Subtitle D MSW landfill units. Samples will be recovered as grab samples from the following locations:

- Phase 1: Sample from existing leachate storage lagoon; and
- Phase 2: Sample from leachate side risers or storage tank.

The parameters to be analyzed will include BOD, COD, temperature, conductivity, pH, ammonia, suspended solids, Appendix I constituents, sulfates, and nitrates.

3.3.3 Record Keeping

Accurate records for the following will be maintained at the landfill in accordance with **Section 1.11**.

Leachate Generation (Monthly):

Phase 1 (Quantity hauled from leachate lagoon)
Phase 2 (Quantity hauled from leachate tank and/or flowmeter data)

Leachate Quality (Semi-Annual):

Phase 1 (From leachate lagoon)
Phase 2 (At side risers or tank)

3.3.4 Leachate Contingency Plan

In the unlikely event that leachate levels within the existing leachate storage lagoon or tanks approach the freeboard capacity, due to unforeseen events, the DWM will be verbally notified (see **Section 1.2.2**) and the leachate flow will be valved off and temporarily stored in the landfill until the level of leachate in the lagoon or tanks can be lowered by pump and haul operations or direct pumping if a force main is in place. Written documentation describing the unforeseen events, the actions carried out to remove the stored leachate, and a strategy for preventing future occurrences will be provided to the DWM within 30 days following any such occurrence.

3.4 LEACHATE MANAGEMENT - C&D LANDFILL UNIT

In order to ensure that heads at the low end of Phase 1 are not excessive, the County will periodically use a lift pump to pump out leachate from the low end of Phase 1 via a side riser pipe into a tanker truck for transfer either into the County's existing storage lagoon or to a wastewater treatment plant (WWTP).

3.5 WATER QUALITY MONITORING

The monitoring program and procedures outlined in the current Water Quality Monitoring Plan will be followed for the monitoring of site groundwater monitoring wells and surface water monitoring locations. The results of the water quality monitoring program will be placed in the facility operating record as described in **Section 1.11**.

3.6 LANDFILL GAS MANAGEMENT

Monitoring will be performed to identify (if any) subsurface migration of landfill gas at explosive levels are present in on-site structures and/or at the property boundary in gas monitoring probes. Methane or other explosive gas concentrations shall not exceed 25 percent of the lower explosive limit (LEL) (1.25% of methane (CH_4)) in on-site structures, such as scale houses, or 100% of the LEL (5% of CH_4) at the facility property boundary.

If landfill gas levels exceed these limits, the following will be performed:

- Immediately take all steps necessary for the protection of personnel, staff, or neighboring properties and notify the DWM;
- Within seven (7) days, place in the operating record a description of events taken following the detection event; and
- Within 60 days, implement a remediation plan for the explosive gas releases, place a copy in the operating record, and notify the DWM that the plan has been implemented.

3.7 VECTOR CONTROL

3.7.1 MSW Landfill Units

Control of insects, rodents, and birds will be accomplished by compaction of the waste and the use of daily cover. Spilled or wind-blown debris along the access road will be cleaned up daily and placed in the landfill. If vector control becomes a problem, additional measures will be taken to ensure the protection of human health.

3.7.2 C&D Landfill Unit

Due to the nature of the waste disposed in this landfill unit, vector control is not anticipated to be of concern. Note that the use of periodic cover will discourage animals from nesting in the waste.

3.8 ODOR CONTROL

3.8.1 MSW Landfill Units

Odorous or potentially odorous materials will be covered as soon as possible to avoid odor problems. If odor control becomes a problem, additional measures will be taken to ensure odor control.

3.8.2 C&D Landfill Unit

Due to the nature of the waste disposed in this landfill unit, odor control is not anticipated to be of concern. However, should odor control be an issue, additional measures will be taken to ensure odor control.

3.9 DUST CONTROL

Dust related to waste hauler traffic on the access roads will be minimized by using a water truck to limit dust on the gravel portion of the road. Dust generated by excavation of cover soil will be limited by watering the cut soil areas if accessible to the water truck.

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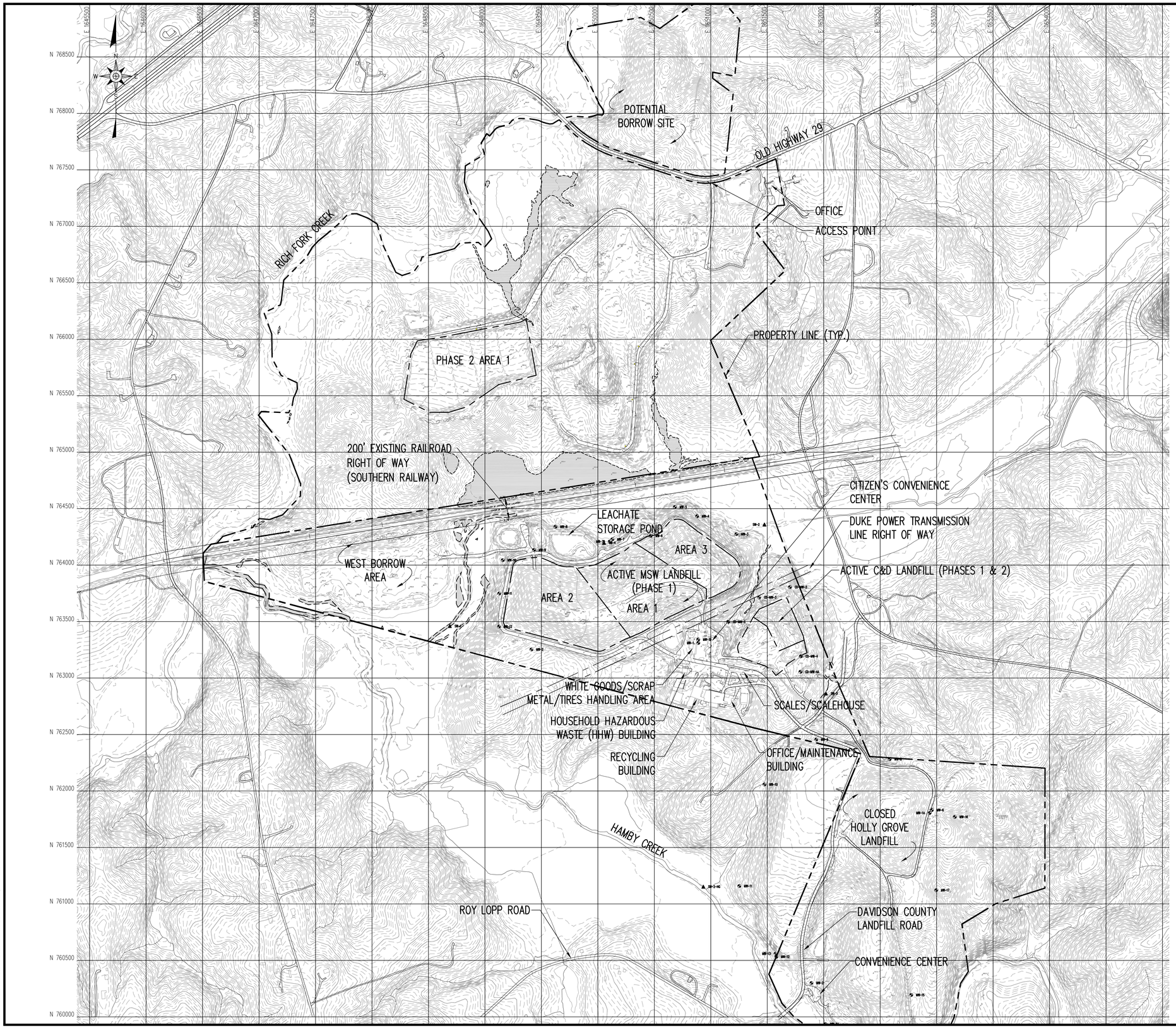

LEGEND

660	EXISTING 10' CONTOUR (SEE REFERENCE 1)
	EXISTING 2' CONTOUR
	PROPERTY LINE
	LIMIT OF LINER (EXISTING LINED UNITS)
	APPROXIMATE EXISTING WASTE LIMITS (UNLINED UNITS)
	WETLAND BOUNDARY (SEE REFERENCE 2)
	STREAM (SEE REFERENCE 2)
MW-8D	EXISTING MONITORING WELL
SW-3	EXISTING SURFACE WATER SAMPLING POINT

REFERENCES

1. OVERALL TOPOGRAPHY PER NORTH CAROLINA DEPARTMENT OF TRANSPORTATION, CONTOUR AND ELEVATION DATA GENERATED FROM LIGHT DETECTION AND RANGING (LIDAR) DATA OBTAINED FROM THE NORTH CAROLINA FLOOD MAPPING PROGRAM AND DATED SEPTEMBER 2004. TOPOGRAPHY IN ACTIVE C&D AND MSW AREAS FROM SPATIAL DATA, AERIAL DATED 4/30/08.
2. WETLAND SURVEY BY LEXINGTON LAND SURVEYING, DATED DATED 3/28/01.
3. WETLANDS AND STREAM LOCATIONS ON SOUTHEAST SIDE OF C&D LANDFILL FROM DELINEATION PERFORMED BY CAROLINA ECOSYSTEMS, INC., FEBRUARY 2009, AND SURVEYED BY MICHAEL GREEN ASSOCIATES, P.A., FEBRUARY 2009.

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NO.	DATE	REVISION

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SEAL

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PROJECT TITLE:
DAVIDSON COUNTY
C&D LANDFILL - PHASES 3 & 4
PERMIT AMENDMENT DRAWINGS

DRAWING TITLE:
EXISTING SITE CONDITIONS

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY:	PROJECT NO.: DAVDCO 08-5
SCALE: AS SHOWN	DATE: MARCH 2009
FILE NAME: DAVDCO-D0500	
SHEET NO. 1	DRAWING NO.

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Appendix A

EPA Method 9095

Paint Filter Liquids Test

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METHOD 9095
PAINT FILTER LIQUIDS TEST
From EPA SW-846

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 minute 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.

4.0 APPARATUS AND MATERIALS

4.1 Conical paint filter: Mesh number 60 (fine meshed size). Available at local paint stores such as Sherwin-Williams and Glidden for an approximate cost of $0.07 each.

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 inch of the filter mesh to protrude should be used to support the filter. The funnel is to 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 EPA SW-846.

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.

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.

7.3 Allow sample to drain for 5 minutes into the graduated cylinder.

7.4 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 required.

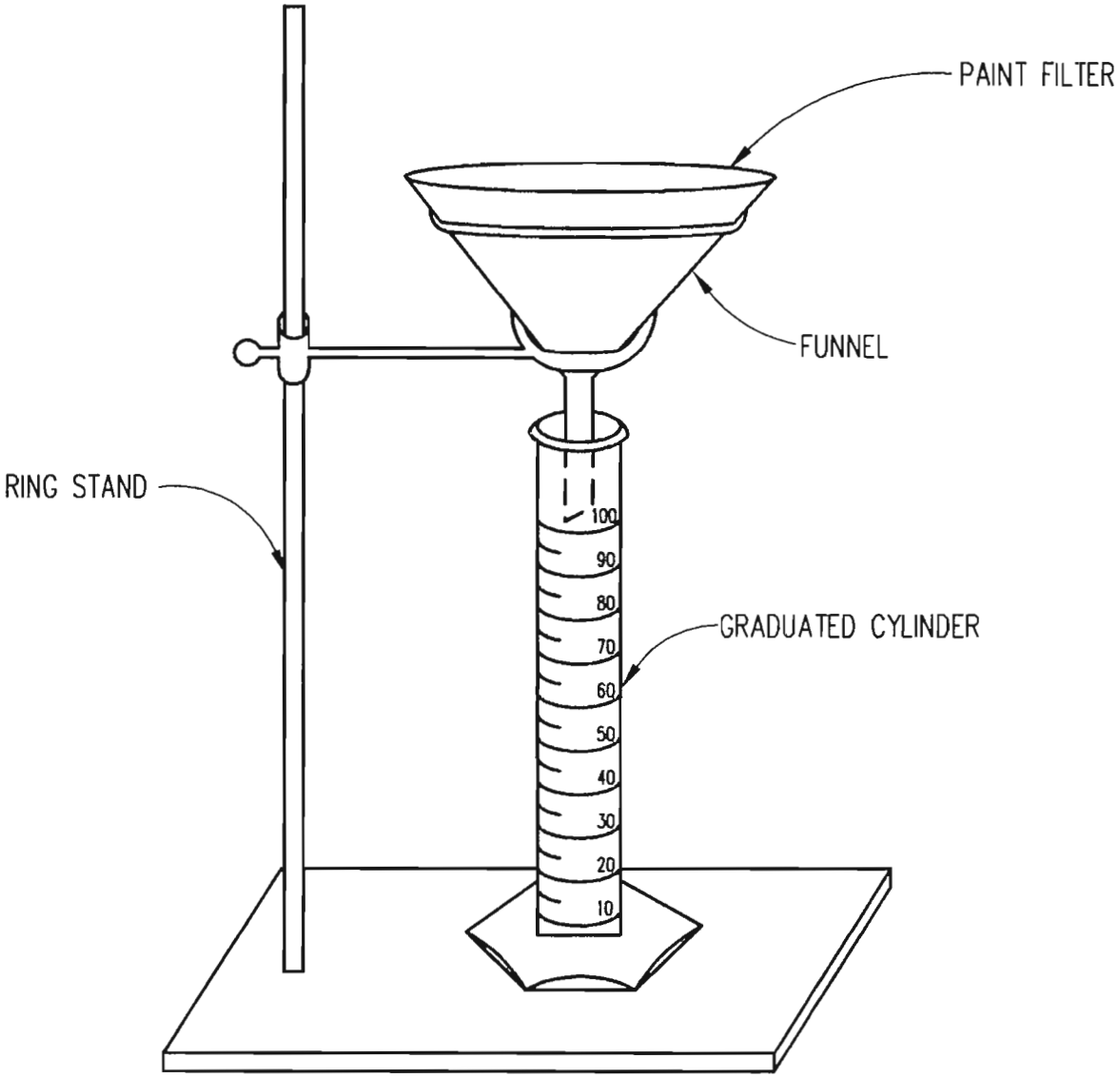
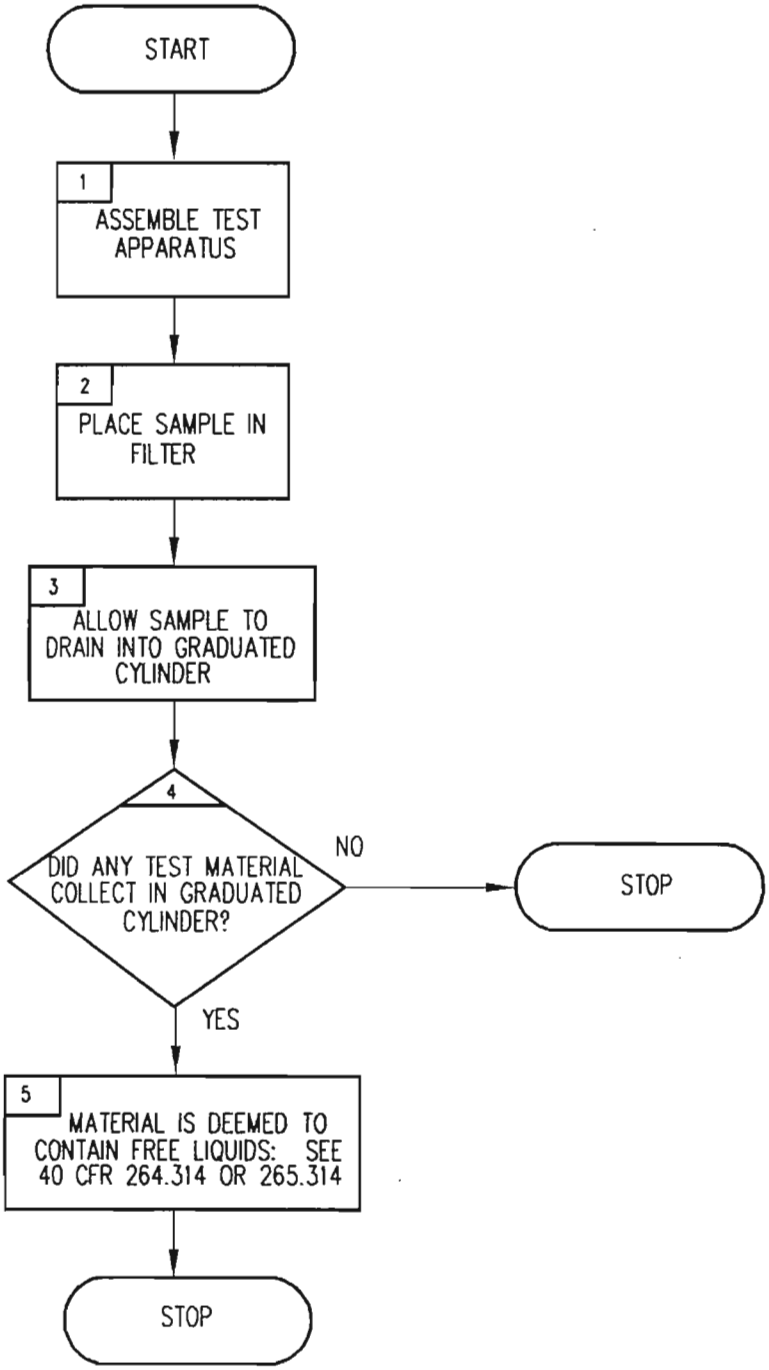


FIGURE 1. PAINT FILTER TEST APPARATUS.

METHOD 9095
PAINT FILTER LIQUIDS TEST



Appendix B

Waste Screening Form

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Davidson County Integrated Solid Waste Management Department
Davidson County C&D Landfill
Permit No. 29-06
(336) 242-2284

WASTE SCREENING FORM

Day / Date: _____ Time Weighed in: _____
Truck Owner: _____ Driver Name: _____
Truck Type: _____ Vehicle ID / Tag No: _____
Weight _____ Tare: _____
Waste Generator / Source: _____

Reason Load Inspected: Random Inspection _____ Staff Initials _____
Detained at Scales _____ Staff Initials _____
Detained by Operating Staff _____ Staff Initials _____

Inspection Location: _____

Approved Waste Determination Form Present? Yes _____ No _____ N/A _____

Description of Load: _____

Load Accepted (signature) _____ Date _____
Load Not Accepted (signature) _____ Date _____

Reason Load Not Accepted (complete only if load not accepted)

Description of Suspicious Contents: Color _____ Haz. Waste Markings _____
Texture _____
Drums Present _____ Smell _____
Est. Cu. Yds. Present in Load _____
Est. Tons Present in Load _____

Davidson County Emergency Management Contacted? Yes _____ No _____

Company or Authority Contacted? _____
Hazardous Materials Present: _____

Hauler Notified (if waste not accepted) Phone: Time Contacted:
Other Observations: _____

Final Disposition
Signed _____ Date _____
Waste Screening Inspector or Solid Waste Director

Attach related correspondence to this form.
File completed form in Operating Record.

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Appendix C

Leachate Recirculation Plan

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Operations Manual
Appendix C: Leachate Recirculation Plan

Davidson County Landfill Facility
Davidson County, North Carolina

Prepared for:
Davidson County Integrated Solid Waste Management
Thomasville, NC

March 2009

RICHARDSON SMITH GARDNER & ASSOCIATES
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DAVIDSON COUNTY
DAVIDSON COUNTY LANDFILL FACILITY

OPERATIONS MANUAL
APPENDIX C: LEACHATE RECIRCULATION PLAN

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- 120-Day Trial Period Monthly Reporting Form
- Leachate Recirculation Monthly Reporting Form
- Leachate Recirculation Daily Log
- Installation Log

DRAWINGS Refer to **Attachment H** of the Permit to Construct Application for the Phase 2 - Area 1 MSW landfill unit.

DAVIDSON COUNTY
DAVIDSON COUNTY LANDFILL FACILITY

OPERATIONS MANUAL
APPENDIX C: LEACHATE RECIRCULATION PLAN

1.0 OVERVIEW

Davidson County has recirculated leachate into the Phase 1 MSW landfill unit (Areas 1 and 3) using horizontal injection trenches and plans to recirculate leachate within the Phase 2 MSW landfill unit both as an alternative to leachate treatment and to promote biodegradation of the waste to produce settlement and resulting additional airspace. By-products of leachate recirculation will be a more biologically stable waste mass and an accelerated production of landfill gas (LFG).

Davidson County plans to use one or more of the following methods to recirculate leachate in Phases 2:

- Horizontal Injection Systems (Trenches/Blanket Drains);
- Vertical Injection Wells;
- Ponds or Near-Surface Trenches; and/or
- Direct Application at Working Face.

Each of these methods is discussed in **Section 4.0**.

2.0 REGULATORY REQUIREMENTS

The recirculation of leachate within lined MSW landfills is provided for in Federal RCRA Subtitle D regulations and not prohibited in North Carolina regulations. It is anticipated that design and operational requirements for recirculation will evolve from guidance provided by the Solid Waste Section of the North Carolina Division of Waste Management (DWM).

2.1 <u>40 CFR 258 RCRA Subtitle D</u>

Federal regulations provide both specific and implied requirements that must be met by landfills recirculating leachate. Relevant sections of the Federal regulations are as follows:

§258.28 (a): Bulk or non-containerized liquid waste may not be placed in the MSWLF units unless: (1) The waste is household waste other than septic waste; or (2) The waste is leachate or gas condensate from the MSWLF unit and the MSWLF unit, whether it is a new or existing MSWLF, or lateral expansion, is designed with a composite liner and leachate collection system as described in §258.40(a)(2) of this part...

§258.40(a)(2): With a composite liner, as defined in paragraph (b) of this section and a leachate collection system that is designed and constructed to maintain less than a 30-cm depth of leachate over the liner. (b) For purposes of this section, *composite liner* means a system consisting of two components: the upper component must consist of a minimum 30-mil flexible membrane liner (FML), and the lower component must consist of at least a two-foot layer of compacted soil with a hydraulic conductivity of no more than $1x10^{-7}$ cm/sec...

2.2 North Carolina Rule NCAC T15A: 13B.1600

North Carolina regulations mirror the above referenced Federal regulations in Rule .1624(b)(1) related to design and construction, Rule .1624(b)(2)(A) related to maximum head, and Rule .1626(9)(a)(ii) related to recirculation of leachate. Currently, the implementation of leachate recirculation is administered using policy established in DWM guidance for leachate recirculation. This guidance establishes basic elements that must be incorporated into a leachate recirculation plan prior to implementation of a 120-day trial period and eventual long-term operation. Key elements of this guidance are listed on **Table 1** along with the location in this plan where the element is addressed.

2.3 Recirculation Over Alternative Liners

Recently Federal approval was given for states to issue research, development, and demonstration (RD&D) permits which would allow leachate recirculation over alternative liners. Davidson County will not proceed with implementation of a leachate recirculation system over an alternative liner until North Carolina adopts this approval.

3.0 IMPACT OF LEACHATE RECIRCULATION ON THE LEACHATE COLLECTION SYSTEM (LCS)

The HELP (v. 3.07) Model was used to evaluate the impact of leachate recirculation on the ability of the LCS to maintain no more than 12 inches of head acting on the composite liner system (except in sumps). This analysis indicates that the average head acting on the liner system is less than 12 inches when a minimum of 30 feet of waste is in place prior to initiating recirculation. The short-term HELP evaluations are conservative in that only a single 30 foot lift of waste is modeled for a 5 year period. As the height of waste is increased, the storage capacity within the waste increases and the resulting head on the liner system decreases.

4.0 LEACHATE RECIRCULATION METHODS AND OPERATIONAL CONSIDERATIONS

As noted above, Davidson County plans to use one or more methods of recirculating leachate into the waste mass. For all methods, a minimum of 30 feet of waste should be in place in the landfill unit prior to the start of leachate recirculation activities. The following sections cover these methods and describe the associated operational considerations. Note that all injection

trenches, blanket drains, vertical injection wells, and near-surface injection trenches which are installed will be documented using the form provided in **Appendix C1**.

4.1 Horizontal Injection Systems (Trenches/Blanket Drains)

Horizontal injection systems will consist of either injection trenches or blanket drains installed horizontally within the landfill. Leachate will be pumped into these systems from the landfill sump pumps using piping placed on the landfill side slopes. Valves will be utilized as required to control the injection to individual trenches or blanket drains.

Injection trenches will consist of a trench excavated in the surface of the waste mass and filled with porous media (stone, tire shreds/chips, crushed glass, etc.) and a perforated injection pipe and backfilled with waste. The trenches are placed at an approximate 30 foot vertical spacing and a maximum 80 foot horizontal spacing. Each successive vertical gallery is staggered to provide for more uniform leachate distribution.

Blanket drains will consist of a blanket drain (drainage geocomposite or layer of porous media) placed in contact with the waste. A perforated injection pipe(s) will be placed under/within the blanket drain. A lift of waste will be placed over the entire drain before leachate recirculation begins.

The leachate injection piping for horizontal injection systems will be high density polyethylene (HDPE) fusion welded pipe having a dimension ratio (DR) of 11 or thicker in order to tolerate expected settlement in the underlying waste. Leachate will be injected under a minimum 10 psi pressure through a series of 1/8 inch holes spaced 10 feet apart. Field tests by RSG have confirmed that this hole size and spacing allows for a very uniform release of leachate from each hole for pipe lengths up to 800 feet in length. Other perforation patterns and injection pressures may also be tried.

Drawing LR1 (Leachate Recirculation Details - Sheet 1 of 2) of the Phase 2 - Area 1 Permit to Construct drawings shows details for the construction of horizontal injection systems.

Depending on the construction of the horizontal injection systems (in particular the perforation pattern of the injection piping) these systems may be used for the future collection of landfill gas (LFG). Optionally, additional perforated piping for LFG collection may be installed during the construction of the horizontal injection systems.

4.2 Vertical Injection Wells

Leachate recirculation using vertical injection wells will consist of installing large or small diameter vertical wells into the waste and injecting leachate through a perforated or slotted pipe (with SCH 80 PVC or HDPE) in much the same fashion as horizontal injection systems. The bottom of vertical injection wells will be no closer than 10 feet from the top of the protective cover.

Large diameter wells will consist of drilling a 36 inch diameter borehole through the waste using a bucket auger, placing a perforated injection pipe and backfill of porous media and completing the well in much the same manner as a landfill gas (LFG) well. Optionally, large diameter wells can be constructed using perforated concrete manhole sections which are placed as the height of waste increases. These manhole sections are filled with porous media and perforated or slotted piping is placed both in the well and radially out from the wells in varying vertical locations to distribute the leachate.

Small diameter wells will consist of drilling small diameter boreholes with hollow stem augers or by vibratory methods and placing a perforated or slotted injection pipe in direct contact with the waste.

Drawing LR2 (Leachate Recirculation Details - Sheet 2 of 2) of the Phase 2 - Area 1 Permit to Construct drawings shows a detail for the construction of a vertical injection well.

As for horizontal injection systems, vertical injection wells (in particular large diameter wells) may be used for the future collection of LFG.

4.3 Ponds or Near-Surface Trenches

Leachate recirculation using ponds or near-surface trenches will consist of excavating shallow ponds or near-surface trenches in flat areas of the landfill which are inactive and filling with leachate to allow the leachate to percolate into the waste below. Either a water truck or piping connected to the leachate pumps will be used to apply leachate to either the ponds or near-surface trenches.

Ponds should have no more than a 2 foot depth of leachate and require a small soil berm around the perimeter of the pond to maintain at least 1 foot of freeboard. If ponds are used, the site may need to employ additional measures to control odors.

Near-surface trenches will consist of an excavated trench up to a maximum 10 foot depth which is filled with porous media and a perforated recirculation pipe and backfilled with waste. If it is desired to collect LFG in the future, HDPE (DR 11 or thicker wall) pipe should be used.

Drawing LR2 of the Phase 2 - Area 1 Permit to Construct drawings shows details for the construction of ponds or near-surface trenches.

4.4 Direct Application at Working Face

Direct application at the working face will consist of applying leachate using a water truck or piping connected to the leachate pumps directly to the waste. The quantity of leachate applied will be limited to that which does not create standing water. Landfill staff may need to utilize small soil berms to contain any leachate runoff depending mainly

workers, the application should only be performed during periods when haulers and other landfill staff are not present in the area. Once applied, the waste should be covered with either waste or daily cover shortly after wetting to contain odors. Direct application at the working face will only be done during daylight hours and no leachate will be applied to the working face when it is raining, or when the waste is too wet. Additionally, spray applications should be avoided in windy conditions.

4.5 Other Operational Considerations

Other operational considerations to be considered in recirculating leachate are as follows:

- Removal of Daily/Intermediate Cover Soil: It is recommended that existing daily/intermediate soil be removed as practical before the placement of additional lifts of waste as excess soil in the landfill can lead to preferential flow paths and leachate seeps.

- Decreased Waste Compaction: Consideration should be given to decreasing the compaction effort in the lift or two of waste under planned locations of horizontal injection systems and ponds or near-surface trenches. This will allow greater quantities of leachate to be recirculated as well as a greater dispersion of leachate in these locations.

5.0 FACILITY MONITORING

The facility must be monitored to ensure that the combination of leachate recirculation and natural precipitation does not produce excessive head on the liner system, side slope seeps, or stability problems. This section reviews a monitoring system to be installed in the landfill to monitor both weather and leachate quantities.

5.1 Weather Monitoring

Daily weather monitoring will be obtained using a rain gauge and tell-tale equipped thermometer located at the landfill office. Daily readings would be obtained for the maximum temperature, total rainfall, and general weather conditions. This information would be recorded on the form provided in **Appendix C1**. This data allows an accurate evaluation of the water-balance over time within the waste.

5.2 Leachate Monitoring

Leachate from the landfill gravity drains to the sumps. The pumps placed within the sumps are equipped with level indicators and an alarm if incoming flow exceeds the pump capability. As long as the pumps handle the incoming flow, excessive head acting on the liner system is prevented.

Landfill personnel will pay particular attention to sudden increases in leachate generation during or immediately after recirculation activities. Sudden increases in rate of leachate generation from the facility not accompanied by precipitation indicates that injected leachate is moving through the waste faster than normal. This may imply either saturation of the waste due to over injection of leachate or short circuiting (via voids in the waste) of the waste by a single injection. Both situations require a cessation of injection to the injection location in question and a modification of the injection sequence.

5.3 Monitoring of Side Slopes

Landfill staff will observe side slopes in particular during and just after leachate recirculation to ensure that leachate run-off or seeps are not produced. Should run-off or seeps be observed, the landfill staff will cease recirculation in the vicinity of the run-off or seeps and will consider methods for remediation. Methods include placement of additional soil, berming, and the installation of drains.

6.0 REPORTS

The following reports will be prepared:

- Pre-Operational Report (this document) and
- 120-Day Trial Period Reporting (Progress and Final Reports).

6.1 Pre-Operational Report

The pre-operational report provides sufficient information to justify the 120-day trial recirculation period. This Leachate Recirculation Plan is the pre-operational report for leachate recirculation within Phase 2. Reporting forms proposed in this pre-operational report will be revised with experience.

6.1.1 Weather Monitoring

A daily rain gauge and thermometer will be installed at the landfill office to allow daily recording of total rainfall and maximum temperature. This data will be recorded at the end of each working day.

6.1.2 Baseline Leachate Sampling

Baseline leachate quality data for Phase 2 will be provided within the last 30 days prior to the initiation of leachate recirculation. This data will include test results for BOD, COD, temperature, conductivity, pH, ammonia, suspended solids, metals, and volatiles.

6.1.3 Operational Procedures

The operational procedures during the 120-day trial recirculation period will be the same as for long-term operations as previously described in **Section 4** depending on the method(s) of leachate recirculation used.

6.1.4 Operational Equipment

The operational equipment used during the 120-day trial recirculation period will be the same as for long-term operations as previously described in **Section 4** depending on the method(s) of leachate recirculation used.

6.1.5 Record Keeping

Daily readings for rainfall, maximum temperature, quantity of leachate generated/recirculated, and leachate injection galleries used will be maintained using the form provided in **Appendix C1**. This form provides for a week of data and allows comments on the daily weather conditions and unusual operating conditions, e.g., odor or seeps. These data sheets will be provided to the State as part of the technical report submitted to DWM in support of implementation of the long-term leachate recirculation program.

6.2 120-Day Trial Period Reporting

6.2.1 Progress Report

After a minimum of 60 days, a progress report will be prepared which describes and documents the monitoring activities since initiation of the 120-day trial period, presents observed difficulties and/or operational modifications, and presents leachate quality data. Leachate quality data will include test results for BOD, COD, temperature, conductivity, pH, ammonia, suspended solids, metals, and volatiles.

6.2.2 Final Report

At the completion of the 120-day trial period, a final report will be prepared which describes and documents the monitoring activities for the entire trial period, presents observed difficulties and/or operational modifications, and presents leachate quality data. Leachate quality data will include test results for BOD, COD, temperature, conductivity, pH, ammonia, suspended solids, metals, and volatiles. The most critical aspect of this report is confirmation that the proposed leachate injection sequence results in acceptable performance. Based on this report, Davidson County will request approval by DWM to implement the long-term leachate recirculation program.

TABLE 1: NC DWM POLICY ELEMENTS FOR LEACHATE RECIRCULATION

Conditions	Policy Element	Section(s)
Preoperative Conditions	A rain gauge and thermometer shall be placed on the site.	6.1.1
	A Baseline sampling of leachate shall be performed.	6.1.2
	An outline of expected operational procedures shall be submitted.	4.0
	A brief description of the equipment and its' associated specifications shall be submitted.	4.0 & Specs.
	A brief description of record-keeping forms shall be submitted including: • daily/weekly record of leachate generated • daily/weekly record of leachate recirculated • weather conditions and other pertinent daily information • a log for reporting operating or other unusual problems, and their subsequent rectification • any other forms or procedures, etc., that the owner/operator will use.	5.0/6.0
	An estimation of height of waste in the cell where leachate is anticipated to be applied.	3.0/4.0
	An analysis of the field capacity of the waste where leachate is to be applied, such that the gallons per unit area does not exceed the field capacity of the waste volume.	3.0
Operating Conditions	Records shall be kept or a daily/weekly basis as outlined.	6.0
	No leachate shall be applied on less than one lift (10 feet) of waste.	3.0/4.0/4.2
	No leachate shall be spray applied or surface circulated when it is raining, or when the waste is too wet.	4.4
	No run-off or side seepage will be allowed.	4.5/5.3
	Odors will be controlled.	4.3/4.4
	Leachate depth shall be monitored in the manhole to ensure that the head on the liner does not exceed one foot for more than 24 hours.	5.2
	Leachate will be spray applied or surface circulated during daylight hours only.	4.4
	The application system will be properly maintained and documented.	4.0/5.0/6.0
	Subsurface distribution systems will be outlined.	4.1/4.2/4.3
	Operation and maintenance of subsurface systems will be proposed.	4.1/4.2/4.3

Appendix C1

Reporting Forms and Logs

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DAVIDSON COUNTY MSW LANDFILL - PHASE 2
LEACHATE RECIRCULATION
120-DAY TRIAL PERIOD MONTHLY REPORTING FORM

Start Date (Day 1): _____

Day	Rain (Inch)	Max. Temp.	Leachate Generated	Leachate Recirculated	Injection Location(s) Used	Problems/Weather (Use Extra Sheet if Required)
1						
2						
3						
4						
5						
6						
7						
8						
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DAVIDSON COUNTY MSW LANDFILL - PHASE 2
LEACHATE RECIRCULATION
LEACHATE RECIRCULATION MONTHLY REPORTING FORM

Start Date (Day 1): _____

Day	Rain (Inch)	Max. Temp.	Leachate Generated	Leachate Recirculated	Injection Location(s) Used	Problems/Weather (Use Extra Sheet if Required)
1						
2						
3						
4						
5						
6						
7						
8						
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31						

DAVIDSON COUNTY MSW LANDFILL - PHASE 2
LEACHATE RECIRCULATION
LEACHATE RECIRCULATION DAILY LOG

Date: _____

Time	Injection Location	Volume Pumped	Remarks

DAVIDSON COUNTY MSW LANDFILL - PHASE 2
LEACHATE RECIRCULATION
INSTALLATION LOG

Injection Device: Horizontal Trench / Horizontal Blanket Drain / Vertical Injection Well / Near-Surface Injection Trench (circle one)

Device ID: _____

Date(s) Installed: _____

Length Installed: _____

Elevation: _____

Number of Holes/Spacing: _____

Hole Size: _____

Coordinates:

Point #: _____ X: _____ Y: _____ Z: _____

Point #: _____ X: _____ Y: _____ Z: _____

Point #: _____ X: _____ Y: _____ Z: _____

Remarks: _____

Installation Sketch:

Appendix D

Mobile Home Deconstruction

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Operations Manual
Appendix D: Mobile Home Deconstruction

Davidson County C&D Landfill
Davidson County, North Carolina

Prepared for:
Davidson County Integrated Solid Waste Management
Thomasville, NC

March 2009

RICHARDSON SMITH GARDNER & ASSOCIATES
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DAVIDSON COUNTY
DAVIDSON COUNTY LANDFILL FACILITY

OPERATIONS MANUAL
APPENDIX D: MOBILE HOME DECONSTRUCTION

1.0 OVERVIEW

This portion of the Operations Manual was prepared for the Mobile Home Deconstruction Area located adjacent to the Davidson County Construction and Demolition Debris (C&D) Landfill unit. The Mobile Home Deconstruction Area is strictly for the deconstruction of mobile homes in order to recycle materials from the mobile homes. Davidson County plans to recycle as many varieties of materials as possible as end users are available. Initially, scrap metal recycling will be conducted. Once an end-user of another material (i.e. glass) is located, these other materials may be recycled. Any non-recyclable material will be disposed of appropriately by the County upon completion of the deconstruction process.

2.0 MOBILE HOME DECONSTRUCTION PROCESS

Mobile homes will be deconstructed using the following processes.

2.1 Access

Mobile home owners seeking disposal will contact the landfill facility and be placed on a waiting list. No more than TWO (2) mobile homes will be allowed on-site for deconstruction at one time. Once space is available for a mobile home, landfill personnel will contact the next owner on the waiting list. The owner will have a 48 hour window in which to contact the landfill facility with information regarding the delivery date and hauler. If owner cannot arrange delivery within this initial 48 hour period, the owner may make alternate arrangements for delivery and must notify the landfill facility a minimum of 48 hours prior to planned delivery. The delivered mobile home will not be weighed on the scales at time of delivery, but the owner will be charged based upon the size and dimensions of the mobile home.

If delivery is not made within 48 hours of the scheduled delivery date, the owners name will be placed on the waiting list and the owner will be notified. If an owner has more than one mobile home, they will be rotated with others on the waiting list.

2.2 Waste Disposal

All mobile homes must be free of garbage, household hazardous waste, and all other non-construction and demolition waste prior to acceptance by the landfill.

2.3 White Goods

White goods will be accepted with the mobile home. White goods will be removed and handled in accordance with all State and Federal regulations. Any white goods containing CFC's will have them managed properly prior to removal of the white goods and deconstruction of the mobile home.

2.4 Asbestos

Since asbestos may be located in the building materials of mobile homes constructed prior to 1983, all mobile homes built before 1/1/1983 will be thoroughly sprayed with water (both interior and exterior) to minimize dust. Upon demolition of a mobile home constructed prior to 1983, the waste generated will be placed in the C&D landfill and covered with six inches of soil or approved alternate cover.

2.5 Deconstruction of Mobile Homes

Once accepted, the mobile home will be placed in the mobile home deconstruction area. Mobile home deconstruction will be dependant upon weather conditions and manpower availability and will ONLY take place in the deconstruction area. Prior to deconstruction, mobile homes constructed before 1983 will be thoroughly sprayed with water to minimize dust (as noted above). The home will then be deconstructed using a track-hoe. The track-hoe will tear the trailer apart and lay the pieces on the ground to be separated by landfill personnel. The personnel will separate the non-recyclable materials from the recyclable materials. Initially, scrap metal is planned for recycling. As other end-users for other materials are available, other materials may be separated for recycling. All material not planned for recycling will be placed in the C&D landfill before the end of the day in which the deconstruction takes place. Material from mobile homes constructed prior to 1983 will be covered prior to the end of the day. All recyclable materials will be stockpiled in the deconstruction area for future recycling. **NO OPEN FLAMES OR CUTTING WITH TORCHES WILL BE ALLOWED WITHIN 100 FEET OF THE C&D LANDFILL.**

2.6 Holding Time for Mobile Homes

All mobile homes must be deconstructed within 45 days from acceptance into the deconstruction area. Upon receipt at the landfill, the date shall be painted on the side or end of the mobile home, or on the frame, for identification purposes for Solid Waste Section personnel.

2.7 Holding Time for Recyclables

Once a recyclable material is removed from a mobile home, it may be stockpiled in the mobile home deconstruction area for up to 45 days. No materials shall be kept in this area for more than 45 days, nor shall they be stockpiled in other areas awaiting recycling.

3.0 RECORD KEEPING PROGRAM

The County shall maintain the following records related to the Mobile Home Deconstruction in an operating record at the landfill (see also **Section 1.11** of the Operations Manual):

A. Mobile Home Acceptance records including dates and description;
B. Owner and hauler information for each mobile home;
C. Date of deconstruction for each mobile home and materials to be recycled;
D. Date and disposal information for all recycled materials ton include location and vendor of recipient of recycled materials.
E. Date and certification of CFC's removed.

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Appendix E

Household Hazardous Waste Plan

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APPROVED
DIVISION OF SOLID WASTE MANAGEMENT
DATE 6/22/01 BY SLC

North Carolina Department of Environment and Natural Resources
Division of Waste Management
Solid Waste Section

APPLICATION FOR A HOUSEHOLD HAZARDOUS WASTE IDENTIFICATION NUMBER

A household hazardous waste I.D. number shall be required to ship collected materials off-site for treatment and/or processing. Please check the appropriate box and fill in the blanks.

Temporary Day [ ] Permanent Site [X]

OPERATOR

City/County DAVIDSON

Contact Person Charles BRUSHWOOD Phone (336) 242-2284

Company Name DAVIDSON COUNTY SOLID WASTE MANAGEMENT

Site Location DAVIDSON County Landfill County DAVIDSON

Contact Persons STEVE SWAIM (336) 242-2856
KARRY BLAYLOCK Phone (336) 242-2289

Mailing Address 220 DAVIDSON County Landfill Rd.
LEXINGTON, NC 27292

TRANSPORTER

Company Name SAFETY-KLEEN (TG) ID No. SCD 987574647

Mailing Address 208 WATLINGTON INDUSTRIAL DRIVE
REIDSVILLE, NC 27320

Contact Person Keith ANDERSON Phone (336) 361-6133

DISPOSER/RECYCLER

Company Name SAFETY-KLEEN (TG), INC. ID No. NCD 000648451

Site Location REIDSVILLE, NORTH CAROLINA

Mailing Address 208 WATLINGTON INDUSTRIAL DRIVE
REIDSVILLE, NC 27320

Contact Person Keith ANDERSON Phone (336) 361-6133

MATERIALS TO BE COLLECTED various Household HAZARDOUS Materials including paints, cleaners, pesticides, herbicides, aerosols, AUTOMOTIVE PRODUCTS, BATTERIES, WAXES, VARNISHES, COATINGS ETC.

MATERIALS TO BE RECYCLED Paints (REUSE), SOLVENTS (BTU RECYCLING) motor oil, lead Acid Batteries, Ni-CAD BATTERIES, MERCURY

(OVER)

DEHNR 3796 (7/91)
Solid Waste Section (Review 7/99)

EXPLANATION N/A

For Temporary Day, dates of collection (mo/day/yr) N/A

I certify that the information supplied is accurate and correct to the best of my knowledge and belief; and that this facility will only accept household hazardous waste.

I am authorized to make this request on behalf of the operator at the location given.

Date 6-22-01 Name Charles Brushwood

Company Title Director Signature Charles Brushwood

Purpose: Application for household hazardous waste identification number. This number shall be used to ship collected materials off-site for treatment and/or processing.

Distribution: Mail completed original to the following address:

Division of Waste Management
Solid Waste Section
1646 Mail Service Center
Raleigh, North Carolina 27699-1646
(919) 733-0692

The Solid Waste Section shall assign an identification number upon receipt of application.

***Temporary Day -** Upon completion of a Temporary Collection day, a report on HHW collected, disposed of, and recycled shall be returned to the Solid Waste Section.

***Permanent Site -** An annual report on HHW collected, disposed of, and recycled shall be returned to the Solid Waste Section.

Disposition: This form shall be maintained in accordance with the standards of the Solid Waste Section's Records Disposition Schedule published by the North Carolina Division of Archives and History.

FOR SECTION'S USE ONLY

Date Received 5/15/2001, Revised 6/22/2001

Date Approved 6/22/2001

HHW Number: NC PH02901001

HHW Contractors and Possible Resources

Envirochem
1005 Investment Blvd.
Apex, NC 27502
contact: Jerry Deakle
Ph# (919) 362-9010
Fax# (919) 362-9005
materials: All Major Chemicals
(is not listed under HHW contractors)

Carolina Environmental Associates, Inc.
PO Box 963
Burlington, NC 27217-0963
contact: Michael Griffin
Ph# (336) 229-0058
Fax# (336) 229-0204
materials: All Major Chemicals including HHW

Environmental Recycling Alternatives, Inc.
PO Box 6417
High Point, NC 27262-6417
contact: Greg Meurs
Ph# (336) 869-8785
Fax# (336) 869-4940
materials: Most Major Chemicals
(is not listed under HHW contractor)

Fluid Recovery Company, Inc.
PO Box 1958
Welcome, NC 27374-1958
contact: George Jones
Ph# (336) 228-0692
Fax# (336) 228-0820
materials: Most Major Chemicals
(is not listed under HHW contractors)

Envirocycle, Inc.
PO Box 5367
High Point, NC 27262-5367
contact: Lynn Kak
Ph# (336) 869-8836
Fax# (336) 869-8704
materials: Batteries (all types), Fluorescent bulbs/ballasts
(is not listed under HHW contractors)

IBS Environmental Services, Inc.
PO Box 1263
Lenoir, NC 28645-1263
contact: David Haynes
Ph# (828) 396-4319
Fax# (828) 396-2367
materials: Batteries (all types), Fluorescent bulbs/ballasts
(is not listed under HHW contractors)

Detrex Corporation
3114 Cullman Ave.
Charlotte, NC 28206-2743
contact: Bob Benson
Ph# (704) 372-9280
Fax# (704) 376-0732
materials: Petro Chemicals
(is not listed under HHW contractors)

Energy Recovery Resource, Inc.
215 Speedrail Court
Concord, NC 28025
contact: Rick Martin
Ph# (704) 455-1333
Fax# (704) 455-5138
materials: Petro Chemicals
(is not listed under HHW contractors)

Noble Oil Services, Inc.
5617 Clyde Rhyne Dr.
Sanford, NC 27330
contact: Lee Booher
Ph# (919) 774-8180
Fax# (919) 775-7732
materials: Motor Oil, Petro Chemicals
(is not listed under HHW contractors)

Holston Group, Inc.
PO Box 720
Waynesville, NC 28786-0720
contact: Larry Diggs
Ph# (336) 416-1663
Fax# (828) 452-2838
materials: Motor Oil, Petro Chemicals
(is not listed under HHW contractors)

Century Env. Services & P-3 Inc.
PO Box 410029
Charlotte, NC 28241-0029
contact: Dave Graves
Ph# (704) 588-7426
Fax# (704) 588-7434
materials: Fluorescent bulbs/ballasts

Four Seasons Environmental, Inc.
PO Box 16590
Greensboro, NC 27406-0590
contact: Quint Barefoot
Ph# (336) 273-2718
Fax# (336) 274-5798
materials: Fluorescent bulbs/ballasts
(is not listed under HHW contractors)

AB Environmental Services
3900B US Hwy 29 N.
Greensboro, NC 27405
contact: Al Bouldin
Ph# (800) 801-9874
materials: Most Major Chemicals and HHW

3RC
1401 S. Martin Luther King Dr.
Winston-Salem, NC 27107
contact: Michele Sakwa
Ph# (336) 784-4300
Fax# (336) 784-4905
materials: Most Major Chemicals and HHW
(listed as an HHW contractor)

Safety-Kleen, Inc.
208 Watlington Industrial Rd.
Reidsville, NC 27320
contact: Keith Anderson
Ph# (336) 342-6106
(800) 437-9749
materials: Most Major Chemicals and HHW
(listed as an HHW contractor)

Ecoflo
2750 Patterson St.
Greensboro, NC 27407
contact: Ann Rudd
Ph# (800) 999-6510
Fax# (336) 855-4139
materials: Most Major Chemicals and HHW
(listed as an HHW contractor)

Heritage Environmental Services, Inc.
4132 Pompano Rd.
Charlotte, NC 28216
contact: Larry Eidy
Ph# (704) 392-6276
Fax# (704) 391-4513
materials: Most Major Chemicals and HHW
(listed as an HHW contractor)

Exide Battery Corp.
4101-C Barringer Dr.
Charlotte, NC 28217-1509
contact: Deidre Hill
Ph# (704) 521-9225
Fax# (704) 521-9164
materials: Lead-Acid Batteries
(is not listed under HHW contractors)

Battery Masters, Inc
PO Box 581
Lexington, NC 27293
contact: Lane Livengood
Ph# (336) 472-2100
materials: Lead-Acid Batteries
(is not listed under HHW contractors)

D & M Salvage
PO Box 1292
Linwood, NC 27299
contact: Thomas Lashon
Ph# (336) 798-4781
materials: Propane Tanks
(is not listed under HHW contractors)

Attachment A

Operational Plan for the Davidson County Permanent Household Hazardous Waste Facility

This plan describes the normal operating procedures for Davidson County's permanent Household Hazardous Waste (HHW) Collection Facility. Additional procedures for emergency situations are contained in a separate Contingency Plan.

The Davidson County Permanent HHW Collection Facility is being established as part of a County effort to more effectively manage HHW and to help prevent improper disposal. This comprehensive effort, initiated by Davidson County's Integrated Solid Waste Staff involves a coordinated program of HHW collection, source reduction, and public education. The program is being supported by Davidson County Integrated Solid Waste Department. More information on this County effort and research conducted by staff before choosing a course of action, can be obtained by calling Steve Swaim Recycling Coordinator. He is a member of the Carolina Recycling Association and is also a member of the Association's HHW council.

The Davidson County Permanent HHW Collection facility will be located at the Davidson County Sanitary Landfill Property.

Facility Staffing

The Davidson County permanent HHW Collection Facility will be operated largely through existing County staff. They will primarily be responsible for the identification, collection, bulking, and temporary storage of materials. There will also be contractors that will be used for training, advisory and technical support until our staff is trained, so that we can ensure the facility stays in compliance. Contractors will be used for some over-packing, and the transportation and disposal/recycling of collected materials from the collection site. Local county staff plan to receive appropriate training but will leave most of the waste related tasks to contractor personnel; the primary exception is that the local staff will conduct the weekly inspections described later in this plan. Further information on the facility staffing is provided in a subsequent section entitled Personnel and Duties.

Throughout this plan, personnel from the waste transportation and disposal contractor are referred to as "contractor personnel." In some instances (as necessary for clarity), they are referred to as "onsite" contractor personnel, to distinguish them from other contractor employees.

User Eligibility

The Davidson County permanent HHW Collection Facility is intended to serve the residents who live within Davidson County. Records will be kept on wastes, and these records will contain information on the types of quantities of wastes, their origin, and the decision regarding acceptance or rejection.

Only household hazardous wastes are currently planned for acceptance at the facility. Businesses needing to dispose of hazardous wastes will be referred to vendors who offer "milk run" programs for picking up wastes at business locations. The County, at its option, may offer limited Conditionally Exempt Small Quantity Generator (CESQG) disposal at an appropriate charge to these businesses.

Each time the collection facility is open, local staff representatives will be present to help direct traffic, check for proof of residency, may conduct a brief survey, and provide educational materials, as they are available. The survey will be designed to determine the types, quantities, and sources of each user's wastes and questions may also be added to solicit user comments on program features such as convenience and publicity. The educational material that may be offered to users will include information on less hazardous alternative products and other HHW topics.

Collection and Screening of Wastes

Once eligibility has been established as described above, the users will be directed to proceed to the waste removal area or form a waiting line if needed. Local staff representatives will direct the flow of traffic to ensure safe and efficient operations. The user at the front of the line will be directed to drive into the receiving area, where wastes can be safely removed from the vehicle. Trained County personnel or County's contracted representatives will check the wastes and remove them from the vehicle. The occupants of the vehicle will be asked to remain in the vehicle; if it is necessary to unlock the trunk for removal of wastes, Staff personnel will request the keys and accomplish this task. Properly trained personnel will maintain safe operations by immediately dealing with any leaking damaged, unlabelled, or potentially shock sensitive or explosive materials.

The public education effort planned for this facility will inform potential users that the collection facility is designed to handle HHW from the following general categories: 1) yard and garden products; 2) automotive products; 3) paints and solvents; 4) household cleaning products; and 5) miscellaneous HHW. Because of difficulties in handling a few specific types of wastes (including explosives, radioactive materials, biologically active or infectious waste.), the educational effort will actively discourage users from bringing these and any other materials not accepted by the program. However, in the event that a misinformed resident brings such wastes to the facility, staff or its contractor will consider taking the wastes to avoid improper disposal or recommend a licensed facility where it may be sent.

The decision regarding these wastes will be based upon risk assessment as well as the specific details of each case and also any advice from the staff or available contractor personnel. As necessary, the transportation and disposal contractor will help find specialized vendors to remove any such wastes for treatment or disposal. Whenever wastes are rejected, the user will be given a waste rejection notice showing the reasons for non-acceptance and providing names of people to contact for further information concerning options for proper disposal.

Wastes Identification and packaging

As the wastes are received, trained personnel will perform initial waste identification and segregation. Some materials that can be managed by local government representatives (such as latex paint, motor oil, and other automotive fluids, and lead-acid and button batteries) may be segregated from hazardous wastes at this time and handled according to local government protocols.

The Davidson County HHW Facility **will not accept unknown waste at this time.** If the generator **can identify** the item and/or items in question, then and only then will the facility accept the item. For example; unlabeled paint cans, unlabeled pesticide containers, unlabeled automotive product containers etc.

Trained staff personnel or contractor will conduct or directly supervise the collection, packaging, storage, and document preparation of the household hazardous wastes collected at the facility. The contractor will arrange the transportation, treatment, recycling, or disposal of these wastes. Many will probably require lab packing. Lab packing of materials may occur on the same day as collection activities, provided that time is available and adequate quantities of compatible materials are received. Otherwise, materials will be safely stored until the next scheduled workday. Additionally, partially filled (packed) containers may remain on-site until adequate amounts are collected and properly packaged for transport.

If pumping, pouring, or bulking of wastes are required, grounding and explosion-proof equipment will be used as needed. For both lab packs and bulk packaging, all containers will be of Department of Transportation (DOT) specification, type, and size most appropriate for the specific waste type and planned treatment or disposal method. Wastes will be packed in fiber, plastic, or steel containers of open or closed-head types, ranging from 5 gallon pails to one cubic yard boxes or as contractor feels safe.

For any necessary lab packing, wastes will first be segregated according to DOT hazard class, then by chemical compatibility and by the acceptance criteria of specific waste recycling, treatment, or disposal facilities. An absorbent material such as vermiculite of Silk-wik will be used to surround inner containers, prevent breakage, absorb any leaking materials, and prevent release from outer (shipping) container. Each inner container will be recorded on container content forms, providing a complete report of the contents of any container.

Whether lab pack or bulk, the filled drums will be closed, labeled, and marked in accordance with DOT and Environmental Protection Agency (EPA) shipping requirements, and the proper information will be recorded on the manifest. The generator's notification and certification will also be prepared, as required under the land-ban regulations if applicable.

Accumulation Time

The storage building at the Davidson County Permanent HHW Collection Facility will be designed to store temporary accumulations of several classes of household hazardous materials. Local staff representatives will be trained as appropriate concerning proper waste segregation and safe storage procedures.

In accordance with state requirements for temporary storage, the date upon which each period of accumulation begins will be clearly marked and visible on each container. Additionally, a complete inventory log of materials will be kept on site. Furthermore, while being stored on-site, all containers with stored household hazardous wastes will be labeled or marked clearly with the words, "Household Hazardous Waste", unless the material is recyclable (e.g. used oil, latex paints, batteries) and is separated from other waste.

Time in storage may vary according to the volume of waste received. Removal of wastes by the contractor will be scheduled as necessary to minimize expense to the local government while still complying with applicable regulations and safety considerations. Wastes will be stored no longer than one (1) year without written permission from the North Carolina DEHR Division of Solid Waste Management.

Storage Building Specifications

The Davidson County Permanent HHW Collection Facility will be designed and constructed to ensure safe and efficient operation. According to state guidance concerning storage of ignitable and reactive wastes, the structure will be located at least 50 feet from the facility's property line. Furthermore, the storage building will be separated from other operational areas of the solid waste facility in order to minimize damage in case of fire.

As required for proper safety and environmental protection, the structure will be: 1) designed to contain leaks and spills; 2) covered to exclude rain water; 3) secured to control access; and 4) constructed in accordance with all applicable National Fire Protection Association codes.

The HHW collection facility will consist of a single storage building. Floor plan and elevation are attached. Although building features may be altered as the engineering work progresses, preliminary facility specifications are noted on the enclosed drawings.

Access Control and Security

Access to the facility and chemical-handling areas will be controlled to prevent unnecessary public exposure to potential harmful substances. Areas where chemicals are handled or stored will be clearly marked using one or more of the following: warning tape barriers, and caution signs. The signs will contain appropriate warning such as 'No Smoking" and "Authorized Personnel Only". In addition, during collection times, staff representatives will be stationed in strategic locations and will serve as checkpoint personnel to direct the flow of traffic and people.

The HHW storage building will be secured after hours of operation against unauthorized access by locked doors and is located with in the Davidson County's Sub Title "D" Facility that is secured by fence, locked gates, dike, berm, and other devices, such as, security video and lights that automatically activate at sun down.

Hours of Operation

The HHW Permanent Collection Facility will be open for collection from 8:00am. until 4:00pm and no more than Tuesday through Saturday. If there is a need to increase the NC DEHNR Division of Solid Waste Management will be notified in writing.

Personnel and Duties

The HHW Permanent Collection Facility will be staffed with well-trained qualified personnel under the leadership of a experienced contractor (until Davidson County has its own experienced staff) that will be contracted by Davidson County. The duties of this contractor and/or the County's own experienced staff are described below.

- Assuring that all onsite staff representatives and contracted personnel have met the training requirements appropriate for their duties;
- Assuring that all onsite staff representatives and contracted personnel are aware of provisions of the Contingency Plan;
- Assuring that all onsite staff representatives and contracted personnel are aware of the potential hazards associated with site operations;
- Assuring that appropriate personal protective equipment is available and properly used, (i.e. full face respirators with an annual fit test, gloves, tyvek suits and aprons);

- Monitoring and safety performance of onsite staff representatives and contracted personnel;
- Correcting any work practices or conditions that may result in injury or exposure to household hazardous substances;
- Preparing any accident/incident reports;
- Implementing all aspects of the staff and contractor's Injury and Illness Prevention Program as applicable to project site;
- Verifying that onsite staff representatives and contracted personnel work in a safe manner according to the health and safety plan;
- Establishing guidelines for wearing and decontaminating (if necessary) personnel protective equipment;
- Observing onsite staff representatives and contracted personnel for signs of exposure or stress;
- Immediately reporting any unusual or unsafe conditions to person in charge;
- Informing onsite staff representatives and contracted personnel of the proper procedure during an emergency;
- Providing first aid if necessary;
- Identifying any onsite staff representatives and contracted personnel having special medical problems;
- Ensuring that any necessary monitoring equipment is properly maintained and good operating order;

Local staff representatives and/or contracted personnel will be responsible for opening the site before each collection event and securing the site at the end of each event. They will be responsible for the safe removal of acceptable materials from residents, and temporary storage of materials, segregation and packaging of those materials, and the temporary storage of materials for pick up by the contractor. As mentioned previously, local staff representatives will also direct traffic, conduct surveys, determine eligibility, and distribute educational materials. Another primary waste-related task that local staff representatives and/or contracted personnel plan to perform is weekly inspections. Contracted personnel will perform these inspections until the local staff representatives have received appropriate training. **All County personnel shall work from the Awareness Level only. This could change to move to a more aggressive role as required training allows.**

Training Plan and Qualifications of Trainers

The contractor will be responsible for training all local staff representatives and contracted personnel. Both Davidson County and the contractor's training programs are designed to enable appropriately trained personnel to receive and handle wastes in a safe, environmentally sound manner and to work in compliance with the contractor's methods and applicable regulations. Appropriate government and contractor personnel assigned to this project will complete the appropriate health and safety training in accordance with the Occupational Safety and Health Administration standard in 29 CFR 1910.120(e).

All onsite contractor and appropriate government personnel will have received a minimum of 24 hours of classroom training experience under the direct supervision of a trained, experienced supervisor.

Local staff representatives will be trained using the same high standards applied to the training of the contracted personnel. Accordingly, the contracted management will supervise the training program. These individuals will have the following qualifications: 1) high school diploma or equivalent (GED); 2) direct experience in handling of hazardous wastes; 3) certification as an environmental trainer; and 4) skills in adult education. This combination of education, experience, and skills is fully appropriate for directing the training of the local staff representatives.

The training program for local staff representatives will be well documented and this record will be on site. Training topics described below.

- Chemical Hazards/Toxicology;
- Spill Management;
- Use of Fire extinguishers;
- Emergency Equipment;
- Decontamination;
- General Safe Work Practices:
- Accident prevention:
- Personal Protective Equipment for HHW Handlers;
- **Contingency Plan Implementation**:
- Weekly Inspection of Storage Containers;
- Weekly Inspections of Operation/Emergency Equipment;
- DOT Standards for Household Hazardous Materials;
- Identification of DOT Chemical Hazard Classes;
- Containerization of Household Hazardous Materials
- Labeling;
- Marking:
- EPS Standards for Household Hazardous Wastes;
- Storage;
- Disposal;
- Record-keeping;
- Chemical Segregation;
- Consolidation of Materials into Single Container (bulking);
- Container Contents Sheets and Other Forms;
- Using buddy system for Bulking

Local staff representatives will not work unsupervised until they have received appropriate training. Onsite contracted personnel and local staff representatives will be required to take part in an annual review of the initial training for the tasks they are performing and any emergency response, which may apply, to those tasks.

As required, complete training records for the local staff representatives (along with job description, job title, and other pertinent information) will be kept at the facility; training records for onsite contracted personnel will be kept at onsite office.

Provisions for ignitable, reactive, or Incompatible Wastes

Staff and contracted personnel will use special precautions to protect ignitable or reactive wastes from sources of ignition or reaction. These wastes will be separated from other wastes being stored in the collection facility. Any ignitable or reactive wastes will be protected from possible sources of ignition or reaction, including but not limited to: open flames, hot surfaces, frictional or radiant heat, and spontaneous ignition (e.g., from heat-producing chemical reactions). Any tools used for equipment maintenance in areas containing ignitable wastes will be of a non-sparking type. Maintenance activities such as welding or cutting, which potentially could generate sparks or open flame, will be allowed only by special permission of the contractor's Project Supervisor or designee. This permission will be granted only after the area has been inspected and tested for flammable vapors, and all ignitable or reactive materials have been removed or protected. Policy will prohibit smoking or open flame within or near storage building. "No Smoking" signs will be placed at the entrance to unloading and storage areas and will be conspicuously placed wherever there is a direct hazard from ignitable or reactive wastes. Areas in which ignitable materials are stored will require the use of explosion-proof equipment and lighting. Proper grounding will be maintained in order to dissipate any accumulation of static charges generated by the movement of household hazardous liquids in pouring or bulking operations.

Regarding incompatible wastes, the following special provisions apply;

- Incompatible wastes will not be placed in the same container;
- Household hazardous wastes will only be placed in new, unused containers or in containers cleaned and reconditioned by a licensed manufacturer (and labeled as such);
- A storage container holding a household hazardous waste that is incompatible with any waste or other materials stored in close proximity will be separated from them by containment structures such as built-curbs or will have secondary containment such as drip pans constructed of steel or polyethylene.;

  As a general rule, the handling and storage of all household hazardous wastes (especially any that are ignitable, reactive, or incompatible) will be conducted so that it does not:

  - Generate extreme heat or pressure, fire or explosion, or violent reaction;
  - Produce uncontrolled toxic mists, fumes, dusts, or gases in sufficient quantities to threaten human health;
  - Produce uncontrolled flammable fumes or gases in sufficient quantities to pose a risk of fire or explosions;

Damage the structural integrity of the device or facility containing the wastes;
- Threaten human health or the environment.

The procedures to comply with these provisions depend upon: 1) proper identification of waste materials as they are received; 2) segregated storage according to compatible hazard class; and 3) no co-mingling, bulking, or combining of incompatible hazard classes. The contractor and other appropriate technical publications will provide guidance.

Operational/Emergency Equipment and Personal Protection Equipment

The HHW collection facility will contain the necessary equipment for protecting contracted personnel and local staff representatives. The facility will also contain the equipment needed to implement the contingency plan. The facility will be equipped with an immediately available two/way radio from which emergency assistance could be summoned. Internal communications will be carried out by voice as the most practical method given the restricted size of the facility. A hand-held, pressurized air horn will also be available to signal an emergency situation.

Other equipment to be kept at the facility will include portable ABC dry chemical fire extinguishers, spill control equipment including clay and/or inert absorbents, pads, shovels, brooms, containers, and various commercial decontamination solutions.

All facility communications or alarm systems, fire protection equipment, spill control equipment, and decontamination equipment will be inspected weekly and maintained as necessary to ensure its presence and proper operation in case of emergency. Fire protection equipment will be tested according to manufacturer specifications. Results of all inspections will be recorded on a customized checklist that will include inspection dates and a list of all systems and equipment to be inspected.

Personal Protection Equipment (PPE) will be used as appropriate to protect contracted personnel and local staff representatives from spills, broken containers, and sharp objects. The level of PPE required for particular tasks is described in the following examples:

<u>Persons Removing Waste from Cars – level II *:</u>
- Chemical resistant (polyethylene-coated type) apron, lab coat and or Tyvek suit;
- Safety glasses with shields;
- Chemical-resistant gloves with outer leather or puncture-resistant gloves (optional);
- Safety shoes;

*Depending on the substances being handled, a high level of PPE (including respirators and goggles or face shield) might be required.

Persons Opening Containers and Bulking Waste – level II:

- Chemical-resistant coveralls;
- Full-face shield;
- Safety glasses;
- Polyurethane or other chemical-resistant safety boots;
- Respirator with organic vapor cartridge and high-efficiency particulate air filter if necessary (as determined according to the waste being handled and annual fit testing);
- Chemical-resistant inner glove and outer puncture-resistant glove.

Persons Segregating Waste from Vehicles – level I;

- Safety glasses (with splash goggles or full face shield when necessary);
- White tyvek and/or vinyl apron (as needed);
- Chemical-resistant safety shoes/boots;
- Respirator (as required - along with annual fit tests);
- Chemical-resistant inner glove and puncture-resistant outer glove.

Persons Sampling HHW – level II;

- Full-face shield and safety glasses;
- Chemical-resistant coveralls;
- Chemical-resistant safety shoes/boots;
- Respirator (as required - along with annual fit tests);
- Chemical-resistant inner glove and outer puncture-resistant glove.

Persons Lab Packing HHW – level I or II;

- Safety glasses (with goggles or full-face shield when necessary);
- White Tyvek with vinyl apron or chemical-resistant coverall;
- Chemical-resistant safety boot;
- Respirator (as required - along with annual fit tests);
- Chemical-resistant inner glove and puncture-resistant outer glove.

{Note: contracted personnel (or appropriately trained local staff representatives) handling or moving drums may require metatarsal safety shoes. Regular safety shoes may be substituted for chemical-resistant safety shoes when no chemical exposure hazard exists.}

Use and Management of Containers

Appropriate containers fitting DOT specifications will always be used for storing wastes at the Davidson County Permanent HHW Collection Facility. Contractor personnel preparing wastes for storage will only use containers that are compatible with the wastes to be stored in them, so that containment ability is not impaired.

All containers holding stored HHW will be checked at least weekly to ensure that they haven't been stored more than one (1) year and also to ensure their integrity.
These inspections, to be conducted by contracted personnel (or appropriately trained local staff representatives), will be used to detect any leaks or deterioration caused by corrosion or other factors. Results of these inspections will be recorded. If a container holding household hazardous waste is found in poor condition or if it begins to leak, contracted personnel (or appropriately trained local staff representatives) will transfer the wastes from the defective container to one that is in good condition or will overpack the container in a suitable storage drum.

Contracted personnel (or appropriately local staff representatives) will ensure that any containers holding household hazardous waste will be kept closed during storage, except when necessary to add or remove waste. Caution will be taken in the movement of all containers to prevent them from being tipped over or punctured. Furthermore, the containers will not be opened, handled, or stored in a manner which may rupture them to leak.

Unobstructed aisle space will be maintained to allow movement of personnel, containers, and emergency equipment within the storage building at all times.

Recycling of Waste

HHW collected at this facility will be recycled or treated whenever economically practical, and incineration or landfilling will be used as a last resort. In keeping with this operating philosophy, it is currently anticipated that the following wastes might be collected for recycling or BTU recovery: motor oil and other automotive fluids, lead-acid batteries, nickel-cadmium batteries, latex paint, fuels and solvents, mercury (from florescent bulbs and other sources) , and aerosol cans.

Transportation and Disposal

When the transportation and disposal contractor arrives at the HHW storage facility for a scheduled pickup, the contractor will ensure that all containers are properly packaged, labeled, documented, and manifested. Contractor personnel will then load the containers onto a contractor vehicle contractor vehicle and will transport them to a licensed facility for final treatment, recycling, or disposal.

Reporting and Documentation

Thorough and accurate records will be maintained to ensure the accurate tracking of household hazardous materials from the generator to final disposal sites. Container Contents Sheets will detail each drum's contents and waste quantities.

Additional records that will be generated to ensure accurate record keeping include the following:

- Drum Tracking Sheet (contractor's in-house form);
- Non-Regulated Manifest;
- Contractor's Material Profile Sheet (for wastes in bulk, 5 gallons or more);
- Waste Certification/Notification (to meet requirements of land-ban requirements if applicable);
- TC Rule Certification/Re-certification (to meet the TCLP Rule requirements if applicable)
- Certificates of Disposal.

Maintenance and Operation of the Facility

The HHW collection facility will be maintained and operated to promote personnel safety and to minimize the possibility of a fire, explosion, or any unplanned sudden or non-sudden release of household hazardous waste or household hazardous waste constituents to air, soil, or surface water which could threaten human health or the environment. The appropriate provisions and procedures necessary to ensure safe and efficient operations have been stated in this plan.

Policy for Dealing with Unacceptable Waste

Radioactive Waste

Smoke detectors are the most likely household waste to contain radioactivity. Residents will be advised by staff employees to mail the used smoke detector back to the manufacturers if they are still in business. If the company is no longer in business, then the Nuclear Regulatory Commission recommends landfilling the smoke detector in a municipal solid waste landfill.

Other household wastes are unlikely to have any measurable radioactivity except status eliminators from record players which have a very short life. The Radiation Protection Office of University of North Carolina recommends landfilling these when they become unusable.

Explosives

If explosives are delivered to the facility, the first step will be to immediately access the possible danger and close the site if necessary until these materials are removed. The N.C. SBI will be called with any small arms ammunition including rifle, shotgun, and handgun. For any military type explosives, the SBI and Explosives Division at Fort Bragg will be notified. If the explosive material is not military in nature then Fort Bragg will not handle it.

Infectious Waste

The County will receive sharps if they are packaged in approved collection boxes, and Davidson County will contract with a licensed medical waste transporter for collection and disposal at an approved facility.

Closure

Upon closure of the Facility, Davidson County will remove all household hazardous waste and any residues. The County will also remove all containers used for storage, equipment used during the operations of the Facility, and manage appropriately.

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Attachment B

Contingency Plan for the Davidson County Permanent Household Hazardous Waste Collection Facility

Responsible Agency: Davidson County Integrated Solid Waste Management
220 Davidson County Landfill Road
Lexington, North Carolina 27292

Facility Address: Davidson County Landfill
220 Davidson County Landfill Road
Lexington, North Carolina 27292

Emergency Coordinators (listed in the order they should be contacted):

Primary Contacts: Charles Brushwood – Solid Waste Management Director
220 Davidson County Landfill Road
Lexington, North Carolina 27292
Office phone: (336) 242-2284 Cell phone: (336) 240-3910

Karry "Country" Blaylock – Landfill Supervisor
220 Davidson County Landfill Road
Lexington, North Carolina 27292
Office phone: (336) 242-2289 Cell phone: (336) 240-4253

Steve Swaim – Recycling Coordinator
220 Davidson County Landfill Road
Lexington, North Carolina 27292
Office phone: (336) 242-2856 Cell Phone: (336) 240-3911

Secondary Contacts: Del Welch – Director of Emergency Management Services
PO Box 923
Lexington, North Carolina 27293
Office phone: (336) 242-2270 Cell phone: (336) 240-3907

Perry Tyler – Davidson County Fire Marshall
301 E. Center Street
Lexington, North Carolina 27292
Office phone: (336) 242-2281 Cell phone: (336) 240-3440

Additional Contacts: Hugh Jernigan – Waste management Specialist
Division of Waste Management/ Solid Waste Division
585 Waughtown Street
Winston-Salem, North Carolina 27107
Office phone: (336) 771-4608 ext. 206

Additional Contacts cont. Keith Anderson – Operations Manager (Contractor)
Safety-Kleen (TS), Inc.
208 Watlington Industrial Dr. Reidsville, NC 27320
(800) 437-9749

Special Agent – Peter Ware, State Bureau of Investigation
Raleigh, North Carolina (919) 662-4500

Contingency Plan Purpose and Implementation

This plan is designed to minimize hazards to human health and the environment from fires, explosions, or any unplanned, sudden or non-sudden release of hazardous constituents to air, soil, or surface water. The provisions of this plan will be carried out **immediately** whenever there is an emergency at the facility.

Contingency Plan Contents

This plan contains emergency procedures for four types of incidents: spills, fires, explosions and non-project-related disasters (as defined below).

- A spill is an unintentional release of materials in a quantity that is sufficient to cause environmental or personal harm.
- A fire is the ignition or conflagration of either waste materials or paper and wood trash.
- An explosion is a sudden detonation of waste materials
- Non-project-related disasters include unlikely events such as tornadoes, earthquakes, floods, or bomb threats.

Facility Staffing and Emergency Responsibilities

The Davidson County Permanent HHW Collection Facility will be operated during the first year or initial contract period by a licensed HHW Contractor/ Hazardous Waste Disposal Firm. The contractor will be chosen through a Bid Proposal Process and will be responsible for training Solid Waste Management personnel in all required and appropriate household hazardous waste facility operational procedures during the initial contract period (one year). At that point, the contractor and Solid Waste Management Officials will make a determination, as to whether Solid Waste Management personnel have been adequately trained to take over management operations of the facility. After the initial contract period, a licensed contractor will be used for transport, disposal/recycling of materials, and some over-packing. In the event of an emergency, all appropriately trained personnel who are available (possibly including both contractor personnel and Solid Waste Management personnel) would participate in the response as directed by the designated Emergency Coordinator. Accordingly, throughout the remainder of this plan, the term "personnel" will be used to refer to appropriately trained representatives of both groups.

Arrangements with Local Authorities

Solid Waste Management Officials will make arrangements to familiarize local authorities with all pertinent aspects of the facility and its operations. In Davidson County, primary emergency authority is assigned to Davidson County Emergency Management Services, with other

agencies in supporting roles. The responsible agency will therefore work with this Emergency Management office to ensure that all appropriate local authorities are properly prepared.

Contingency Plan Revisions

This contingency plan will be kept at the facility and will also be distributed to local authorities (as described above). The contingency plan will immediately be revised whenever:

a) The plan fails in an emergency;
b) There are significant changes in facility design, construction, operation, or maintenance;
c) The list of emergency contacts is changed;
d) The list of emergency equipment is changed.

Emergency Response Materials and Equipment

A variety of emergency response materials and equipment will be kept at the facility. These materials will include some or all of the following, as deemed necessary by the Regional Coordinator or Project Supervisor for this facility: spill control equipment (described in a subsequent section), decontamination solutions, fire extinguishers, personal protective equipment, self-contained breathing apparatus, emergency eyewash station, and first aid kit.

Designation of Emergency Coordinator

At the time of an emergency, there will be at least one local government representative either on the facility premises or on call with the responsibility for coordinating all emergency response measures. This coordinator will be familiar with all aspects of the facility's contingency plan, all operations and activities at the facility, local and characteristics of wastes to be handled, location of all facility records, and facility layout. In addition, this person will have the authority to commit the resources needed to implement the contingency plan. The emergency coordinator will coordinate all emergency responses with the contractor's Project Supervisor or designee and will supervise the implementation of emergency procedures described in the following sections of this plan.

Spill Response Equipment and Procedures

Normal spill prevention techniques will be used at the facility, and standard spill control equipment will be available. This equipment will include some or all of the following: bulk absorbents, over-pack drums, absorbent booms or pillows, polyethylene liners, containers for contaminated absorbent, non-sparking tools, and decontamination products. All County Personnel will work from the Awareness Level only at first. This could change to a more aggressive role as required training would allow. In the event that a release occurs, the following procedures will be used:

1) The individual who notices the spill will alert other personnel by voice or three blasts of an air horn.
2) All personnel will stop work and secure their areas of responsibility.

3) The emergency coordinator will direct all public participants to a safe area if necessary.

4) The emergency coordinator will identify the characteristics, exact source, amount, and real extent of any released materials. The coordinator will assess the possible hazards to human health and the environment, considering both direct and indirect effects (e.g., the effects of any toxic, irritating or asphyxiating gases that are generated, or the effects of any hazardous surface-water runoff from water or any chemical agents used). The emergency coordinator will also determine the proper protective equipment needed and will monitor for leaks, pressure buildup, gas generation, or ruptures in equipment as appropriate.

5) If the release is serious enough to affect human health or the environment outside of the facility, the emergency coordinator will immediately contact local authorities and will also notify the National Response Center or the government official designated as the on-scene coordinator for the area. This report will include: name and telephone number of the reporter; name, address, and telephone number of the responsible agency; name, address, and telephone number of the facility; date and time of the incident; type of incident; name and quantities of materials involved; extent of injuries; and possible hazards to human health and the environment.

6) Personnel will be assigned to control the spill and prevent its spread or other complications. If necessary, personnel can be assigned to isolate storm drains and sewers. Personnel will don their protective equipment and take the appropriate steps for cleaning up the spill. Any incompatible materials located near the spill will be removed. A fire watch will be established and the local fire department will be notified. Reasonable measures will be taken to ensure that the problem does not recur or spread to other wastes.

7) If the emergency coordinator determines that outside assistance is needed, then appropriate calls will be made using the emergency phone list.

8) Once the spill is contained and cleaned up, any response equipment used will be decontaminated, inspected, and put back in service when returned to an acceptable condition.

9) If the emergency coordinator determines that a significant amount of wastes escaped from the facility's secondary containment structures, the facility's transportation and disposal contractor will take soil and/or surface-water samples to determine the extent of contamination of the area and possible remedial action.

10) The affected areas of the facility will not be placed in operation again until the responsible agency listed at the beginning of this plan has notified the appropriate authorities that the facility is once again functional.

11) The responsible agency will make a report of the incident in the operating record and will also notify the NC DENR's Division of Solid Waste Management/Solid Waste Section within 24 hours. A written report will be filed with the Division within 15 days, and it should include all of the information in item (5) above, plus the estimated quantity and disposition of recovered material from the incident.

Fire/Explosion Response Procedures

Emergency procedures to be used in the event of a fire or explosion are as follows:

1)The individual who notices the fire or explosion will alert other personnel by voice or a long blast (at least 10 seconds) from an air horn.

2) All personnel will stop work and secure their areas of responsibility.

3) The emergency coordinator will alert the local fire department and will move public participants to a secure location.

4) Personnel will be assigned to contain and halt the fire unless an explosion is possible (in which case the emergency coordinator will call for evacuation). If the fire is chemical in nature or spreads to the chemical waste, personnel will don positive pressure self-contained breathing apparatus. Personnel will fight the fire using fire extinguishers and/or soil and absorbents. Water will generally not be used if the fire is due to the ignition of a flammable liquid, because the water spray could cause spattering or allow the liquid to spread.

5) If the fire goes beyond the incipient stage and cannot be controlled with extinguishers, the emergency coordinator will notify appropriate authorities and prepare to evacuate the work area. Personnel will assist local responders when necessary. Such assistance may include helping to evacuate local residents; blocking off storm drains and berming water sources; removing all unnecessary personnel and vehicles from the area; and removing waste material if possible.

6) If the fire or explosion is serious enough to affect human health or the environment outside of the facility, the emergency coordinator will immediately contact local authorities and will also notify the National Response Center or the government official designated as the on-scene coordinator for the area. This report will include: name and telephone number of the reporter; name, address, and telephone number of the responsible agency; name, address, and telephone number of the facility; date and time of the incident; type of incident; name and quantities of materials involved; extent of injuries, and possible hazards to human health and the environment.

7) Once the fire has been extinguished, then cleanup of the area will commence. During cleanup activities, the emergency coordinator will monitor for leaks, pressure buildup, gas generation, or ruptures in equipment as appropriate. If the fire was chemical in origin or spread to the waste area, all potentially contaminated cleanup materials will be disposed of as waste.

8) Further response to a fire will proceed according to steps 8 through 11 described under the preceding spill response section of this contingency plan.

Procedures for Non-Project-Related Disasters

In the unlikely event of disasters such as floods, tornadoes, earthquakes, and bomb threats, the following procedures will be used:

1) The individual noticing the situation will notify other personnel by voice or long blast (at least 10 seconds) of an air horn.

2) All personnel will stop work and secure their areas of responsibility.

3) The emergency coordinator will alert the appropriate authorities and move personnel to a secure location. The affected area will be secured to prevent access.

4) If necessary, further procedures will be determined and implemented when appropriate, given the specific nature of the emergency.

Evacuation Plans

Whenever there is an emergency incident at the facility, the emergency coordinator will decide if evacuation is necessary. In making this decision, the emergency coordinator will consider various factors, including the following: a) potential for the fire and/or explosion to intensify or spread; b) potential for release of toxic fumes; and c) quantity of released material;

If evacuation of the facility is necessary, personnel will be immediately notified by voice or air horn. The following procedures will then be implemented:

1) All personnel will leave the facility as quickly as possible through the nearest exit and proceed directly to a designated assembly area at a safe distance from the facility. All site personnel will be accounted for. If any personnel are missing, attempts to find them will be made as long as it does not involve endangering the lives of others. No personnel or vehicles will be allowed to re-enter the facility unless specifically authorized by the emergency coordinator. Normally, the only persons allowed to re-enter will be the emergency response personnel.

2) After the emergency is over, re-entry will not be allowed until the emergency coordinator has determined that the facility is safe and has given appropriate notification to personnel.

3) Drills will periodically be held to practice these evacuation procedures and will be treated with the same seriousness as an actual emergency.

ATTACHMENT
E

Closure And Post-Closure Plan

Davidson County Landfill
Davidson County, North Carolina

Prepared for:
Davidson County Integrated Solid Waste Management Department
Thomasville, NC

March 2009

RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services
14 N. Boylan Avenue
Raleigh, North Carolina 27603

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DAVIDSON COUNTY LANDFILL

CLOSURE AND POST-CLOSURE PLAN

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SECTION 1.0
CLOSURE PLAN

1.1 OVERVIEW

This plan is intended to serve as a guide for the proposed closure. A formalized Closure Plan for each landfill unit (or incremental portion thereof) will be submitted to the Solid Waste Section of the North Carolina Department of Environment and Natural Resources Division of Waste Management (DWM) for approval prior to beginning closure construction.

1.2 MAXIMUM CLOSURE AREA AND WASTE CAPACITY

The following are the estimated areas and capacity for each landfill unit to be closed under this plan.

Landfill Unit	Closure Area (Acres)	Gross Capacity (CY)[1]	Net (Waste) Capacity (CY/Tons)[1]
MSW Landfill Units			
Phase 1 (Areas 1 - 3)	15.9 (See Note 2)	2,229,303	1,913,735 CY 1,332,605 Tons
Phase 1 (Areas 1 - 3) Vertical Expansion (See Note 3)	-----	62,100	55,890 CY 43,063 Tons
Phase 2 (Area 1)	14.7	903,896	803,343 CY 582,423 Tons
Total (MSW):	30.6	3,195,299	2,772,968 CY 1,948,091 Tons
C&D Landfill Units			
Phases 1-4	7.6	302,807	252,722 CY 139,078 Tons

Notes:

1. With the exception of the Phase 1 Vertical Expansion (see Note 3), the volume and tonnage figures assumed for MSW landfill unit are based on the currently approved Facility Plan (reference: Permit to Construct Application for Phase 2 Area 1 (Vol. 1 of 2), prepared by Richardson Smith Gardner & Associates, Inc., dated February 2007). Volume and tonnage figures for the C&D landfill are based on the Facility and Engineering Plan submitted as part of the Permit Amendment Application for the Phases 3 and 4 landfill units. Note that the gross capacities reported are from bottom of waste (top of protective cover or subgrade as appropriate) to top of final cover.

2. The area shown for the Phase 1 MSW unit reflects the area remaining to be closed. Approximately 16 acres was closed in 2005 (reference: Partial Closure Construction CQA Certification Report, prepared by Joyce Engineering, Inc., dated November 2005).

3. The volumes shown for the Phase 1 vertical expansion are as reported in the Request for Permit Modification, prepared by Richardson Smith Gardner & Associates, Inc., dated March 2008.

1.3 FINAL COVER SYSTEM

The final cover systems for the MSW and C&D landfill units will consist of the following components (top-down):

MSW Landfill Units:

- a 24-inch thick vegetative soil layer;
- a drainage geocomposite (with drainage breaks);
- a 30-mil textured LLDPE geomembrane; and
- a 12-inch thick intermediate cover layer.

C&D Landfill Units:

- an 18-inch thick vegetative soil layer; and
- an 18-inch thick soil liner with a hydraulic conductivity of no more than 1×10^{-5} cm/sec ("compacted soil barrier").

The final cover system will be placed on prepared intermediate cover at a maximum slope of 4H:1V. Surface water control devices and landfill gas (LFG) components will also be incorporated into the final cover of each landfill unit. The final cover surface will be vegetated upon completion of the final cover installation according to the project seeding specifications.

Where applicable, placement of the vegetative soil layer over the cover geosynthetics must be done with care to avoid damage to these materials. This soil layer should be placed from the bottom up using a small dozer equipped with low ground contact pressure (6 psi or less) tracks. A minimum of 12 inches of soil should be maintained between the dozer tracks and the underlying geosynthetics. The soil buffer should receive no compaction other than that provided by the dozer tracks. Pans or other heavy equipment should not operate on the vegetative soil layer.

Refer to the appropriate permit application for a detailed discussion and details related to the design of the final cover system for each landfill unit.

1.4 LANDFILL GAS SYSTEM

For the MSW landfill units and C&D landfill units, a landfill gas system is provided in the final cover design. This system includes a system of collection wells or vents placed within the waste to capture the gas and either passively vent or flare the gas via utility flares or, as required, actively collect and flare the gas via header piping and a blower/flare system. The collection wells should be placed before any geosynthetics are placed.

Refer to the appropriate permit application for a detailed discussion and details related to the design of the landfill gas system for each landfill unit.

1.5 SURFACE WATER SYSTEMS

Precipitation falling on the cover will infiltrate into the cover or run off the cover. Short-term the run-off runs down the surface of the intermediate cover. Long-term the run-off is collected in a series of drainage breaks built into the areas covered by final cover. These drainage breaks are provided along side slopes (rain gutters and/or diversion berms). Water captured by rain gutters or diversion berms is routed toward one of the down pipes. Flow in the down pipes is routed to the base of the landfill and to one of the site sediment basins.

Refer to the appropriate permit application for a detailed discussion and details related to the design of surface water systems for each landfill unit.

1.5.1 Incremental Operation

During much of the life of the landfill, surface run-off will be handled by the intermediate cover system. Operations must strive to provide operational grading that encourages run-off from the intermediate cover to drain to the perimeter channels along the perimeter berms or to areas covered by final cover. Corrugated polyethylene (CPE) piping and temporary soil diversion berms must be installed if required to accomplish this run-off routing.

1.5.2 Required Maintenance

The surface water systems must be inspected annually and immediately after every major storm. Sediment build-up in the drainage features/devices must be cleaned out on a regular basis to promote run-off. Sediments removed can be used as daily or intermediate cover.

1.6 CLOSURE SCHEDULE

Closure activities must begin on the following schedule:

MSW Landfill Units (15A NCAC 13B.1627(c)(5)):

- No later that 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.

C&D Landfill Units (15A NCAC 13B.0543(c)(5)):

- No later that 30 days after the date on which the C&DLF unit receives the known final receipt of wastes;
- No later than 30 days after the date that a 10 acre or greater area of waste, is within in 15 feet of final design grades; or

- No later than one year after the most recent receipt of wastes, if the C&DLF unit has remaining capacity.

All closure activities shall be completed within 180 days. Exemptions and extensions may be approved by the DWM.

1.7 CLOSURE VERIFICATION

The following procedures will be implemented following closure:

- A Construction Quality Assurance (CQA) report will be submitted to the DWM. This report will describe the observations and tests used before, during, and upon completion of construction to ensure that the construction materials meet the final cover design specifications and the construction and certification requirements. The CQA report will contain as-built drawings.

- A signed certification from a registered Professional Engineer verifying that closure has been completed in accordance with the closure plan will be submitted to the DWM.

- At least one sign notifying all persons of the closing of the landfill (or incremental portions thereof) and that wastes are no longer accepted will be posted. Suitable barriers will be installed as necessary at former access points to prevent new waste from being deposited.

- Within 90 days, a survey plat, prepared by a registered Professional Land Surveyor, indicating the location and dimensions of landfill disposal areas, will be prepared.

- A notation will be recorded on the deed notifying any potential purchaser of the property that the land has been used as a landfill facility and that future use is restricted under the approved closure plan. A copy of the deed notation as recorded will be filed with the operating record.

SECTION 2.0
POST-CLOSURE PLAN

2.1 OVERVIEW

This Post-Closure Plan has been developed to outline steps to be taken to ensure the integrity of the landfill during its post-closure care period. The post-closure care period will last at least 30 years after final closure and, at a minimum, will consist of the following:

- Maintaining the integrity and effectiveness of final cover system;
- Performing groundwater and surface water monitoring;
- Maintaining and operating a gas monitoring system; and
- Maintaining run-on/run-off controls.

No wastes will remain exposed after closure of the landfill. Access to the closed site by the public will not pose a health hazard.

2.2 POST-CLOSURE CONTACT

All correspondence and questions concerning the post-closure care of the landfill should be directed to:

Davidson County Integrated Solid Waste Management Department
Attn: Charles Brushwood, Director
1242 Old Highway 29
Thomasville, NC 27360
Phone: (336) 242-2284
Fax: (336) 249-7524.

2.3 POST-CLOSURE USE

After filling operations cease at the landfill and the landfill is officially closed in accordance with the Closure Plan, each landfill unit will be maintained as a grassy hill. Davidson County will maintain control of the property and prevent public access to it during the post-closure period.

There may be (an) access road(s) on the final cover to allow proper maintenance during post-closure. Precise location of the access road(s) will be determined as a part of operations. Low ground pressure and rubber tire vehicles will be used for maintenance.

2.4 MAINTENANCE

2.4.1 Repair of Security Control Devices

All security control devices will be inspected and maintained as necessary to ensure access to the site is controlled. Locks, vehicular gates, and fencing will be replaced if functioning improperly. Warning signs will be kept legible at all times and will be replaced if damaged by inclement weather or vandalism.

2.4.2 Erosion Damage Repair

If erosion of the final cover occurs during post-closure, the affected area will be repaired and reseeded as necessary. If necessary, rolled erosion control products (RECPs) will be used to expedite rapid revegetation of slopes and to secure topsoil in place.

2.4.3 Correction of Settlement, Subsidence, and Displacement

Minimum slopes of 5 percent will be maintained after settlement in order to prevent ponding and allow for proper drainage without infiltration. If vertical or horizontal displacement occurs due to differential settlement, cracks will be filled with appropriate material and final cover will be reestablished. Excessive vertical displacement is not anticipated.

2.4.4 Leachate Management System (Lined Units)

In order to maintain the free flow in leachate collection piping, they will be cleared of debris using the manholes or cleanout locations for access. If pipes should crush or buckle within the landfill, leachate will flow through the gravel columns. The leachate collection system (LCS) includes a continuous blanket drain on the base of the landfill which will allow drainage of leachate even in the very unlikely event of total failure of the leachate collection pipes.

2.4.5 Closure of Leachate Storage Lagoon and Tanks

After closure of the Phase 1 and Phase 2 MSW landfill units have been achieved, the generation of leachate will eventually curtail. The flow rate immediately after closure should decrease to approximately 100 gallons/acre/day. Toward the end of the 30-year post-closure period, the flow should approach zero, at which time the storage lagoon (Phase 1) or the storage tanks (Phase 2) will not be required. The following procedures will be followed to properly close the leachate storage lagoon and tanks:

- Completely drain and remove all liquids, sludges, sediments, etc. from the storage lagoon or tanks.

- Disassemble the lagoon or tanks, piping, and appurtenances and dispose of

the contents in a manner approved by the DWM.

- Sample and analyze the underlying soil for appropriate constituents inherent to leachate. Assess the results for evidence of contaminant migration.

- If contamination of underlying soils is exhibited, perform an assessment as to the degree of contamination and develop remedial actions.

- Obtain approval of the DWM for the assessment and associated remedial measures.

- Perform the remedial actions as necessary to limit any threats to public, health, and the environment.

- Restore the area(s) to closely match pre-existing conditions in the vicinity of the containment area(s). Activities may include: filling, grading, topsoiling, and seeding.

2.4.6 Repair of Run-On/Run-Off Control Structures

All drainage swales, ditches, and perimeter channels will be repaired, cleaned, or realigned in order to maintain their original condition. Any culverts that are damaged will be repaired or replaced.

2.4.7 Landfill Gas System

The landfill gas system will be maintained by the County and operated in accordance with any site air quality permits. Proper operation of the system is verified through testing at the landfill gas monitoring wells.

If gas wells/vents do not function as a result of irregular settlement, accumulation of liquids (condensate, leachate, water), binding or corrosion, additional and/or replacement wells/vents can be installed if necessary in accordance with the current Landfill Gas Management Plan.

2.4.8 Groundwater Monitoring Wells

Procedures outlined in the current Water Quality Monitoring Plan or subsequent revision will take precedence; however, a brief description follows. All groundwater monitoring wells have been installed with concrete pads and protective casings to prevent accidental damage by vehicles and equipment. The wells are also equipped with a locking cap to discourage vandalism. Groundwater wells will be inspected regularly (at the time of sampling) to ensure integrity. Persons inspecting a well should look at the overall condition of the well, for signs of well tampering, and cracking or degradation of the

concrete pad. Should a well require replacement, the defective well should be abandoned in accordance with specifications provided in the SAP and a new well installed at a location that is approved by the DWM.

2.5 MONITORING PLAN

The closed unit will be monitored for a minimum of 30 years. A series of inspections will be scheduled to ensure the integrity and effectiveness of the final cover system, surface water systems, groundwater monitoring system, landfill gas system, and to protect human health and the environment.

2.5.1 Inspection Frequencies

Inspections to be conducted during the post-closure care period will occur regularly as shown in **Table 2.1**.

2.5.2 Quarterly Inspections

Quarterly inspections of the closed site will be conducted by the County. These inspections will include examination of the security control devices for signs of deterioration or vandalism to ensure access to the site is limited to authorized persons. Each disposal area will be checked to ensure the integrity of the final cover system is maintained, erosion damage is repaired, vegetative cover persists, and that cover settlement, subsidence, and displacement are minimal. Drainage swales and channels will be cleared of litter and debris and benchmark integrity will be noted and maintained.

2.5.3 Semi-Annual Inspections

Semi-annual inspections of the site during the post-closure period will be conducted by the County with attention paid to integrity and drainage of the final cover system and condition of the groundwater and gas monitoring systems.

A report of findings will be made to the responsible party, including recommendations for actions deemed necessary to ensure the site continues to meet the closure performance standard.

2.6 ENGINEERING CERTIFICATION

Based on the County's monitoring reports, annual certifications by a registered engineer will be placed in the operating record. They will certify that the closure plan has been followed, noting discrepancies along with the corrective actions undertaken. At the end of the post closure period, the individual certifications will be compiled into a final document and forwarded to the DWM.

TABLE 2.1: POST-CLOSURE INSPECTION FREQUENCIES

INSPECTION ACTIVITY	YEAR 1	YEARS 2-30
Security Control Devices	Quarterly	Quarterly
Vegetative Cover Condition	Quarterly[1]	Quarterly
Surface Water Systems	Quarterly[1]	Quarterly
Erosion Damage	Quarterly[1]	Quarterly
Cover Drainage System	Quarterly[1]	Semi-Annually
Cover Settlement, Subsidence, and Displacement	Quarterly[1]	Semi-Annually
Leachate Management System	Quarterly	Semi-Annually
Landfill Gas System	Quarterly[3]	Semi-Annually[3]
Groundwater Monitoring System	Semi-Annually	Semi-Annually[2]
Benchmark Integrity	Annually	Annually
Leachate Collection Pipe Cleanout	Annually	Annually

Notes:

1. These items will be inspected after each large storm event (i.e. $\geq$ 1 inch in any 24 hours).
2. Or in accordance with groundwater monitoring schedule described in the current Water Quality Monitoring Plan.
3. Or in accordance with the current Landfill Gas Management Plan or air quality permit(s).

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SECTION 3.0
CLOSURE/POST-CLOSURE COST ANALYSIS

3.1 OVERVIEW

The purpose of this section is to provide a written estimate in current dollars of all costs associated with all activities specified in the written closure and post-closure plans which have been developed for the MSW (Phases 1 and 2) and the C&D (Phases 1 and 2) landfill units of the Davidson County Landfill.

3.2 ESTIMATED CLOSURE COSTS

Tables 3.1A, 3.1B, and 3.1C summarize the estimated costs for complete closure of the MSW Phase 1 (Areas 1 - 3), MSW Phase 2 (Area 1) and C&D (Phases 1-4) landfill units, respectively (the current maximum area to be closed). The cost estimate for each unit is based on a third party providing the necessary services and includes labor in the unit prices given. The estimated closure costs will be reviewed and updated as required to reflect adjustments for inflation, increased costs in construction or materials, or any other adjustments to the Closure Plan.

3.3 ESTIMATED POST-CLOSURE COSTS

Tables 3.2A, 3.2B, and 3.2C summarize the estimated costs for the post-closure care maintenance activities for the MSW Phase 1 (Areas 1 - 3), MSW Phase 2 (Area 1) and C&D (Phases 1-4) landfill units, respectively. The cost estimate for each unit is based on a third party providing the necessary services and includes labor in the unit prices given. The estimated post-closure costs will be reviewed and updated as required to reflect adjustments for inflation, rising costs of anticipated post-closure care, or any other adjustments to the Post-Closure Plan.

TABLE 3.1A: MSW - PHASE 1 - CLOSURE COST ESTIMATE[1]

ITEM	QUANTITY	UNITS	UNIT COST	ITEM COST (2009 $)
Surface Preparation	15.9	Acre	$10,000	$159,000
Landfill Gas System	15.9	Acre	$15,000	$238,500
30 mil Textured LLDPE Geomembrane	693,000	SF	$0.45	$311,850
Drainage Geocomposite	693,000	SF	$0.55	$381,150
Vegetative Soil Layer (24")	52,000	CY	$5.00	$260,000
Erosion Control (Rain Gutters, Diversion Berms, Down Pipes, Drainage Channels, Etc.)	15.9	Acre	$15,000	$238,500
Revegetation	15.9	Acre	$1,500	$23,850
Surveying	15.9	Acre	$2,000	$31,800
			Subtotal:	$1,644,650
Bonds, Mobilization, & Insurance			(4% of Subtotal):	$65,786
			Subtotal:	$1,710,436
			Contingency (10%):	$171,044
			Construction Subtotal:	**$1,881,480**
Engineering	15.9	Acre	$2,000	$31,800
CQA	15.9	Acre	$6,000	$95,400
			TOTAL:	**$2,008,680**

Notes:

1. Assumes closure of 15.9 acres (Phase 1 - Areas 1-3).

TABLE 3.1 B: MSW - PHASE 2 - CLOSURE COST ESTIMATE[1]

ITEM	QUANTITY	UNITS	UNIT COST	ITEM COST (2009 $)
Surface Preparation	14.7	Acre	$10,000	$147,000
Landfill Gas System	14.7	Acre	$15,000	$220,500
30 mil Textured LLDPE Geomembrane	641,000	SF	$0.45	$288,450
Drainage Geocomposite	641,000	SF	$0.55	$352,550
Vegetative Soil Layer (24")	48,000	CY	$5.00	$240,000
Erosion Control (Rain Gutters, Diversion Berms, Down Pipes, Drainage Channels, Etc.)	14.7	Acre	$15,000	$220,500
Revegetation	14.7	Acre	$1,500	$22,050
Surveying	14.7	Acre	$2,000	$29,400
			Subtotal:	$1,520,450
Bonds, Mobilization, & Insurance			(4% of Subtotal):	$60,818
			Subtotal:	$1,581,268
			Contingency (10%):	$158,127
			Construction Subtotal:	**$1,739,395**
Engineering	14.7	Acre	$2,000	$29,400
CQA	14.7	Acre	$6,000	$88,200
			TOTAL:	**$1,856,995**

Notes:

1. Assumes closure of 14.7 acres (Phase 2 - Area 1).

TABLE 3.1C: C&D UNIT - CLOSURE COST ESTIMATE[1]

ITEM	QUANTITY	UNITS	UNIT COST	ITEM COST (2009 $)
Surface Preparation	7.6	Acre	$2,000	$15,200
Landfill Gas System	7.6	Acre	$3,000	$22,800
Compacted Soil Barrier (18")	18,400	CY	$7.00	$128,800
Vegetative Soil Layer (18")	18,400	CY	$4.00	$73,600
Erosion Control (Diversion Berms, Down Pipes, Drainage Channels, Etc.)	7.6	Acre	$5,000	$38,000
Revegetation	7.6	Acre	$1,500	$11,400
Surveying	7.6	Acre	$2,000	$15,200
			Subtotal:	$305,000
Bonds, Mobilization, & Insurance			(4% of Subtotal):	$12,200
			Subtotal:	$317,200
			Contingency (10%):	$31,720
			Construction Subtotal:	**$348,920**
Engineering	7.6	Acre	$2,000	$15,200
CQA	7.6	Acre	$6,000	$45,600
			TOTAL:	**$409,720**

Notes:

1. Assumes closure of 7.6 acres (Phases 1 - 4).

TABLE 3.2A: MSW - PHASE 1 - POST-CLOSURE COST ESTIMATE[1]

ITEM	QUANTITY	UNIT	UNIT COST	TOTAL (2009 $)
Site Inspection And Record Keeping	60	HR	$75	$4,500
Revegetation (5% Total Area)	2	Acre	$1,500	$3,000
Mowing (once per year)	32	Acre	$100	$3,200
Erosion Control	1	LS	$5,000	$5,000
Gates/Fences	1	LS	$1,000	$1,000
Groundwater/Surface Water Monitoring & Reporting (15 Long-Term Wells/Points - Semi-Annual)	15	Each	$1,000	$30,000
Methane Monitoring & Reporting (Semi-Annual After Year 1)	2	Each	$2,500	$5,000
Leachate Management[2]	1	LS	$43,287	$43,287
			Subtotal:	$94,987
			Contingency (10%):	$9,499
			ANNUAL TOTAL:	**$104,486**
			30-YEAR TOTAL:	**$3,134,571**

Notes:

1. Assumes post-closure of MSW Phase 1 (Areas 1 - 3) (31.9 Ac.).
2. Leachate treatment based on 100 gal/ac/day x 31.9 acres lined x 365 x $20/1,000 gal. ($23,287/year) plus $5,000/year staff cost plus $3,000/year lab cost plus $2,000/year leachate collection line cleanout costs. Also include $10,000 per year to account for decommissioning leachate facilities (leachate storage lagoon) ($300,000 assumed) at the end of the post-closure period.

TABLE 3.2B: MSW - PHASE 2 - POST-CLOSURE COST ESTIMATE[1]

ITEM	QUANTITY	UNIT	UNIT COST	TOTAL (2009 $)
Site Inspection And Record Keeping	60	HR	$75	$4,500
Revegetation (5% Total Area)	1	Acre	$1,500	$1,500
Mowing (once per year)	15	Acre	$100	$1,500
Erosion Control	1	LS	$5,000	$5,000
Gates/Fences	1	LS	$1,000	$1,000
Groundwater/Surface Water Monitoring & Reporting (15 Long-Term Wells/Points - Semi-Annual)	15	Each	$1,000	$30,000
Methane Monitoring & Reporting (Semi-Annual After Year 1)	2	Each	$2,500	$5,000
Leachate Management[2]	1	LS	$64,018	$30,731
			Subtotal:	$79,231
			Contingency (10%):	$7,923
			ANNUAL TOTAL:	**$87,154**
			30-YEAR TOTAL:	**$2,614,623**

Notes:

1. Assumes post-closure of MSW Phase 2 (Area 1) (14.7 Ac.)
2. Leachate treatment based on 100 gal/ac/day x 14.7 acres lined x 365 x $20/1,000 gal. ($10,731/year) plus $5,000/year staff cost plus $3,000/year lab cost plus $2,000/year leachate collection line cleanout costs. Also include $10,000 per year to account for decommissioning leachate facilities (leachate storage lagoon) ($300,000 assumed) at the end of the post-closure period.

TABLE 3.2C: C&D UNIT - POST-CLOSURE COST ESTIMATE[1]

ITEM	QUANTITY	UNIT	UNIT COST	TOTAL (2009 $)
Site Inspection And Record Keeping	20	HR	$75	$1,500
Revegetation (5% Total Area)	0.4	Acre	$1,500	$600
Mowing (once per year)	8	Acre	$100	$800
Erosion Control	1	LS	$2,000	$2,000
Gates/Fences	1	LS	$500	$500
Groundwater/Surface Water Monitoring & Reporting (5 Long-Term Wells/Points - Semi-Annual)	5	Each	$1,000	$10,000
Methane Monitoring & Reporting (Semi-Annual After Year 1)	2	Each	$1,000	$2,000
			Subtotal:	$17,400
			Contingency (10%):	$1,740
			ANNUAL TOTAL:	**$19,140**
			30-YEAR TOTAL:	**$574,200**

Notes:

1. Assumes post-closure of C&D Phases 1- 4 (7.6Ac.).

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ATTACHMENT
F

Erosion and Sedimentation Control Plan

Davidson County C&D Landfill - Phases 3 & 4
Lexington, North Carolina

Prepared for:

Davidson County Integrated Solid Waste Management
Lexington, North Carolina

March 2009

RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services
14 N. Boylan Avenue
Raleigh, North Carolina 27603

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DAVIDSON COUNTY
DAVIDSON COUNTY C&D LANDFILL - PHASES 3 & 4

EROSION AND SEDIMENTATION CONTROL PLAN

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DAVIDSON COUNTY
DAVIDSON COUNTY C&D LANDFILL - PHASES 3 & 4

EROSION AND SEDIMENTATION CONTROL PLAN

1.0 NARRATIVE

1.1 Project Description

Davidson County plans to construct Phases 3 & 4 of their C&D landfill at their existing landfill facility located off of Roy Lopp Road near Lexington. The construction and operation of the landfill will require the disturbance of approximately 12.2 acres (11.1 acres of which were previously permitted as part of the approval for Phase 2). This plan discusses erosion and sedimentation control measures used both initially and long-term on this project.

1.2 Contact Information

1.2.1 Engineer: For questions regarding this erosion and sedimentation control plan, please contact the following:

Richardson Smith Gardner & Associates, Inc.
Attn.: Pieter K. Sheer, P.E.
14 N. Boylan Ave.
Raleigh, NC 27607
Phone: (919) 828-0577
Fax: (919) 828-3899.

1.2.2 Owner: The owner of the site and the person to contact should sediment control issues arise during the land-disturbing activity is as follows:

Davidson County Integrated Solid Waste Management
Attn.: Charles Brushwood, Director
220 Davidson County Landfill Road
Lexington, NC 27292
Phone: (336) 242-2284
Fax: (336) 249-7524.

1.3 Existing Site Conditions

The proposed C&D landfill site occupies a portion of a previously approved active borrow area in the central portion of the landfill facility. Existing ground surface elevations vary from El. 740 (feet) along the ridge near the south end of the site, decreasing to El. 677 at the toe of the planned sediment basin. Currently, much of the site has been cleared for previously permitted borrow activities.

1.4 Adjacent Areas

The proposed site lies within County landfill property on all sides. To the north, lies the existing active landfill units (Phases 1 & 2). A potion of Phase 4 is within a previously permitted borrow area.

1.5 Site Soils Information

Within the proposed site, the soils within the upper few feet of the surface are generally classified as stiff sandy silts and dense clayey, silty sands. This layer quickly grades down to partially weathered rock (PWR). Borrow soils to be used as structural fill, etc. will come from other on-site borrow areas and will generally consist of sandy silts and clayey, silty sands. For purposes of runoff calculations soils were conservatively assumed to be in hydrologic soil group (HSG) "C".

2.0 DESIGN GUIDELINES AND PROCEDURES

The erosion and sediment control design for the landfill was conducted based on guidelines and procedures as set forth in the following references:

1. HydroCAD Software Solutions, LLC (2006), HydroCAD Stormwater Modeling System Owner's Manual - Version 8, Chocorua, NH.

2. North Carolina Division of Land Resources (2006 Update), North Carolina Erosion & Sediment Control Planning & Design Manual, Raleigh, NC.

3. Malcom, H. Rooney (1989 & 2003 Supplement), Elements of Urban Stormwater Design, NC State Univ., Raleigh, NC.

All stormwater flow volumes were calculated using the HydroCAD computer program (utilizing USDA-NRCS (SCS) methods) and/or the Rational Method based on a 25-year 24-hour storm event. This storm event, which is a requirement of current North Carolina solid waste regulations, exceeds the 10-year event required by current North Carolina Sediment Control regulations. Rainfall quantities and/or intensities used in the analyses were derived from an analysis of design storms for the site. Drainage areas were determined using a planimeter and/or AutoCAD on topographic sheets of the project area. For each drainage area, runoff curve numbers (SCS methods) and/or runoff coefficients (Rational Method) were selected based on ground cover conditions. Times of concentration were calculated by HydroCAD using SCS methods.

3.0 EROSION AND SEDIMENTATION CONTROL MEASURES

The following erosion and sedimentation control measures are to be constructed as part of the initial and final construction of the landfill. Appendices A, B, and C to this plan include calculations, technical specifications, and plans and details for each of these measures,

respectively.

The following erosion and sedimentation control measures were designed using the final drainage areas which were found to represent a worst case for design.

3.1 Sediment Basins

Two permanent sediment basins; Sediment Basin 1 and Sediment Basin 2 will serve the site. Basin 1 (previously remitted) has been constructed on the northwest side of the project area and Basin 2 will be located on southeast side of the project area.

Sediment basins are subject to several design requirements. Each sediment basin must have a basin volume of 1,800 ft^3/acre of disturbed area and should have a surface area (measured at crest of principal spillway (riser)) of 0.01 acres/cfs (based on the peak flow from the 10-year storm). Each basin must include a riser/barrel principal spillway and must have an emergency spillway (preferably a weir-type spillway). The crest of the emergency spillway is set one foot above the invert of the riser and the spillway must pass the peak run-off from the design storm event with one foot (min.) of freeboard to the crest of berm. Each riser/barrel assembly must be provided with an anchor displacing a buoyant weight of at least 1.1 times the weight of water displaced by the riser. Each riser must also be provided with a method of dewatering the basin. In addition to E&SCP&DM requirements, each sediment basin was designed to have an adequate surface area to achieve an 80% settling efficiency of a 40 micron (silt size) particle at the peak discharge from the design storm. Each sediment basin was modeled with the HydroCAD computer program and a spreadsheet was used to verify the design requirements.

3.2 Temporary Sediment Traps

The design of the existing East Sediment Trap which will remain in service, was verified in accordance with E&SCP&DM Section 6.60. The main consideration in the design of a temporary sediment trap is that the disturbed drainage area contributing flow to the basin not exceed 5 acres. Other design criteria include a basin volume of 3,600 ft^3/acre of disturbed area and a spillway weir length sized to pass the 10-year peak storm as given in Table 6.60a, E&SCP&DM. Other design requirements of temporary sediment trap design also meet the criteria of Section 6.60.

3.3 Drainage Channels

Drainage channel calculations were conducted using a reformulation of Manning's Equation in a spreadsheet format. The calculations determine the normal depth of flow based on the peak discharge from the design storm (from HydroCAD) and assumed channel dimensions/slope(s). Both temporary and/or permanent channel linings were chosen, as appropriate, based on the calculated velocity and/or shear stress. Temporary channel linings (if specified) were designed based on the peak discharge from a 2-year

24-hour design storm.

3.4 Culverts

One (1) new culvert will be used at the site to convey flow beneath a roadway. This culvert will be directed to Sediment Basin No.2. This culvert was designed based on an analysis of inlet and outlet control under the influence of the design storm using HydroCAD. The culvert outlet was designed with outlet stabilization based on criteria set forth in E&SCP&DM, Section 6.41.

3.5 Drop Inlets

One (1) weir-type drop inlet will be used to route flow into Sediment Basin No. 2. This drop inlet was designed based on an analysis of the flow capacity of the open sides (weirs) of the drop inlet compared to the maximum flow from the design storm. Prior to vegetative stabilization of the adjacent channel, this drop inlet will be protected from sedimentation by a placing a wire mesh and coarse aggregate filter around all sides of the drop inlet.

3.6 Silt Fence

Silt fencing design was based on criteria set forth in E&SCP&DM, Section 6.62 including the limitation of 100 feet of fencing for each ¼ acre of drainage area.

3.7 Vegetative Stabilization

Vegetative stabilization will be in accordance with the seeding schedule in the project specifications (provided as an attachment to this plan). The seeding schedule was based on Table 6.11k of E&SCP&DM which is applicable to this site.

3.8 Side Slope Swales

Side slope swales are to be placed along final cover side slopes at 20 to 30 foot vertical increments. Flow from the side slope swales is directed to the down pipes or perimeter channels. The capacity and erosion potential of these swales was checked using the reformulation of Manning's Equation from EOUSD as stated above for design flows.

3.9 Down Pipes

Down Pipes were designed based on an analysis of inlet and outlet control under the influence of the design storm to determine the governing headwater condition. Down pipes will be adequately anchored to the landfill side slopes and each will be outleted to the stabilized perimeter channels.

4.0 SCHEDULE FOR IMPLEMENTATION

All erosion control measures will be placed before any land disturbance or waste placement may begin in that portion of the site which drains to the erosion control measures. Vegetative stabilization of disturbed areas will be in accordance with the following requirements:

- Temporary or permanent ground cover (or other acceptable measure(s)) adequate to restrain erosion on erodible slopes or other areas will be stabilized within fifteen (15) working days or twenty-one (21) calendar days following completion of any phase of grading.

5.0 INSPECTION AND MAINTENANCE

All erosion and sedimentation control measures will be inspected at least once every seven calendar days and within 24 hours after any storm event of greater than 0.5 inches of rain per 24 hour period. A rain gauge will be maintained on the site and a record of the rainfall amounts and dates will be kept properly.

During inspections, any stormwater discharges from the site will be observed for stormwater discharge characteristics to evaluate the effectiveness of the erosion and sedimentation control measures incorporating Best Management Practices (BMPs). If visible sedimentation is leaving the disturbed limits of the site, corrective action will be taken immediately to control the discharge of sediments.

Repairs to erosion and sedimentation control measures will be made as needed and accumulated sediment removed if necessary. All sediments which are removed from erosion and sedimentation control measures will be disposed of in an approved manner at a location to be designated by the Engineer in such a manner that further erosion and sedimentation will not occur.

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Appendix A

Erosion and Sedimentation Control Calculations

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DAVIDSON COUNTY
DAVIDSON COUNTY C&D LANDFILL - PHASES 3 & 4

EROSION AND SEDIMENTATION CONTROL PLAN
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PROJECT Davidson County C&D Landfill - Phases 3 & 4

JOB NO. Davidco 08-5

DATE 12/15/08

SUBJECT Analysis of Design Storms

COMPUTED BY KBS

CHECKED BY PKS

Objective To compile the expected design storm depths and intensities over various return periods. These design storm values will be used in various calculations.

References Rainfall data was obtained from the following references:

Frederick, R.H., V.A. Myers, and E.P. Anciello (1977), "Five to 60-Minute Precipitation Frequency for the Eastern and Central United States," NOAA Technical Memo. NWS HYDRO-35, National Weather Service, NOAA, U.S. Dept. Of Commerce, Silver Spring, MD.

U.S. Weather Bureau (1961), "Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years," U.S. Weather Bureau Technical Paper 40.

DESIGN STORMS.WPD

RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services
14 N. Boylan Avenue Tel: 919-828-0577
Raleigh, NC 27603 Fax: 919-828-3899

SHEET: 2 / 2
JOB #: Davdco 08-5
DATE: 12/15/08
BY: KBS
CHKD BY: PKS

Davidson County C&D Landfill - Phases 3 & 4
Analysis of Design Storms

LOCATION: **Lexington, NC**

DURATION	RETURN PERIOD 2-YR P (in)	100-YR P (in)	SOURCE
5 min	0.47	0.81	NOAA HYDRO-35
15 min	0.90	1.70	NOAA HYDRO-35
60 min	1.60	3.40	NOAA HYDRO-35
2 hr to 24 hr Rainfall Events =	**USER INPUT**		USWB TP-40

DEPTH-DURATION-FREQUENCY TABLE

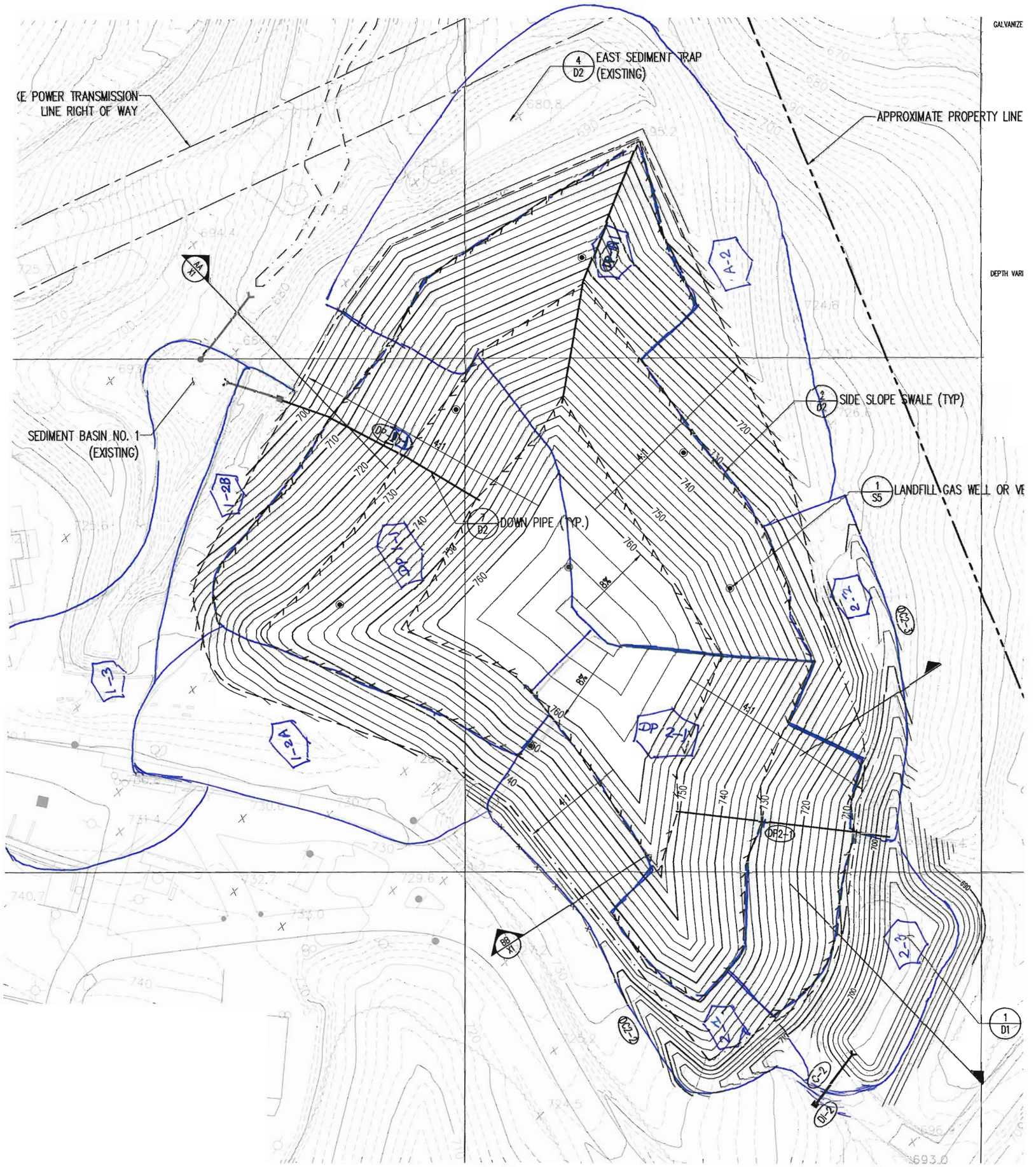
DURATION	RETURN PERIOD 2-YR (in)	5-YR (in)	10-YR (in)	25-YR (in)	50-YR (in)	100-YR (in)
5 min	0.47	0.54	0.60	0.68	0.74	0.81
10 min	0.72	0.86	0.96	1.11	1.22	1.34
15 min	0.90	1.08	1.21	1.40	1.55	1.70
30 min	1.24	1.54	1.75	2.06	2.30	2.53
60 min	1.60	2.02	2.32	2.74	3.07	3.40
2 hr	1.93	2.45	2.95	3.30	3.75	4.20
3 hr	2.20	2.75	3.20	3.65	4.10	4.50
6 hr	2.60	3.20	3.70	4.30	4.90	5.40
12 hr	3.05	3.80	4.40	5.05	5.65	6.30
24 hr	3.55	4.50	5.20	6.00	6.60	7.30

INTENSITY-DURATION-FREQUENCY TABLE

DURATION	RETURN PERIOD 2-YR (in/hr)	5-YR (in/hr)	10-YR (in/hr)	25-YR (in/hr)	50-YR (in/hr)	100-YR (in/hr)
5 min	5.64	6.50	7.16	8.16	8.94	9.72
10 min	4.34	5.15	5.75	6.63	7.32	8.01
15 min	3.60	4.32	4.84	5.60	6.20	6.80
30 min	2.49	3.08	3.51	4.12	4.59	5.07
60 min	1.60	2.02	2.32	2.74	3.07	3.40
2 hr	0.97	1.23	1.48	1.65	1.88	2.10
3 hr	0.73	0.92	1.07	1.22	1.37	1.50
6 hr	0.43	0.53	0.62	0.72	0.82	0.90
12 hr	0.25	0.32	0.37	0.42	0.47	0.53
24 hr	0.15	0.19	0.22	0.25	0.28	0.30

1/1

DRAINAGE AREAS



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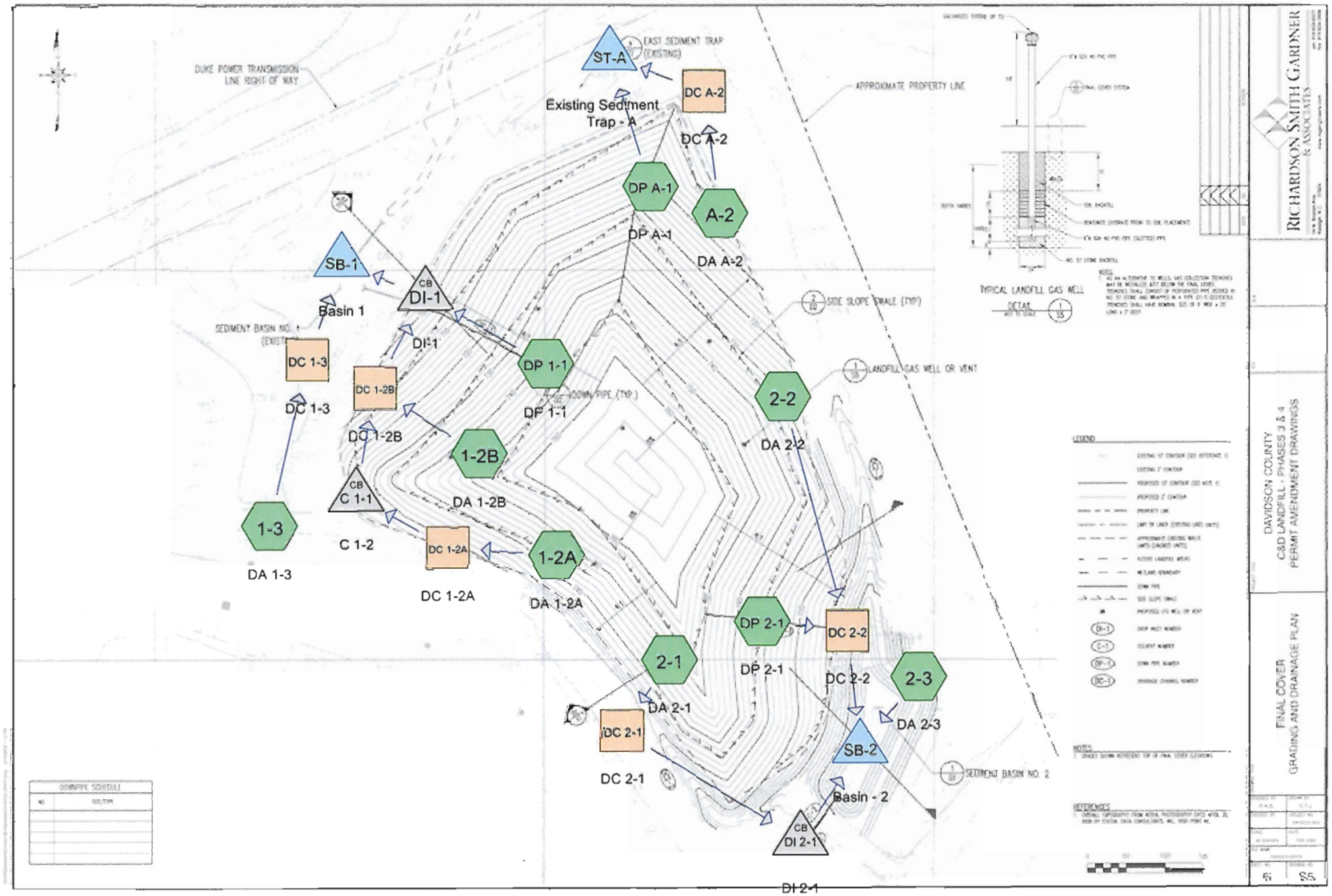

Subcat Reach Pond Link

Drainage Diagram for Davidson Rev.1

Prepared by Richardson Smith Gardner & Associates, Inc. 3/20/2009

HydroCAD® 8.00 s/n 004004 © 2006 HydroCAD Software Solutions LLC

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1-2A: DA 1-2A Runoff Area=0.900 ac Runoff Depth>3.42"
Flow Length=300' Slope=0.0760 '/' Tc=2.6 min CN=79 Runoff=6.26 cfs 0.257 af

Subcatchment 1-2B: DA 1-2B Runoff Area=0.400 ac Runoff Depth>3.42"
Flow Length=30' Slope=0.2500 '/' Tc=1.3 min CN=79 Runoff=2.83 cfs 0.114 af

Subcatchment 1-3: DA 1-3 Runoff Area=2.700 ac Runoff Depth>3.42"
Flow Length=600' Slope=0.1100 '/' Tc=4.3 min CN=79 Runoff=18.08 cfs 0.770 af

Subcatchment 2-1: DA 2-1 Runoff Area=0.660 ac Runoff Depth>3.42"
Flow Length=110' Slope=0.2500 '/' Tc=3.7 min CN=79 Runoff=4.51 cfs 0.188 af

Subcatchment 2-2: DA 2-2 Runoff Area=0.640 ac Runoff Depth>3.42"
Flow Length=100' Slope=0.2000 '/' Tc=3.7 min CN=79 Runoff=4.37 cfs 0.182 af

Subcatchment 2-3: DA 2-3 Runoff Area=0.400 ac Runoff Depth>3.42"
Tc=5.0 min CN=79 Runoff=2.60 cfs 0.114 af

Subcatchment A-2: DA A-2 Runoff Area=2.100 ac Runoff Depth>3.42"
Flow Length=650' Slope=0.0860 '/' Tc=5.3 min CN=79 Runoff=13.49 cfs 0.598 af

Subcatchment DP 1-1: DP 1-1 Runoff Area=2.000 ac Runoff Depth>3.42"
Flow Length=337' Tc=6.3 min CN=79 Runoff=12.33 cfs 0.570 af

Subcatchment DP 2-1: DP 2-1 Runoff Area=1.730 ac Runoff Depth>3.42"
Flow Length=275' Tc=4.4 min CN=79 Runoff=11.54 cfs 0.493 af

Subcatchment DP A-1: DP A-1 Runoff Area=2.100 ac Runoff Depth>3.42"
Flow Length=485' Tc=7.9 min CN=79 Runoff=12.51 cfs 0.598 af

Reach DC 1-2A: DC 1-2A Avg. Depth=0.29' Max Vel=4.74 fps Inflow=6.26 cfs 0.257 af
n=0.030 L=150.0' S=0.0600 '/' Capacity=223.59 cfs Outflow=6.05 cfs 0.256 af

Reach DC 1-2B: DC 1-2B Avg. Depth=0.30' Max Vel=6.25 fps Inflow=8.66 cfs 0.371 af
n=0.030 L=255.0' S=0.0980 '/' Capacity=285.81 cfs Outflow=8.35 cfs 0.370 af

Reach DC 1-3: DC 1-3 Avg. Depth=0.44' Max Vel=7.86 fps Inflow=18.08 cfs 0.770 af
n=0.030 L=200.0' S=0.1000 '/' Capacity=177.51 cfs Outflow=17.41 cfs 0.769 af

Reach DC 2-1: DC 2-1 Avg. Depth=0.16' Max Vel=4.44 fps Inflow=4.51 cfs 0.188 af
n=0.030 L=290.0' S=0.1034 '/' Capacity=386.95 cfs Outflow=4.14 cfs 0.188 af

Reach DC 2-2: DC 2-2 Avg. Depth=0.33' Max Vel=6.92 fps Inflow=15.90 cfs 0.676 af
n=0.030 L=275.0' S=0.1018 '/' Capacity=416.70 cfs Outflow=15.03 cfs 0.675 af

Reach DC A-2: DC A-2 Avg. Depth=0.63' Max Vel=6.41 fps Inflow=13.49 cfs 0.598 af
n=0.035 L=540.0' S=0.0726 '/' Capacity=77.66 cfs Outflow=12.61 cfs 0.597 af

Pond C 1-1: C 1-2 Peak Elev=719.76' Inflow=6.05 cfs 0.256 af
18.0" x 64.0' Culvert Outflow=6.05 cfs 0.256 af

Pond DI 2-1: DI 2-1 Peak Elev=694.48' Inflow=4.14 cfs 0.188 af
18.0" x 48.0' Culvert Outflow=4.14 cfs 0.188 af

Pond DI-1: DI-1 Peak Elev=692.30' Inflow=20.43 cfs 0.940 af
18.0" x 50.0' Culvert Outflow=20.43 cfs 0.940 af

Pond SB-1: Basin 1 Peak Elev=687.66' Storage=37,886 cf Inflow=37.83 cfs 1.709 af
Primary=9.25 cfs 1.140 af Secondary=0.00 cfs 0.000 af Outflow=9.25 cfs 1.140 af

Pond SB-2: Basin - 2 Peak Elev=695.14' Storage=23,793 cf Inflow=21.76 cfs 0.976 af
Primary=2.53 cfs 0.483 af Secondary=0.00 cfs 0.000 af Outflow=2.53 cfs 0.483 af

Pond ST-A: Existing Sediment Trap - A Peak Elev=682.95' Storage=15,600 cf Inflow=25.10 cfs 1.195 af
Outflow=40.84 cfs 0.869 af

Total Runoff Area = 13.630 ac Runoff Volume = 3.884 af Average Runoff Depth = 3.42"
100.00% Pervious Area = 13.630 ac 0.00% Impervious Area = 0.000 ac

Subcatchment 1-2A: DA 1-2A

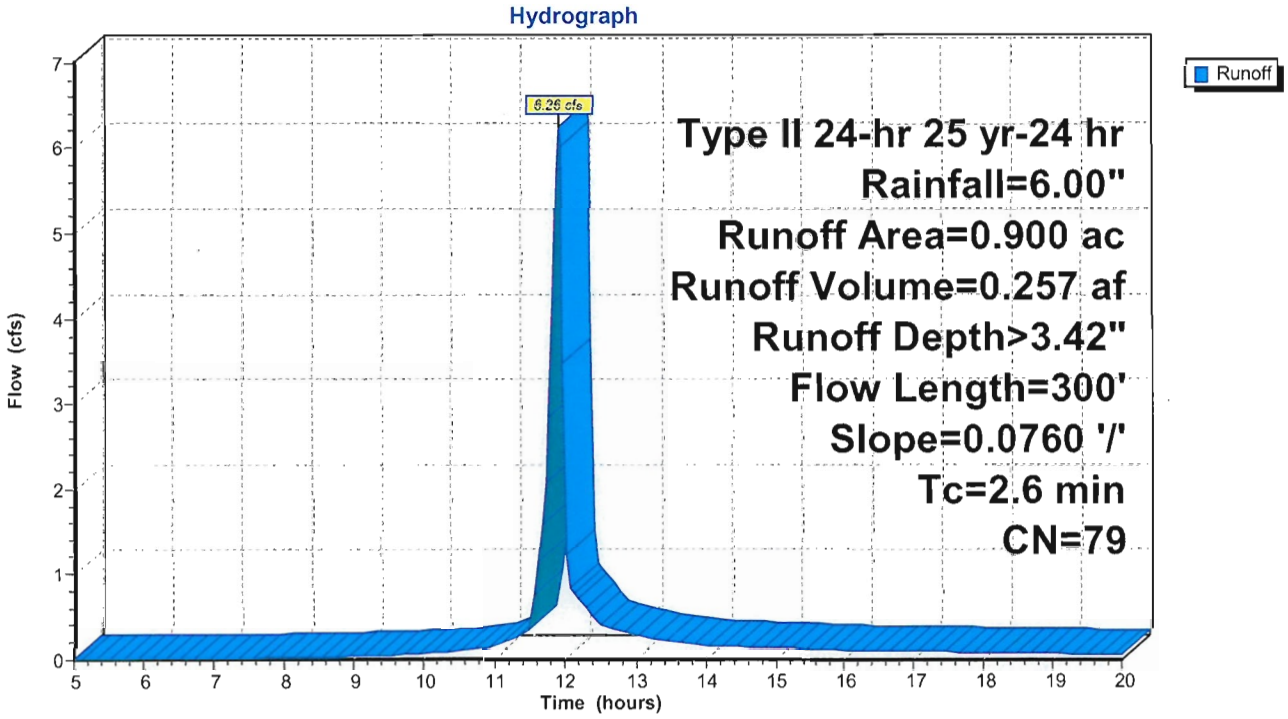
Runoff = 6.26 cfs @ 11.93 hrs, Volume= 0.257 af, Depth> 3.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 yr-24 hr Rainfall=6.00"

Area (ac)	CN	Description
0.900	79	50-75% Grass cover, Fair, HSG C
0.900		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	300	0.0760	1.93		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment 1-2A: DA 1-2A



Subcatchment 1-2B: DA 1-2B

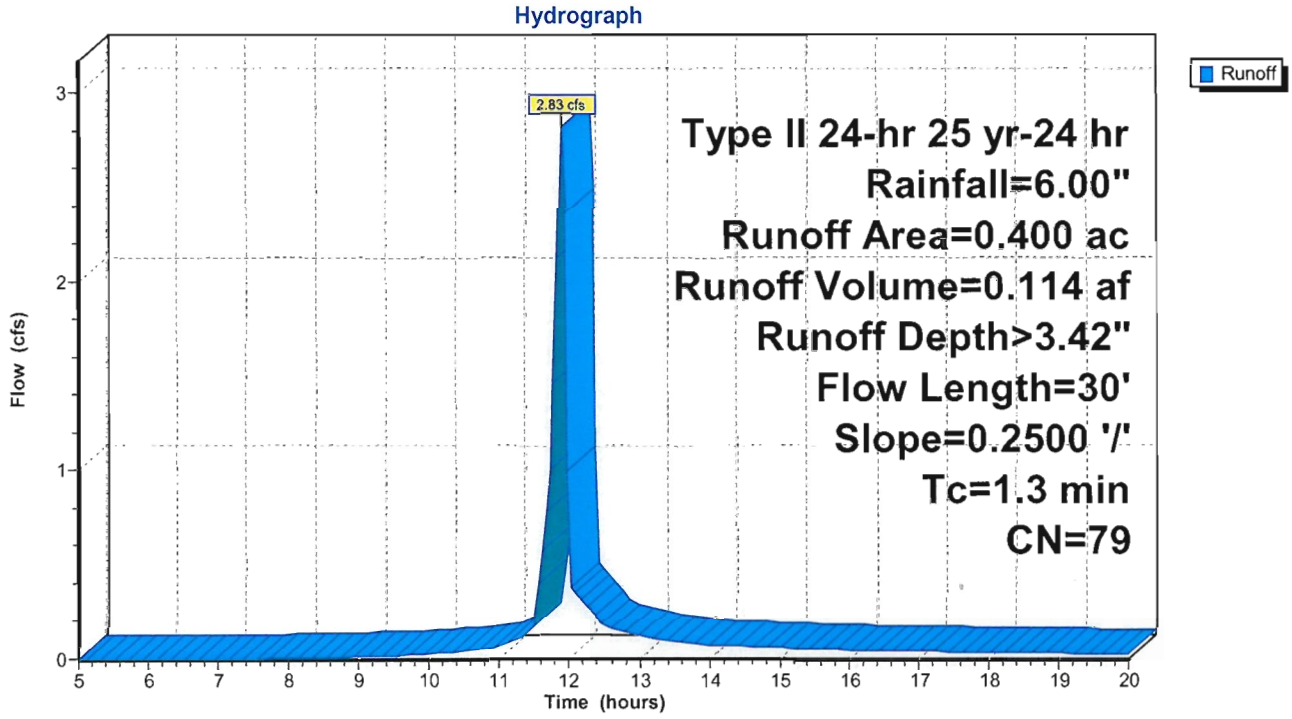
Runoff = 2.83 cfs @ 11.91 hrs, Volume= 0.114 af, Depth> 3.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 yr-24 hr Rainfall=6.00"

Area (ac)	CN	Description
0.400	79	50-75% Grass cover, Fair, HSG C
0.400		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	30	0.2500	0.39		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.55"

Subcatchment 1-2B: DA 1-2B



Subcatchment 1-3: DA 1-3

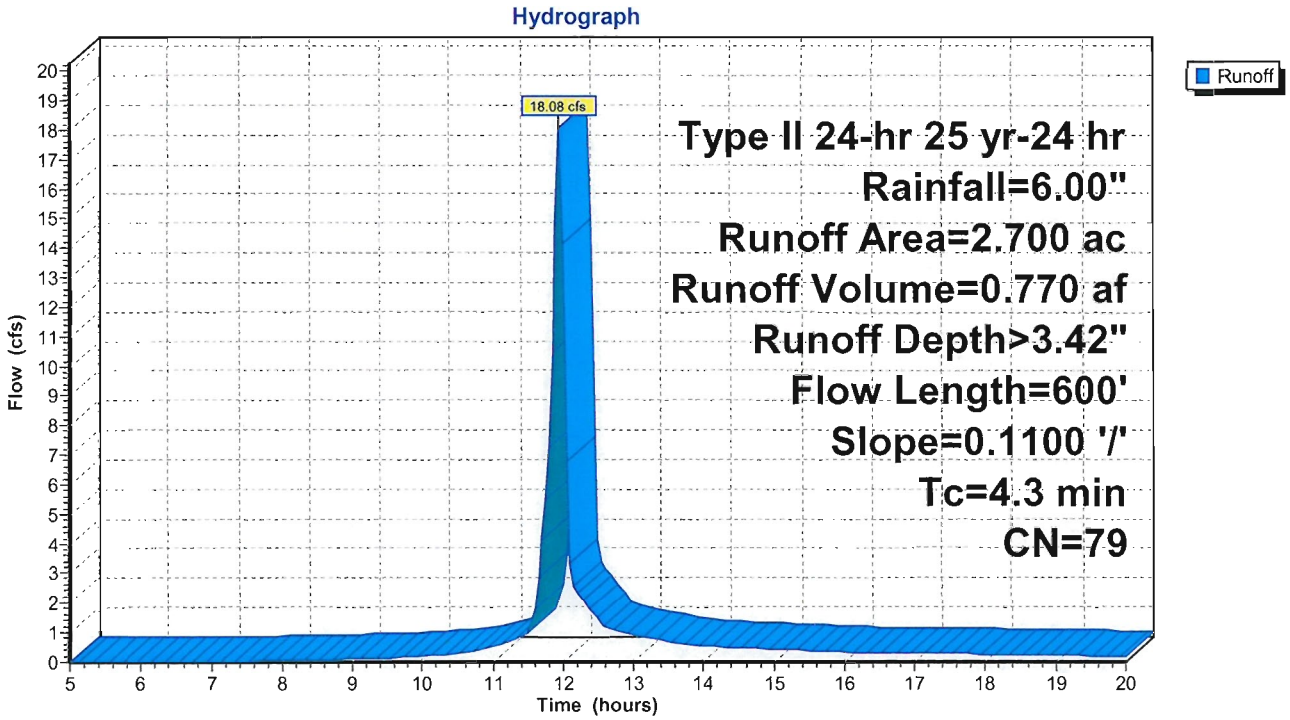
Runoff = 18.08 cfs @ 11.95 hrs, Volume= 0.770 af, Depth> 3.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 yr-24 hr Rainfall=6.00"

Area (ac)	CN	Description
2.700	79	50-75% Grass cover, Fair, HSG C
2.700		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	600	0.1100	2.32		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment 1-3: DA 1-3



Subcatchment 2-1: DA 2-1

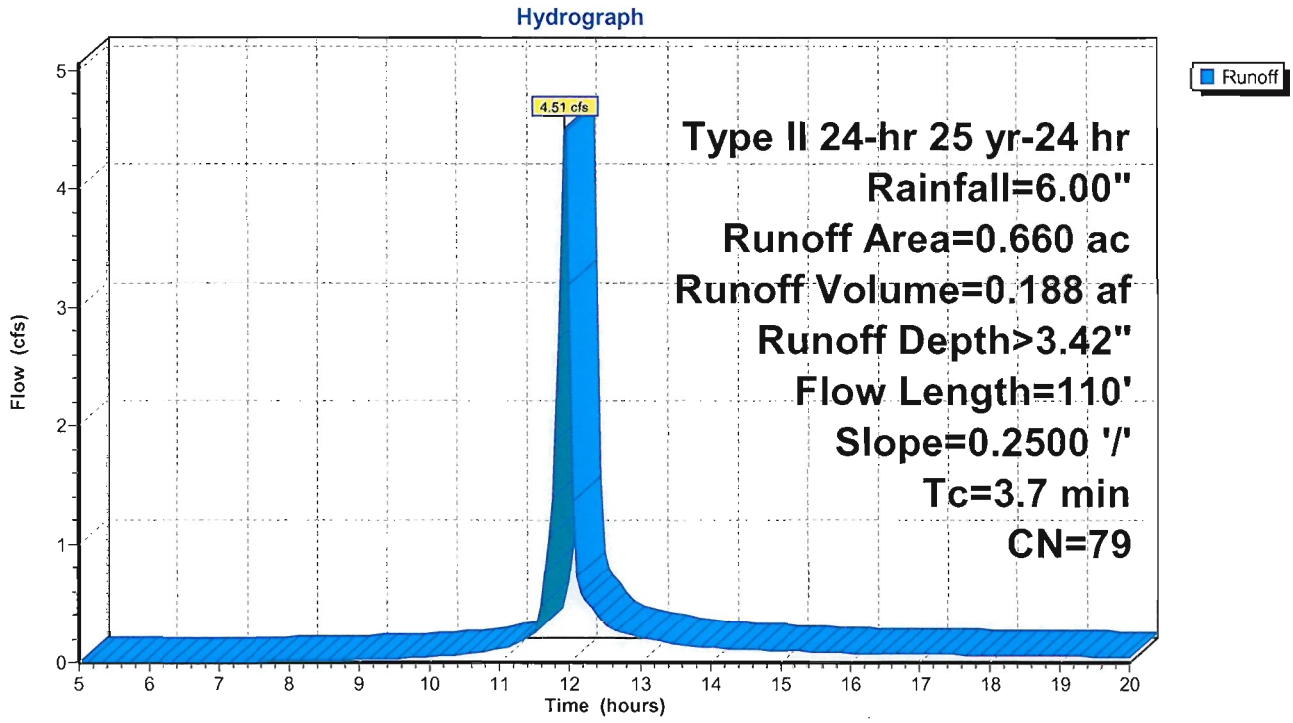
Runoff = 4.51 cfs @ 11.94 hrs, Volume= 0.188 af, Depth> 3.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 yr-24 hr Rainfall=6.00"

Area (ac)	CN	Description
0.660	79	50-75% Grass cover, Fair, HSG C
0.660		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	110	0.2500	0.50		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.55"

Subcatchment 2-1: DA 2-1



Subcatchment 2-2: DA 2-2

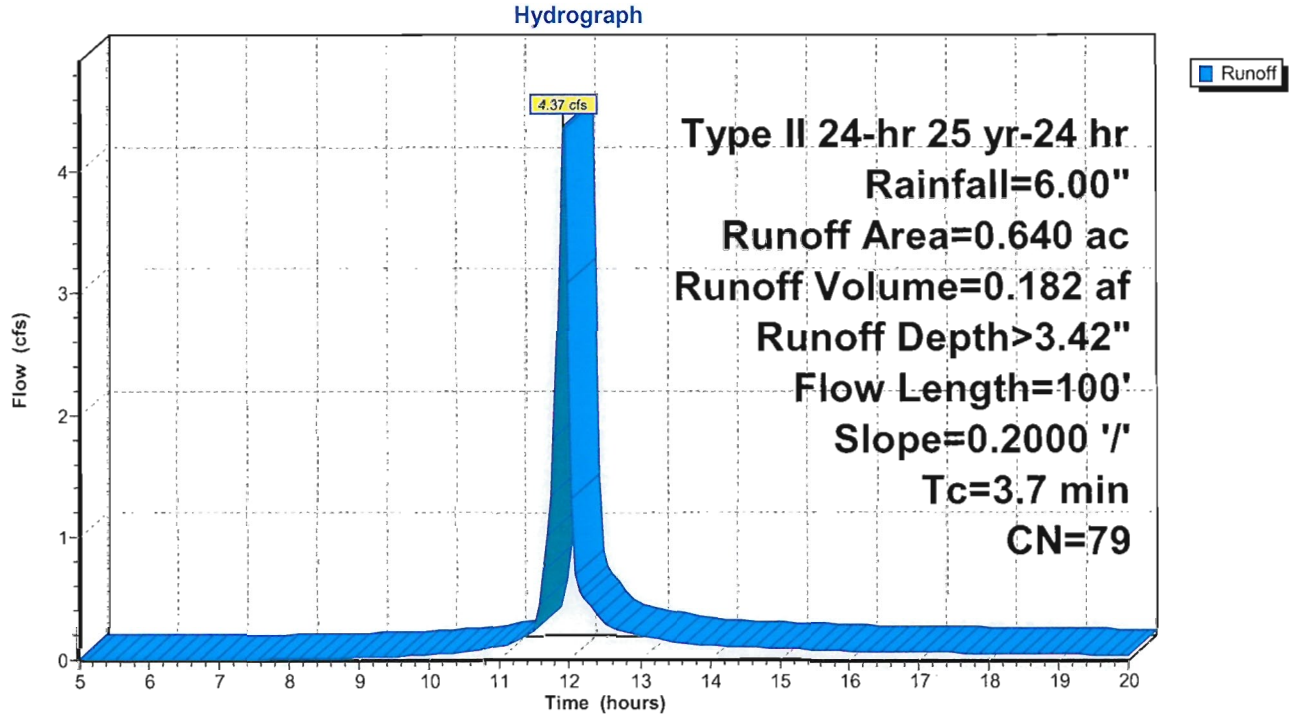
Runoff = 4.37 cfs @ 11.94 hrs, Volume= 0.182 af, Depth> 3.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 yr-24 hr Rainfall=6.00"

Area (ac)	CN	Description
0.640	79	50-75% Grass cover, Fair, HSG C
0.640		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	100	0.2000	0.45		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.55"

Subcatchment 2-2: DA 2-2



Subcatchment 2-3: DA 2-3

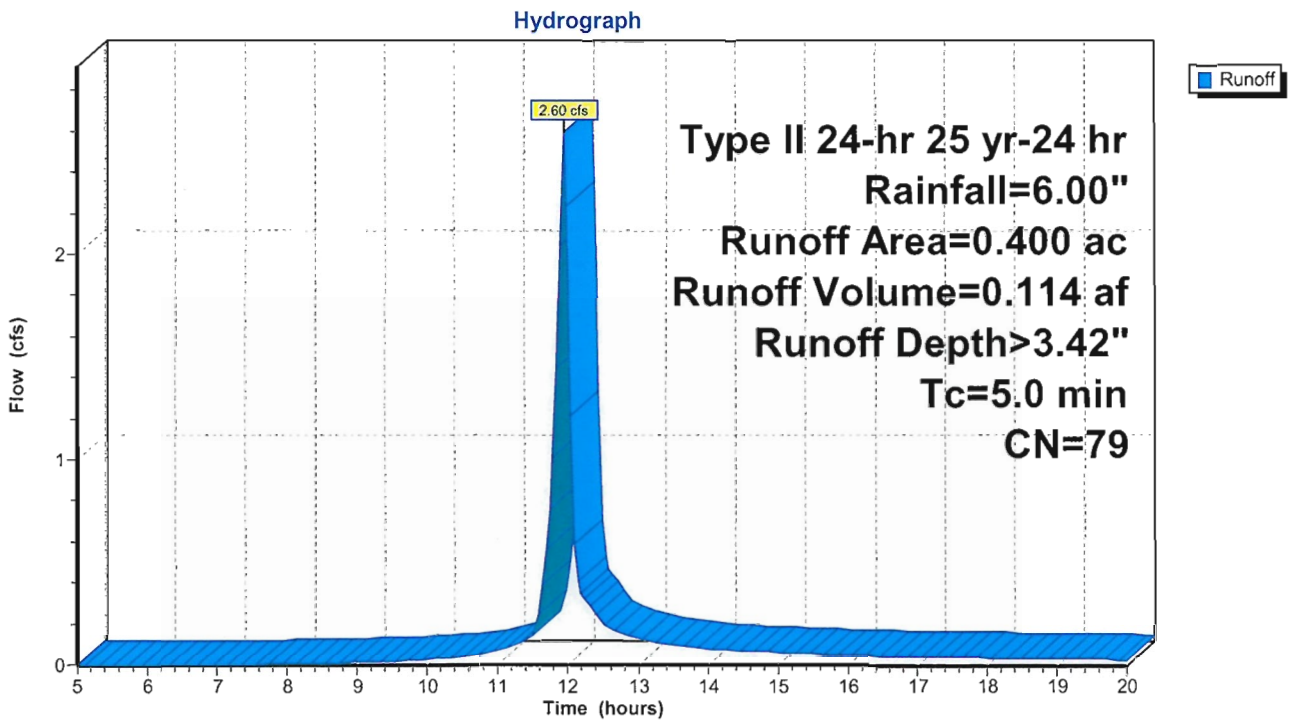
Runoff = 2.60 cfs @ 11.96 hrs, Volume= 0.114 af, Depth> 3.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 yr-24 hr Rainfall=6.00"

Area (ac)	CN	Description
0.400	79	50-75% Grass cover, Fair, HSG C
0.400		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2-3: DA 2-3



Subcatchment A-2: DA A-2

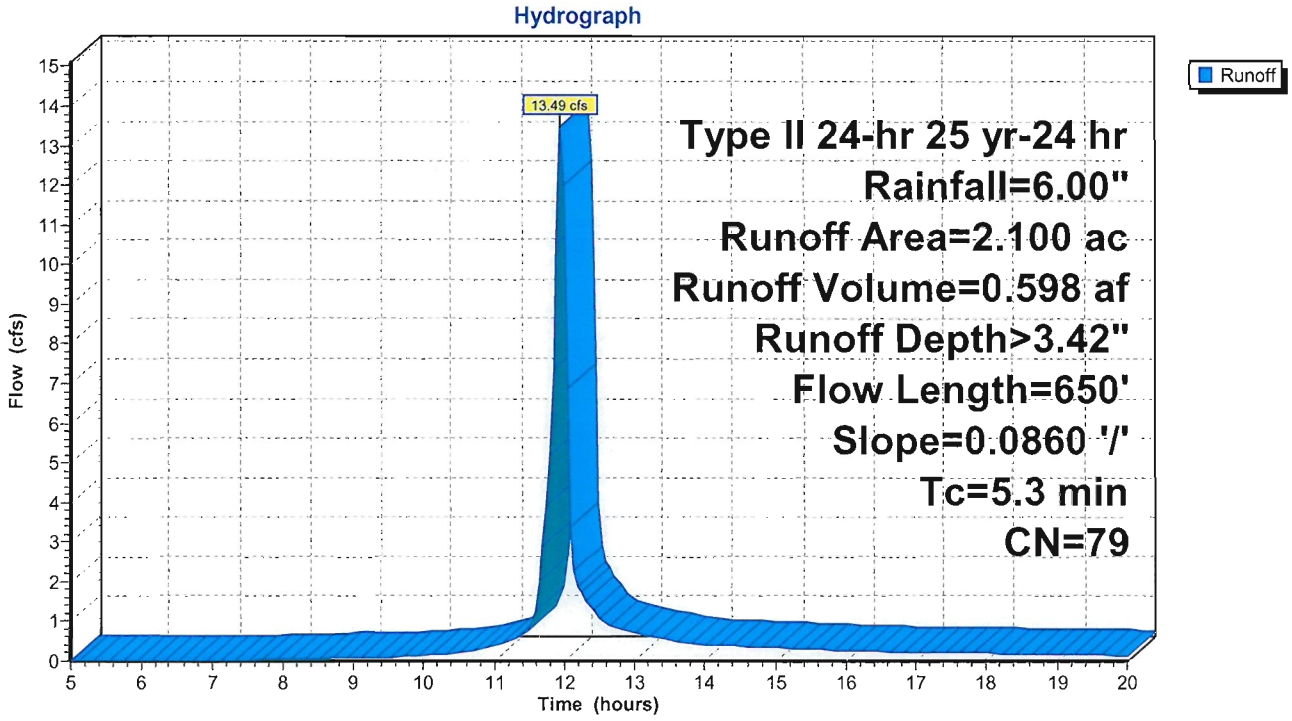
Runoff = 13.49 cfs @ 11.96 hrs, Volume= 0.598 af, Depth> 3.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 yr-24 hr Rainfall=6.00"

Area (ac)	CN	Description
2.100	79	50-75% Grass cover, Fair, HSG C
2.100		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	650	0.0860	2.05		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment A-2: DA A-2



Subcatchment DP 1-1: DP 1-1

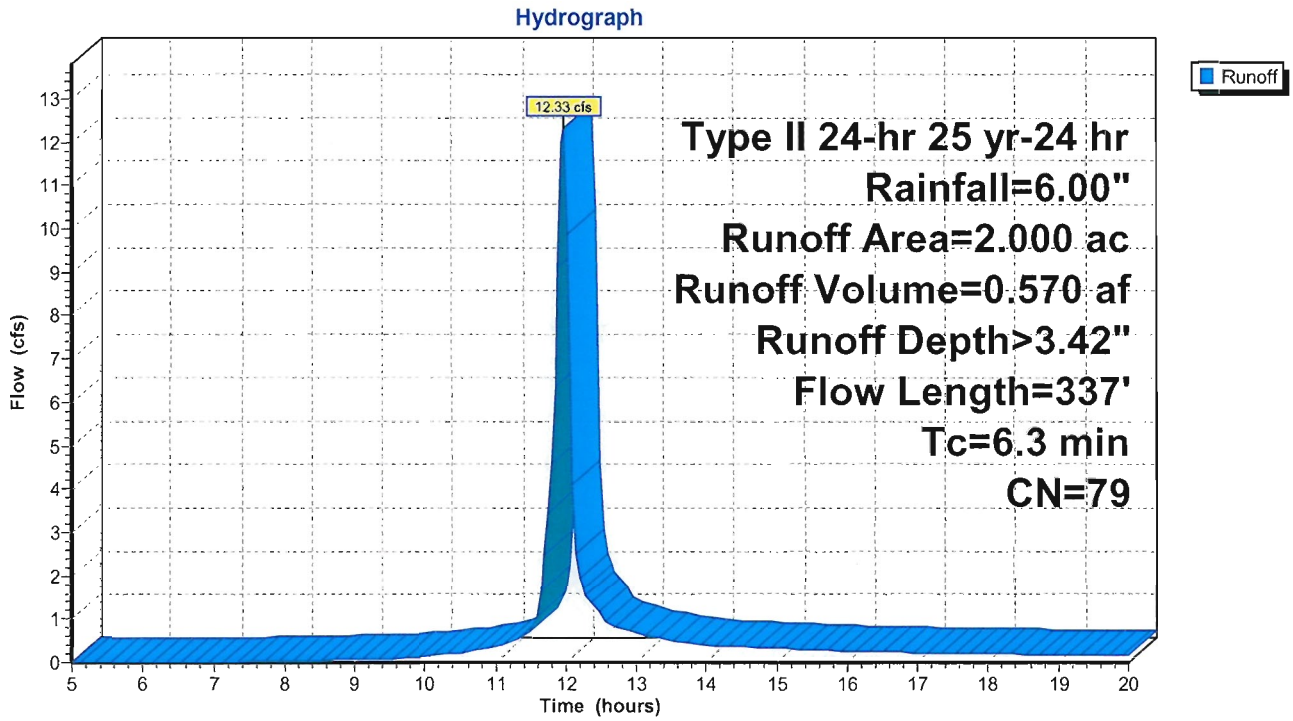
Runoff = 12.33 cfs @ 11.97 hrs, Volume= 0.570 af, Depth> 3.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 yr-24 hr Rainfall=6.00"

Area (ac)	CN	Description
2.000	79	50-75% Grass cover, Fair, HSG C
2.000		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	75	0.0800	0.29		**Sheet Flow, Landfill slope-1** Grass: Short n= 0.150 P2= 3.55"
1.9	50	0.2500	0.43		**Sheet Flow, Landfill Slope-2** Grass: Short n= 0.150 P2= 3.55"
0.2	212	0.2500	15.46	27.31	**Circular Channel (pipe), Down Pipe-2** Diam= 18.0" Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.025 Corrugated PE, corrugated interior
6.3	337	Total			

Subcatchment DP 1-1: DP 1-1



Subcatchment DP 2-1: DP 2-1

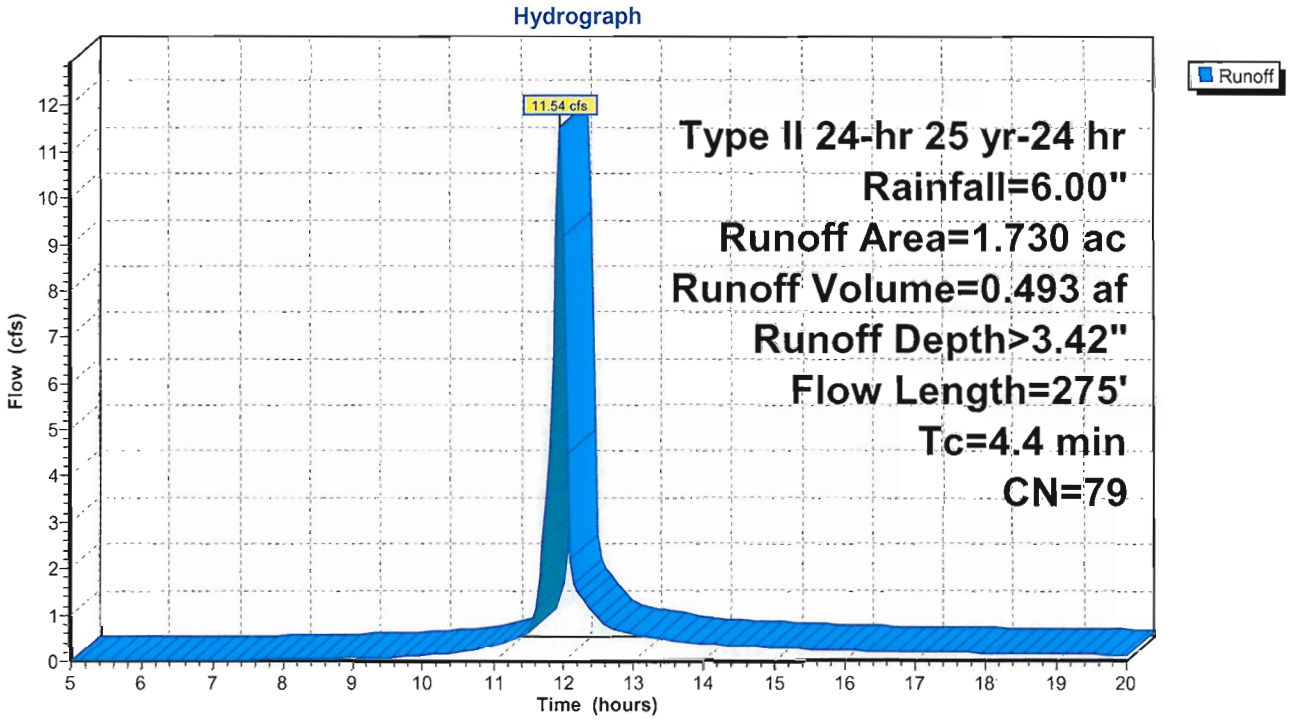
Runoff = 11.54 cfs @ 11.95 hrs, Volume= 0.493 af, Depth> 3.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 yr-24 hr Rainfall=6.00"

Area (ac)	CN	Description
1.730	79	50-75% Grass cover, Fair, HSG C
1.730		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	75	0.0800	0.29		**Sheet Flow, Landfill Slope** Grass: Short n= 0.150 P2= 3.55"
0.2	200	0.2675	15.99	28.25	**Circular Channel (pipe), Down Pipe** Diam= 18.0" Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.025 Corrugated PE, corrugated interior
4.4	275	Total			

Subcatchment DP 2-1: DP 2-1



Subcatchment DP A-1: DP A-1

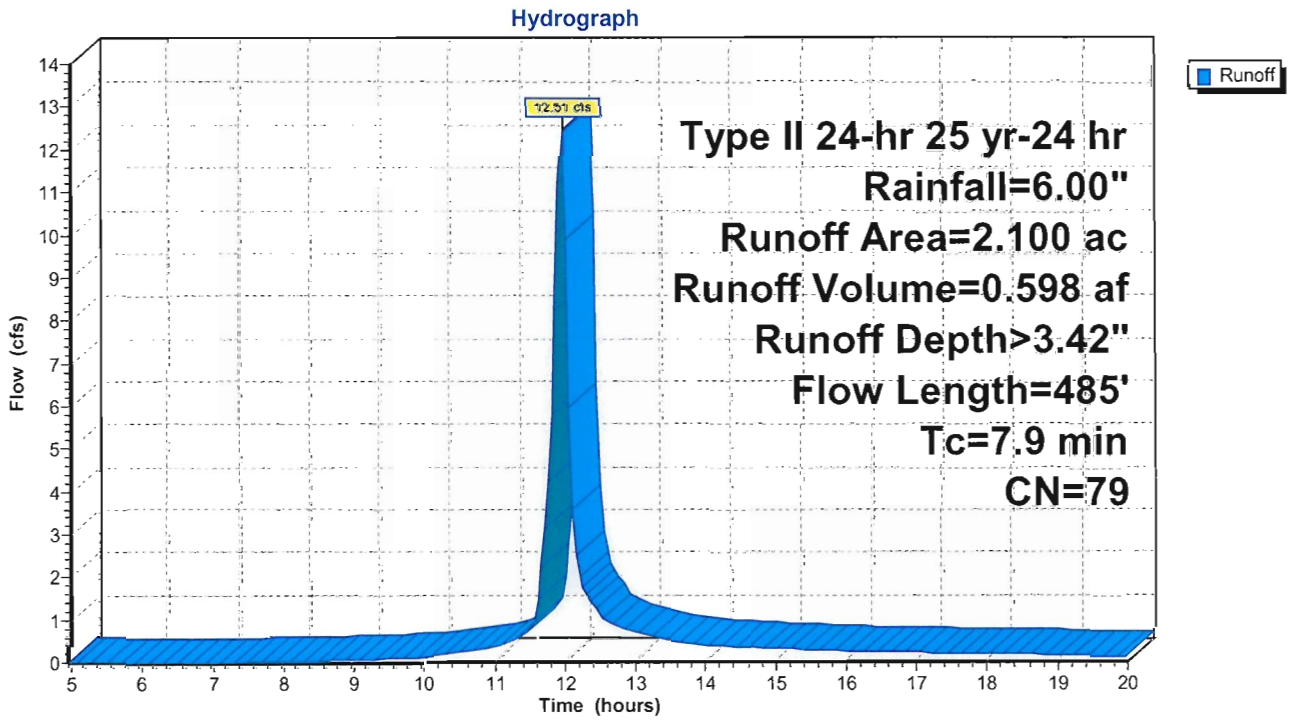
Runoff = 12.51 cfs @ 11.99 hrs, Volume= 0.598 af, Depth> 3.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 yr-24 hr Rainfall=6.00"

Area (ac)	CN	Description
2.100	79	50-75% Grass cover, Fair, HSG C
2.100		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	75	0.0800	0.29		**Sheet Flow, Landfill Slope-1** Grass: Short n= 0.150 P2= 3.55"
3.4	100	0.2500	0.49		**Sheet Flow, Labdfill slope-2** Grass: Short n= 0.150 P2= 3.55"
0.3	310	0.2600	15.76	27.85	**Circular Channel (pipe), Down Pipe -1** Diam= 18.0" Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.025 Corrugated PE, corrugated interior
7.9	485	Total			

Subcatchment DP A-1: DP A-1



Reach DC 1-2A: DC 1-2A

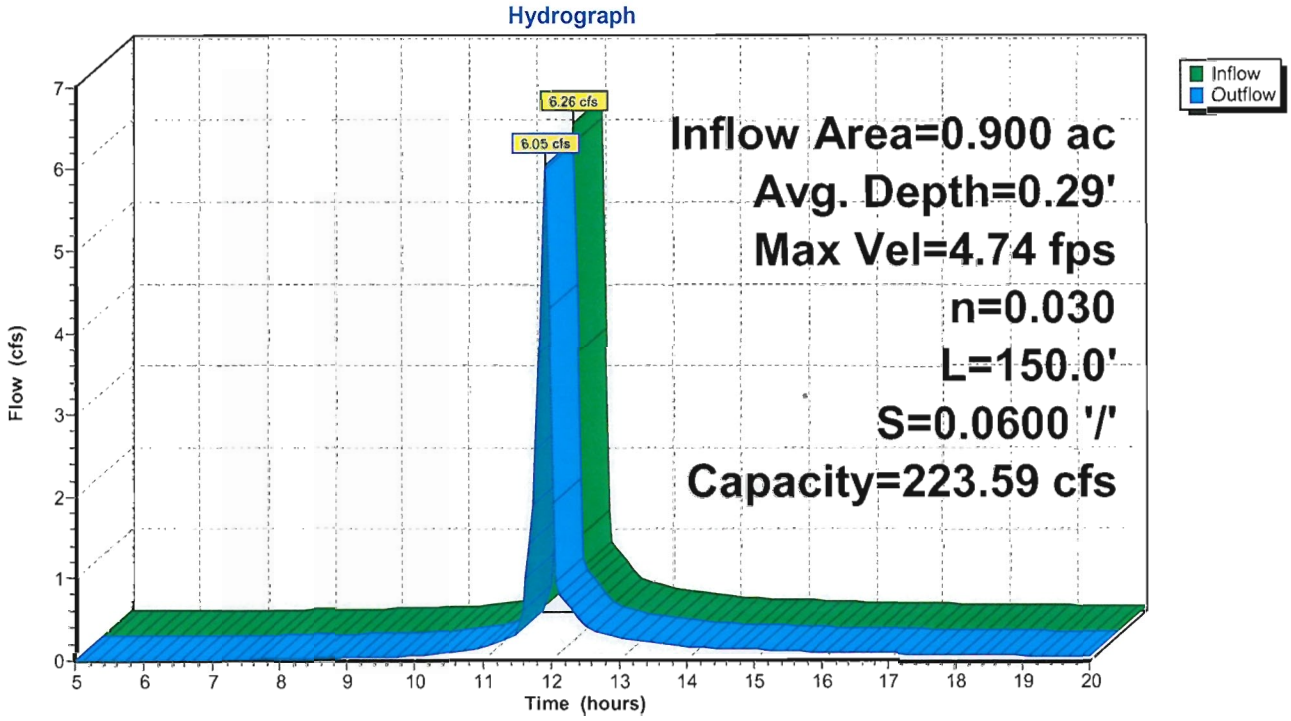
Inflow Area = 0.900 ac, Inflow Depth > 3.42" for 25 yr-24 hr event
Inflow = 6.26 cfs @ 11.93 hrs, Volume= 0.257 af
Outflow = 6.05 cfs @ 11.94 hrs, Volume= 0.256 af, Atten= 3%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.74 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.20 fps, Avg. Travel Time= 2.1 min

Peak Storage= 196 cf @ 11.93 hrs, Average Depth at Peak Storage= 0.29'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 223.59 cfs

4.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 150.0' Slope= 0.0600 '/'
Inlet Invert= 728.00', Outlet Invert= 719.00'

Reach DC 1-2A: DC 1-2A



Reach DC 1-2B: DC 1-2B

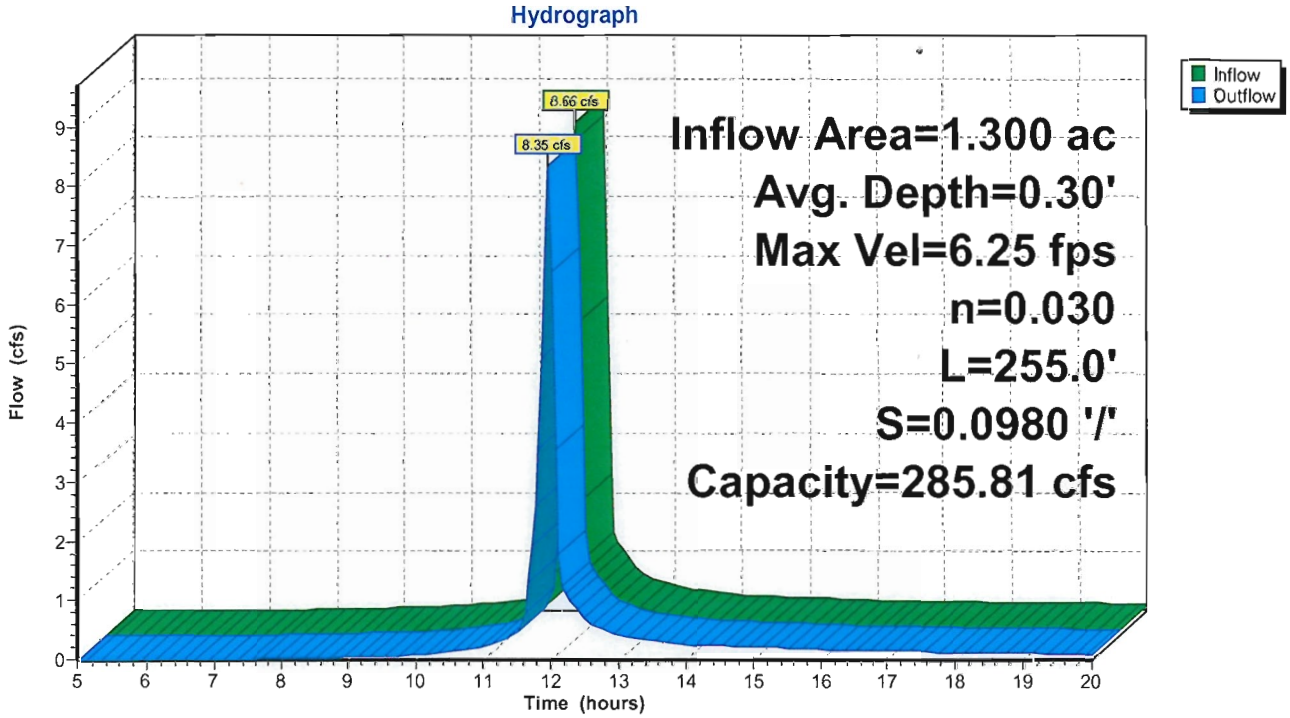
Inflow Area = 1.300 ac, Inflow Depth > 3.42" for 25 yr-24 hr event
Inflow = 8.66 cfs @ 11.93 hrs, Volume= 0.371 af
Outflow = 8.35 cfs @ 11.94 hrs, Volume= 0.370 af, Atten= 4%, Lag= 0.9 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.25 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.59 fps, Avg. Travel Time= 2.7 min

Peak Storage= 351 cf @ 11.94 hrs, Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 285.81 cfs

4.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 255.0' Slope= 0.0980 '/'
Inlet Invert= 718.00', Outlet Invert= 693.00'

Reach DC 1-2B: DC 1-2B



Reach DC 1-3: DC 1-3

Inflow Area = 2.700 ac, Inflow Depth > 3.42" for 25 yr-24 hr event
Inflow = 18.08 cfs @ 11.95 hrs, Volume= 0.770 af
Outflow = 17.41 cfs @ 11.96 hrs, Volume= 0.769 af, Atten= 4%, Lag= 0.6 min

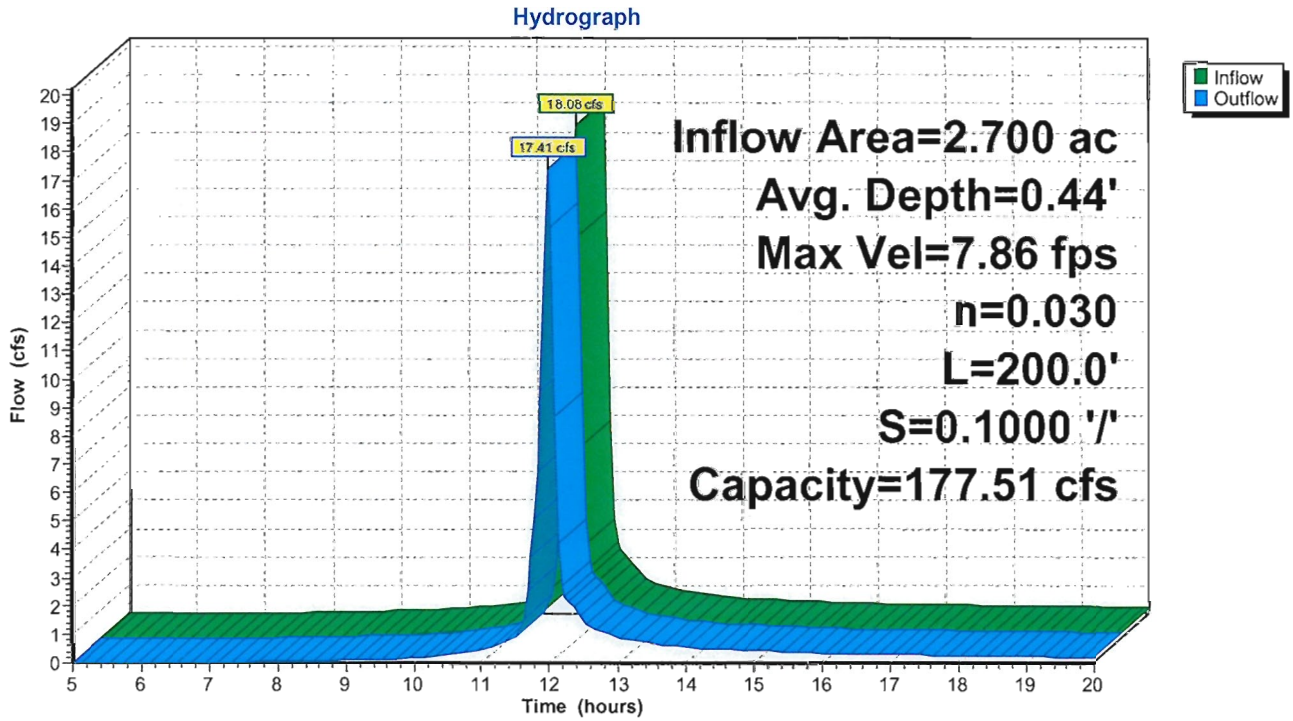
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.86 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.98 fps, Avg. Travel Time= 1.7 min

Peak Storage= 454 cf @ 11.95 hrs, Average Depth at Peak Storage= 0.44'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 177.51 cfs

4.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.5 '/' Top Width= 11.50'
Length= 200.0' Slope= 0.1000 '/'
Inlet Invert= 702.00', Outlet Invert= 682.00'

‡

Reach DC 1-3: DC 1-3



Reach DC 2-1: DC 2-1

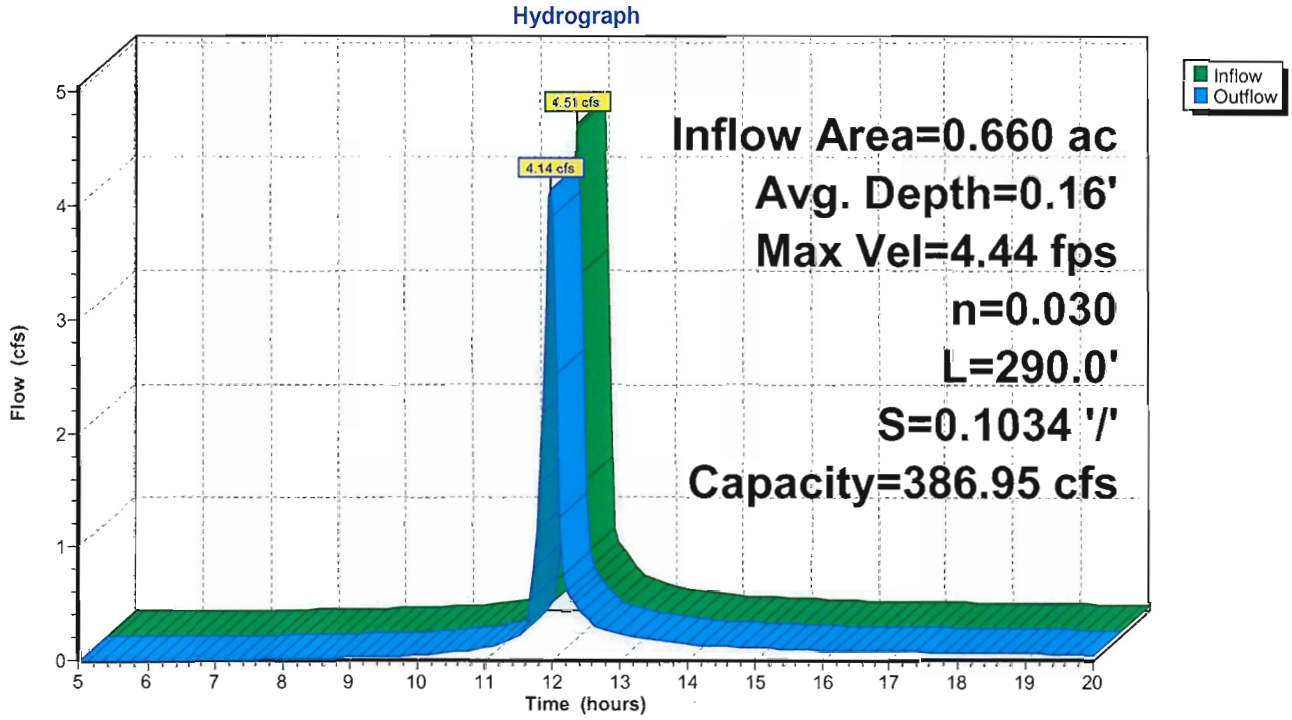
Inflow Area = 0.660 ac, Inflow Depth > 3.42" for 25 yr-24 hr event
Inflow = 4.51 cfs @ 11.94 hrs, Volume= 0.188 af
Outflow = 4.14 cfs @ 11.97 hrs, Volume= 0.188 af, Atten= 8%, Lag= 1.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.44 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 1.30 fps, Avg. Travel Time= 3.7 min

Peak Storage= 286 cf @ 11.95 hrs, Average Depth at Peak Storage= 0.16'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 386.95 cfs

6.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 14.00'
Length= 290.0' Slope= 0.1034 '/'
Inlet Invert= 732.00', Outlet Invert= 702.00'

Reach DC 2-1: DC 2-1



Reach DC 2-2: DC 2-2

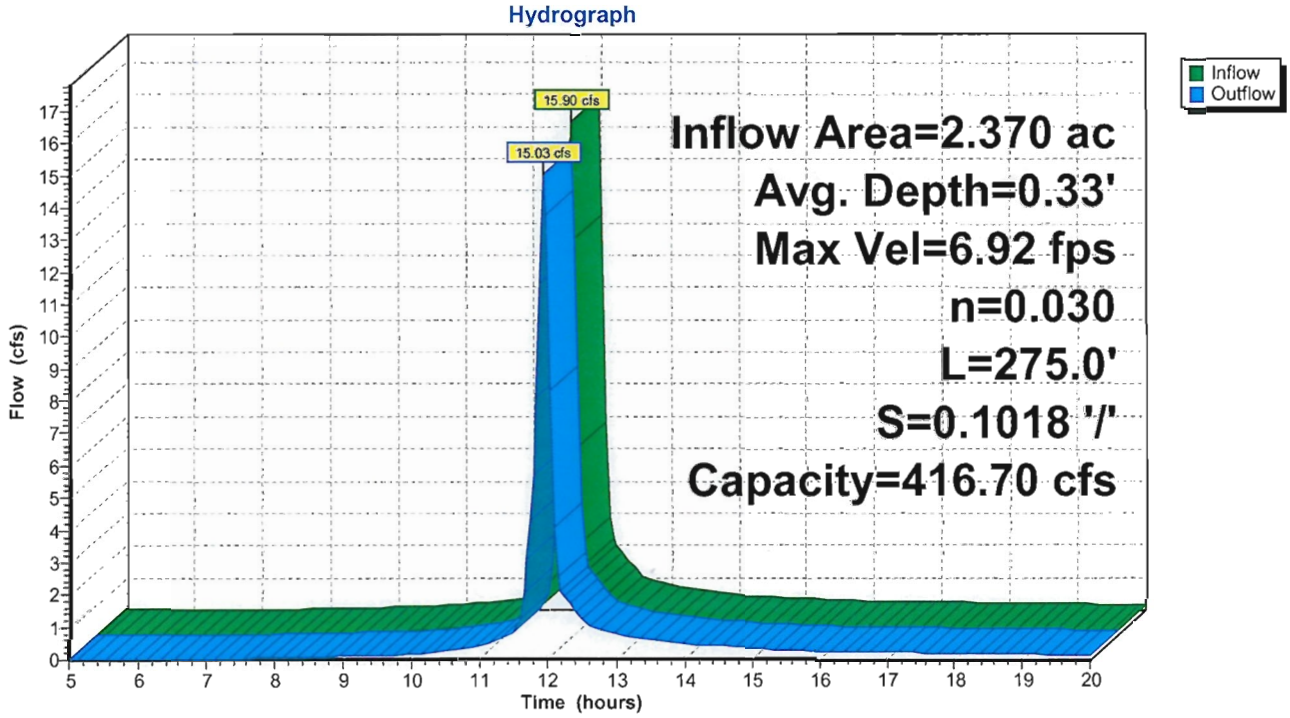
Inflow Area = 2.370 ac, Inflow Depth > 3.42" for 25 yr-24 hr event
Inflow = 15.90 cfs @ 11.95 hrs, Volume= 0.676 af
Outflow = 15.03 cfs @ 11.96 hrs, Volume= 0.675 af, Atten= 5%, Lag= 0.9 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.92 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.73 fps, Avg. Travel Time= 2.7 min

Peak Storage= 620 cf @ 11.95 hrs, Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 416.70 cfs

6.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.5 '/' Top Width= 16.00'
Length= 275.0' Slope= 0.1018 '/'
Inlet Invert= 720.00', Outlet Invert= 692.00'

Reach DC 2-2: DC 2-2



Reach DC A-2: DC A-2

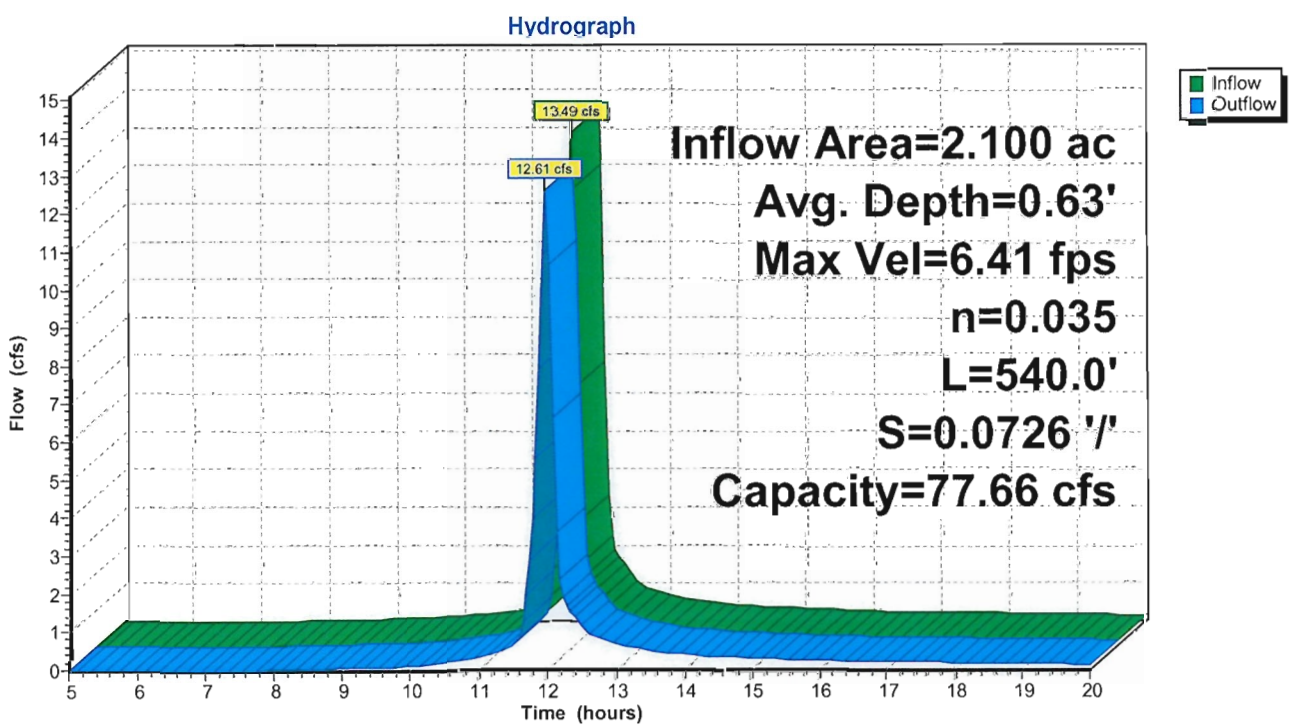
Inflow Area = 2.100 ac, Inflow Depth > 3.42" for 25 yr-24 hr event
Inflow = 13.49 cfs @ 11.96 hrs, Volume= 0.598 af
Outflow = 12.61 cfs @ 12.00 hrs, Volume= 0.597 af, Atten= 6%, Lag= 2.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.41 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 1.84 fps, Avg. Travel Time= 4.9 min

Peak Storage= 1,101 cf @ 11.98 hrs, Average Depth at Peak Storage= 0.63'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 77.66 cfs

2.00' x 1.50' deep channel, n= 0.035
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 540.0' Slope= 0.0726 '/'
Inlet Invert= 720.00', Outlet Invert= 680.80'

Reach DC A-2: DC A-2



Pond C 1-1: C 1-2

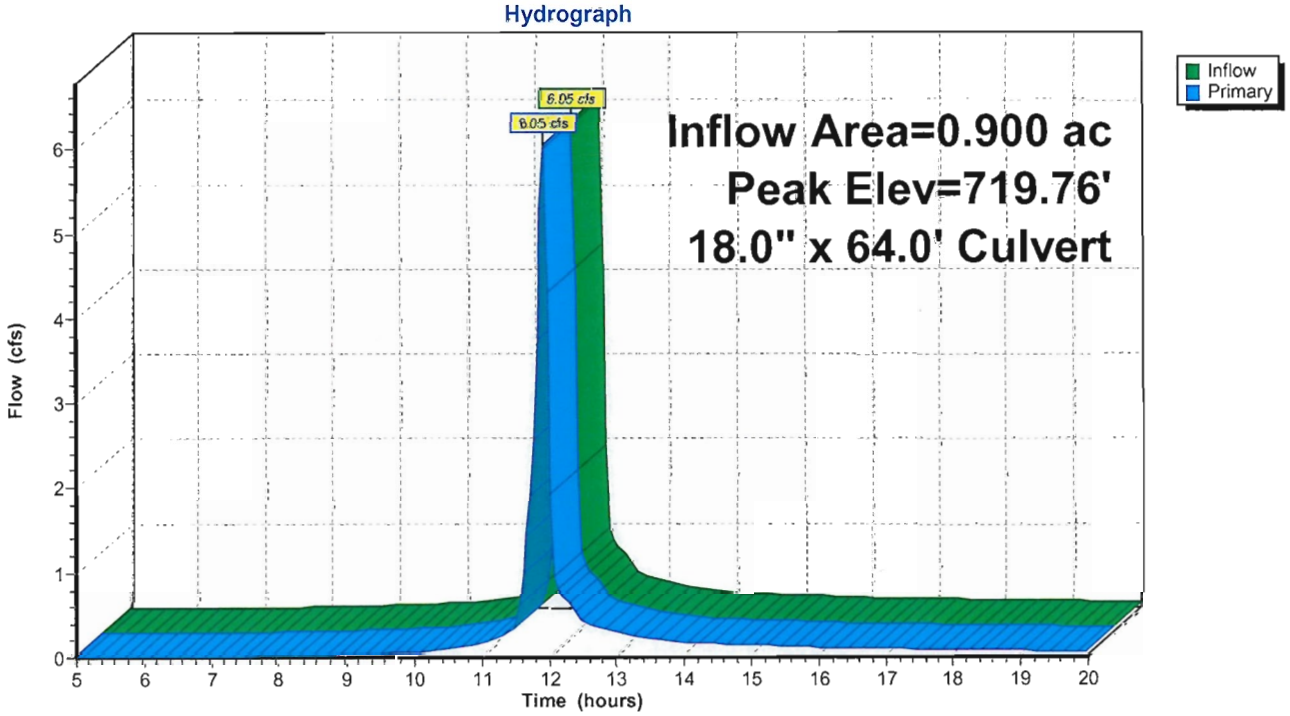
Inflow Area =	0.900 ac,	Inflow Depth >	3.42"	for	25 yr-24 hr event
Inflow =	6.05 cfs @	11.94 hrs,	Volume=	0.256 af	
Outflow =	6.05 cfs @	11.94 hrs,	Volume=	0.256 af,	Atten= 0%, Lag= 0.0 min
Primary =	6.05 cfs @	11.94 hrs,	Volume=	0.256 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 719.76' @ 11.94 hrs
Flood Elev= 720.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	718.50'	**18.0" x 64.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 717.50' S= 0.0156 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=5.86 cfs @ 11.94 hrs HW=719.73' (Free Discharge)
└─**1=Culvert** (Inlet Controls 5.86 cfs @ 3.78 fps)

Pond C 1-1: C 1-2



Pond DI 2-1: DI 2-1

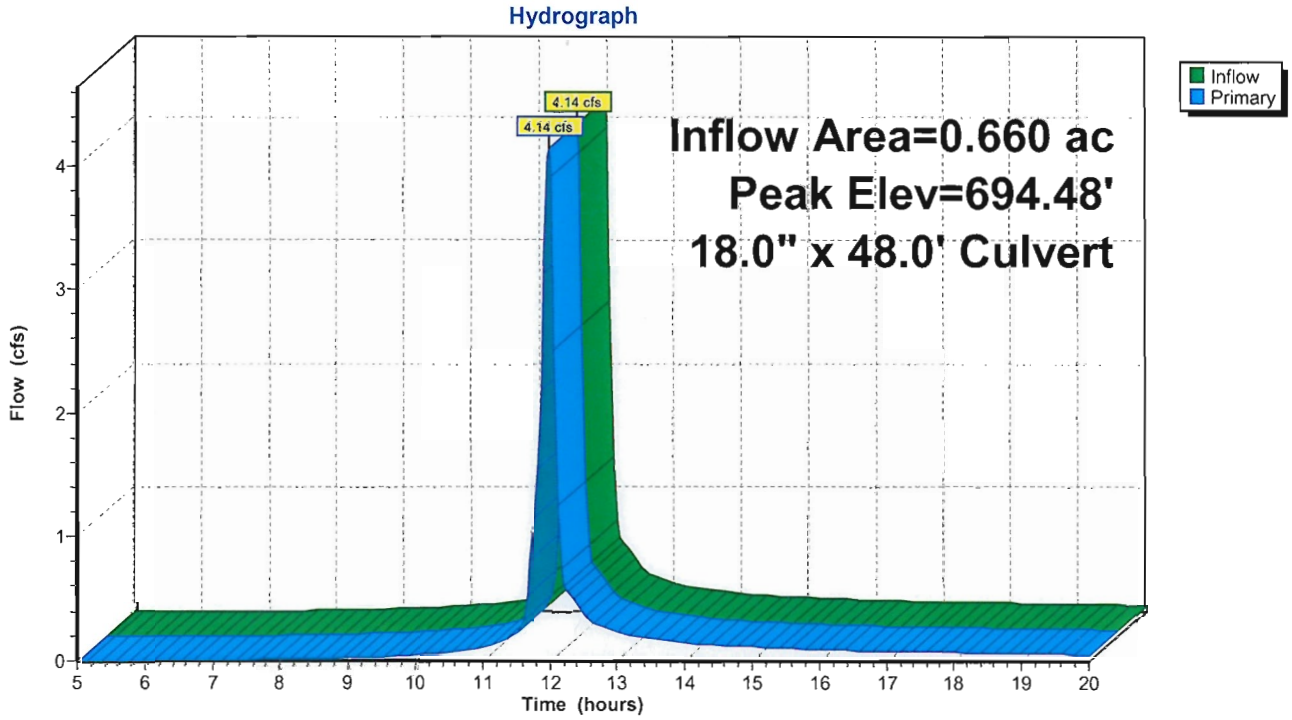
Inflow Area =	0.660 ac,	Inflow Depth >	3.42"	for	25 yr-24 hr event
Inflow =	4.14 cfs @	11.97 hrs,	Volume=	0.188 af	
Outflow =	4.14 cfs @	11.97 hrs,	Volume=	0.188 af,	Atten= 0%, Lag= 0.0 min
Primary =	4.14 cfs @	11.97 hrs,	Volume=	0.188 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 694.48' @ 11.97 hrs
Flood Elev= 702.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	693.50'	**18.0" x 48.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 692.00' S= 0.0313 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections

Primary OutFlow Max=4.01 cfs @ 11.97 hrs HW=694.46' (Free Discharge)
└─**1=Culvert** (Inlet Controls 4.01 cfs @ 3.34 fps)

Pond DI 2-1: DI 2-1



Pond DI-1: DI-1

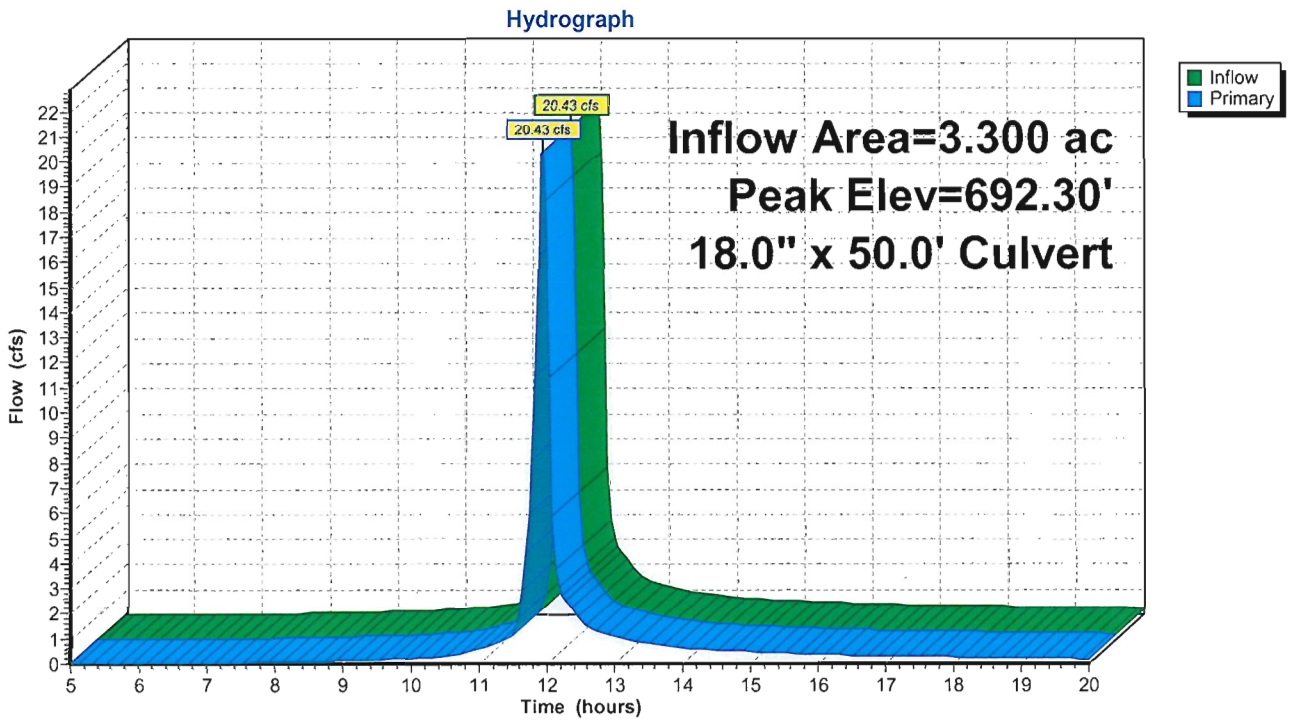
Inflow Area =	3.300 ac,	Inflow Depth >	3.42"	for	25 yr-24 hr event
Inflow =	20.43 cfs @	11.96 hrs,	Volume=	0.940 af	
Outflow =	20.43 cfs @	11.96 hrs,	Volume=	0.940 af,	Atten= 0%, Lag= 0.0 min
Primary =	20.43 cfs @	11.96 hrs,	Volume=	0.940 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 692.30' @ 11.96 hrs
Flood Elev= 692.67'

Device	Routing	Invert	Outlet Devices
#1	Primary	685.80'	**18.0" x 50.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 680.80' S= 0.1000 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=20.00 cfs @ 11.96 hrs HW=692.08' (Free Discharge)
└─**1=Culvert** (Inlet Controls 20.00 cfs @ 11.32 fps)

Pond DI-1: DI-1



Pond SB-1: Basin 1

Inflow Area =	6.000 ac,	Inflow Depth >	3.42"	for	25 yr-24 hr event
Inflow =	37.83 cfs @	11.96 hrs,	Volume=	1.709 af	
Outflow =	9.25 cfs @	12.10 hrs,	Volume=	1.140 af,	Atten= 76%, Lag= 8.5 min
Primary =	9.25 cfs @	12.10 hrs,	Volume=	1.140 af	
Secondary =	0.00 cfs @	5.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 687.66' @ 12.12 hrs Surf.Area= 8,166 sf Storage= 37,886 cf

Plug-Flow detention time= 173.8 min calculated for 1.140 af (67% of inflow)
Center-of-Mass det. time= 104.4 min (879.2 - 774.8)

Volume	Invert	Avail.Storage	Storage Description
#1	680.00'	40,740 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

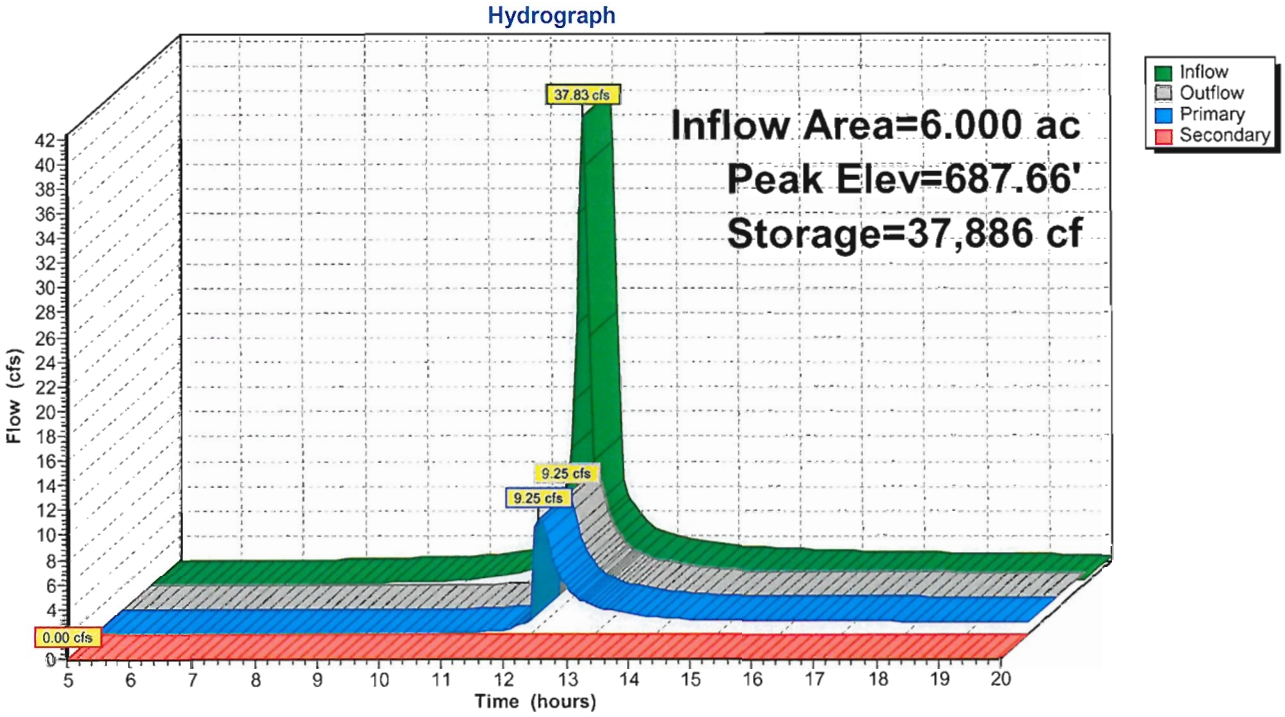
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
680.00	2,240	0	0
682.00	3,500	5,740	5,740
684.00	4,950	8,450	14,190
686.00	6,550	11,500	25,690
688.00	8,500	15,050	40,740

Device	Routing	Invert	Outlet Devices
#1	Primary	680.00'	**12.0" x 80.0' long Barrel** CPP, square edge headwall, Ke= 0.500 Outlet Invert= 678.00' S= 0.0250 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Device 1	687.00'	**24.0" Horiz. Riser** Limited to weir flow C= 0.600
#3	Device 1	681.00'	**0.5" Vert. Dewatering Holes X 25.00 columns** X 3 rows with 9.0" cc spacing C= 0.600
#4	Secondary	688.00'	**20.0' long x 10.0' breadth Emergency Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=9.25 cfs @ 12.10 hrs HW=687.65' (Free Discharge)
└─**1=Barrel** (Barrel Controls 9.25 cfs @ 11.78 fps)
  ├─**2=Riser** (Passes < 10.70 cfs potential flow)
  └─**3=Dewatering Holes** (Passes < 1.19 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=680.00' (Free Discharge)
└─**4=Emergency Spillway** (Controls 0.00 cfs)

Pond SB-1: Basin 1



Pond SB-2: Basin - 2

Inflow Area =	3.430 ac,	Inflow Depth >	3.42"	for	25 yr-24 hr event
Inflow =	21.76 cfs @	11.96 hrs,	Volume=	0.976 af	
Outflow =	2.53 cfs @	12.33 hrs,	Volume=	0.483 af,	Atten= 88%, Lag= 21.9 min
Primary =	2.53 cfs @	12.33 hrs,	Volume=	0.483 af	
Secondary =	0.00 cfs @	5.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 695.14' @ 12.33 hrs Surf.Area= 9,574 sf Storage= 23,793 cf

Plug-Flow detention time= 180.4 min calculated for 0.483 af (49% of inflow)
Center-of-Mass det. time= 101.4 min (876.7 - 775.3)

Volume	Invert	Avail.Storage	Storage Description
#1	692.00'	57,520 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

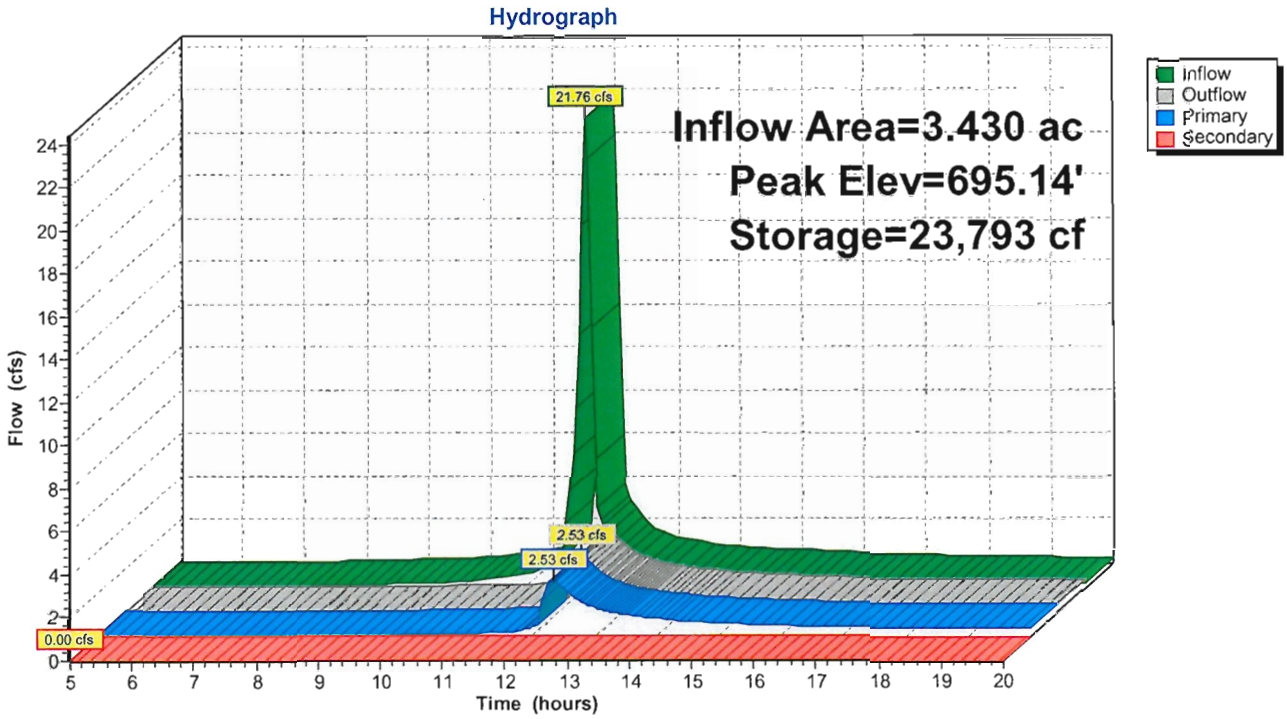
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
692.00	5,850	0	0
694.00	7,945	13,795	13,795
696.00	10,800	18,745	32,540
698.00	14,180	24,980	57,520

Device	Routing	Invert	Outlet Devices
#1	Primary	692.00'	**15.0" x 70.0' long Barrel** CMP, square edge headwall, Ke= 0.500 Outlet Invert= 686.00' S= 0.0857 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior
#2	Device 1	695.00'	**3.00' x 3.00' Horiz. Riser** Limited to weir flow C= 0.600
#3	Secondary	696.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#4	Device 1	692.00'	**3.0" Vert. 3" Skimmer Orifice** C= 0.600

Primary OutFlow Max=2.49 cfs @ 12.33 hrs HW=695.14' (Free Discharge)
└─**1=Barrel** (Passes 2.49 cfs of 9.37 cfs potential flow)
  ├─**2=Riser** (Weir Controls 2.08 cfs @ 1.23 fps)
  └─**4=3" Skimmer Orifice** (Orifice Controls 0.41 cfs @ 8.36 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=692.00' (Free Discharge)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond SB-2: Basin - 2



Pond ST-A: Existing Sediment Trap - A

Inflow Area = 4.200 ac, Inflow Depth > 3.41" for 25 yr-24 hr event
Inflow = 25.10 cfs @ 11.99 hrs, Volume= 1.195 af
Outflow = 40.84 cfs @ 12.00 hrs, Volume= 0.869 af, Atten= 0%, Lag= 0.3 min
Primary = 40.84 cfs @ 12.00 hrs, Volume= 0.869 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 682.95' @ 12.00 hrs Surf.Area= 8,100 sf Storage= 15,600 cf
Flood Elev= 683.00' Surf.Area= 8,100 sf Storage= 15,600 cf

Plug-Flow detention time= 100.2 min calculated for 0.866 af (73% of inflow)
Center-of-Mass det. time= 37.5 min (814.6 - 777.1)

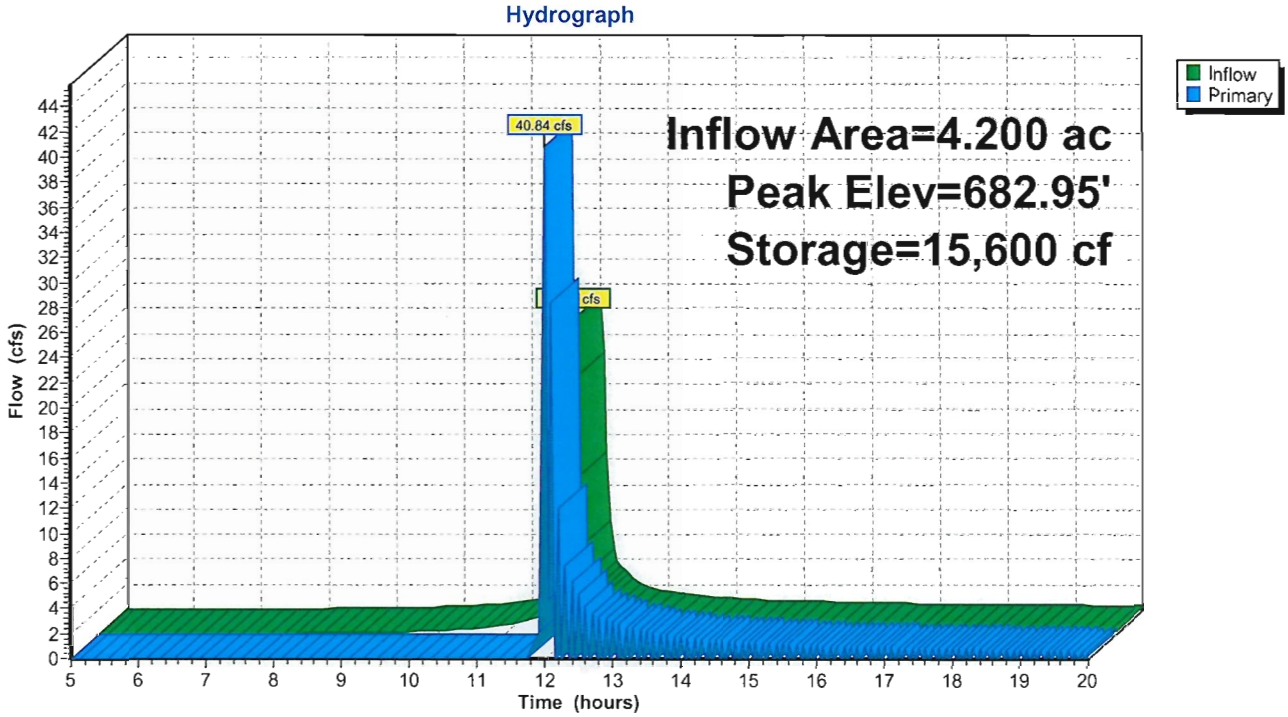
Volume	Invert	Avail.Storage	Storage Description
#1	678.00'	15,600 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
678.00	300	0	0
680.00	3,600	3,900	3,900
682.00	8,100	11,700	15,600

Device	Routing	Invert	Outlet Devices
#1	Primary	682.00'	**143.0 deg x 12.0' long Sharp-Crested Vee/Trap Weir** C= 2.47

Primary OutFlow Max=40.33 cfs @ 12.00 hrs HW=682.94' (Free Discharge)
└**1=Sharp-Crested Vee/Trap Weir** (Weir Controls 40.33 cfs @ 2.88 fps)

Pond ST-A: Existing Sediment Trap - A



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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1-2A: DA 1-2A Runoff Area=0.900 ac Runoff Depth>2.76"
Flow Length=300' Slope=0.0760 '/' Tc=2.6 min CN=79 Runoff=5.12 cfs 0.207 af

Subcatchment 1-2B: DA 1-2B Runoff Area=0.400 ac Runoff Depth>2.76"
Flow Length=30' Slope=0.2500 '/' Tc=1.3 min CN=79 Runoff=2.31 cfs 0.092 af

Subcatchment 1-3: DA 1-3 Runoff Area=2.700 ac Runoff Depth>2.76"
Flow Length=600' Slope=0.1100 '/' Tc=4.3 min CN=79 Runoff=14.74 cfs 0.620 af

Subcatchment 2-1: DA 2-1 Runoff Area=0.660 ac Runoff Depth>2.76"
Flow Length=110' Slope=0.2500 '/' Tc=3.7 min CN=79 Runoff=3.68 cfs 0.152 af

Subcatchment 2-2: DA 2-2 Runoff Area=0.640 ac Runoff Depth>2.76"
Flow Length=100' Slope=0.2000 '/' Tc=3.7 min CN=79 Runoff=3.57 cfs 0.147 af

Subcatchment 2-3: DA 2-3 Runoff Area=0.400 ac Runoff Depth>2.76"
Tc=5.0 min CN=79 Runoff=2.12 cfs 0.092 af

Subcatchment A-2: DA A-2 Runoff Area=2.100 ac Runoff Depth>2.76"
Flow Length=650' Slope=0.0860 '/' Tc=5.3 min CN=79 Runoff=10.99 cfs 0.482 af

Subcatchment DP 1-1: DP 1-1 Runoff Area=2.000 ac Runoff Depth>2.75"
Flow Length=337' Tc=6.3 min CN=79 Runoff=10.15 cfs 0.459 af

Subcatchment DP 2-1: DP 2-1 Runoff Area=1.730 ac Runoff Depth>2.76"
Flow Length=275' Tc=4.4 min CN=79 Runoff=9.41 cfs 0.397 af

Subcatchment DP A-1: DP A-1 Runoff Area=2.100 ac Runoff Depth>2.75"
Flow Length=485' Tc=7.9 min CN=79 Runoff=10.18 cfs 0.482 af

Reach DC 1-2A: DC 1-2A Avg. Depth=0.25' Max Vel=4.43 fps Inflow=5.12 cfs 0.207 af
n=0.030 L=150.0' S=0.0600 '/' Capacity=223.59 cfs Outflow=4.92 cfs 0.207 af

Reach DC 1-2B: DC 1-2B Avg. Depth=0.26' Max Vel=5.82 fps Inflow=7.05 cfs 0.299 af
n=0.030 L=255.0' S=0.0980 '/' Capacity=285.81 cfs Outflow=6.77 cfs 0.298 af

Reach DC 1-3: DC 1-3 Avg. Depth=0.40' Max Vel=7.36 fps Inflow=14.74 cfs 0.620 af
n=0.030 L=200.0' S=0.1000 '/' Capacity=177.51 cfs Outflow=14.15 cfs 0.620 af

Reach DC 2-1: DC 2-1 Avg. Depth=0.14' Max Vel=4.11 fps Inflow=3.68 cfs 0.152 af
n=0.030 L=290.0' S=0.1034 '/' Capacity=386.95 cfs Outflow=3.35 cfs 0.151 af

Reach DC 2-2: DC 2-2 Avg. Depth=0.29' Max Vel=6.44 fps Inflow=12.97 cfs 0.544 af
n=0.030 L=275.0' S=0.1018 '/' Capacity=416.70 cfs Outflow=12.20 cfs 0.544 af

Reach DC A-2: DC A-2 Avg. Depth=0.56' Max Vel=6.05 fps Inflow=10.99 cfs 0.482 af
n=0.035 L=540.0' S=0.0726 '/' Capacity=77.66 cfs Outflow=10.23 cfs 0.481 af

Pond C 1-1: C 1-2 Peak Elev=719.59' Inflow=4.92 cfs 0.207 af
18.0" x 64.0' Culvert Outflow=4.92 cfs 0.207 af

Pond DI 2-1: DI 2-1 Peak Elev=694.37' Inflow=3.35 cfs 0.151 af
18.0" x 48.0' Culvert Outflow=3.35 cfs 0.151 af

Pond DI-1: DI-1 Peak Elev=690.35' Inflow=16.62 cfs 0.757 af
18.0" x 50.0' Culvert Outflow=16.62 cfs 0.757 af

Pond SB-1: Basin 1 Peak Elev=687.20' Storage=34,234 cf Inflow=30.76 cfs 1.377 af
Primary=2.95 cfs 0.854 af Secondary=0.00 cfs 0.000 af Outflow=2.95 cfs 0.854 af

Pond SB-2: Basin - 2 Peak Elev=695.03' Storage=22,726 cf Inflow=17.65 cfs 0.787 af
Primary=0.68 cfs 0.310 af Secondary=0.00 cfs 0.000 af Outflow=0.68 cfs 0.310 af

Pond ST-A: Existing Sediment Trap - A Peak Elev=682.90' Storage=15,600 cf Inflow=20.39 cfs 0.963 af
Outflow=37.26 cfs 0.645 af

Total Runoff Area = 13.630 ac Runoff Volume = 3.130 af Average Runoff Depth = 2.76"
100.00% Pervious Area = 13.630 ac 0.00% Impervious Area = 0.000 ac

Subcatchment 1-2A: DA 1-2A

Runoff = 5.12 cfs @ 11.93 hrs, Volume= 0.207 af, Depth> 2.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 yr - 24 hr Rainfall=5.20"

Area (ac)	CN	Description
0.900	79	50-75% Grass cover, Fair, HSG C
0.900		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	300	0.0760	1.93		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment 1-2B: DA 1-2B

Runoff = 2.31 cfs @ 11.91 hrs, Volume= 0.092 af, Depth> 2.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 yr - 24 hr Rainfall=5.20"

Area (ac)	CN	Description
0.400	79	50-75% Grass cover, Fair, HSG C
0.400		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	30	0.2500	0.39		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.55"

Subcatchment 1-3: DA 1-3

Runoff = 14.74 cfs @ 11.95 hrs, Volume= 0.620 af, Depth> 2.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 yr - 24 hr Rainfall=5.20"

Area (ac)	CN	Description
2.700	79	50-75% Grass cover, Fair, HSG C
2.700		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	600	0.1100	2.32		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment 2-1: DA 2-1

Runoff = 3.68 cfs @ 11.94 hrs, Volume= 0.152 af, Depth> 2.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 yr - 24 hr Rainfall=5.20"

Area (ac)	CN	Description
0.660	79	50-75% Grass cover, Fair, HSG C
0.660		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	110	0.2500	0.50		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.55"

Subcatchment 2-2: DA 2-2

Runoff = 3.57 cfs @ 11.94 hrs, Volume= 0.147 af, Depth> 2.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 yr - 24 hr Rainfall=5.20"

Area (ac)	CN	Description
0.640	79	50-75% Grass cover, Fair, HSG C
0.640		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	100	0.2000	0.45		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.55"

Subcatchment 2-3: DA 2-3

Runoff = 2.12 cfs @ 11.96 hrs, Volume= 0.092 af, Depth> 2.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 yr - 24 hr Rainfall=5.20"

Area (ac)	CN	Description
0.400	79	50-75% Grass cover, Fair, HSG C
0.400		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment A-2: DA A-2

Runoff = 10.99 cfs @ 11.96 hrs, Volume= 0.482 af, Depth> 2.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 yr - 24 hr Rainfall=5.20"

Area (ac)	CN	Description
2.100	79	50-75% Grass cover, Fair, HSG C
2.100		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	650	0.0860	2.05		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment DP 1-1: DP 1-1

Runoff = 10.15 cfs @ 11.98 hrs, Volume= 0.459 af, Depth> 2.75"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 yr - 24 hr Rainfall=5.20"

Area (ac)	CN	Description
2.000	79	50-75% Grass cover, Fair, HSG C
2.000		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	75	0.0800	0.29		**Sheet Flow, Landfill slope-1** Grass: Short n= 0.150 P2= 3.55"
1.9	50	0.2500	0.43		**Sheet Flow, Landfill Slope-2** Grass: Short n= 0.150 P2= 3.55"
0.2	212	0.2500	15.46	27.31	**Circular Channel (pipe), Down Pipe-2** Diam= 18.0" Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.025 Corrugated PE, corrugated interior
6.3	337	Total			

Subcatchment DP 2-1: DP 2-1

Runoff = 9.41 cfs @ 11.95 hrs, Volume= 0.397 af, Depth> 2.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 yr - 24 hr Rainfall=5.20"

Area (ac)	CN	Description
1.730	79	50-75% Grass cover, Fair, HSG C
1.730		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	75	0.0800	0.29		**Sheet Flow, Landfill Slope** Grass: Short n= 0.150 P2= 3.55"
0.2	200	0.2675	15.99	28.25	**Circular Channel (pipe), Down Pipe** Diam= 18.0" Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.025 Corrugated PE, corrugated interior
4.4	275	Total			

Subcatchment DP A-1: DP A-1

Runoff = 10.18 cfs @ 11.99 hrs, Volume= 0.482 af, Depth> 2.75"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 yr - 24 hr Rainfall=5.20"

Area (ac)	CN	Description
2.100	79	50-75% Grass cover, Fair, HSG C
2.100		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	75	0.0800	0.29		**Sheet Flow, Landfill Slope-1** Grass: Short n= 0.150 P2= 3.55"
3.4	100	0.2500	0.49		**Sheet Flow, Labdfill slope-2** Grass: Short n= 0.150 P2= 3.55"
0.3	310	0.2600	15.76	27.85	**Circular Channel (pipe), Down Pipe -1** Diam= 18.0" Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.025 Corrugated PE, corrugated interior
7.9	485	Total			

Reach DC 1-2A: DC 1-2A

Inflow Area = 0.900 ac, Inflow Depth > 2.76" for 10 yr - 24 hr event
Inflow = 5.12 cfs @ 11.93 hrs, Volume= 0.207 af
Outflow = 4.92 cfs @ 11.94 hrs, Volume= 0.207 af, Atten= 4%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.43 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 1.14 fps, Avg. Travel Time= 2.2 min

Peak Storage= 171 cf @ 11.94 hrs, Average Depth at Peak Storage= 0.25'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 223.59 cfs

4.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 150.0' Slope= 0.0600 '/'
Inlet Invert= 728.00', Outlet Invert= 719.00'

Reach DC 1-2B: DC 1-2B

Inflow Area = 1.300 ac, Inflow Depth > 2.76" for 10 yr - 24 hr event
Inflow = 7.05 cfs @ 11.93 hrs, Volume= 0.299 af
Outflow = 6.77 cfs @ 11.95 hrs, Volume= 0.298 af, Atten= 4%, Lag= 1.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.82 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.52 fps, Avg. Travel Time= 2.8 min

Peak Storage= 306 cf @ 11.94 hrs, Average Depth at Peak Storage= 0.26'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 285.81 cfs

4.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 255.0' Slope= 0.0980 '/'
Inlet Invert= 718.00', Outlet Invert= 693.00'

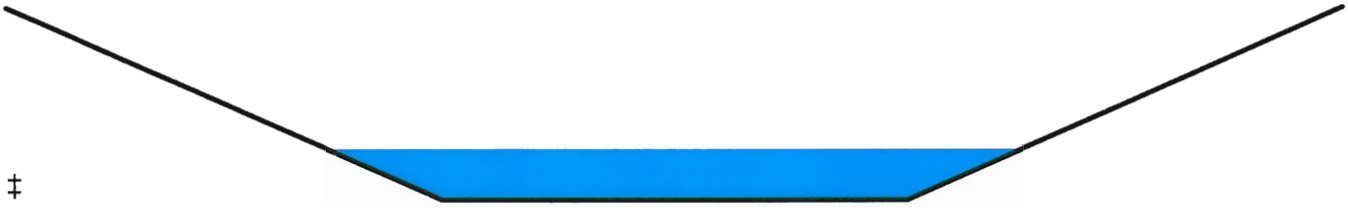
Reach DC 1-3: DC 1-3

Inflow Area = 2.700 ac, Inflow Depth > 2.76" for 10 yr - 24 hr event
Inflow = 14.74 cfs @ 11.95 hrs, Volume= 0.620 af
Outflow = 14.15 cfs @ 11.96 hrs, Volume= 0.620 af, Atten= 4%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.36 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.88 fps, Avg. Travel Time= 1.8 min

Peak Storage= 395 cf @ 11.95 hrs, Average Depth at Peak Storage= 0.40'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 177.51 cfs

4.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.5 '/' Top Width= 11.50'
Length= 200.0' Slope= 0.1000 '/'
Inlet Invert= 702.00', Outlet Invert= 682.00'



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Reach DC 2-1: DC 2-1

Inflow Area = 0.660 ac, Inflow Depth > 2.76" for 10 yr - 24 hr event
Inflow = 3.68 cfs @ 11.94 hrs, Volume= 0.152 af
Outflow = 3.35 cfs @ 11.97 hrs, Volume= 0.151 af, Atten= 9%, Lag= 1.8 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.11 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 1.27 fps, Avg. Travel Time= 3.8 min

Peak Storage= 251 cf @ 11.95 hrs, Average Depth at Peak Storage= 0.14'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 386.95 cfs

6.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 14.00'
Length= 290.0' Slope= 0.1034 '/'
Inlet Invert= 732.00', Outlet Invert= 702.00'

Reach DC 2-2: DC 2-2

Inflow Area = 2.370 ac, Inflow Depth > 2.76" for 10 yr - 24 hr event
Inflow = 12.97 cfs @ 11.95 hrs, Volume= 0.544 af
Outflow = 12.20 cfs @ 11.96 hrs, Volume= 0.544 af, Atten= 6%, Lag= 1.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.44 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.64 fps, Avg. Travel Time= 2.8 min

Peak Storage= 542 cf @ 11.96 hrs, Average Depth at Peak Storage= 0.29'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 416.70 cfs

6.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.5 '/' Top Width= 16.00'
Length= 275.0' Slope= 0.1018 '/'
Inlet Invert= 720.00', Outlet Invert= 692.00'

‡

Reach DC A-2: DC A-2

Inflow Area = 2.100 ac, Inflow Depth > 2.76" for 10 yr - 24 hr event
Inflow = 10.99 cfs @ 11.96 hrs, Volume= 0.482 af
Outflow = 10.23 cfs @ 12.00 hrs, Volume= 0.481 af, Atten= 7%, Lag= 2.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.05 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 1.75 fps, Avg. Travel Time= 5.1 min

Peak Storage= 949 cf @ 11.98 hrs, Average Depth at Peak Storage= 0.56'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 77.66 cfs

2.00' x 1.50' deep channel, n= 0.035
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 540.0' Slope= 0.0726 '/'
Inlet Invert= 720.00', Outlet Invert= 680.80'

Pond C 1-1: C 1-2

Inflow Area = 0.900 ac, Inflow Depth > 2.75" for 10 yr - 24 hr event
Inflow = 4.92 cfs @ 11.94 hrs, Volume= 0.207 af
Outflow = 4.92 cfs @ 11.94 hrs, Volume= 0.207 af, Atten= 0%, Lag= 0.0 min
Primary = 4.92 cfs @ 11.94 hrs, Volume= 0.207 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 719.59' @ 11.94 hrs
Flood Elev= 720.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	718.50'	**18.0" x 64.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 717.50' S= 0.0156 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=4.79 cfs @ 11.94 hrs HW=719.58' (Free Discharge)
└**1=Culvert** (Inlet Controls 4.79 cfs @ 3.53 fps)

Pond DI 2-1: DI 2-1

Inflow Area = 0.660 ac, Inflow Depth > 2.75" for 10 yr - 24 hr event
Inflow = 3.35 cfs @ 11.97 hrs, Volume= 0.151 af
Outflow = 3.35 cfs @ 11.97 hrs, Volume= 0.151 af, Atten= 0%, Lag= 0.0 min
Primary = 3.35 cfs @ 11.97 hrs, Volume= 0.151 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 694.37' @ 11.97 hrs
Flood Elev= 702.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	693.50'	**18.0" x 48.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 692.00' S= 0.0313 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections

Primary OutFlow Max=3.25 cfs @ 11.97 hrs HW=694.35' (Free Discharge)
└**1=Culvert** (Inlet Controls 3.25 cfs @ 3.14 fps)

Pond DI-1: DI-1

Inflow Area = 3.300 ac, Inflow Depth > 2.75" for 10 yr - 24 hr event
Inflow = 16.62 cfs @ 11.96 hrs, Volume= 0.757 af
Outflow = 16.62 cfs @ 11.96 hrs, Volume= 0.757 af, Atten= 0%, Lag= 0.0 min
Primary = 16.62 cfs @ 11.96 hrs, Volume= 0.757 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 690.35' @ 11.96 hrs
Flood Elev= 692.67'

Device	Routing	Invert	Outlet Devices
#1	Primary	685.80'	**18.0" x 50.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 680.80' S= 0.1000 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=16.22 cfs @ 11.96 hrs HW=690.18' (Free Discharge)
└**1=Culvert** (Inlet Controls 16.22 cfs @ 9.18 fps)

Pond SB-1: Basin 1

Inflow Area = 6.000 ac, Inflow Depth > 2.75" for 10 yr - 24 hr event
Inflow = 30.76 cfs @ 11.96 hrs, Volume= 1.377 af
Outflow = 2.95 cfs @ 12.45 hrs, Volume= 0.854 af, Atten= 90%, Lag= 29.7 min
Primary = 2.95 cfs @ 12.45 hrs, Volume= 0.854 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 687.20' @ 12.45 hrs Surf.Area= 7,718 sf Storage= 34,234 cf

Plug-Flow detention time= 215.1 min calculated for 0.854 af (62% of inflow)
Center-of-Mass det. time= 141.7 min (921.4 - 779.7)

Volume	Invert	Avail.Storage	Storage Description
#1	680.00'	40,740 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
680.00	2,240	0	0
682.00	3,500	5,740	5,740
684.00	4,950	8,450	14,190
686.00	6,550	11,500	25,690
688.00	8,500	15,050	40,740

Device	Routing	Invert	Outlet Devices
#1	Primary	680.00'	**12.0" x 80.0' long Barrel** CPP, square edge headwall, Ke= 0.500 Outlet Invert= 678.00' S= 0.0250 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Device 1	687.00'	**24.0" Horiz. Riser** Limited to weir flow C= 0.600
#3	Device 1	681.00'	**0.5" Vert. Dewatering Holes X 25.00 columns** X 3 rows with 9.0" cc spacing C= 0.600
#4	Secondary	688.00'	**20.0' long x 10.0' breadth Emergency Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=2.95 cfs @ 12.45 hrs HW=687.20' (Free Discharge)
└─**1=Barrel** (Passes 2.95 cfs of 9.01 cfs potential flow)
  ├─**2=Riser** (Weir Controls 1.80 cfs @ 1.45 fps)
  └─**3=Dewatering Holes** (Orifice Controls 1.15 cfs @ 11.20 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=680.00' (Free Discharge)
└─**4=Emergency Spillway** (Controls 0.00 cfs)

Pond SB-2: Basin - 2

Inflow Area =	3.430 ac,	Inflow Depth > 2.75"	for 10 yr - 24 hr event	
Inflow =	17.65 cfs @	11.96 hrs, Volume=	0.787 af	
Outflow =	0.68 cfs @	13.65 hrs, Volume=	0.310 af, Atten= 96%, Lag= 101.3 min	
Primary =	0.68 cfs @	13.65 hrs, Volume=	0.310 af	
Secondary =	0.00 cfs @	5.00 hrs, Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 695.03' @ 13.65 hrs Surf.Area= 9,414 sf Storage= 22,726 cf

Plug-Flow detention time= 238.7 min calculated for 0.310 af (39% of inflow)
Center-of-Mass det. time= 154.3 min (934.4 - 780.2)

Volume	Invert	Avail.Storage	Storage Description
#1	692.00'	57,520 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
692.00	5,850	0	0
694.00	7,945	13,795	13,795
696.00	10,800	18,745	32,540
698.00	14,180	24,980	57,520

Device	Routing	Invert	Outlet Devices
#1	Primary	692.00'	**15.0" x 70.0' long Barrel** CMP, square edge headwall, Ke= 0.500 Outlet Invert= 686.00' S= 0.0857 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior
#2	Device 1	695.00'	**3.00' x 3.00' Horiz. Riser** Limited to weir flow C= 0.600
#3	Secondary	696.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#4	Device 1	692.00'	**3.0" Vert. 3" Skimmer Orifice** C= 0.600

Primary OutFlow Max=0.60 cfs @ 13.65 hrs HW=695.03' (Free Discharge)
└─**1=Barrel** (Passes 0.60 cfs of 9.16 cfs potential flow)
  ├─**2=Riser** (Weir Controls 0.19 cfs @ 0.56 fps)
  └─**4=3" Skimmer Orifice** (Orifice Controls 0.40 cfs @ 8.21 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=692.00' (Free Discharge)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond ST-A: Existing Sediment Trap - A

Inflow Area = 4.200 ac, Inflow Depth > 2.75" for 10 yr - 24 hr event
Inflow = 20.39 cfs @ 12.00 hrs, Volume= 0.963 af
Outflow = 37.26 cfs @ 12.05 hrs, Volume= 0.645 af, Atten= 0%, Lag= 3.2 min
Primary = 37.26 cfs @ 12.05 hrs, Volume= 0.645 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 682.90' @ 12.05 hrs Surf.Area= 8,100 sf Storage= 15,600 cf
Flood Elev= 683.00' Surf.Area= 8,100 sf Storage= 15,600 cf

Plug-Flow detention time= 114.1 min calculated for 0.645 af (67% of inflow)
Center-of-Mass det. time= 44.4 min (826.4 - 782.0)

Volume	Invert	Avail.Storage	Storage Description
#1	678.00'	15,600 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
678.00	300	0	0
680.00	3,600	3,900	3,900
682.00	8,100	11,700	15,600

Device	Routing	Invert	Outlet Devices
#1	Primary	682.00'	**143.0 deg x 12.0' long Sharp-Crested Vee/Trap Weir** C= 2.47

Primary OutFlow Max=37.26 cfs @ 12.05 hrs HW=682.90' (Free Discharge)
└─**1=Sharp-Crested Vee/Trap Weir** (Weir Controls 37.26 cfs @ 2.82 fps)

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1-2A: DA 1-2A Runoff Area=0.900 ac Runoff Depth>1.47"
Flow Length=300' Slope=0.0760 '/' Tc=2.6 min CN=79 Runoff=2.82 cfs 0.110 af

Subcatchment 1-2B: DA 1-2B Runoff Area=0.400 ac Runoff Depth>1.47"
Flow Length=30' Slope=0.2500 '/' Tc=1.3 min CN=79 Runoff=1.26 cfs 0.049 af

Subcatchment 1-3: DA 1-3 Runoff Area=2.700 ac Runoff Depth>1.47"
Flow Length=600' Slope=0.1100 '/' Tc=4.3 min CN=79 Runoff=8.07 cfs 0.331 af

Subcatchment 2-1: DA 2-1 Runoff Area=0.660 ac Runoff Depth>1.47"
Flow Length=110' Slope=0.2500 '/' Tc=3.7 min CN=79 Runoff=2.02 cfs 0.081 af

Subcatchment 2-2: DA 2-2 Runoff Area=0.640 ac Runoff Depth>1.47"
Flow Length=100' Slope=0.2000 '/' Tc=3.7 min CN=79 Runoff=1.96 cfs 0.079 af

Subcatchment 2-3: DA 2-3 Runoff Area=0.400 ac Runoff Depth>1.47"
Tc=5.0 min CN=79 Runoff=1.16 cfs 0.049 af

Subcatchment A-2: DA A-2 Runoff Area=2.100 ac Runoff Depth>1.47"
Flow Length=650' Slope=0.0860 '/' Tc=5.3 min CN=79 Runoff=5.99 cfs 0.257 af

Subcatchment DP 1-1: DP 1-1 Runoff Area=2.000 ac Runoff Depth>1.47"
Flow Length=337' Tc=6.3 min CN=79 Runoff=5.55 cfs 0.245 af

Subcatchment DP 2-1: DP 2-1 Runoff Area=1.730 ac Runoff Depth>1.47"
Flow Length=275' Tc=4.4 min CN=79 Runoff=5.15 cfs 0.212 af

Subcatchment DP A-1: DP A-1 Runoff Area=2.100 ac Runoff Depth>1.47"
Flow Length=485' Tc=7.9 min CN=79 Runoff=5.54 cfs 0.257 af

Reach DC 1-2A: DC 1-2A Avg. Depth=0.18' Max Vel=3.59 fps Inflow=2.82 cfs 0.110 af
n=0.030 L=150.0' S=0.0600 '/' Capacity=223.59 cfs Outflow=2.67 cfs 0.110 af

Reach DC 1-2B: DC 1-2B Avg. Depth=0.18' Max Vel=4.70 fps Inflow=3.83 cfs 0.159 af
n=0.030 L=255.0' S=0.0980 '/' Capacity=285.81 cfs Outflow=3.62 cfs 0.159 af

Reach DC 1-3: DC 1-3 Avg. Depth=0.28' Max Vel=6.02 fps Inflow=8.07 cfs 0.331 af
n=0.030 L=200.0' S=0.1000 '/' Capacity=177.51 cfs Outflow=7.66 cfs 0.331 af

Reach DC 2-1: DC 2-1 Avg. Depth=0.10' Max Vel=3.25 fps Inflow=2.02 cfs 0.081 af
n=0.030 L=290.0' S=0.1034 '/' Capacity=386.95 cfs Outflow=1.84 cfs 0.081 af

Reach DC 2-2: DC 2-2 Avg. Depth=0.20' Max Vel=5.17 fps Inflow=7.10 cfs 0.291 af
n=0.030 L=275.0' S=0.1018 '/' Capacity=416.70 cfs Outflow=6.63 cfs 0.290 af

Reach DC A-2: DC A-2 Avg. Depth=0.40' Max Vel=5.09 fps Inflow=5.99 cfs 0.257 af
n=0.035 L=540.0' S=0.0726 '/' Capacity=77.66 cfs Outflow=5.51 cfs 0.256 af

Pond C 1-1: C 1-2 Peak Elev=719.26' Inflow=2.67 cfs 0.110 af
18.0" x 64.0' Culvert Outflow=2.67 cfs 0.110 af

Pond DI 2-1: DI 2-1 Peak Elev=694.12' Inflow=1.84 cfs 0.081 af
18.0" x 48.0' Culvert Outflow=1.84 cfs 0.081 af

Pond DI-1: DI-1 Peak Elev=687.67' Inflow=9.02 cfs 0.404 af
18.0" x 50.0' Culvert Outflow=9.02 cfs 0.404 af

Pond SB-1: Basin 1 Peak Elev=684.79' Storage=18,339 cf Inflow=16.67 cfs 0.735 af
Primary=0.85 cfs 0.501 af Secondary=0.00 cfs 0.000 af Outflow=0.85 cfs 0.501 af

Pond SB-2: Basin - 2 Peak Elev=693.72' Storage=11,609 cf Inflow=9.58 cfs 0.420 af
Primary=0.30 cfs 0.197 af Secondary=0.00 cfs 0.000 af Outflow=0.30 cfs 0.197 af

Pond ST-A: Existing Sediment Trap - A Peak Elev=682.10' Storage=15,600 cf Inflow=11.00 cfs 0.514 af
Outflow=1.13 cfs 0.156 af

Total Runoff Area = 13.630 ac Runoff Volume = 1.671 af Average Runoff Depth = 1.47"
100.00% Pervious Area = 13.630 ac 0.00% Impervious Area = 0.000 ac

Subcatchment 1-2A: DA 1-2A

Runoff = 2.82 cfs @ 11.93 hrs, Volume= 0.110 af, Depth> 1.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 yr-24 hr Rainfall=3.55"

Area (ac)	CN	Description
0.900	79	50-75% Grass cover, Fair, HSG C
0.900		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	300	0.0760	1.93		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment 1-2B: DA 1-2B

Runoff = 1.26 cfs @ 11.91 hrs, Volume= 0.049 af, Depth> 1.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 yr-24 hr Rainfall=3.55"

Area (ac)	CN	Description
0.400	79	50-75% Grass cover, Fair, HSG C
0.400		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	30	0.2500	0.39		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.55"

Subcatchment 1-3: DA 1-3

Runoff = 8.07 cfs @ 11.95 hrs, Volume= 0.331 af, Depth> 1.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 yr-24 hr Rainfall=3.55"

Area (ac)	CN	Description
2.700	79	50-75% Grass cover, Fair, HSG C
2.700		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	600	0.1100	2.32		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment 2-1: DA 2-1

Runoff = 2.02 cfs @ 11.95 hrs, Volume= 0.081 af, Depth> 1.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 yr-24 hr Rainfall=3.55"

Area (ac)	CN	Description
0.660	79	50-75% Grass cover, Fair, HSG C
0.660		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	110	0.2500	0.50		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.55"

Subcatchment 2-2: DA 2-2

Runoff = 1.96 cfs @ 11.95 hrs, Volume= 0.079 af, Depth> 1.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 yr-24 hr Rainfall=3.55"

Area (ac)	CN	Description
0.640	79	50-75% Grass cover, Fair, HSG C
0.640		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	100	0.2000	0.45		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.55"

Subcatchment 2-3: DA 2-3

Runoff = 1.16 cfs @ 11.96 hrs, Volume= 0.049 af, Depth> 1.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 yr-24 hr Rainfall=3.55"

Area (ac)	CN	Description
0.400	79	50-75% Grass cover, Fair, HSG C
0.400		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment A-2: DA A-2

Runoff = 5.99 cfs @ 11.96 hrs, Volume= 0.257 af, Depth> 1.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 yr-24 hr Rainfall=3.55"

Area (ac)	CN	Description
2.100	79	50-75% Grass cover, Fair, HSG C
2.100		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	650	0.0860	2.05		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment DP 1-1: DP 1-1

Runoff = 5.55 cfs @ 11.98 hrs, Volume= 0.245 af, Depth> 1.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 yr-24 hr Rainfall=3.55"

Area (ac)	CN	Description
2.000	79	50-75% Grass cover, Fair, HSG C
2.000		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	75	0.0800	0.29		**Sheet Flow, Landfill slope-1** Grass: Short n= 0.150 P2= 3.55"
1.9	50	0.2500	0.43		**Sheet Flow, Landfill Slope-2** Grass: Short n= 0.150 P2= 3.55"
0.2	212	0.2500	15.46	27.31	**Circular Channel (pipe), Down Pipe-2** Diam= 18.0" Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.025 Corrugated PE, corrugated interior
6.3	337	Total			

Subcatchment DP 2-1: DP 2-1

Runoff = 5.15 cfs @ 11.95 hrs, Volume= 0.212 af, Depth> 1.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 yr-24 hr Rainfall=3.55"

Area (ac)	CN	Description
1.730	79	50-75% Grass cover, Fair, HSG C
1.730		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	75	0.0800	0.29		**Sheet Flow, Landfill Slope** Grass: Short n= 0.150 P2= 3.55"
0.2	200	0.2675	15.99	28.25	**Circular Channel (pipe), Down Pipe** Diam= 18.0" Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.025 Corrugated PE, corrugated interior
4.4	275	Total			

Subcatchment DP A-1: DP A-1

Runoff = 5.54 cfs @ 12.00 hrs, Volume= 0.257 af, Depth> 1.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 yr-24 hr Rainfall=3.55"

Area (ac)	CN	Description
2.100	79	50-75% Grass cover, Fair, HSG C
2.100		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	75	0.0800	0.29		**Sheet Flow, Landfill Slope-1** Grass: Short n= 0.150 P2= 3.55"
3.4	100	0.2500	0.49		**Sheet Flow, Labdfill slope-2** Grass: Short n= 0.150 P2= 3.55"
0.3	310	0.2600	15.76	27.85	**Circular Channel (pipe), Down Pipe -1** Diam= 18.0" Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.025 Corrugated PE, corrugated interior
7.9	485	Total			

Reach DC 1-2A: DC 1-2A

Inflow Area = 0.900 ac, Inflow Depth > 1.47" for 2 yr-24 hr event
Inflow = 2.82 cfs @ 11.93 hrs, Volume= 0.110 af
Outflow = 2.67 cfs @ 11.95 hrs, Volume= 0.110 af, Atten= 5%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.59 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.03 fps, Avg. Travel Time= 2.4 min

Peak Storage= 116 cf @ 11.94 hrs, Average Depth at Peak Storage= 0.18'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 223.59 cfs

4.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 150.0' Slope= 0.0600 '/'
Inlet Invert= 728.00', Outlet Invert= 719.00'

Reach DC 1-2B: DC 1-2B

Inflow Area = 1.300 ac, Inflow Depth > 1.47" for 2 yr-24 hr event
Inflow = 3.83 cfs @ 11.94 hrs, Volume= 0.159 af
Outflow = 3.62 cfs @ 11.96 hrs, Volume= 0.159 af, Atten= 6%, Lag= 1.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.70 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 1.35 fps, Avg. Travel Time= 3.1 min

Peak Storage= 205 cf @ 11.94 hrs, Average Depth at Peak Storage= 0.18'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 285.81 cfs

4.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 255.0' Slope= 0.0980 '/'
Inlet Invert= 718.00', Outlet Invert= 693.00'

Reach DC 1-3: DC 1-3

Inflow Area = 2.700 ac, Inflow Depth > 1.47" for 2 yr-24 hr event
Inflow = 8.07 cfs @ 11.95 hrs, Volume= 0.331 af
Outflow = 7.66 cfs @ 11.97 hrs, Volume= 0.331 af, Atten= 5%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.02 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 1.64 fps, Avg. Travel Time= 2.0 min

Peak Storage= 263 cf @ 11.96 hrs, Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 177.51 cfs

4.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.5 '/' Top Width= 11.50'
Length= 200.0' Slope= 0.1000 '/'
Inlet Invert= 702.00', Outlet Invert= 682.00'

‡

Reach DC 2-1: DC 2-1

Inflow Area = 0.660 ac, Inflow Depth > 1.47" for 2 yr-24 hr event
Inflow = 2.02 cfs @ 11.95 hrs, Volume= 0.081 af
Outflow = 1.84 cfs @ 11.99 hrs, Volume= 0.081 af, Atten= 9%, Lag= 2.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.25 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 1.23 fps, Avg. Travel Time= 3.9 min

Peak Storage= 171 cf @ 11.96 hrs, Average Depth at Peak Storage= 0.10'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 386.95 cfs

6.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 14.00'
Length= 290.0' Slope= 0.1034 '/'
Inlet Invert= 732.00', Outlet Invert= 702.00'

Reach DC 2-2: DC 2-2

Inflow Area = 2.370 ac, Inflow Depth > 1.47" for 2 yr-24 hr event
Inflow = 7.10 cfs @ 11.95 hrs, Volume= 0.291 af
Outflow = 6.63 cfs @ 11.98 hrs, Volume= 0.290 af, Atten= 7%, Lag= 1.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.17 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 1.44 fps, Avg. Travel Time= 3.2 min

Peak Storage= 366 cf @ 11.96 hrs, Average Depth at Peak Storage= 0.20'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 416.70 cfs

6.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.5 '/' Top Width= 16.00'
Length= 275.0' Slope= 0.1018 '/'
Inlet Invert= 720.00', Outlet Invert= 692.00'

‡

Reach DC A-2: DC A-2

Inflow Area = 2.100 ac, Inflow Depth > 1.47" for 2 yr-24 hr event
Inflow = 5.99 cfs @ 11.96 hrs, Volume= 0.257 af
Outflow = 5.51 cfs @ 12.01 hrs, Volume= 0.256 af, Atten= 8%, Lag= 3.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.09 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 1.52 fps, Avg. Travel Time= 5.9 min

Peak Storage= 614 cf @ 11.99 hrs, Average Depth at Peak Storage= 0.40'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 77.66 cfs

2.00' x 1.50' deep channel, n= 0.035
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 540.0' Slope= 0.0726 '/'
Inlet Invert= 720.00', Outlet Invert= 680.80'

Pond C 1-1: C 1-2

Inflow Area = 0.900 ac, Inflow Depth > 1.47" for 2 yr-24 hr event
Inflow = 2.67 cfs @ 11.95 hrs, Volume= 0.110 af
Outflow = 2.67 cfs @ 11.95 hrs, Volume= 0.110 af, Atten= 0%, Lag= 0.0 min
Primary = 2.67 cfs @ 11.95 hrs, Volume= 0.110 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 719.26' @ 11.95 hrs
Flood Elev= 720.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	718.50'	**18.0" x 64.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 717.50' S= 0.0156 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=2.64 cfs @ 11.95 hrs HW=719.26' (Free Discharge)
└**1=Culvert** (Inlet Controls 2.64 cfs @ 2.96 fps)

Pond DI 2-1: DI 2-1

Inflow Area =	0.660 ac,	Inflow Depth >	1.47"	for	2 yr-24 hr event
Inflow =	1.84 cfs @	11.99 hrs,	Volume=	0.081 af	
Outflow =	1.84 cfs @	11.99 hrs,	Volume=	0.081 af,	Atten= 0%, Lag= 0.0 min
Primary =	1.84 cfs @	11.99 hrs,	Volume=	0.081 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 694.12' @ 11.98 hrs
Flood Elev= 702.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	693.50'	**18.0" x 48.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 692.00' S= 0.0313 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections

Primary OutFlow Max=1.77 cfs @ 11.99 hrs HW=694.11' (Free Discharge)
└**1=Culvert** (Inlet Controls 1.77 cfs @ 2.65 fps)

Pond DI-1: DI-1

Inflow Area =	3.300 ac,	Inflow Depth >	1.47"	for	2 yr-24 hr event
Inflow =	9.02 cfs @	11.97 hrs,	Volume=	0.404 af	
Outflow =	9.02 cfs @	11.97 hrs,	Volume=	0.404 af,	Atten= 0%, Lag= 0.0 min
Primary =	9.02 cfs @	11.97 hrs,	Volume=	0.404 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 687.67' @ 11.97 hrs
Flood Elev= 692.67'

Device	Routing	Invert	Outlet Devices
#1	Primary	685.80'	**18.0" x 50.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 680.80' S= 0.1000 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=8.73 cfs @ 11.97 hrs HW=687.60' (Free Discharge)
└**1=Culvert** (Inlet Controls 8.73 cfs @ 4.94 fps)

Pond SB-1: Basin 1

Inflow Area =	6.000 ac,	Inflow Depth >	1.47"	for	2 yr-24 hr event
Inflow =	16.67 cfs @	11.97 hrs,	Volume=	0.735 af	
Outflow =	0.85 cfs @	13.27 hrs,	Volume=	0.501 af,	Atten= 95%, Lag= 78.2 min
Primary =	0.85 cfs @	13.27 hrs,	Volume=	0.501 af	
Secondary =	0.00 cfs @	5.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 684.79' @ 13.27 hrs Surf.Area= 5,580 sf Storage= 18,339 cf

Plug-Flow detention time= 221.8 min calculated for 0.501 af (68% of inflow)
Center-of-Mass det. time= 149.4 min (942.9 - 793.4)

Volume	Invert	Avail.Storage	Storage Description
#1	680.00'	40,740 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
680.00	2,240	0	0
682.00	3,500	5,740	5,740
684.00	4,950	8,450	14,190
686.00	6,550	11,500	25,690
688.00	8,500	15,050	40,740

Device	Routing	Invert	Outlet Devices
#1	Primary	680.00'	**12.0" x 80.0' long Barrel** CPP, square edge headwall, Ke= 0.500 Outlet Invert= 678.00' S= 0.0250 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Device 1	687.00'	**24.0" Horiz. Riser** Limited to weir flow C= 0.600
#3	Device 1	681.00'	**0.5" Vert. Dewatering Holes X 25.00 columns** X 3 rows with 9.0" cc spacing C= 0.600
#4	Secondary	688.00'	**20.0' long x 10.0' breadth Emergency Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.85 cfs @ 13.27 hrs HW=684.79' (Free Discharge)
└─**1=Barrel** (Passes 0.85 cfs of 7.57 cfs potential flow)
  ├─**2=Riser** (Controls 0.00 cfs)
  └─**3=Dewatering Holes** (Orifice Controls 0.85 cfs @ 8.32 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=680.00' (Free Discharge)
└─**4=Emergency Spillway** (Controls 0.00 cfs)

Pond SB-2: Basin - 2

Inflow Area =	3.430 ac,	Inflow Depth > 1.47"	for 2 yr-24 hr event	
Inflow =	9.58 cfs @	11.98 hrs, Volume=	0.420 af	
Outflow =	0.30 cfs @	14.63 hrs, Volume=	0.197 af, Atten= 97%, Lag= 159.5 min	
Primary =	0.30 cfs @	14.63 hrs, Volume=	0.197 af	
Secondary =	0.00 cfs @	5.00 hrs, Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 693.72' @ 14.63 hrs Surf.Area= 7,651 sf Storage= 11,609 cf

Plug-Flow detention time= 242.7 min calculated for 0.196 af (47% of inflow)
Center-of-Mass det. time= 159.4 min (953.4 - 794.1)

Volume	Invert	Avail.Storage	Storage Description
#1	692.00'	57,520 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
692.00	5,850	0	0
694.00	7,945	13,795	13,795
696.00	10,800	18,745	32,540
698.00	14,180	24,980	57,520

Device	Routing	Invert	Outlet Devices
#1	Primary	692.00'	**15.0" x 70.0' long Barrel** CMP, square edge headwall, Ke= 0.500 Outlet Invert= 686.00' S= 0.0857 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior
#2	Device 1	695.00'	**3.00' x 3.00' Horiz. Riser** Limited to weir flow C= 0.600
#3	Secondary	696.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#4	Device 1	692.00'	**3.0" Vert. 3" Skimmer Orifice** C= 0.600

Primary OutFlow Max=0.30 cfs @ 14.63 hrs HW=693.72' (Free Discharge)
└─**1=Barrel** (Passes 0.30 cfs of 6.18 cfs potential flow)
  ├─**2=Riser** (Controls 0.00 cfs)
  └─**4=3" Skimmer Orifice** (Orifice Controls 0.30 cfs @ 6.08 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=692.00' (Free Discharge)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond ST-A: Existing Sediment Trap - A

Inflow Area =	4.200 ac,	Inflow Depth >	1.47"	for	2 yr-24 hr event
Inflow =	11.00 cfs @	12.00 hrs,	Volume=	0.514 af	
Outflow =	1.13 cfs @	13.35 hrs,	Volume=	0.156 af,	Atten= 90%, Lag= 80.8 min
Primary =	1.13 cfs @	13.35 hrs,	Volume=	0.156 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 682.10' @ 13.35 hrs Surf.Area= 8,100 sf Storage= 15,600 cf
Flood Elev= 683.00' Surf.Area= 8,100 sf Storage= 15,600 cf

Plug-Flow detention time= 251.1 min calculated for 0.155 af (30% of inflow)
Center-of-Mass det. time= 162.3 min (958.1 - 795.7)

Volume	Invert	Avail.Storage	Storage Description
#1	678.00'	15,600 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
678.00	300	0	0
680.00	3,600	3,900	3,900
682.00	8,100	11,700	15,600

Device	Routing	Invert	Outlet Devices
#1	Primary	682.00'	**143.0 deg x 12.0' long Sharp-Crested Vee/Trap Weir** C= 2.47

Primary OutFlow Max=1.12 cfs @ 13.35 hrs HW=682.10' (Free Discharge)
└─**1=Sharp-Crested Vee/Trap Weir** (Weir Controls 1.12 cfs @ 0.95 fps)

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PROJECT Davidson County C&D Landfill - Phases 3 & 4

SUBJECT Drainage Channel Analysis

JOB NO. Davidson 08-5
DATE 12/15/08
COMPUTED BY KBS
CHECKED BY PKS

Objective

To design drainage channels, ditches, etc. to handle stormwater flow from the design storm(s). The main design criteria will be to ensure that all drainage channels, ditches, etc. will be able to accommodate the peak discharge from the design storm without overtopping and without exceeding the allowable shear stress and/or velocity of the selected channel lining.

References

Federal Highway Administration (2001), Urban Drainage Design Manual, Hydraulic Engineering Circular No. 22, FHWA NHI-01-021, Second Ed., U.S. Dept. of Transportation, Washington, D.C.

North Carolina Division of Land Resources (2006), North Carolina Erosion & Sediment Control Planning & Design Manual, Raleigh, NC.

Malcom, H. Rooney (1989 & 2003 Supplement), Elements of Urban Stormwater Design, NC State Univ., Raleigh, NC.

Pennsylvania DEP Bureau of Watershed Protection (2000), Erosion and Sediment Pollution Control Program Manual.

Analysis

The following approach is used in the design of drainage channels:

1. Determine the peak discharge from the design storm(s) (from HydroCAD or spreadsheet methods). For permanent linings (Grass, TRM, rip rap, gabions, etc.) use the peak discharge from the 25-Yr 24-Hr storm unless otherwise specified. For grass lined channels, a smaller design storm (2-Yr 24-Hr - unless otherwise specified) is used to evaluate temporary linings.
2. Input other design parameters (bottom width; side slopes; minimum freeboard, min./max. slopes; and channel lining).
3. Based on the design parameters calculate normal depth of flow, velocity, Froude number, and maximum shear stress for both max./min. slopes. Also determine the critical slope and corresponding normal depth.
4. Compare the velocity and/or shear stress to allowable values (the maximum slope values will control). If values are exceeded, revise design parameters as required.
5. Based on normal depth values and required freeboard (generally use the greater of 6 inches or 25% of the flow depth), determine the minimum channel depth and top width for both max./min. slopes (the minimum slope values will control).
6. If the channel has a significant curved reach, evaluate the shear stress and superelevation of the water surface in the bend.

DRAINAGE CHANNEL.WPD

RICHARDSON SMITH GARDNER & ASSOCIATES
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Calculations

- Manning's Equation:

$$Q = \frac{1.49\,AR^{2/3}S^{1/2}}{n} = AV \qquad \text{(HEC-22 Eq. 5-5)}$$

where:
- Q = discharge (cfs)
- n = Manning's roughness coefficient (See Below)
- A = cross sectional area of flow (ft^2)
- R = hydraulic radius (ft) = A/P
- P = wetted perimeter
- S = slope of channel (ft/ft)
- V = average channel velocity (ft/sec)

- Maximum Shear Stress (Tractive Force Method):

$$\tau_d = \gamma d S \qquad \text{(HEC-22 Eq. 5-13)}$$

where:
- τ_d = maximum shear stress on channel lining (lb/ft^2)
- γ = unit weight of water (62.4 lb/ft^3)
- d = maximum depth of flow (ft)
- S = channel slope (ft/ft)

- Froude Number:

$$Fr = \frac{v}{\sqrt{\frac{gA}{T}}}$$

where:
- Fr = Froude number (dimensionless)
- v = flow velocity (ft/sec)
- g = acceleration of gravity (32.2 ft/sec^2)
- A = cross-sectional area of flow (ft^2)
- T = top width of flow (ft)

Note that A/T = the hydraulic depth (D). For $Fr > 1.0$, flow is supercritical; $Fr < 1.0$, flow is subcritical; $Fr = 1.0$, flow is critical.

Critical Slope:

The critical slope (S_c) is the slope at which $Fr = 1.0$. When the slope is between $0.7S_c$ and $1.3S_c$, unstable flow may occur as small flow disturbances can initiate a change in the flow state. If slopes are within this range, consider additional freeboard.

- Manning's Roughness Coefficient (n):

Grass:

$$n = \frac{R^{1/6}}{\left[K + 19.97\log\left(R^{1.4}S^{0.4}\right)\right]}$$ (HEC-22 Eq. 5-6 - 5-10)

where:
R = hydraulic radius (ft)
K = vegetative coefficient (depending on retardance class)
= 15.8 (Class A)
= 23.0 (Class B)
= 30.2 (Class C)
= 34.6 (Class D)
= 37.7 (Class E)
S = slope of channel (ft/ft)

Rip Rap:

$$n = \frac{y^{1/6}}{21.6\log\left(\frac{y}{d_{50}}\right) + 14}$$ (PA DEP Manual Fig. 3)

where:
y = depth of flow (ft)
d_{50} = median size of rip rap (ft)

- Curved Channels (Where Applicable):

Shear Stress in Bend:

$$\tau_b = K_b \tau_d \qquad \text{(HEC-22 Eq. 5-15)}$$

where:
τ_d = bend shear stress (lb/ft^2)
K_b = function of R_c/B (use HEC-22 Chart 21)
τ_d = maximum shear stress on channel lining (lb/ft^2)
R_c = radius to the centerline of the channel (ft)
B = bottom width of channel (ft)

Superelevation at Outside of Bend:

$$\Delta d = 0.5\frac{V^2 T}{gR_c} \qquad \text{(HEC-22 Eq. 5-11 modified)}$$

where:
Δd = superelevation of water surface between the outer channel bank and the centerline of the channel (avg. water surface before bend) (ft)
V = average channel velocity (ft/sec)
T = top width of flow (ft)
g = acceleration of gravity (32.2 ft/sec^2)
R_c = radius to the centerline of the channel (ft)

- Allowable Shear Stress/Velocity:

Grass-Lined Channels:

For grass-lined channels, an allowable velocity approach is applicable for slopes flatter than 10%. For slopes of 10% and steeper appropriate permanent linings should be used. For use in the evaluation of curved channels, the following allowable shear stress values (lb/ft^2) can be assumed based on retardance class:

Class A: 3.70
Class B: 2.10
Class C: 1.00
Class D: 0.60
Class E: 0.35

Rip Rap-Lined Channels:

For rip rap-lined channels, an allowable velocity approach is applicable for slopes flatter than 10% (see attached table). For slopes of 10% or steeper, use the following equation:

$$\tau_{allow} = 4 \times d_{50} \qquad \text{(HEC-22 Eq. 5-17)}$$

where: τ_{allow} = allowable shear stress (lb/ft^2)
d_{50} = median size of rip rap (ft)

Reno Mattress or Gabion-Lined Channels:

For Reno mattress or gabion-lined channels, use allowable velocity for slopes flatter than 10% and allowable shear stress for slopes of 10% or steeper (see attached table).

Riprap Gradation, Filter Blanket Requirements, Maximum Velocities

	Graded Rock Size (in)			Filter Blanket Requirements**		
NSA No.	Max.	d_{50}*	Min.	Size NSA No.	Placement Thickness	V_{max} (ft/sec
R-1	1.5	.75	No. 8	FS-1	N/A	2.5
R-2	3	1.5	1	FS-1	N/A	4.5
R-3	6	3	2	FS-1	3	6.5
R-4	12	6	3	FS-2	4	9.0
R-5	18	9	5	FS-2	6	11.5
R-6	24	12	7	FS-3	8	13.0
R-7	30	15	12	FS-3	10	14.5

* The d_{50} stone size is the size exceeded by 50% of the total weight of the tonnage shipped (i.e. 50% by weight shall consist of pieces larger than the d_{50} stone size").

** This is a general standard. Soil conditions at each site should be analyzed to determine actual filter size. A suitable woven or non-woven geotextile underlayment, used according to manufacturer's recommendations, may be substituted for the filter stone.

Ref: PA DEP Manual Table 9

Maximum Permissible Velocities for Reno Mattress & Gabions

Type	n	Thickness Inches	Rock Fill Gradation (in)	Permissible* Velocity (fps)	Permissible** Shear Stress (lb/ft^2)
Reno Mattress	.025 - .030	6	3 - 6	6.0	8.35
	.025 - .030	6 - 10	3 - 6	12.0	8.35
	.025 - .030	10 - 12	3 - 6	15.0	8.35
	.025 - .030	12 - 18	4 - 6	18.0	8.35
Gabion	.027	>18	5 - 9	22.0	8.35

* Permissible velocities may be increased by the introduction of sand mastic grout. Refer to manufacturer's recommendations/specifications for permissible velocities and for recommendations regarding filters or geotextile fabric underlayment when using Reno mattresses or gabions for channel linings.

** Based on vegetation completely grown.

Ref: PA DEP Manual Table 13

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SHEET: 6 / 7
JOB #: Davidco 08-5
DATE: 12/15/08
BY: KBS
CHKD BY: PKS

Davidson County C&D Landfill - Phases 3 & 4
Drainage Channel Analysis (TRM Lined)

Channel No. DC 2-1 & DC 2-2

Design Parameters:

PEAK DISCHARGE, $Q25$ = 14.0 ft^3/s Source: HydroCAD 25-Yr 24-Hr

Bottom Width, B = 6.0 ft
Left Side Slope, z_1 = 2.5 horizontal :1 vertical
Right Side Slope, z_2 = 2.5 horizontal :1 vertical

Minimum Freeboard = 0.5 ft

Maximum Channel Slope, S_{max} = 0.110 ft/ft
Minimum Channel Slope, S_{min} = 0.070 ft/ft

Turf Reinforcement Matting (TRM) Lining:
Grass Retardance = D
K = 34.6
TRM Product Name = Propex - Landlok TRM 435, or equal
τ_{allow} = 5.0 lb/ft^2

Normal Depth

Depth of Flow (Norm. Depth) Y_n ft	Manning's Roughness Coefficient n	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius $R=A/P$ ft	Top Width T ft	Hydraulic Depth $D=A/T$ ft	Average Velocity V_n ft/s	Flow Rate Q ft^3/s	Froude Number F_r (Normal) #	Maximum Shear Stress τ_d lb/ft^2	Factor of Safety τ_{allow}/τ_d	Comment
Maximum Slope:												
0.44	0.057	3.12	8.37	0.37	8.20	0.38	4.49	14.0	1.28	**3.0**	1.7	**O.K.**
Minimum Slope:												
0.50	0.058	3.63	8.69	0.42	8.50	0.43	3.78	13.7	1.02	**2.2**	2.3	**O.K.**

Critical Depth

Depth of Flow (Crit. Depth) Y_c ft	Manning's Roughness Coefficient n	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius $R=A/P$ ft	Top Width T ft	Hydraulic Depth $D=A/T$ ft	Section Factor $Z=AD^{1/2}$ $ft^{2.5}$	Flow Rate Q ft^3/s	Average Velocity V_c ft/s	Froude Number F_r (Critical) #	Uniform-Flow Critical Slope S_c ft/ft	Comment
0.51	0.058	3.71	8.75	0.42	8.55	0.43	2.44	13.9	3.74	1.00	0.067	**Slopes Near Sc - Check Freeboard.**

Determination of Minimum Channel Depth & Top Width

Maximum Slope		Minimum Slope	
Minimum Channel Depth ft	Minimum Top Width T ft	Minimum Channel Depth ft	Minimum Top Width T ft
0.94	10.70	**1.00**	**11.00**

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SHEET: ~~6/6~~ 7/7
JOB #: DAVDCO-13
DATE: 04/13/05
BY: PKS
CHKD BY:

Davidson County C&D Landfill - Phase 2
Normal Depth Analysis **Channel No. Side Slope Swale**

Peak Flow Rate:

Drainage Area (Ac.) =	1 (User Input)	~~Portion of Area 3~~ Max Area
Hydraulic Length (ft) =	600 (User Input)	Head of Area 3 to Down Pipe No. 2
Fall Along Length (ft) =	24 (User Input)	EL. 750 - EL. 726
Time of Conc. (min.) =	3.7	
Intensity (in/hr) =	8.16 (User Input) (25 Year Storm)	
Runoff Coefficient =	0.5 (User Input) (EOUSD - Exhibit 1 - Unimproved, Cleared Conditions, Modified)	
Q (cfs) =	4.1	

Ditch/Channel Parameters: (User Input)

Lining:	TRM
Maximum Slope (ft/ft) =	0.1
Minimum Slope (ft/ft) =	0.01
n =	0.03 (User Input)
B (ft) =	0
M =	2.75

MAXIMUM SLOPE

Normal Depth Calculations:

nQ/(1.49s^0.5) = 0.259773682

y (ft) = 0.5 (Iterate)

accuracy = 0.1

f(M,y,B) = 0.261770538

Normal Depth (ft) = 0.5

Velocity:

V (ft/s) = 5.98

Liner Shear Stress:

T (lb/ft^2) = 3.12

Froude Number:

Fr = 2.11

MINIMUM SLOPE

Normal Depth Calculations:

nQ/(1.49s^0.5) = 0.82147651

y (ft) = 0.77 (Iterate)

accuracy = 0.1

f(M,y,B) = 0.827896572

Normal Depth (ft) = 0.77

Velocity:

V (ft/s) = 2.52

Liner Shear Stress:

T (lb/ft^2) = 0.48

Froude Number:

Fr = 0.72

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Objective To design down pipes to handle the peak discharge from the design storm.

Reference Debo, T.N., and Reese, A.J. (1995), Municipal Storm Water Management, Lewis Publishers, Boca Raton, FL.

Malcom, H. Rooney (1989 & 2003 Supplement), Elements of Urban Stormwater Design, NC State Univ., Raleigh, NC.

Analysis The following approach is used in the design of down pipes:

1. Determine the peak discharge from the design storm(s). Use the Rational Method.
2. For each pipe size, determine the maximum area (A), to handle the predicted peak discharge (Q) with an added factor of safety. Analyze down pipes based on partial flow to determine flow depth and velocity then compare the full flow capacity of each pipe size with the calculated peak flow rate to verify the desired factor of safety. Analyze down pipe inlets as a culverts under inlet control.

Calculations

- Down Pipe Inlets (Inlet Control):

Determine Q_{max}:

For $Z \leq D$:

$$Q_{\max} = 0.372 C_d D (Z)^{3/2}$$ (Malcom Equation III-13)

For $Z > D$:

$$Q_{\max} = 0.0437 C_d D^2 \left(Z - \frac{D}{24} \right)^{1/2}$$ (Malcom Equation III-13)

where:
Q_{max} = flow capacity of inlet (cfs)
Z = height of water above pipe invert (ft)
= allowable headwater depth (HW)
C_d = coefficient of discharge
D = inside diameter of pipe (in)

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Determine Factor of Safety (FS):

$$FS = \frac{Q_{\max}}{Q}$$

Iterate the drainage area (A) to each inlet such that $Q_{max}/Q \geq$ the desired factor of safety.

- Down Pipes:

Determine Flow Capacity of Pipe:

$$Q_{\max} = \frac{0.463 D^{8/3} S^{1/2}}{n} \qquad \text{(D\&R Equation 8.24)}$$

where:
Q_{max} = flow capacity of pipe (cfs)
D = inside diameter of pipe (ft)
S = pipe slope (ft/ft)
n = Manning's roughness coefficient

Determine Factor of Safety (FS):

$$FS = \frac{Q_{\max}}{Q}$$

Iterate the drainage area (A) to each drainage structure such that $Q_{max}/Q \geq$ the desired factor of safety.

Determine Flow Depth:

$$h = \frac{1}{2}\left(1 - \cos\left(\frac{\theta}{2}\right)\right) D \qquad \text{(D\&R Equation 8.29)}$$

where:
h = flow depth (inches)
θ = central angle

$$\theta = \frac{3\pi}{2}\left[1 - \left(1 - (\pi K)^{1/2}\right)^{1/2}\right]^{1/2} \qquad \text{(D\&R Equation 8.28)}$$

K = constant

$$K = 0.673QnD^{-8/3}S^{-1/2}$$ (D&R Equation 8.27)

Determine Flow Velocity:

$$V = \frac{Q}{A} = \frac{Q}{D^2 \frac{(\theta - \sin\theta)}{8}}$$ (D&R Equation 8.30 for "A")

where: V = flow velocity (ft/sec)
A = cross-sectional area of flow (ft^3)

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JOB #: Davidco 08-5
DATE: 12/15/08
BY: KBS
CHKD BY:

Davidson County C&D Landfill - Phases 3 & 4
Down Pipe Analysis (HDPE Pipe)

Input Parameters:

Manning's Rougness Coefficient =	**0.013**	--> HDPE Pipe
Runoff Coefficient =	**0.60**	
Rainfall Intensity =	**8.94**	IN/HR ---> 50 YR - 5 MIN STORM
Allowable Headwater Depth (Above Pipe Invert) (Down Pipe Inlets) =	**3.0**	FEET
Orifice Coef. Of Discharge (Down Pipe Inlets) =	**0.6**	TYPICAL

Down Pipe Inlets

ID	Drainage Area (AC)	Runoff Volume (Q) (CFS)	Pipe I.D. (SDR 26) (IN)	X-Sectional Area (SF)	Flow Capacity (Q_{max}) (CFS)	Factor of Safety (>/= 1.10)
Max. Area - 12"	**0.90**	4.83	**11.8**	0.76	5.78	1.20
Max. Area - 14"	**1.10**	5.90	**12.9**	0.91	6.85	1.16
Max. Area - 16"	**1.50**	8.05	**14.8**	1.19	8.87	1.10
Max. Area - 18"	**1.80**	9.66	**16.6**	1.50	10.98	1.14
Max. Area - 24"	**3.00**	16.09	**22.2**	2.69	18.61	1.16

Down Pipes

ID	Drainage Area (AC)	Runoff Volume (Q) (CFS)	Pipe I.D. (SDR 26) (IN)	Pipe Slope (%)	Flow Capacity (Q_{max}) (CFS)	Factor of Safety (>/= 1.10)	K (CONSTANT)	θ (< 265°)	Flow Depth (IN)	Flow Area (SF)	Flow Velocity (FPS)
Max. Area - 12"	**1.40**	7.51	**11.8**	**7**	9.01	1.20	0.260	224	8.12	0.56	13.48
Max. Area - 14"	**1.90**	10.19	**12.9**	**7**	11.43	1.12	0.278	233	9.32	0.70	14.51
Max. Area - 16"	**2.70**	14.48	**14.8**	**7**	16.48	1.14	0.274	231	10.57	0.91	15.86
Max. Area - 18"	**3.70**	19.85	**16.6**	**7**	22.39	1.13	0.276	232	11.94	1.16	17.15
Max. Area - 24"	**8.00**	42.91	**22.2**	**7**	48.60	1.13	0.275	231	15.92	2.06	20.80

Pipe Dimensions

Standard Dimension Ratio (SDR) of Pipe = **26**

Nominal Pipe Size (IN)	Pipe O.D. (IN)	Min. Wall Thickness (IN)	Pipe I.D. (IN)
12	**12.75**	0.490	11.8
14	**14**	0.538	12.9
16	**16**	0.615	14.8
18	**18**	0.692	16.6
24	**24**	0.923	22.2

PROJECT Davidson County C&D Landfill - Phases 3 & 4

SUBJECT Drop Inlet Analysis

JOB NO. Davidson 08-5
DATE 1/29/09
COMPUTED BY KBS
CHECKED BY PKS

Objective To design drop inlets to handle stormwater flow from the design storm(s). The main design criteria will be to ensure that all drop inlets will be able to accommodate the peak rate of run off from the design storm without exceeding the allowable headwater depth.

Reference Malcom, H. Rooney (1989 & 2003 Supplement), Elements of Urban Stormwater Design, NC State Univ., Raleigh, NC.

Analysis The following approach is used in the design of drop Inlets:

1. Determine the peak discharge from the design storm(s) (from HydroCAD or spreadsheet methods). Use the peak discharge from the 25-Yr 24-Hr storm unless otherwise specified.
2. As appropriate, analyze the inlet structure as a weir-type inlet and/or grated inlet.
3. Analyze the outlet structure separately by evaluating its behavior as a culvert.

Calculations

- Weir-Type Inlet ⇒ Use the Weir Equation:

$$Q = C_W L H^{3/2}$$ (Malcom Eq. I-6)

where:
Q = peak discharge (cfs)
C_w = weir coefficient (=3.0 for free overfall)
L = length of weir (ft)
H = driving head (ft) (= allowable headwater above crest of weir)

- Grated Inlet ⇒ Use the Orifice Equation:

$$Q = C_d A \sqrt{2gh}$$ (Malcom Eq. I-7)

where:
Q = peak discharge (cfs)
C_d = coefficient of discharge (0.6 = typical value)
A = cross-sectional area of flow at orifice entrance (ft^2)
g = acceleration of gravity (32.2 ft/sec^2)
h = driving head (ft) (= allowable headwater above grate)

DROP INLET.WPD

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DATE: 1/28/09
BY: KBS
CHKD BY: RKS

Davidson County C&D Landfill - Phases 3 & 4
Drop Inlet Analysis **Drop Inlet No.: DI 2-1**

Peak Discharge:

PEAK DISCHARGE, *Q25* (cfs) = 4.0 Source: HydroCAD 25-Yr 24-Hr

Drop Inlet Parameters:

Weir Coefficient = 3.0
Coefficient of Discharge (Orifice) = 0.6
Allowable Driving Head (ft) = 1.5

Weir-Type Inlet:

L (ft) = 8
Q (cfs) = 44.1 (Max >> Reqd) ✓

PROJECT Davidson County C&D Landfill - Phases 3 & 4

SUBJECT Concrete Pipe Strength Analysis

JOB NO. Davidson 08-5
DATE 1/29/09
COMPUTED BY KBS
CHECKED BY PKS

Objective To determine the loads acting on each concrete pipe and evaluate the required pipe strength. Select the appropriate class of pipe to satisfy the strength requirement.

Reference

American Concrete Pipe Association (1992), Concrete Pipe Design Manual, ACPA, Vienna, VA.

American Concrete Pipe Association (1994), "Design Data 40 - Standard Installations and Bedding Factors for the Indirect Design Method", ACPA, Vienna, VA.

American Society for Testing and Materials, "ASTM C 76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, & Sewer Pipe", ASTM, Philadelphia.

Analysis The analysis is based on the following procedure recommended by the American Concrete Pipe Association (ACPA). Note that the design parameters will vary depending on the type of installation (embankment or trench).

1. Determination of Earth Load, W_E:

   Based on the assumed concrete pipe parameters (size, backfill, etc.) use the tables and figures in the Concrete Pipe Design Manual to determine the earth load acting on the pipe. Note that the values determined in the tables and figures are based on a backfill unit weight of 100 lbs/ft^3. This value must be adjusted for the anticipated backfill unit weight. Also, for non-trench installations, values for projection ratio, p (vertical distance between the top of the pipe and natural ground divided by the outside vertical height of the pipe), and settlement ratio, r_{sd}, must be determined in order to use the figures. Table 43 of the Concrete Pipe Design Manual gives suggested values for r_{sd} based on the known or assumed value of p.

2. Determination of Live Load, W_L:

   Based on the concrete pipe parameters (size, backfill, etc.) use the tables in the Concrete Pipe Design Manual to determine the live load acting on the pipe. Note that the values for backfill heights of 10 feet or more and considered insignificant to the design of the pipe.

3. Selection of Standard Installation:

   Select the Standard Installation based on the guidance given in Design Data 40. Note that a Type 1 Standard Installation requires the highest construction quality and degree of inspection while a Type 4 Standard Installation requires virtually no construction quality or inspection.

CONCRETE PIPE.WPD

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4. Determination of Bedding Factors:

Determine the bedding factors based on the guidance given in Design Data 40. For embankment installations, the bedding factor, B_{fe}, is found from Table 4 of Design Data 40 depending on the selected Standard Installation. For trench installations the bedding factor is based on the following equation:

$$B_{fv} = \frac{\left(B_{fe} - B_{fo}\right)\left(B_d - B_c\right)}{\left(B_{dt} - B_c\right)} - B_{fo} \qquad \text{(Design Data 40 Eqn. 5)}$$

where:
B_{fv} = variable bedding factor, trench
B_{fe} = bedding factor, embankment (Design Data 40 Table 4)
B_{fo} = minimum bedding factor, trench (Design Data 40 Table 6)
B_d = trench width at top of pipe (ft)
B_c = outside horizontal span of pipe (ft)
B_{dt} = transition width at top of pipe (ft) (given in Concrete Pipe Design Manual tables for earth load).

Use Table 7A of Design Data 40 to determine the live load bedding factor, B_{fLL}.

5. Application of Factor of Safety, FS:

According to the ACPA, a factor of safety of 1.0 should be applied if the 0.01-inch crack strength is used as the design criterion rather than the ultimate strength.

6. Selection of Pipe Strength/Class:

The required three-edge bearing strength of circular reinforced concrete pipe is expressed as D_{load} in the following equation:

$$D_{load} = \left[\frac{W_E}{BF} + \frac{W_L}{B_{fLL}}\right] + \frac{FS}{D} \qquad \text{(Design Data 40 Eqn. 6)}$$

where:
W_E = earth load on pipe (lbs/linear ft)
W_L = live load on pipe (lbs/linear ft)
BF = bedding factor
= B_{fe} for embankment installations
= B_{fv} for trench installations
B_{fLL} = live load bedding factor
FS = factor of safety
D = pipe diameter (ft)

Note that if B_{fLL} is greater than B_{fe} for embankment installations or B_{fv} for trench installations, use B_{fe} or B_{fv} in place of B_{fLL}.

Select class of reinforced concrete pipe based on the following ASTM C-76 guidelines:

Pipe Class	Maximum D-Load For 0.01-inch Crack (lbs/lf/ft of diameter)
I	800
II	1,000
III	1,350
IV	2,000
V	3,000

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SHEET: 4 / 4
JOB #: Davidson 08-5
DATE: 1/29/09
BY: KBS
CHKD BY:

Davidson County C&D Landfill - Phases 3 & 4
Concrete Pipe Strength Analysis
(Positive Projecting Embankment Installation)

Culvert No.: C 2-1

Concrete Pipe Parameters:

Type of Pipe =	Circular, Concrete	
Pipe Diameter, *D* (in) =	18	
Outside Horzontal Span, *Bc* (ft) =	1.92	**(From Concrete Pipe Design Manual Table 45)**
Height of Backfill, *H* (ft) =	8.5	
Backfill Type =	Sand	
Backfill Unit Wt. (lbs/ft^3) =	120	
Standard Installation =	Type 4	

Determine Earth Load:

Projection Ratio, *p* =	0.3	**(Known or Assumed)**
Settlement Ratio, *rsd* =	1	**(From Concrete Pipe Design Manual Table 43)**
rsd x *p* =	0.3	
W_E (lbs/LF) (@ 100 pcf) =	2,350	**(From Concrete Pipe Design Manual - Figure 163)**
W_E (lbs/LF) (Adjusted) =	2,820	

Determine Live Load:

W_L (lbs/LF) =	205	**(From Concrete Pipe Design Manual Table 45)**

Determine Bedding Factors:

Embankment Bedding Factor, *Bfe* =	1.7	**(From ACPA Design Data 40 Table 4)**
Live Load Bedding Factor, *Bfll* =	2.2	**(From ACPA Design Data 40 Table 7A)**

Factor of Safety:

Factor of Safety, *FS* =	1.0	**(Use 1.0 for Reinforced; 1.25 to 1.5 for Non-Reinforced)**

Selection of Required Pipe Strength/Class:

D_{load} (lbs/LF/ft) = 1,186

Pipe Class	Max. D-Load	
I	800	
II	1,000	
III	1,350	**Use Class III RCP**
IV	2,000	
V	3,000	

(Table per ASTM C 76)

Objective To design a sediment basin(s) to satisfy erosion and sediment control requirements and to handle the flow from the design storm.

References

American Concrete Pipe Association (1996), "Design Data 41 - Manhole Floatation", ACPA, Irving, TX.

Malcom, H. Rooney (1989 & 2003 Supplement), Elements of Urban Stormwater Design, NC State Univ., Raleigh, NC.

North Carolina Division of Land Resources (2006), North Carolina Erosion & Sediment Control Planning & Design Manual, Raleigh, NC.

Virginia Department of Conservation and Recreation (1992), Virginia Erosion & Sediment Control Handbook, Third Edition, Richmond, VA.

Analysis The following approach is used to properly size and evaluate each sediment basin:

1. Design for Wet (If Applicable) and Dry Storage.
2. Route Design Storm.
3. Design Outlet Structures (Design Riser/Barrel Structures and Perform Riser Base Calculations, Anti-Seepage Collar Calculations, & Emergency Spillway Calculations).

Calculations

- Design for Wet (If Applicable) and Dry Storage:

  - Determine required wet (if applicable) and dry storage volumes based on applicable erosion and sedimentation control requirements.

  - If applicable, calculate the desired surface area at the principal spillway. For some locations:

$$A = 0.01 Q_P$$

where: A = desired surface area (acres)
Q_P = peak discharge from design storm (cfs)
(NC - Use 10-yr 24-hr storm; GA - Use 2-yr 24-hr storm)

SED BASIN-GENERAL.WPD

- Set up a stage-storage relationship for the proposed basin as shown below. Based on this relationship and the required volume(s) and/or desired surface area, determine the required wet storage (if applicable) and dry storage elevations. Alternatively the elevation(s) can be determined from a graphical stage-storage relationship.

$$S = K_S Z^b \qquad \text{(Malcom Eq. III-7)}$$

where:
S = storage volume (ft^3)
K_S, b = linear regression constants describing the stage-storage relationship
Z = stage referenced to the bottom elevation included in the analysis (ft)

- Set sediment basin cleanout elevation.

- Size the outlet device to release the dry storage volume (WQ_V) over the desired drawdown period (typically this is a minimum of 24 hours). Use the following equation:

$$A_O = \frac{A_S\sqrt{2h}}{TC_d(20{,}428)}$$

where:
A_o = surface area of dewatering hole(s) (ft^2)
A_s = surface area of basin (at principal spillway) (ft^2)
h = average head of water above hole (= (elev. of principal spillway - elev. of wet storage or (if not applicable) bottom of basin)/2) (ft)
C_d = coefficient of contraction (=0.60)
T = detention time (hrs.) (vary over recommended limits)

Select a standard pipe size and number of holes. Verify that the projected drawdown period is within the recommended limits.

- Size a drain for the basin for maintenance (and emergency situations). The drain should dewater the basin (to principal spillway) within 24 hours. Use the above equation to determine A_o of the basin drain. The inlet of the drain should be protected from the sediment storage zone.

- Evaluate basin shape. Compare with the recommended length to width ratio. If this ratio is not achieved, the basin should be modified or baffles should be added as required.

- Route Design Storm:

  - Route the design storm through the basin and determine the maximum pool elevation and the peak discharge (via HydroCAD, spreadsheet methods, or other). Depending on local requirements, multiple design storms may need to be considered and the peak discharge may need to be compared with the pre-development value.

  - Based on the peak stage of the design storm, check settling efficiency of the design particle. The design particle is typically 40 microns (0.04 mm) (within silt size criteria).

    - Settling Velocity of Design Particle

$$V_O = \frac{g}{18}\left[\frac{(S_S - 1)}{\nu}\right]d^2 \qquad \text{(Malcom Eq. IV-3)}$$

where:
V_o = settling velocity (ft/s) - convert from (m/s)
g = gravitational acceleration (m/s^2)
S_s = specific gravity of design particle
υ = kinematic viscosity of the fluid (m^2/s)
(= 1.14 x 10^{-6} m^2/s @ 15°C Ref. Streeter, 1975)
d = diameter of design particle (m)

    - Surface Area

$$A_S = bK_S Z^{(b-1)} \qquad \text{(Malcom Eq. IV-7)}$$

where:
A_S = surface area at given stage (Z) (ft)
K_S, b = linear regression constants describing the stage-storage relationship

    - Settling Efficiency

$$E = 1 - \left[1 + \frac{V_O A_S}{NQ}\right]^{-N} \qquad \text{(Malcom Eq. IV-1)}$$

where:
E = settling efficiency (decimal fraction - convert to %)
A_S = surface area at given stage (Z) (ft)
N = number of effective cells (N = 2 with forebay)
Q = discharge at given stage (Z) (cfs)

- Design of Outlet Structures:

  - Design riser/barrel structures based on information used in routing the design storm.

  - Design base for riser structure to resist design uplift force. Base must have a buoyant weight of at least the design uplift force. If a concrete riser structure is used, the buoyant weight of the riser can be accounted for in the calculations.

    - Design Uplift Force (↑F)

$$\uparrow F = (FS)V_{Riser}\gamma_{H2O} - W_{Riser} - W_{Top} - W_{Soil} - R_{soil}$$

where:
$\uparrow F$ = design uplift force (lbs)
FS = factor of safety (use 1.25)
V_{Riser} = interior volume of the riser (ft^2)
γ_{H2O} = density of water (62.4 pcf)
W_{Riser} = buoyant weight of riser (not including base or top) (lbs)
W_{Top} = buoyant weight of riser top (lbs)
W_{Soil} = buoyant weight of soil backfill around riser (above base projection) (lbs)
R_{Soil} = sliding resistance of soil backfill around riser (lbs)*

* See American Concrete Pipe Association Design Data 41 for more information.

    - Volume of Concrete for Base

$$V_{Conc} = \frac{\uparrow F}{W_{Conc,B}} = \frac{\uparrow F}{(150 - 62.4)}$$

where:
V_{Conc} = volume of concrete (ft^2)
$W_{Conc,B}$ = buoyant weight of concrete (150 - 62.4 = 87.6 lbs)

  - Determine anti-seepage collar requirements based on the following equation. Alternatively, a filter diaphragm may be designed.

$$L_S = y(z+4)\left[1 + \frac{s}{(0.25 - s)}\right]$$ (VA E&SC Handbook p. III-102)

where:
L_S = length of pipe in the saturated zone (ft)
y = distance from barrel invert to riser crest (ft)
z = slope of upstream embankment (zH:1V)
s = pipe slope (ft/ft)

Determine L_S and use design chart to determine anti-seepage collar requirements. If more than one collar is used, the spacing between collars should be 14 times the projection (P) of the collar above the barrel. The first collar should be set at 2P from the riser or a minimum length to bury collar in slope.

- Design crest length of emergency spillway to handle flow from the design storm using the following equation. Determine peak flow from stormwater routing program. If applicable, design outlet channel as a drainage channel or rock chute.

$$Q_P = C_W L H^{3/2} \qquad \text{(Malcom Eq. I-6)}$$

where:
Q_P = peak discharge from design storm (cfs)
C_w = weir coefficient (=3.0 for free overfall)
L = length of weir (ft)
H = driving head (ft) (= allowable headwater above crest of weir or calculated value from stormwater routing program)

RICHARDSON SMITH GARDNER & ASSOCIATES
Engineering and Geological Services
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Raleigh, NC 27603 Fax: 919-828-3899

SHEET: 6 / 9
JOB #: Davidson 08-5
DATE: 3/23/09
BY: KBS/PKS
CHKD BY:

Davidson County C&D Landfill - Phases 3 & 4
Sediment Basin Analysis **Basin No.: Basin-2**

DESIGN FOR WET (IF APPLICABLE) AND DRY STORAGE:

Areas Draining Into Basin:

Drainage Area	Area (acres)
A1. Landfill Slopes	3.4
A2. Other Areas	0.0
Total =	3.4 Acres

Basin Requirements:

Wet Storage:

Required Storage Capacity (ft^3/Ac.) =	0	**Enter "0" if Not Applicable.**
Required Storage Capacity (ft^3) =	0	
Required Depth of Wet Storage (ft) =	0.0	**Enter "0" if Not Applicable.**

Dry Storage:

Required Storage Capacity (ft^3/Ac.) =	1,800	**To Crest of Principal Spillway**
Required Storage Capacity (ft^3) =	6,120	
Multipier (X) for Desired Surface Area (Qp x X) =	0.01	**At Crest of Principal Spillway**
Peak Discharge into Basin (Qp) (cfs) =	22.0	**From HydroCAD - 25-Yr, 24-Hr. Storm**
Desired Surface Area (Ac) =	0.22	
Desired Surface Area (ft^3) =	9,583	

Determine Stage-Storage Function:

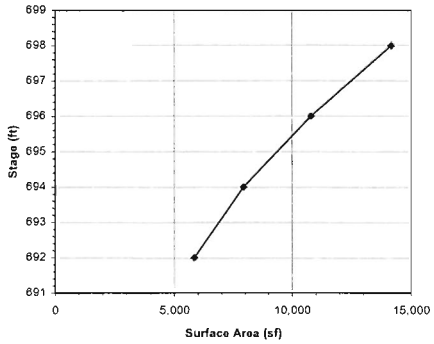
Contour	Area (ft^2)	Area (acres)	Incremental Volume (ft^3)	Cumulative Volume (ft^3)	Stage (ft)	ln S	ln Z	Z est
692	5,850	0.13		0	0			
694	7,945	0.18	13,795	13,795	2	9.53	0.69	2.00
696	10,800	0.25	18,745	32,540	4	10.39	1.39	4.00
698	14,180	0.33	24,980	57,520	6	10.96	1.79	6.00

Linear Regression Constants:

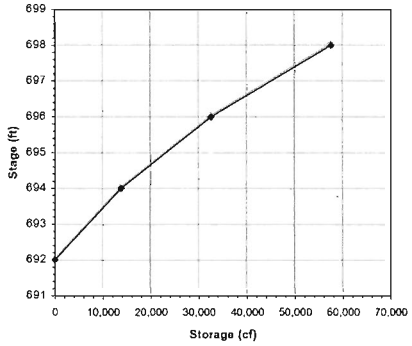
Ks = 5,572 Storage = 5572 z^1.29
b = 1.29

***CAUTION: CHECK INPUT FOR REGRESSION ANALYSIS!**

Stage-Surface Area Relationship



Stage-Storage Relationship



SHEET:	7,9
JOB #:	Davidson 08-5
DATE:	3/23/09
BY:	KBS/PKS
CHKD BY:	

Basin Design Elevations:

Bottom of Basin Elevation =	692.0	

Wet Storage:

Required Storage Capacity (ft^3) =	0	
Min. Elev. of Wet Storage (Permanent Pool) =	692.0	
Selected Elev. of Wet Storage (Permanent Pool) =	692.0	**O.K.**
Actual Wet Storage Volume (ft^3) =	0	**O.K.**

Dry Storage:

Required Storage Capacity (ft^3) =	6,120	**= Required Dry Storage + Actual Wet Storage**
Min. Elev. of Principal Spillway =	693.1	
Selected Elev. of Principal Spillway =	695.0	**O.K.**
Actual Total Storage Volume (ft^3) =	23,065	**O.K.**
Desired Surface Area (ft^2) =	9,583	
Actual Surface Area at Principal Spillway (ft^2) =	9,941	**O.K.**

Cleanout:

Cleanout Requirement (% of Wet Storage) =	0	**Enter "0" if Not Applicable**
Cleanout Requirement (% of Total Storage) =	33	
Basin Cleanout Volume (ft^3) =	7,611	**Based on 33% of Total Storage Volume**
Basin Cleanout Elevation =	693.3	

Dewatering of Dry Storage:

Option: Faircloth Skimmer

Storage Volume (ft3) =	23,065	
Required Orifice Diameter (in) =	3	From www.fairclothskimmer.com for 2+ day drawdown

Basin Drain Calculations: **N/A**

Basin Shape:

Length of Basin (ft) =	110	**Measured at Principal Spillway Elevation**
Width of Basin (ft) =	30	**Measured at Principal Spillway Elevation**
Desired Length to Width Ratio (X:1) =	3	
Actual Length to Width Ratio (X:1) =	3.7	**O.K.**

SHEET:	8/9
JOB #:	Davidson 08-5
DATE:	3/23/09
BY:	KBS/PKS
CHKD BY:	

ROUTE DESIGN STORM: **Use HydroCAD or Other Method.**

Design Parameters:

Design Storm: 25-Yr, 24-Hr
Design Storm Rainfall (in) = 6
Rainfall Distribution: Type II
Runoff Method: SCS TR-20

Results:

Maximum Pool Elevation = 695.1
Surface Area at Maximum Pool (ft^2) = 10,075
Peak Discharge (cfs) = 2.6

Check Settling Efficiency:

Particle Data:

Diam. (microns) = 40
Specific Gravity = 2.65
Settling Veloc. (ft/s) = 0.004140
Reynolds No. (<0.5) = 0.044284 **O.K.**

Efficiency Data:

Desired Efficiency (%) = 80
No. of Effective Cells = 1

Settling Efficiency (%) = 94.1 **O.K.**

DESIGN OUTLET STRUCTURES:

Design Riser/Barrel Structures:

Riser Design:

Type of Riser: Concrete - Rectangular
Riser Base Elevation = 692.0
Riser Top Elevation = 695.0
Riser Height (ft) = 3.0

Outlets:

Outlet No. 1 (for Dewatering Dry Storage): Size: 3" Skimmer Orifice **From Above - Dewatering of Dry Storage**
Invert Elevation: 692.0 **May Vary For Multiple Holes**
Outlet No. 2 (Principal Spillway): Size: 3' Wide x 6" High Weir (x4)
Invert Elevation: 695.0

Concrete Riser Wall Thickness (in) = 6.0

Riser Inside Length (ft) = 3.0
Riser Inside Width (ft) = 3.0
Approx. Rect. Concrete Riser Interior Volume (cf) = 27
Approx. Rect. Concrete Riser Vol. of Concrete (cf) = 21

Barrel Design:

Type of Barrel: CMP
Diameter (in) = 15
Inv. In Elevation = 692.0
Inv. Out Elevation = 686.0
Length (ft) = 70.0
Slope (ft/ft) = 0.086

SHEET:	9 / 9
JOB #:	Davidson 08-5
DATE:	3/23/09
BY:	KBS/PKS
CHKD BY:	

Riser Base Calculations:

Design Uplift Force:

Factor of Safety =	1.25	
F (unadjusted) (lbs) =	2,106	
	0	
Approx. Rect. Concrete Riser Buoyant Wt. (lbs) =	1,472	**Factors in 80% of the Weight of the Concrete Riser to Account for Outlets.**
Buoyant Wt. of Riser Top (lbs) =	700	**4' x 4' x 6" Thick (8 cf) x (150 - 62.4)**
Buoyant Wt. of Surrounding Soil Acting on Ext. Base (lbs) =	0	
Sliding Resistance of Surrounding Soil (lbs) =	0	
F (adjusted) (lbs) =	-66	

Concrete Base:

Required Volume of Concrete (ft^3) =	-0.7	
Length (ft) =	3.0	
Width (ft) =	3.0	
Thickness (ft) =	0.5	
Actual Volume of Concrete (ft^3) =	4.5	**O.K.**

Anti-Seepage Collar Calculations: (Alternatively - Design Filter Diaphragm)

Slope of Upstream Embankment (zH:1V) =	2.5	
Slope of Outlet Pipe (ft/ft) =	0.086	
Ls (ft) =	30	
Number of Collars:	2	
Length of Each Collar (ft) =	3.5	**From Design Chart Based on Ls and No. of Collars**
Width of Each Collar (ft) =	3.5	**From Design Chart Based on Ls and No. of Collars**
Collar Projection, P (ft) =	1.125	
Spacing of Subsequent Anti-Seep Collars (ft) =	16	**= 14P**

Emergency Spillway Calculations:

Crest Elev. (ft) =	696.0	
Required Freeboard (ft) =	2.0	
Top of Berm Elev. (ft) =	698.0	
Required Capacity (cfs) =	0.0	**From HydroCAD - 25-Yr, 24-Hr. Storm**
Driving Head (ft) =	0	**From HydroCAD - 25-Yr, 24-Hr. Storm**
Weir Coefficient =	3.0	
Length of Crest (ft) =	0.0	**Determine by Weir Equation***
Design Crest Length (ft) =	20	

*** Length = 20 ft minimum.**

SUMMARY DATA:

Basin No.: Basin-2

Elev. of Bottom of Basin =	692.0	
Cleanout Elev. (ft) =	693.3	
Elev. of Wet Storage (Permanent Pool) =	NA	
Elev. of Principal Spillway =	695.0	**See Above for Riser and Other Design Information.**
Emergency Spillway Elev. (ft) =	696.0	
Top of Berm Elev. (ft) =	698.0	
Top of Berm Width (ft) =	10	
Barrel Diameter (in) =	15	
Barrel Slope (%) =	8.6	

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PROJECT Davidson County C&D Landfil - Phases 3 & 4

SUBJECT Outlet Protection Analysis

JOB NO. Davidson 08-5
DATE 12/17/08
COMPUTED BY KBS
CHECKED BY DKS

Objective To design outlet protection for culverts and/or drainage channels based on the maximum flow from the design storm. Rip rap aprons are applicable when the Froude Number (Fr) is less than or equal to 2.5 (Debo and Reese). For higher Froude Numbers, rip rap outlet basins, baffled outlets, and/or other methods are more appropriate.

Reference

Debo, T.N., and Reese, A.J. (1995), Municipal Storm Water Management, Lewis Publishers, Boca Raton, FL, Section 8.11 - pp. 289-290; Section 12.6 - pp. 523-526.

Federal Highway Administration (2000), Hydraulic Design of Energy Dissipators for Culverts and Channels, Hydraulic Engineering Circular No. 14, FHWA EPD-86-110, Metric Ed., U.S. Dept. of Transportation, Washington, D.C.

North Carolina Division of Land Resources (2006), North Carolina Erosion & Sediment Control Planning & Design Manual, Raleigh, NC.

Analysis For each outlet, determine the Froude Number (Fr) based on the pipe Manning's number, diameter, slope, and design discharge. Use the methods described in Section 8.11 of Debo and Reese. Select the method of outlet protection, as appropriate, and perform design calculations.

Rip Rap Aprons:

If Fr $\leq$ 2.5, a rip rap apron may be used. The following design approach is based on Section 12.6 of Debo and Reese and Section 8.06 of the NC Erosion & Sediment Control Planning and Design Manual:

1. Determine the tailwater condition and select the appropriate design chart.

2. Using the appropriate design chart, determine the d_{50} rip-rap size and minimum apron length (La) based on the maximum design flow (Q), flow depth (d), and/or velocity (v) (depending on whether the pipe is flowing full or partially full).

3. Using the same chart, determine apron dimensions.

4. Determine the maximum stone diameter: $d_{max} = 1.5 \times d_{50}$

5. Determine the apron thickness:
   Thickness = $1.5 \times d_{max}$ (No Filter Geotextile)
   Thickness = $1.5 \times d_{50}$ (With Filter Geotextile)

Other Methods:

If Fr > 2.5, consider the use of a rip rap basin, baffled outlet, or other device. Design method according to FHA guidelines using HY8-Energy program (or other documented source).

OUTLET PROTECTION.WPD

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SHEET: 2.3
JOB #: Davidson 08-5
DATE: 12/30/08
BY: KBS
CHKD BY: DKS

Davidson County C&D Landfill - Phases 3 & 4
Outlet Protection Analysis - Rip Rap Aprons (Circular Pipe)

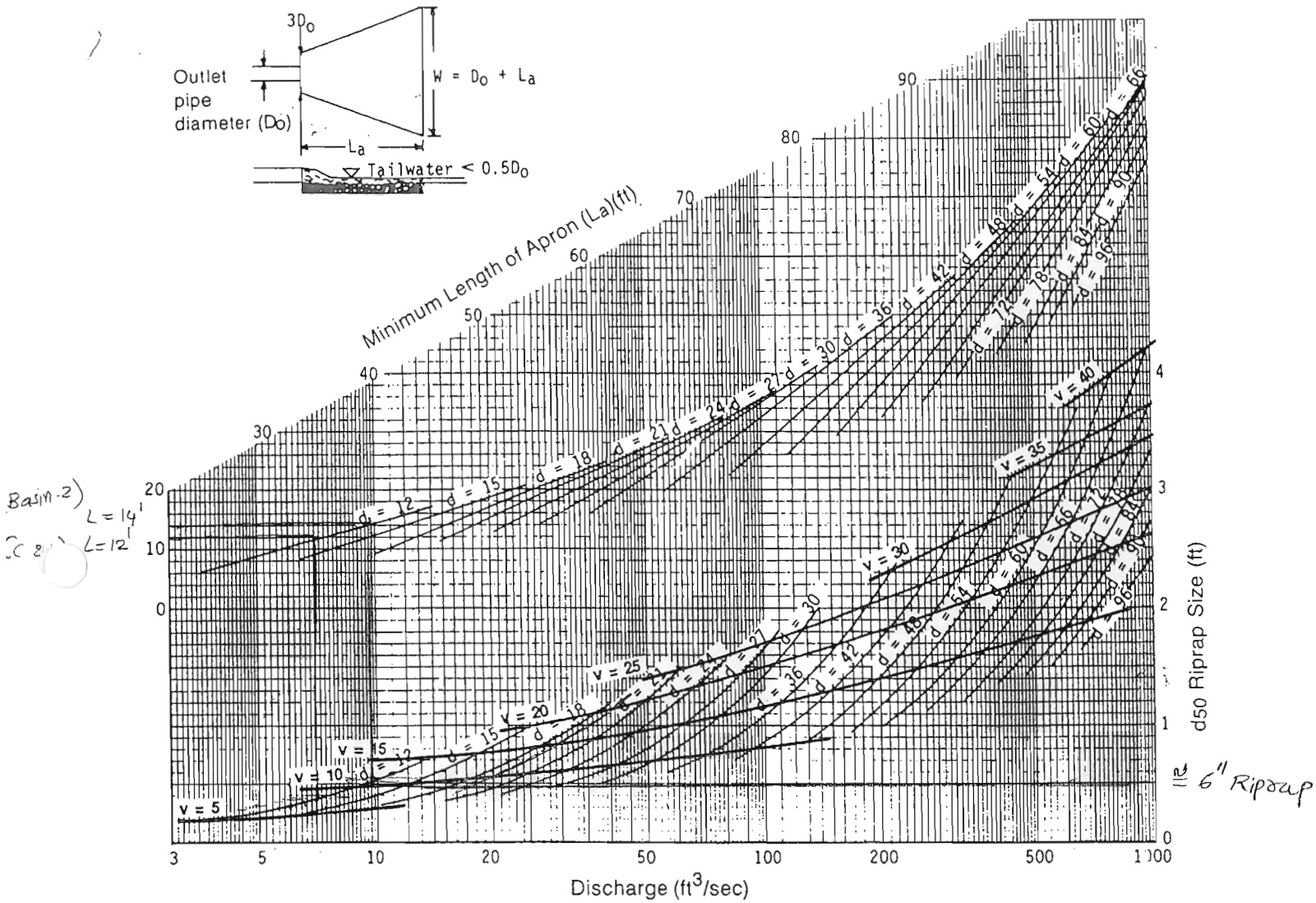
Rip Rap Aprons:

	C 2-1	Basin - 2
Pipe Type:	RCP	CMP
Manning's Coefficient:	0.012	0.020
Diameter (D_O) (in) =	18	15
Slope (%) =	3.1	8.6
Design Discharge (cfs) =	**4.2**	**8.5**
Source of Discharge Data:	HydroCAD 25-Yr 24-Hr	HydroCAD 25-Yr 24-Hr
K =	0.065	0.215
θ (degrees) =	138	205
Flow Depth (d) (in) =	**5.7**	**9.1**
Flow Area (ft^2) =	0.5	0.8
Flow Velocity (v) (ft/sec) =	**8.6**	**10.8**
Froude Number =	2.20	2.19
Rip Rap Aprons Applicable?	**Yes**	**Yes**
Tailwater Condition (Low or High)*:	Low	Low
d_{50} (ft)** =	**0.50**	**0.50**
d_{max} (ft) =	0.75	0.75
Apron Thickness (X) (ft):	-----	-----
No Geotextile:	1.13	1.13
With Geotextile:	**0.75**	**0.75**
Apron Dimensions (ft):	-----	-----
Length (La)** =	**12**	**14**
Width (W) =	**13.5**	**15.3**

*Tailwater Conditions: Low: $Tw < 0.5D_O$; High: $Tw > 0.5D_O$
** Value from Chart.

Riprap Outlet Protection Analysis for C 2-1 & Basin-2

3/3



Curves may not be extrapolated.

Figure 8.06a Design of outlet protection protection from a round pipe flowing full, minimum tailwater condition (T_w < 0.5 diameter)

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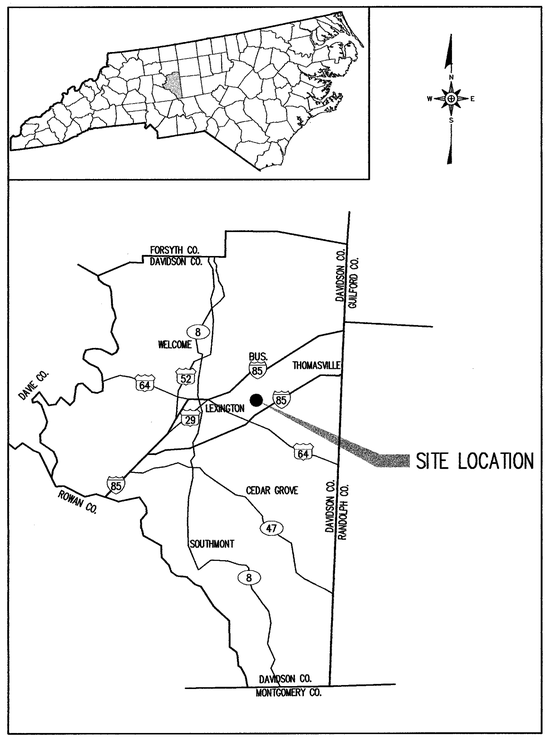
ATTACHMENT
G

DAVIDSON COUNTY INTEGRATED SOLID WASTE MANAGEMENT
LEXINGTON, NORTH CAROLINA

CONSTRUCTION & DEMOLITION DEBRIS (C&D) LANDFILL PHASES 3 & 4 PERMIT AMENDMENT DRAWINGS

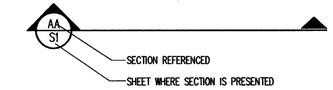
MARCH 2009



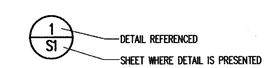
NOT TO SCALE

SHEET NO.	DRAWING NO.	TITLE
1		TITLE – COVER SHEET
2	S1	EXISTING SITE CONDITIONS
3	S2	SITE DEVELOPMENT PLAN – BASE GRADES
4	S3	SITE DEVELOPMENT PLAN – FINAL COVER GRADES
5	S4	PHASE 4 – SUBGRADE GRADING AND DRAINAGE PLAN
6	S5	FINAL COVER GRADING AND DRAINAGE PLAN
7	D1	DETAILS (SHEET 1 OF 4)
8	D2	DETAILS (SHEET 2 OF 4)
9	D3	DETAILS (SHEET 3 OF 4)
10	D4	DETAILS (SHEET 4 OF 4)
11	X1	ENGINEERING CROSS SECTIONS
12	P1	PHASING PLAN

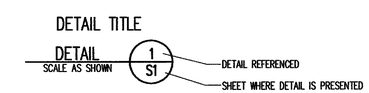
STANDARD SECTION LOCATION CALLOUT (SHEET AND DETAIL)



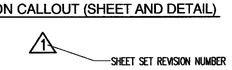
STANDARD DETAIL CALLOUT

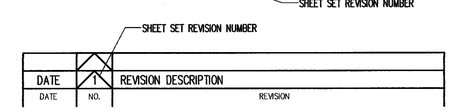


STANDARD DETAIL LABEL AND CALLOUT



STANDARD REVISION CALLOUT (SHEET AND DETAIL)





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FILE NAME
DAVDCO-D0470

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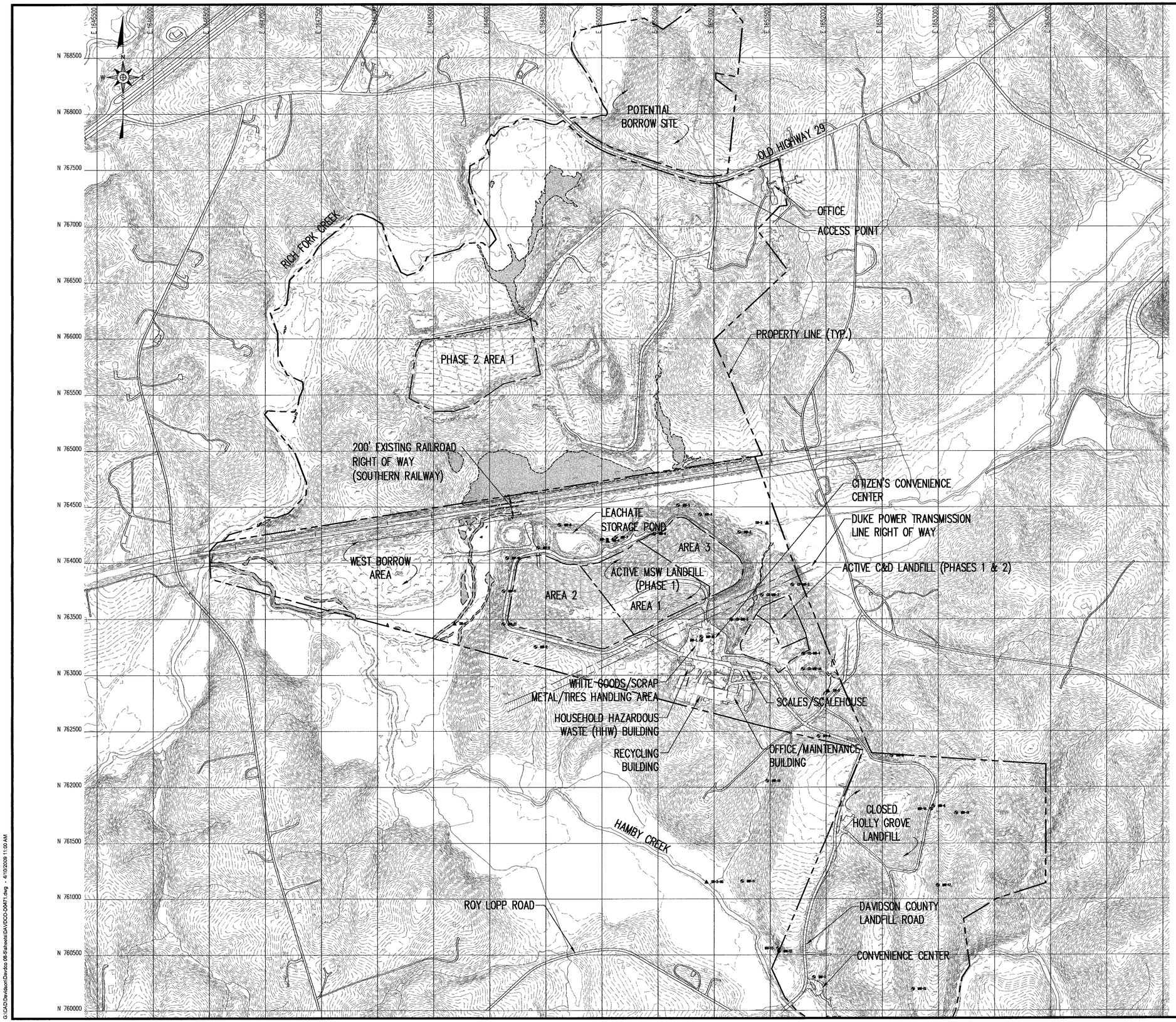

LEGEND

660	EXISTING 10' CONTOUR (SEE REFERENCE 1)
	EXISTING 2' CONTOUR
	PROPERTY LINE
	LIMIT OF LINER (EXISTING LINED UNITS)
	APPROXIMATE EXISTING WASTE LIMITS (UNLINED UNITS)
	WETLAND BOUNDARY (SEE REFERENCE 2)
	STREAM (SEE REFERENCE 2)
MW-8D	EXISTING MONITORING WELL
SW-3	EXISTING SURFACE WATER SAMPLING POINT

REFERENCES

1. OVERALL TOPOGRAPHY PER NORTH CAROLINA DEPARTMENT OF TRANSPORTATION, CONTOUR AND ELEVATION DATA GENERATED FROM LIGHT DETECTION AND RANGING (LIDAR) DATA OBTAINED FROM THE NORTH CAROLINA FLOOD MAPPING PROGRAM AND DATED SEPTEMBER 2004. TOPOGRAPHY IN ACTIVE C&D AND MSW AREAS FROM SPATIAL DATA, AERIAL DATED 4/30/08.
2. WETLAND SURVEY BY LEXINGTON LAND SURVEYING, DATED DATED 3/28/01.
3. WETLANDS AND STREAM LOCATIONS ON SOUTHEAST SIDE OF C&D LANDFILL FROM DELINEATION PERFORMED BY CAROLINA ECOSYSTEMS, INC., FEBRUARY 2009, AND SURVEYED BY MICHAEL GREEN ASSOCIATES, P.A., FEBRUARY 2009.

0 400' 800' 1200'

NO.	DATE	REVISION

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PROJECT TITLE:
DAVIDSON COUNTY
C&D LANDFILL - PHASES 3 & 4
PERMIT AMENDMENT DRAWINGS

DRAWING TITLE:
EXISTING SITE CONDITIONS

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY: PKS	PROJECT NO.: DAVDCO 08-5
SCALE: AS SHOWN	DATE: MARCH 2009
FILE NAME: DAVDCO-D0471	
SHEET NO. 2	DRAWING NO. S1

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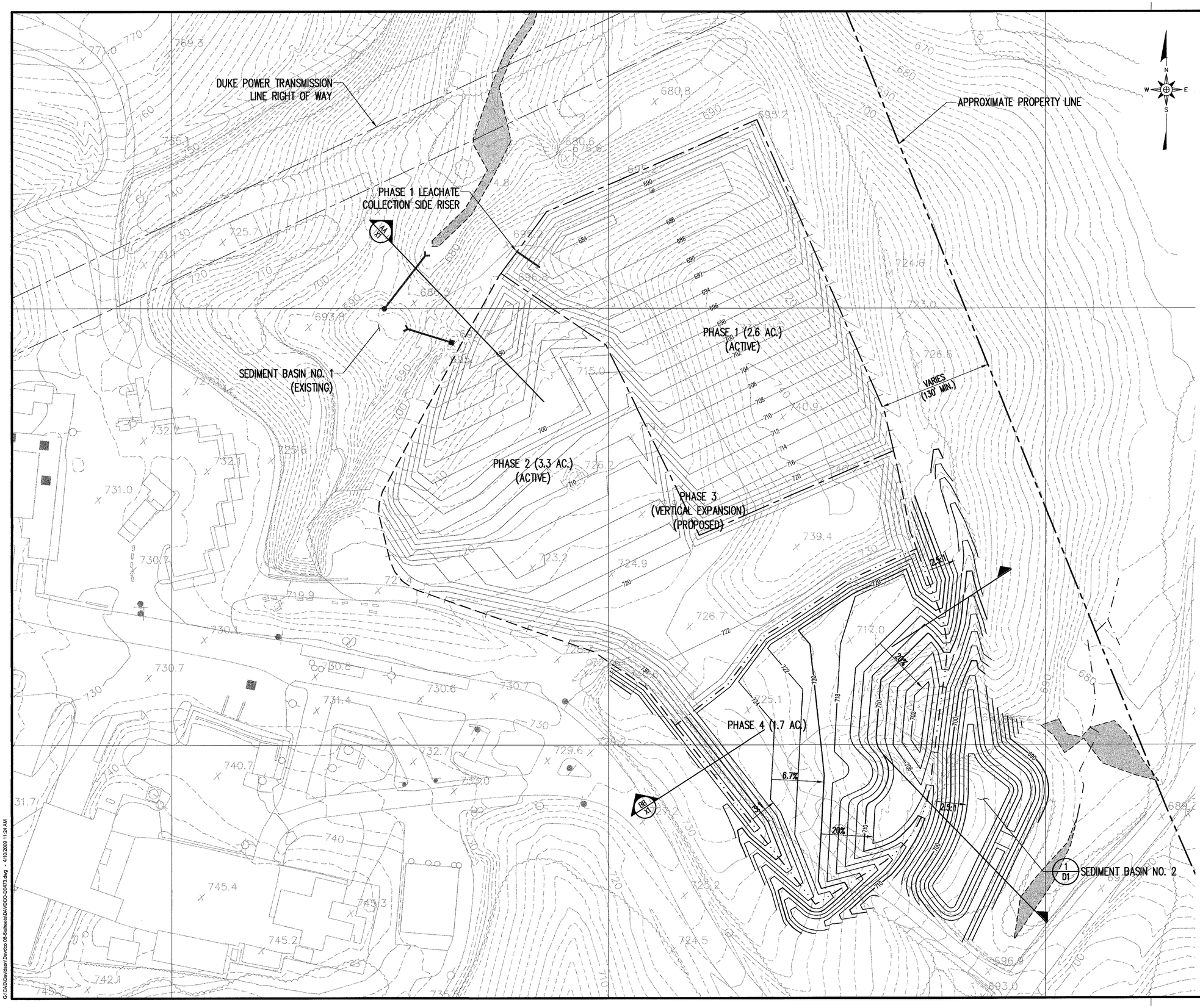

LEGEND

- 660 — EXISTING 10' CONTOUR (SEE REFERENCE 1)
- EXISTING 2' CONTOUR
- 710 — PROPOSED 10' CONTOUR (SEE NOTE 1)
- PROPOSED 2' CONTOUR
- PROPERTY LINE
- LIMIT OF LINER (EXISTING LINED UNITS)
- APPROXIMATE EXISTING WASTE LIMITS (UNLINED UNITS)
- PROPOSED LANDFILL AREAS
- WETLAND BOUNDARY (SEE REFERENCE 2)
- STREAM (SEE REFERENCE 2)

NOTES

1. GRADES SHOWN REPRESENT SUBGRADE ELEVATIONS.

REFERENCES

1. OVERALL TOPOGRAPHY FROM AERIAL PHOTOGRAPHY DATED APRIL 30, 2008 BY SPATIAL DATA CONSULTANTS, INC., HIGH POINT, NC.
2. WETLANDS AND STREAM LOCATIONS ON SOUTHEAST SIDE OF C&D LANDFILL FROM DELINEATION PERFORMED BY CAROLINA ECOSYSTEMS, INC., FEBRUARY 2009, AND SURVEYED BY MICHAEL GREEN ASSOCIATES, P.A., FEBRUARY 2009.

0 50' 100' 150'

NO.	DATE	REVISION

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PROJECT TITLE: DAVIDSON COUNTY C&D LANDFILL - PHASES 3 & 4 PERMIT AMENDMENT DRAWINGS

DRAWING TITLE: SITE DEVELOPMENT PLAN BASE GRADES

DESIGNED BY: P.K.S.	DRAWN BY: J.A.L.
CHECKED BY: KBJ	PROJECT NO.: DAVDCO 08-5
SCALE: AS SHOWN	DATE: MARCH 2009
FILE NAME: DAVDCO-D0473	
SHEET NO. 3	DRAWING NO. S2

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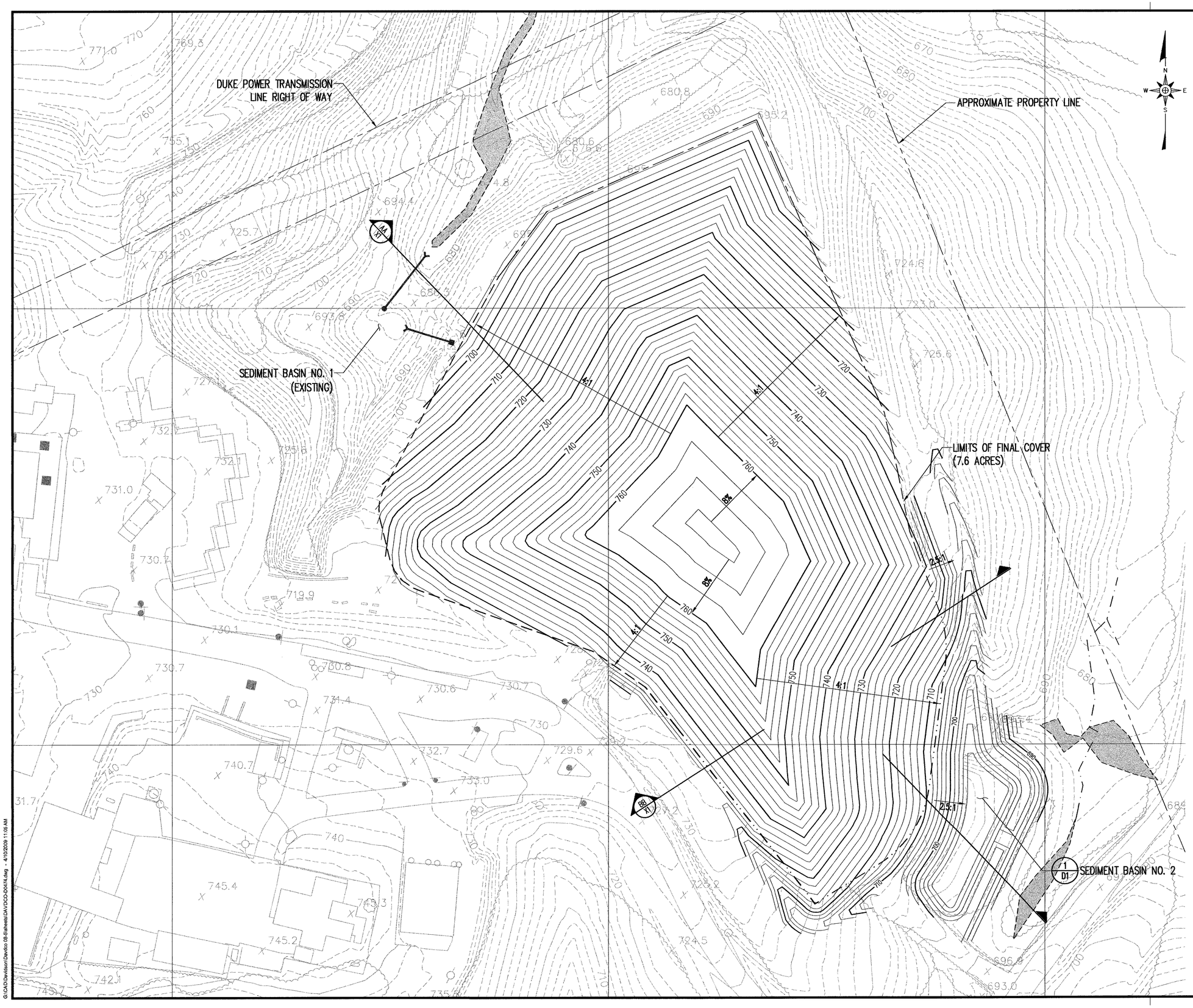

LEGEND

- 660 — EXISTING 10' CONTOUR (SEE REFERENCE 1)
- EXISTING 2' CONTOUR
- 710 — PROPOSED 10' CONTOUR (SEE NOTE 1)
- PROPOSED 2' CONTOUR
- PROPERTY LINE
- LIMIT OF LINER (EXISTING LINED UNITS)
- APPROXIMATE EXISTING WASTE LIMITS (UNLINED UNITS)
- PROPOSED LANDFILL AREAS
- WETLAND BOUNDARY (SEE REFERENCE 2)
- STREAM (SEE REFERENCE 2)

NOTES

1. GRADES SHOWN REPRESENT TOP OF FINAL COVER ELEVATIONS.

REFERENCES

1. OVERALL TOPOGRAPHY FROM AERIAL PHOTOGRAPHY DATED APRIL 30, 2008 BY STATIAL DATA CONSULTANTS, INC., HIGH POINT, NC.
2. WETLANDS AND STREAM LOCATIONS ON SOUTHEAST SIDE OF C&D LANDFILL FROM DELINEATION PERFORMED BY CAROLINA ECOSYSTEMS, INC., FEBRUARY 2009, AND SURVEYED BY MICHAEL GREEN ASSOCIATES, P.A., FEBRUARY 2009.

0 50' 100' 150'

DATE	NO.	REVISION

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PROJECT TITLE:
DAVIDSON COUNTY
C&D LANDFILL - PHASES 3 & 4
PERMIT AMENDMENT DRAWINGS

DRAWING TITLE:
SITE DEVELOPMENT PLAN
FINAL COVER GRADES

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY: KBL	PROJECT NO.: DAVDCO 08-5
SCALE: AS SHOWN	DATE: MARCH 2009
FILE NAME: DAVDCO-D0474	
SHEET NO. 4	DRAWING NO. S3

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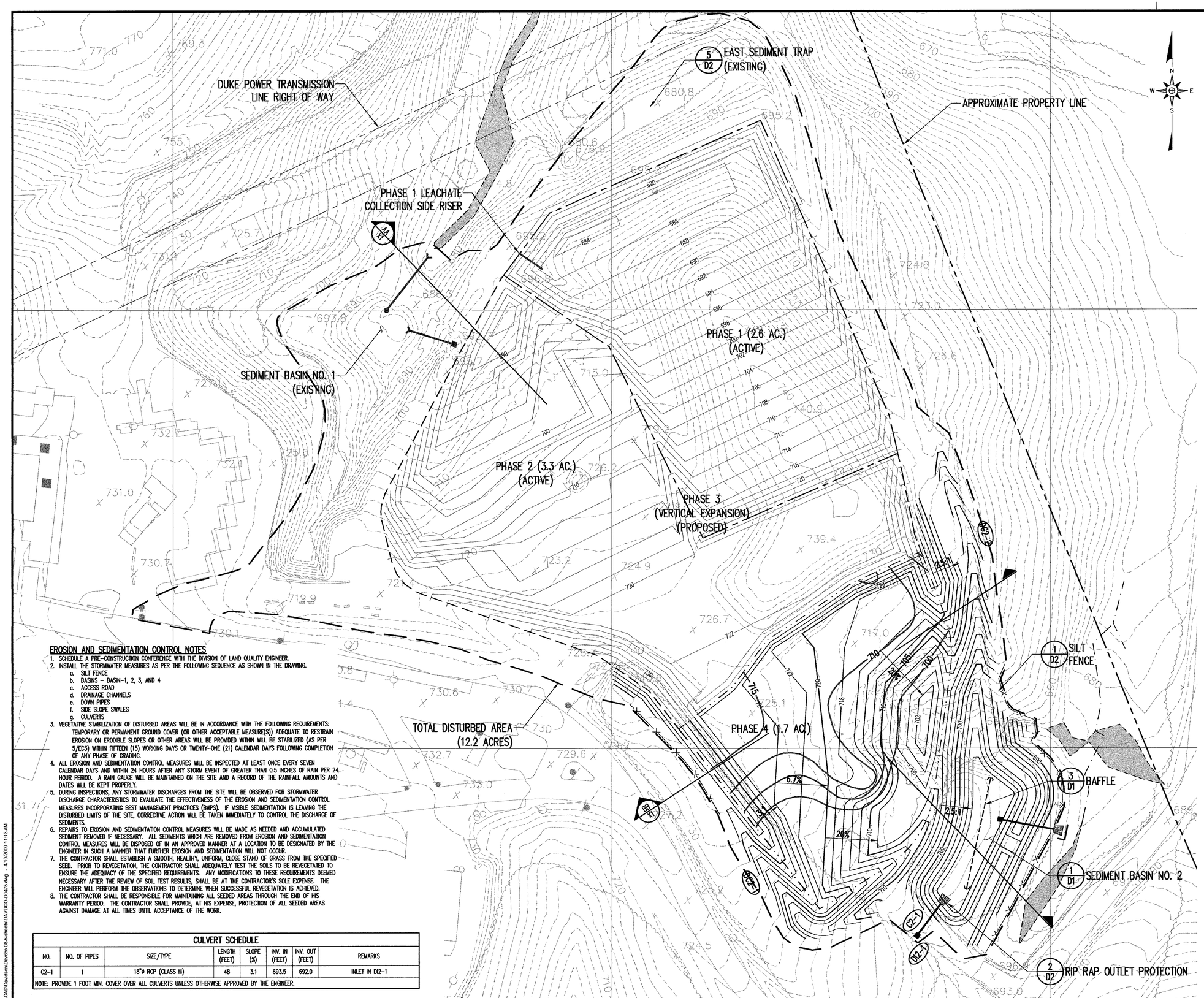

EROSION AND SEDIMENTATION CONTROL NOTES

1. SCHEDULE A PRE-CONSTRUCTION CONFERENCE WITH THE DIVISION OF LAND QUALITY ENGINEER.
2. INSTALL THE STORMWATER MEASURES AS PER THE FOLLOWING SEQUENCE AS SHOWN IN THE DRAWING.
   a. SILT FENCE
   b. BASINS – BASIN-1, 2, 3, AND 4
   c. ACCESS ROAD
   d. DRAINAGE CHANNELS
   e. DOWN PIPES
   f. SIDE SLOPE SWALES
   g. CULVERTS
3. VEGETATIVE STABILIZATION OF DISTURBED AREAS WILL BE IN ACCORDANCE WITH THE FOLLOWING REQUIREMENTS: TEMPORARY OR PERMANENT GROUND COVER (OR OTHER ACCEPTABLE MEASURE(S)) ADEQUATE TO RESTRAIN EROSION ON ERODIBLE SLOPES OR OTHER AREAS WILL BE PROVIDED WITHIN WILL BE STABILIZED (AS PER 5/EC3) WITHIN FIFTEEN (15) WORKING DAYS OR TWENTY-ONE (21) CALENDAR DAYS FOLLOWING COMPLETION OF ANY PHASE OF GRADING.
4. ALL EROSION AND SEDIMENTATION CONTROL MEASURES WILL BE INSPECTED AT LEAST ONCE EVERY SEVEN CALENDAR DAYS AND WITHIN 24 HOURS AFTER ANY STORM EVENT OF GREATER THAN 0.5 INCHES OF RAIN PER 24-HOUR PERIOD. A RAIN GAUGE WILL BE MAINTAINED ON THE SITE AND A RECORD OF THE RAINFALL AMOUNTS AND DATES WILL BE KEPT PROPERLY.
5. DURING INSPECTIONS, ANY STORMWATER DISCHARGES FROM THE SITE WILL BE OBSERVED FOR STORMWATER DISCHARGE CHARACTERISTICS TO EVALUATE THE EFFECTIVENESS OF THE EROSION AND SEDIMENTATION CONTROL MEASURES INCORPORATING BEST MANAGEMENT PRACTICES (BMPS). IF VISIBLE SEDIMENTATION IS LEAVING THE DISTURBED LIMITS OF THE SITE, CORRECTIVE ACTION WILL BE TAKEN IMMEDIATELY TO CONTROL THE DISCHARGE OF SEDIMENTS.
6. REPAIRS TO EROSION AND SEDIMENTATION CONTROL MEASURES WILL BE MADE AS NEEDED AND ACCUMULATED SEDIMENT REMOVED IF NECESSARY. ALL SEDIMENTS WHICH ARE REMOVED FROM EROSION AND SEDIMENTATION CONTROL MEASURES WILL BE DISPOSED OF IN AN APPROVED MANNER AT A LOCATION TO BE DESIGNATED BY THE ENGINEER IN SUCH A MANNER THAT FURTHER EROSION AND SEDIMENTATION WILL NOT OCCUR.
7. THE CONTRACTOR SHALL ESTABLISH A SMOOTH, HEALTHY, UNIFORM, CLOSE STAND OF GRASS FROM THE SPECIFIED SEED. PRIOR TO REVEGETATION, THE CONTRACTOR SHALL ADEQUATELY TEST THE SOILS TO BE REVEGETATED TO ENSURE THE ADEQUACY OF THE SPECIFIED REQUIREMENTS. ANY MODIFICATIONS TO THESE REQUIREMENTS DEEMED NECESSARY AFTER THE REVIEW OF SOIL TEST RESULTS, SHALL BE AT THE CONTRACTOR'S SOLE EXPENSE. THE ENGINEER WILL PERFORM THE OBSERVATIONS TO DETERMINE WHEN SUCCESSFUL REVEGETATION IS ACHIEVED.
8. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING ALL SEEDED AREAS THROUGH THE END OF HIS WARRANTY PERIOD. THE CONTRACTOR SHALL PROVIDE, AT HIS EXPENSE, PROTECTION OF ALL SEEDED AREAS AGAINST DAMAGE AT ALL TIMES UNTIL ACCEPTANCE OF THE WORK.

CULVERT SCHEDULE

NO.	NO. OF PIPES	SIZE/TYPE	LENGTH (FEET)	SLOPE (%)	INV. IN (FEET)	INV. OUT (FEET)	REMARKS
C2-1	1	18"ø RCP (CLASS III)	48	3.1	693.5	692.0	INLET IN DI2-1
NOTE: PROVIDE 1 FOOT MIN. COVER OVER ALL CULVERTS UNLESS OTHERWISE APPROVED BY THE ENGINEER.							

LEGEND

- 680 — EXISTING 10' CONTOUR (SEE REFERENCE 1)
- EXISTING 2' CONTOUR
- 710 — PROPOSED 10' CONTOUR (SEE NOTE 1)
- PROPOSED 2' CONTOUR
- 700 — TOP OF BEDROCK CONTOUR
- PROPERTY LINE
- LIMIT OF LINER (EXISTING LINED UNITS)
- APPROXIMATE EXISTING WASTE LIMITS (UNLINED UNITS)
- PROPOSED LANDFILL AREAS
- LIMIT OF DISTURBANCE
- SILT FENCE
- WETLAND BOUNDARY (SEE REFERENCE 2)
- STREAM (SEE REFERENCE 2)

NOTES

1. GRADES SHOWN REPRESENT SUBGRADE ELEVATIONS.

REFERENCES

1. OVERALL TOPOGRAPHY FROM AERIAL PHOTOGRAPHY DATED APRIL 30, 2008 BY SPATIAL DATA CONSULTANTS, INC., HIGH POINT, NC.
2. WETLANDS AND STREAM LOCATIONS ON SOUTHEAST SIDE OF C&D LANDFILL FROM DELINEATION PERFORMED BY CAROLINA ECOSYSTEMS, INC., FEBRUARY 2009, AND SURVEYED BY MICHAEL GREEN ASSOCIATES, P.A., FEBRUARY 2009.

0 50' 100' 150'

NO.	DATE	REVISION

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SEAL:

PROJECT TITLE: DAVIDSON COUNTY C&D LANDFILL - PHASES 3 & 4 PERMIT AMENDMENT DRAWINGS

DRAWING TITLE: PHASE 4 - SUBGRADE GRADING AND DRAINAGE PLAN

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY: KBA	PROJECT NO.: DAVDCO 08-5
SCALE: AS SHOWN	DATE: MARCH 2009
FILE NAME: DAVDCO-D0475	
SHEET NO. 5	DRAWING NO. S4

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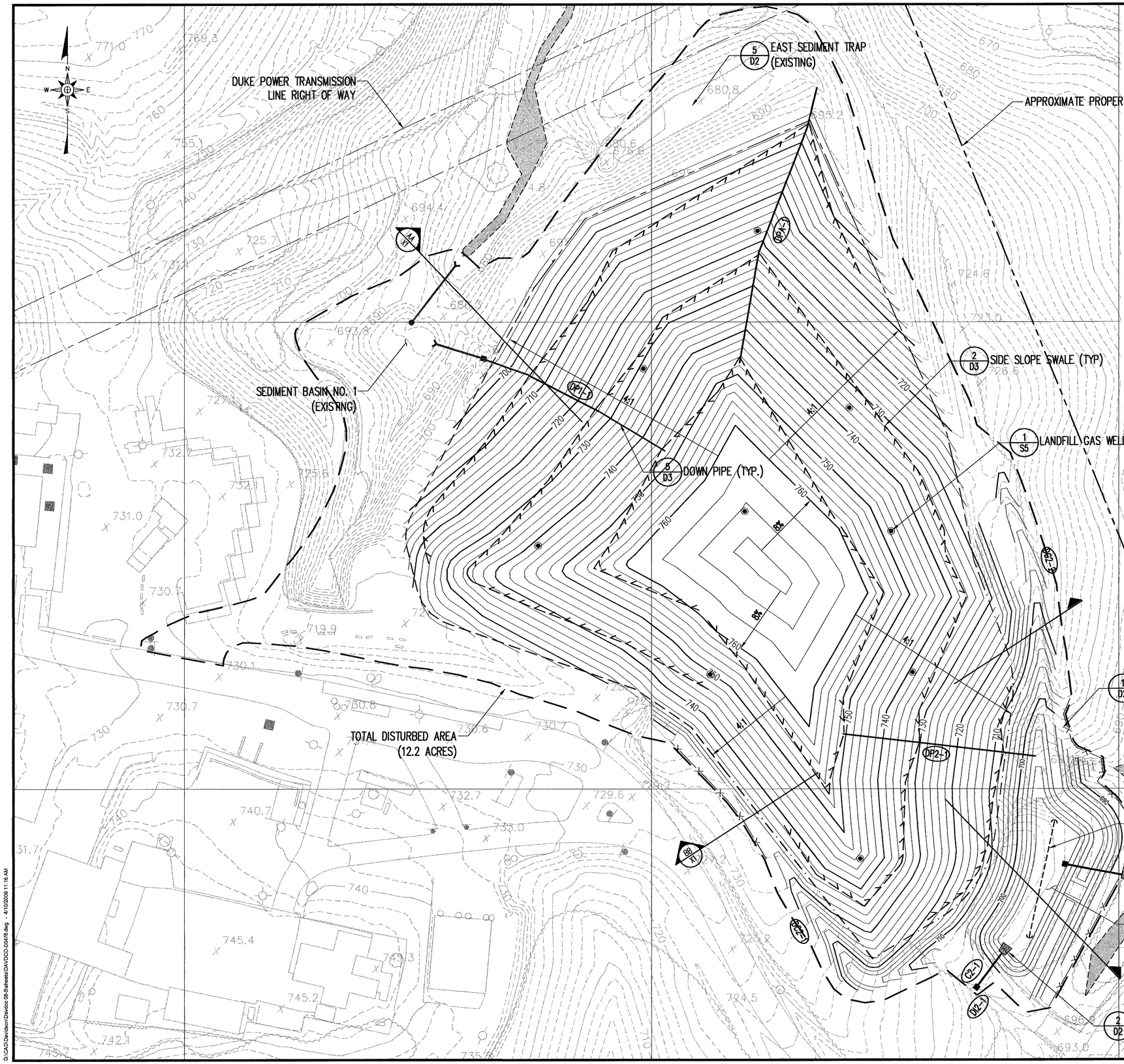

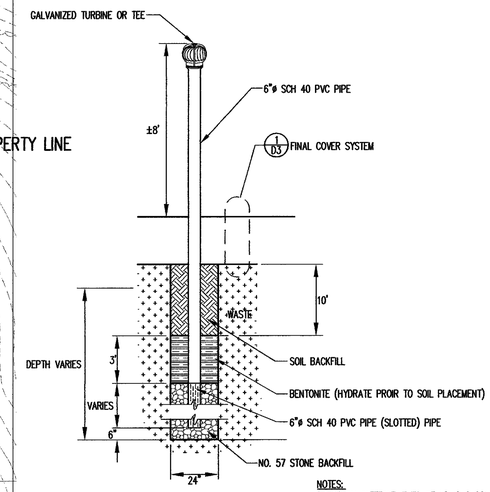

TYPICAL LANDFILL GAS WELL

DETAIL 1/S5
NOT TO SCALE

NOTES:
1. AS AN ALTERNITIVE TO WELLS, GAS COLLECTION TRENCHES MAY BE INSTALLED JUST BELOW THE FINAL COVER. TRENCHES SHALL CONSIST OF PERFORATED PIPE BEDDED IN NO. 57 STONE AND WRAPPED IN A TYPE GT-S GEOTEXTILE. TRENCHES SHALL HAVE NOMINAL SIZE OF 6' WIDE x 20' LONG x 2' DEEP.

LEGEND

- 660 — EXISTING 10' CONTOUR (SEE REFERENCE 1)
- EXISTING 2' CONTOUR
- PROPOSED 10' CONTOUR (SEE NOTE 1)
- PROPOSED 2' CONTOUR
- PROPERTY LINE
- LIMIT OF LINER (EXISTING LINED UNITS)
- APPROXIMATE EXISTING WASTE LIMITS (UNLINED UNITS)
- LIMIT OF DISTURBANCE
- PROPOSED LANDFILL AREAS
- WETLAND BOUNDARY (SEE REFERENCE 2)
- STREAM (SEE REFERENCE 2)
- DOWN PIPE
- SIDE SLOPE SWALE
- SILT FENCE
- PROPOSED LFG WELL OR VENT
- DI-1 DROP INLET NUMBER
- C-1 CULVERT NUMBER
- DP-1 DOWN PIPE NUMBER
- DC-1 DRAINAGE CHANNEL NUMBER

NOTES

1. GRADES SHOWN REPRESENT TOP OF FINAL COVER ELEVATIONS.

REFERENCES

1. OVERALL TOPOGRAPHY FROM AERIAL PHOTOGRAPHY DATED APRIL 30, 2008 BY SPATIAL DATA CONSULTANTS, INC., HIGH POINT, NC.
2. WETLANDS AND STREAM LOCATIONS ON SOUTHEAST SIDE OF C&D LANDFILL FROM DELINEATION PERFORMED BY CAROLINA ECOSYSTEMS, INC., FEBRUARY 2009, AND SURVEYED BY MICHAEL GREEN ASSOCIATES, P.A., FEBRUARY 2009.

0 50' 100' 150'

NO.	DATE	REVISION

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PROJECT TITLE:
DAVIDSON COUNTY
C&D LANDFILL - PHASES 3 & 4
PERMIT AMENDMENT DRAWINGS

DRAWING TITLE:
FINAL COVER
GRADING AND DRAINAGE PLAN

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY: PKS	PROJECT NO.: DAVDCO 06-5
SCALE: AS SHOWN	DATE: MARCH 2009
FILE NAME: DAVDCO-D0476	
SHEET NO. 6	DRAWING NO. S5

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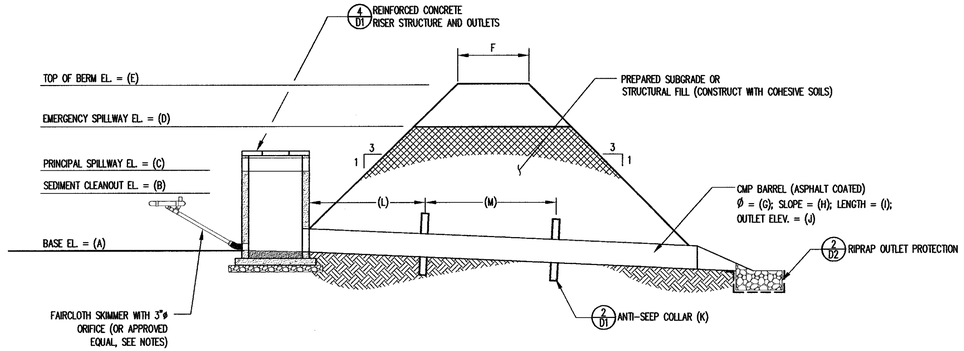
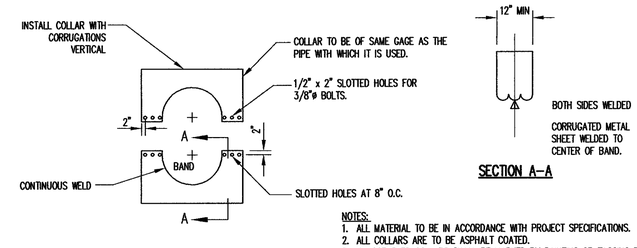


SEDIMENT BASIN SCHEDULE													
BASIN #	A	B	C	D	E	F	G	H	I	J	K	L	M
2	692'	693.3'	695'	696'	698'	10'	15"	6.7%	60'	688'	3.5'X3.5'	10'	16'

NOTE:
1. SEE FIGURE 6.64A FROM THE 6/06 EDITION OF THE NC EROSION AND SEDIMENT CONTROL PLANNING AND DESIGN MANUAL. ALSO REFER TO J.W. FAIRCLOTH & SON INC. (WWW.FAIRCLOTHSKIMMER.COM) FOR INSTALLATION INFORMATION.
2. FAIRCLOTH SKIMMER SHOWN ROTATED FROM INSTALLED POSITION.
3. INSTALL STONE PAD 2'x9'x0.75" THICK.

TYPICAL SEDIMENT BASIN CROSS SECTION

DETAIL 1/D1
NOT TO SCALE



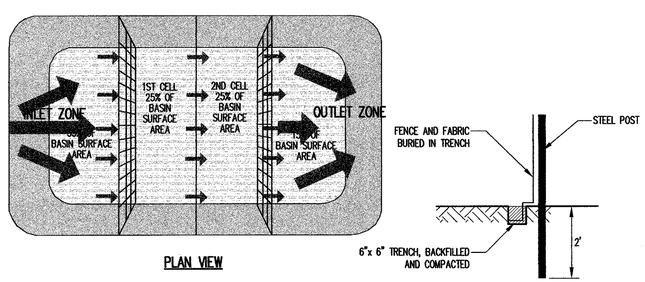
SECTION A-A

ELEVATION OF UNASSEMBLED COLLAR

NOTES:
1. ALL MATERIAL TO BE IN ACCORDANCE WITH PROJECT SPECIFICATIONS.
2. ALL COLLARS ARE TO BE ASPHALT COATED.
3. UNASSEMBLED COLLARS SHALL BE MARKED BY PAINTING OR TAGGING TO IDENTIFY MATCHING PAIRS.
4. THE LAP BETWEEN THE TWO HALF SECTIONS AND BETWEEN THE PIPE AND CONNECTING BAND SHALL BE CAULKED WITH ASPHALT MASTIC AT TIME OF INSTALLATION.
5. EACH COLLAR SHALL BE FURNISHED WITH TWO 1/2"ø RODS WITH STANDARD TANK LUGS FOR CONNECTING COLLARS TO PIPE

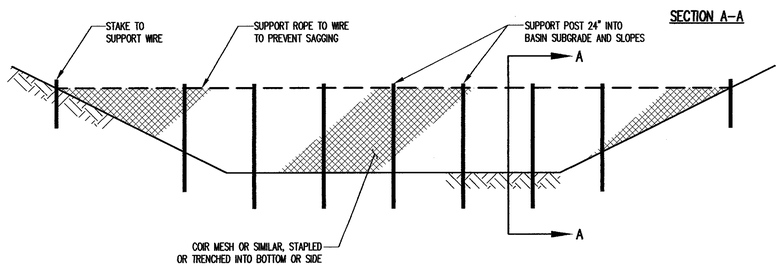
CORRUGATED METAL ANTI-SEEP COLLAR

DETAIL 2/D1
NOT TO SCALE



PLAN VIEW

SECTION A-A

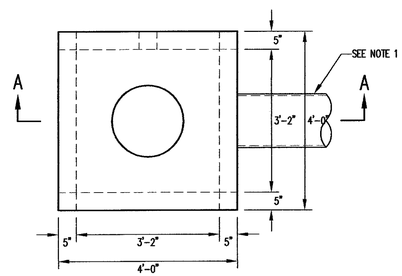


ELEVATION

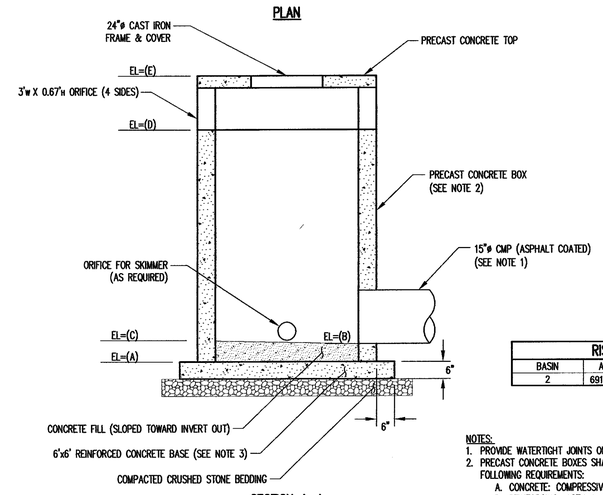
BAFFLES

DETAIL 3/D1
NOT TO SCALE

NOTES:
1. BAFFLE MATERIAL SHOULD BE SECURED AT THE BOTTOM AND SIDES USING STAPLES OR BY TRENCHING AS FOR SILT FENCE.
2. MOST OF THE SEDIMENT WILL ACCUMULATE IN THE FIRST BAY, WHICH SHOULD BE READILY ACCESSIBLE FOR MAINTENANCE.
3. PROVIDE 3 BAFFLES (USE TWO IF LESS THAN 20 FEET IN LENGTH).
4. BAFFLE SHALL BE 700 g/m^2 COIR EROSION BLANKET.
5. TOPS OF BAFFLES SHOULD BE 2 INCHES LOWER THAN THE TOP OF THE BERMS.
6. INSPECT BAFFLES FOR REPAIR ONCE A WEEK AND AFTER EACH RAINFALL.



PLAN



SECTION A-A

RISER SCHEDULE					
BASIN	A	B	C	D	E
2	691.5'	692'	692.3'	695'	696.0'

NOTES:
1. PROVIDE WATERTIGHT JOINTS ON ALL PIPING.
2. PRECAST CONCRETE BOXES SHALL CONFORM TO THE FOLLOWING REQUIREMENTS:
   A. CONCRETE: COMPRESSIVE STRENGTH 4000 PSI
   B. REINFORCING: ASTM A-615, GRADE 60
   C. MEETS H-20 LOADING.
3. BASE MUST BE PHYSICALLY ATTACHED OR INTEGRATED INTO THE DESIGN OF THE RISER STRUCTURE.

RISER DETAILS

DETAIL 4/D1
NOT TO SCALE

NO.	DATE	REVISION

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NORTH CAROLINA PROFESSIONAL SEAL 021666 ENGINEER PETER K. SCHWEIGER 3/10/09

PROJECT TITLE:
DAVIDSON COUNTY
C&D LANDFILL - PHASES 3 & 4
PERMIT AMENDMENT DRAWINGS

DRAWING TITLE:
DETAILS
(SHEET 1 OF 4)

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY: KBA	PROJECT NO.: DAVDCO 08-5
SCALE: AS SHOWN	DATE: MARCH 2009
FILE NAME: DAVDCO-D0477	
SHEET NO. 7	DRAWING NO. D1

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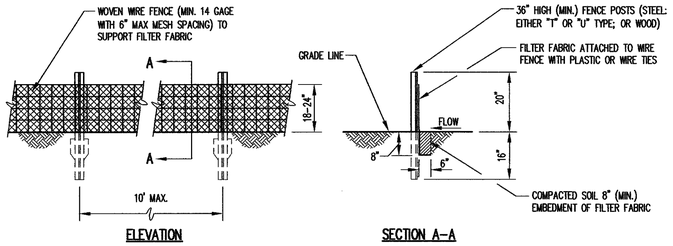
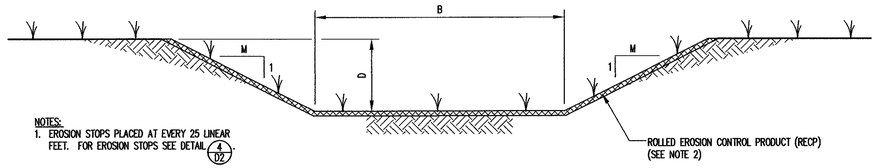


SILT FENCE

DETAIL 1/D2
NOT TO SCALE



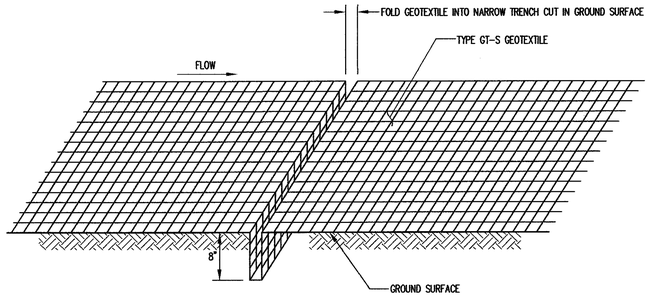
NOTES:
1. EROSION STOPS PLACED AT EVERY 25 LINEAR FEET. FOR EROSION STOPS SEE DETAIL 4/D2
2. FOR ANCHORAGE OF RECP, SEE DETAIL 1/D4

RECP LINED CHANNELS

DRAINAGE CHANNEL SCHEDULE				
DRAINAGE CHANNEL NO.	LINING	B (FT)	D (FT)	M
DC 2-1	TRM*	6.0	2.0	2.0
DC 2-2	TRM	6.0	2.0	2.5
*TRM= TURF REINFORCED MATTING				

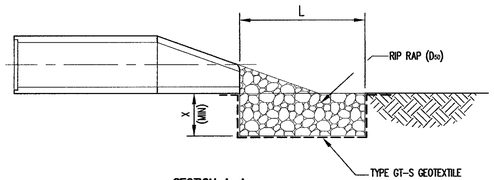
DRAINAGE CHANNEL DETAILS

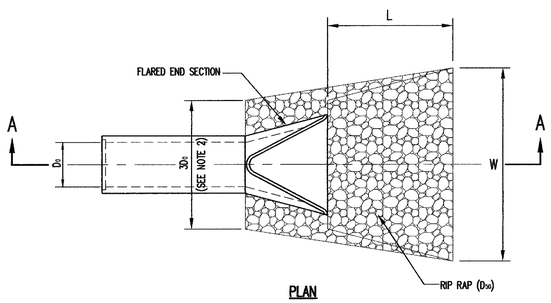
DETAIL 3/D2
NOT TO SCALE



EROSION STOP DETAIL

DETAIL 4/D2
NOT TO SCALE



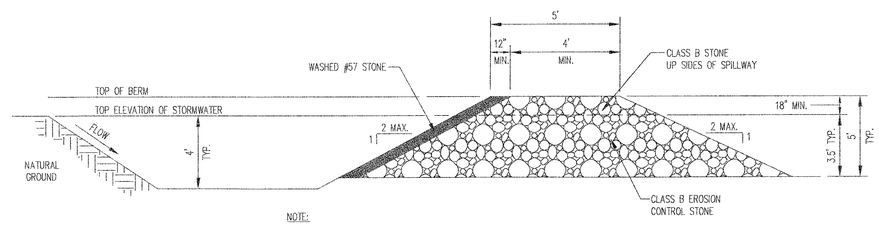


NOTES:
1. D_{50} REFERS TO THE MINIMUM REQUIRED AVERAGE STONE SIZE.
2. FOR MORE THAN ONE PIPE, EXTEND RIP RAP 1.0' MIN. BEYOND OUTSIDE EDGES OF PIPES.

RIP RAP OUTLET PROTECTION SCHEDULE					
PIPE	D_P (IN)	L (FT)	W (FT)	X (FT)	D_{50} (IN)
C 2-1	18	8	9.5	1	6
BASIN 2	15	12	13.5	1	6

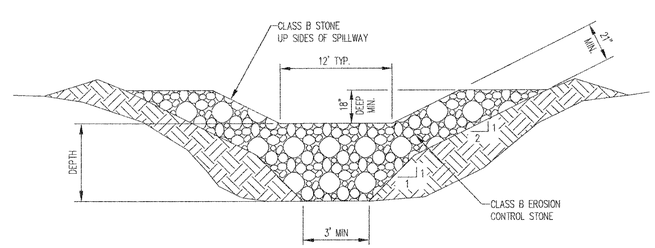
RIP RAP OUTLET PROTECTION (OUTLET TO FLAT AREA)

DETAIL 2/D2
NOT TO SCALE



NOTE:
CLEAN TRAP WHEN SEDIMENT REACHES ONE-HALF OF THE DESIGN DEPTH.

SECTION THRU TRAP AND OUTLET



SECTION THRU BERM AND OUTLET

TYPICAL EXISTING SEDIMENT TRAP

DETAIL 5/D2
NOT TO SCALE

REVISION		
NO.	DATE	

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NORTH CAROLINA PROFESSIONAL SEAL 021668 ENGINEER PIETER K. SCHUIL 4/13/09

PROJECT TITLE:
DAVIDSON COUNTY
C&D LANDFILL - PHASES 3 & 4
PERMIT AMENDMENT DRAWINGS

DRAWING TITLE:
DETAILS
(SHEET 2 OF 4)

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY: KBA	PROJECT NO.: DAVDCO 08-5
SCALE: AS SHOWN	DATE: MARCH 2009
FILE NAME: DAVDCO-D0487	
SHEET NO. 8	DRAWING NO. D2

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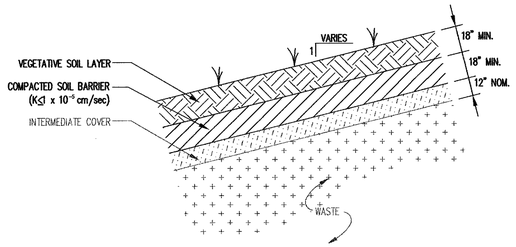
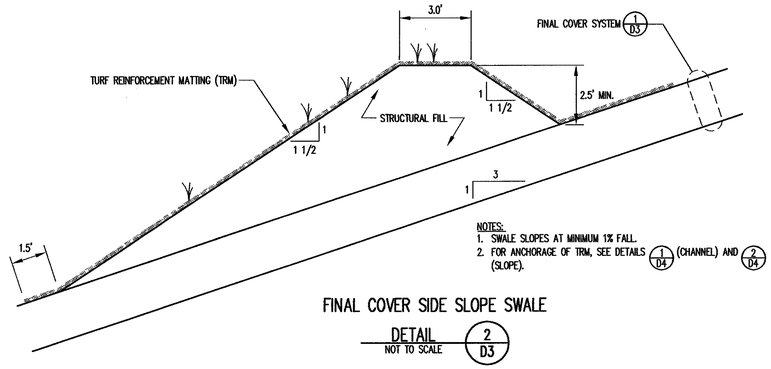


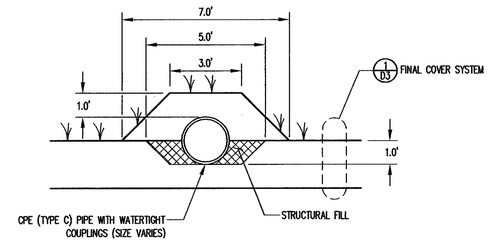
FINAL COVER SYSTEM

DETAIL 1/D3
NOT TO SCALE



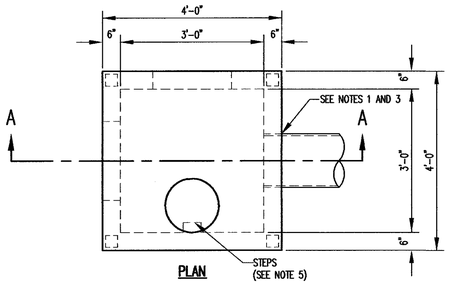
FINAL COVER SIDE SLOPE SWALE

DETAIL 2/D3
NOT TO SCALE

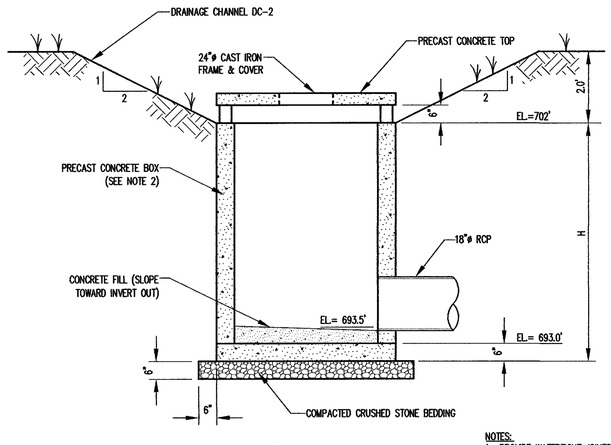


DOWN PIPE ON SLOPE

DETAIL 3/D3
NOT TO SCALE



PLAN

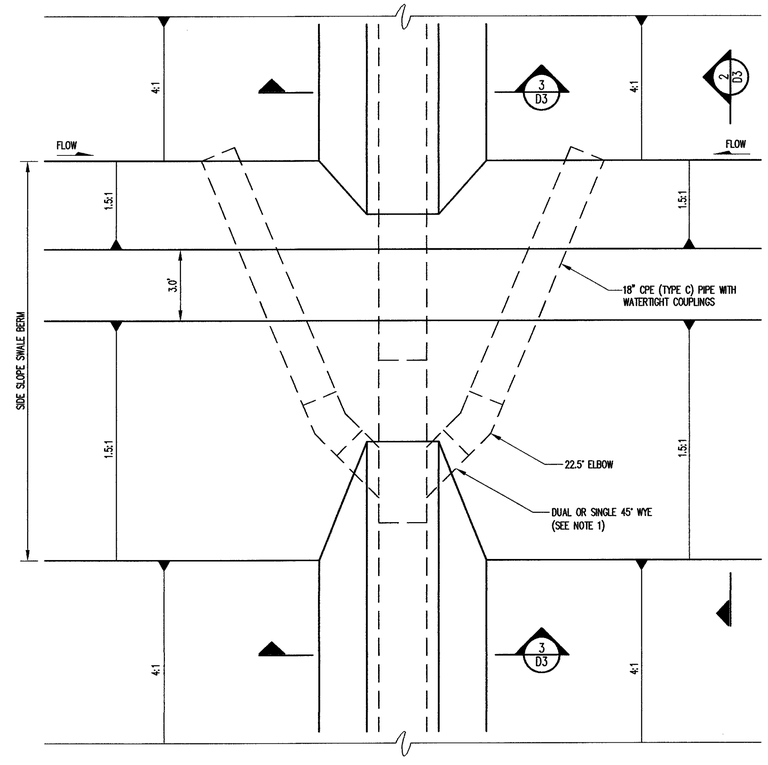


SECTION A-A

DROP INLET

DETAIL 4/D3
NOT TO SCALE

NOTES:
1. PROVIDE WATERTIGHT JOINTS ON ALL PIPING.
2. PRECAST CONCRETE BOXES SHALL CONFORM TO THE FOLLOWING REQUIREMENTS:
   A. CONCRETE: COMPRESSIVE STRENGTH 4000 PSI
   B. REINFORCING: ASTM A-615, GRADE 60
   C. MEETS H-20 LOADING.
3. PIPES MAY BE ORIENTED DIFFERENTLY WITH RESPECT TO THE THE CHANNEL THAN DISPLAYED HERE. SEE DRAWING EC1 FOR PROPER ORIENTATION.
4. THE CONTRACTOR SHALL PROVIDE ADEQUATE PROTECTION FROM SEDIMENTATION FOR ALL DROP INLETS USING GRAVEL AND WIRE MESH FILTERS OR OTHER METHOD AS APPROVED BY THE ENGINEER.
5. PROVIDE STEPS FOR DROP INLETS WITH H>4.5'. STEPS SHALL HAVE A 16" SPACING THE FULL HEIGHT OF THE DROP INLET. START FIRST STEP 6" BELOW TOP.



NOTES:
1. DEPENDING ON LOCATION AND SIZE OF DOWN PIPE, WYE FITTING MAY BE SINGLE OR DUAL AND MAY BE A REDUCING WYE.

DOWN PIPE

DETAIL 5/D3
NOT TO SCALE

REVISION | NO. | DATE

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SEAL

SEAL: NORTH CAROLINA PROFESSIONAL SEAL 027665 ENGINEER PETER K. SOMMERVILLE 4/10/2009

PROJECT TITLE:
DAVIDSON COUNTY
C&D LANDFILL - PHASES 3 & 4
PERMIT AMENDMENT DRAWINGS

DRAWING TITLE:
DETAILS
(SHEET 3 OF 4)

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY: KBS	PROJECT NO.: DAVDCO 08-5
SCALE: AS SHOWN	DATE: MARCH 2009
FILE NAME: DAVDCO-D0478	
SHEET NO. 9	DRAWING NO. D3

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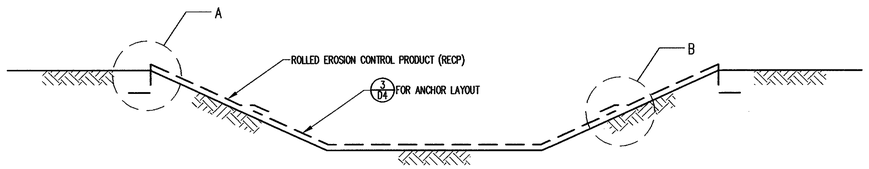

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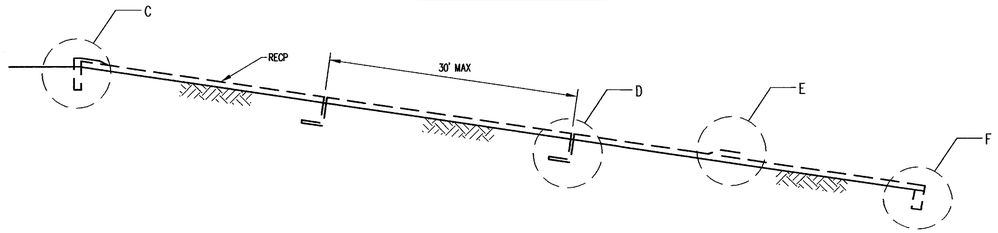

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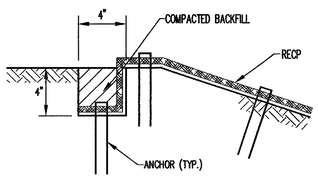

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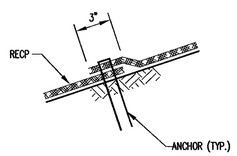

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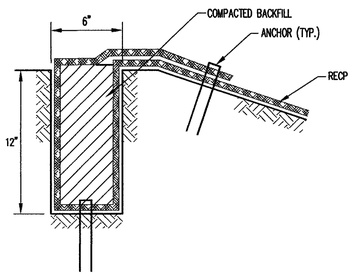

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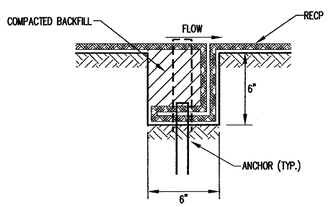

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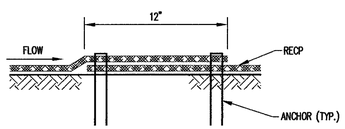

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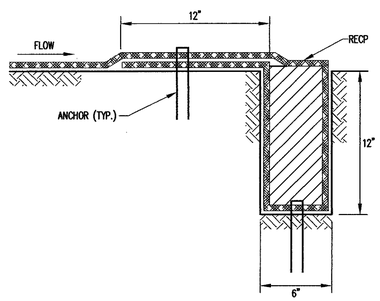

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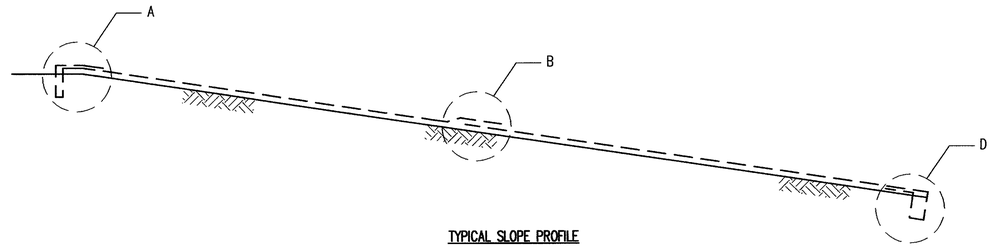
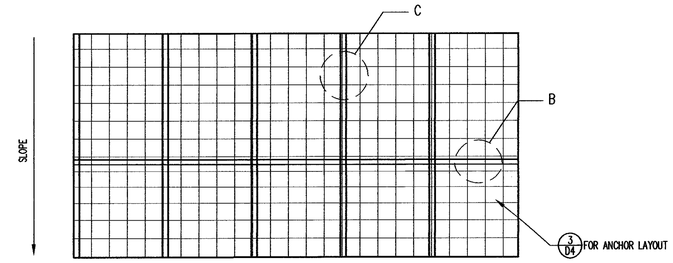
INSTALLATION OF ROLLED EROSION CONTROL PRODUCTS (CHANNELS)

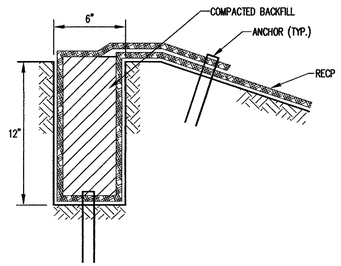
DETAIL 1/D4
NOT TO SCALE



TYPICAL SLOPE PROFILE



TYPICAL SLOPE PLAN VIEW



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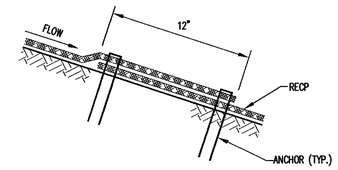

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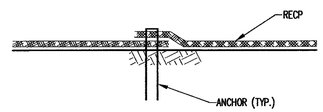
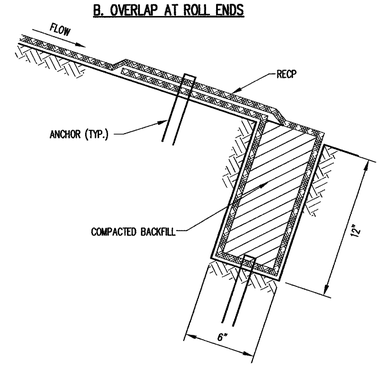


C. OVERLAP AT ADJACENT EDGES



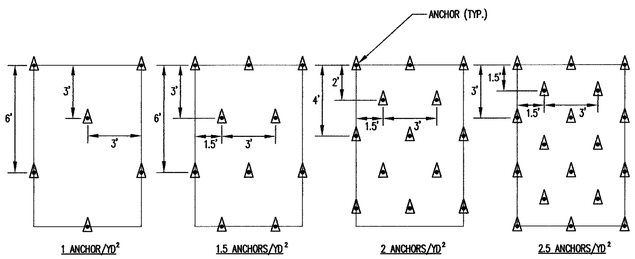
D. DOWNSLOPE TERMINAL ANCHOR TRENCH

NOTE:
1. PLACE ANCHORS AT ANCHOR TRENCHES, OVERLAPS, AND CHECK SLOTS ON 1 FOOT CENTERS. IF APPLICABLE, STAGGER ANCHOR SPACING BETWEEN MULTIPLE ROWS OF ANCHORS.

INSTALLATION OF ROLLED EROSION CONTROL PRODUCTS (SLOPES)

DETAIL 2/D4
NOT TO SCALE

ANCHOR SPACING SCHEDULE	
LOCATION	REQUIRED ANCHOR SPACING (ANCHORS/YD^2)
ALL CHANNELS	2.5
1.5H:1V SLOPES	2.0
2H:1V SLOPES	2.0
2.5H:1V SLOPES	1.5
3H:1V SLOPES	1.5
3.5H:1V SLOPES	1.0
4H:1V SLOPES	1.0



ANCHOR LAYOUT

DETAIL 3/D4
NOT TO SCALE

RICHARDSON SMITH GARDNER & ASSOCIATES
14 N. Boylan Ave.
Raleigh, N.C. 27603
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REVISION | NO. | DATE

SEAL

PROJECT TITLE:
DAVIDSON COUNTY
C&D LANDFILL - PHASES 3 & 4
PERMIT AMENDMENT DRAWINGS

DRAWING TITLE:
DETAILS
(SHEET 4 OF 4)

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY: KBA	PROJECT NO.: DAVDCO 08-5
SCALE: AS SHOWN	DATE: MARCH 2009
FILE NAME: DAVDCO-D0479	
SHEET NO. 10	DRAWING NO. D4

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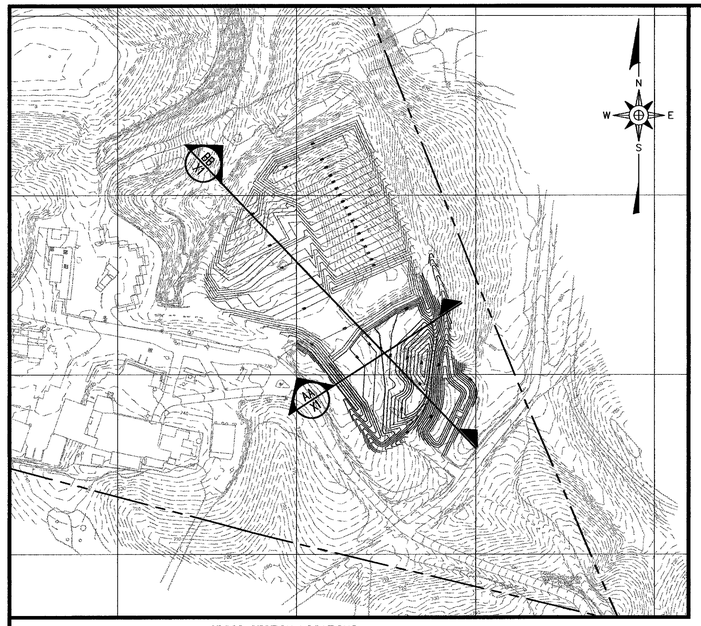

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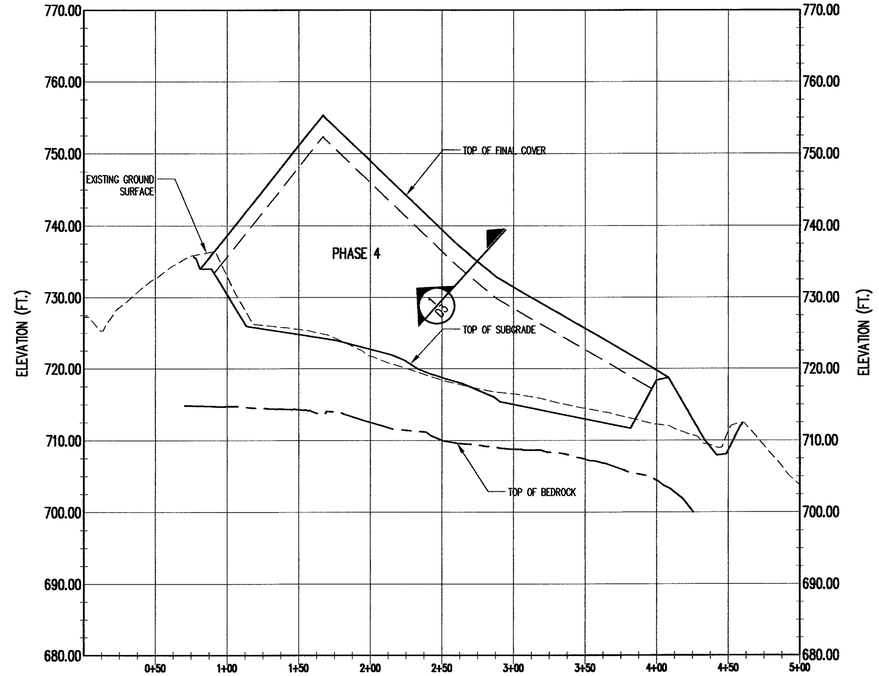

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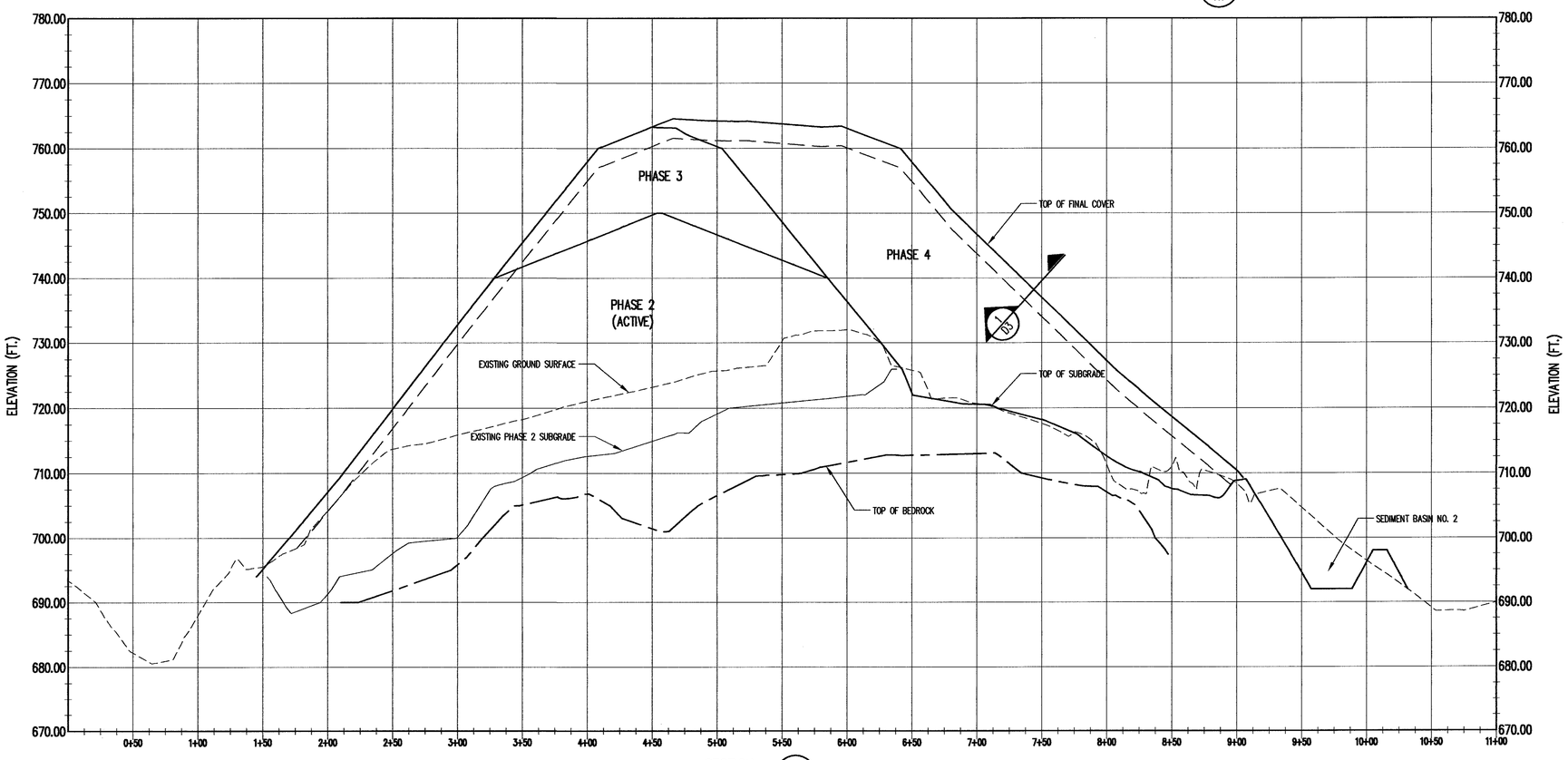

SECTION BB X1
NOT TO SCALE

LEGEND

- 660 — EXISTING 10' CONTOUR (SEE REFERENCE 1)
- EXISTING 2' CONTOUR
- PROPERTY LINE
- EXISTING GROUND (SEE REFERENCE 1)
- PROPOSED GRADES
- TOP OF BEDROCK

NOTES

1. GRADES SHOWN REPRESENT SUBGRADE ELEVATIONS.

REFERENCES

1. OVERALL TOPOGRAPHY FROM AERIAL PHOTOGRAPHY DATED APRIL 30, 2008 BY STATIAL DATA CONSULTANTS, INC., HIGH POINT, NC.

30' 20' 10' 0

0 50' 100' 150'

NO.	DATE	REVISION

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SEAL

SEAL: NORTH CAROLINA PROFESSIONAL SEAL 021666 ENGINEER PETER K. SCHOLZ 6/12/09

PROJECT TITLE:
DAVIDSON COUNTY
C&D LANDFILL - PHASES 3 & 4
PERMIT AMENDMENT DRAWINGS

DRAWING TITLE:
ENGINEERING CROSS SECTIONS

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY: KBB	PROJECT NO.: DAVDCO 08-5
SCALE: AS SHOWN	DATE: MARCH 2009
FILE NAME: DAVDCO-D0480	
SHEET NO. 11	DRAWING NO. X1

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REFERENCES

1. OVERALL TOPOGRAPHY FROM AERIAL PHOTOGRAPHY DATED APRIL 30, 2008 BY SPATIAL DATA CONSULTANTS, INC., HIGH POINT, NC.

NO.	DATE	REVISION

RICHARDSON SMITH GARDNER & ASSOCIATES
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PROJECT TITLE:

DAVIDSON COUNTY
C&D LANDFILL - PHASES 3 & 4
PERMIT AMENDMENT DRAWINGS

DRAWING TITLE:

PHASING PLAN

DESIGNED BY: P.K.S.	DRAWN BY: C.T.J.
CHECKED BY: KBR	PROJECT NO.: DAVDCO 08-5
SCALE: AS SHOWN	DATE: MARCH 2009
FILE NAME: DAVDCO-D0484	
SHEET NO. 12	DRAWING NO. P1

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ATTACHMENT
H

Design Hydrogeologic Report

Davidson County C&D Landfill
Phases 1 through 4
Thomasville, North Carolina

NC Solid Waste Permit No. 29-06 CDLF

Prepared For:

Davidson County Integrated Solid Waste
1242 Old Hwy 29
Thomasville, North Carolina 27360

Prepared By:

RICHARDSON SMITH GARDNER
& ASSOCIATES
ENGINEERING & GEOLOGICAL
SERVICES

April 2009

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Design Hydrogeologic Report

Davidson County C&D Landfill - Phases 3 & 4
Davidson County, North Carolina

Prepared for:
Davidson County Integrated Solid Waste Management Department
Thomasville, North Carolina

RSG Project No. DAVDCO-08-5

Joan A. Smyth, P.G.
Principal, Senior Hydrogeologist

NORTH CAROLINA LICENSED SEAL 1369 GEOLOGIST JOAN A. SMYTH

April 2009

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14 N. BOYLAN AVENUE
RALEIGH, NORTH CAROLINA 27603

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Thomasville, North Carolina

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Davidson County C&D Landfill Phases 3 & 4
Thomasville, North Carolina

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1.0 INTRODUCTION

Davidson County currently owns and operates a C&D landfill located southeast of the lined Phase 1 municipal solid waste (MSW) landfill. The permit to construct (PTC) for Phase 1 of the existing C&D landfill was submitted in July 2000[1] and a Construction Quality Assurance Report was submitted in August 2001[2]. The PTC for Phase 2 of the C&D landfill was approved on September 8, 2005[3]. The PTC for Phase 2 included a complete Site Study for the entire proposed C&D landfill including the Phase 4 area. Phase 2 of the C&D landfill is currently in operation, while Phase 3 is comprised of a proposed vertical expansion over the footprint created by Phases 1, 2 and 4. Phase 4 is comprised of approximately 1.7 acres located to the southeast of Phases 1 and 2. Existing Site Conditions are shown on **Figure 1**.

Geological and geotechnical conditions at the planned C&D site are typical of site conditions for the MSW landfill. There are no flood plains, wetlands, or endangered species identified within the C&D footprint. Soils are relatively thin to non-existent in the C&D footprint. Ground water characteristics at the site are sufficiently well understood to design an effective ground water monitoring network.

The overall site contains a perennial stream (Jimmy's Creek) that provides an on-site ground water discharge feature. An unnamed tributary of Jimmy's Creek is located to the northeast and downgradient of the C&D landfill. There are no potable wells located between the planned C&D landfill expansion and the ground water discharge feature. Depths to bedrock and/or ground water are such that the current grading plan will meet regulatory vertical separation requirements.

2.0 SITE STUDY UPDATES

Although a complete Site Study for the entire proposed C&D landfill was submitted with the Permit to Construct Application for Phase 2 in 2005, there are two areas that require an updated evaluation for Phase 4. These are a revision of the aerial photo to one that was taken within 1 year of this submittal, and an evaluation of wetlands adjacent to the proposed Phase 4 area. These are discussed in more detail below.

2.1 Site Characterization

A current (2008) aerial photo of the C&D landfill and surrounding 2000 foot area is included as **Figure 2**. This aerial photo indicates little new development since the previous Site Suitability

---

[1]G. N. Richardson and Associates, Inc., Permit to Construct Application Davidson County C&D Landfill - Phase 1, July 2000.

[2]G. N. Richardson and Associates, Inc, Construction Quality Assurance Report Davidson County C&D Landfill - Phase 1, August 2001.

[3]G. N. Richardson and Associates, Inc., Permit to Construct Application Davidson County C&D Landfill - Phase 2, September 2005.

submittal for Phase 2. Within the 2000 foot radius, there is a mobile home park, Lower Lake Estates, which has been in that location and has not increased in size since the previous submittal. No additional home development has occurred at the mobile home park, nor in the remaining area of the 2000 foot radius. The majority of the area within the 2000 foot radius is Davidson County Landfill property.

2.2 Wetlands Evaluation

In December, 2008 a wetland evaluation was performed for the area downgradient of the proposed Phase 4 area. Although the proposed Phase 4 footprint is not located in wetlands, there are wetlands in the surrounding area. The wetland evaluation was performed by Carolina Ecosystems, Inc. A letter report outlining their investigation and conclusions is included in **Appendix A**. **Figure 3** shows the surveyed wetland areas adjacent to the proposed Phase 4 area. As you can see in **Figure 3**, the design of Phase 4 and all of its appurtenances are located outside the wetland features.

3.0 REGIONAL AND LOCAL GEOLOGY

The Davidson County Landfill facility is located in the Piedmont Physiographic Province of North Carolina. More specifically, the Geologic Map of North Carolina (1985) indicates that the site lies within, but at the western margin of, the Carolina Slate Belt. This belt includes predominantly volcanic and sedimentary rocks of Late Proterozoic to Cambrian age that have been metamorphosed and intruded by numerous igneous plutons. The boundary zone between the Carolina Slate Belt and the adjacent Charlotte Belt is known as the Gold Hill/Silver Hill shear zone.

The most detailed mapping of the area was published by the US Geological Survey in the Geologic Map of Charlotte by Goldsmith, Milton and Horton (1988). This mapping indicates that the site vicinity is underlain by three stratigraphic units: metavolcanic rocks (mv), and felsic metavolcanic rocks (mvf).

The metavolcanic rocks include mafic, intermediate and felsic volcanic rocks, rocks from the Flat Swamp Member of the Cid Formation, and metavolcanic rocks of the Battleground Formation. The Battleground Formation is characterized as a quartz-sericite schist and phyllite. It contains subordinate beds of quartz-pebble conglomerate, quartzite, kyanite or sillmanite quartzite and manganiferous schist. The felsic metavolcanic rocks (mvf) are fine to medium grained rhyolitic and rhyodacitic metatuffs. Locally these are coarse-grained. This unit contains minor intermediate and mafic metavolcanic rocks and is probably correlative, at least in part, with felsic metavolcanic rocks of the Battleground Formation. Metamorphosed granitic plutons are also mapped in the area of the site. These plutons are megacrystic and well foliated.
The rocks of this region are intruded by a swarm of metagabbro and metabasalt dikes and conformable sheets. This metagabbro typically crops out as round residual boulders that show no foliation except in the Gold Hill/Silver Hill shear zone.

The Geologic Map of Charlotte (Goldsmith and Horton, 1988) suggests that a fault splay of the Gold Hill/Silver Hill shear zone may lie to the east of the area of investigation and the C & D cell footprint. The northwest trending fault splay, if present, may cross through the Scarlett Branch valley between the Scarlett Landfill cell and the Subtitle D MSW landfill site. This map is included as **Figure 4**.

Piezometers were installed on-site during July, 1998 and February, 2000. Eight piezometers were installed by a combination of hollow stem auger, air rotary, air hammer and rock coring techniques. In general, auger refusal was encountered between the surface and 25 feet below grade. Half of the borings (B-2 through B-5) encountered auger refusal at the surface, the remaining borings (B-1, and B-6 through B-8) encountered auger refusal between 6 feet and 25 feet. A map of these borings and current monitoring wells is included as **Figure 3**.

Soils encountered include sandy silt and partially weathered rock. In this instance, partially weathered rock is defined as soils with a standard penetration test blow count of 100+ blows per foot.

The geologic cross-sections, included on **Figure 5,** depict the geologic conditions at the site. In general, the site can be characterized as having a mantle of silty sandy soil in some areas with either a granitic or dioritic bedrock below, and at the surface in other areas due to past borrowing techniques. A Bedrock Surface Map is included as **Figure 6**.

4.0 SITE GEOLOGIC INVESTIGATION

4.1 Soil Borings/Piezometers .0538 (b) (1)

A test boring investigation of the planned C&D site was performed in 1998. A total of six test borings were installed and named B-1 through B-8. Due to the shallow nature of bedrock on the site, the borings were advanced using air rotary drilling. Test boring data are summarized on **Table 1**. **Figure 3** shows the locations of the test boring and ground water level observation points.

The test borings and relevant site features are shown on **Figure 3**. Vertical and horizontal control is tied into the site grid, referencing permanent bench marks located at the base of a large electrical transmission line on-site.

An additional soil investigation was conducted in September 2004. This investigation included the advancement of 28 hollow stem auger soil borings in a grid pattern down to bedrock (defined by “auger refusal”). This work was performed in order to create an accurate map of the bedrock surface across the proposed C&D area. The location of these borings are also shown on **Figure 3**. Ground elevations, depth to rock measurements and bedrock elevations (as defined by hollow stem auger refusal) are summarized in **Table 1**.

4.1.1 Formation Descriptions .0538(b) (2) (I)

As stated above, the metavolcanic rocks include mafic, intermediate and felsic volcanic rocks, rocks from the Flat Swamp Member of the Cid Formation, and metavolcanic rocks of the Battleground Formation. The Battleground Formation is characterized as a quartz-sericite schist and phyllite. It contains subordinate beds of quartz-pebble conglomerate, quartzite, kyanite or sillmanite quartzite and manganiferous schist. The felsic metavolcanic rocks (mvf) are fine to medium grained rhyolitic and rhyodacitic metatuffs.

4.1.2 Bedrock Investigation .0538 (b) (2) (D) and (F)

A total of 28 soil borings were advanced to bedrock in a grid pattern in order to delineate the rock surface across the entire proposed C&D landfill footprint. Of these borings, only one (AP-24) encountered bedrock in the upper 4 feet of soil. The remaining borings encountered bedrock between 4 and 18.5 feet below grade. A bedrock surface map is included as **Figure 6**.

Bedrock at the site is both granite and diorite. Seams of these bedrock types have been seen on other portions of the site as well. One rock core was collected from boring B-7. This rock core encountered diorite at a depth of 16.5 feet below grade. The RQD of the core was 16% while the total recovery was 75% (100% from 16.5 ft. to 24 ft. below grade). This indicates highly fractured rock on-site. It should also be noted that the partially weathered rock and bedrock (as defined by auger refusal) are rippable using the equipment on-site. This was common practice while the areas occupied by Phases 1 and 2 of the C&D landfill were being used for borrow.

4.2 Laboratory/Geotechnical Testing .0538 (a) (4)

The soil test borings were sampled with standard penetration test techniques (ASTM D-1586). Soil samples were visually classified by an experienced soils technician. Laboratory testing was performed on representative samples to confirm the field classifications.

Due to the shallow nature of bedrock in this area, only one soil sample could be collected. The results of the laboratory testing are presented in **Table 2**. The thin surface soils across the area were similar to the soil sample collected. Soil boring logs are presented in **Appendix B**. Soil classifications consist of sand, silt, clay and partially weathered rock.

During site investigations, only one shelby tube sample was collected during drilling. The sample was shipped to a geotechnical laboratory for grain size analysis and compaction testing. Four additional samples were collected during test pit evaluations at the site in July 2005. These samples were analyzed for sieve analysis and Atterberg limits. A remolded permeability was also completed on a composite of the four samples. The laboratory results for these samples are included in **Appendix C**.

The permeability sample was remolded as a composite of four individual soil samples for the sole purpose of evaluating permeability in the soils. The analyzed permeability of this remolded sample was 7×10^{-5} cm/sec.

4.3 Other Investigative Tools .0538 (a) (5)

As stated above, a series of soil borings were advanced in a grid pattern in order to evaluate the thickness of soils above bedrock at the site. The data from this investigation is summarized in **Table 1**. This information was used to create a bedrock surface map of the proposed C&D area. No other investigative tools were utilized to evaluate this site.

4.4 Stratigraphic Cross Sections .0538 (a) (6) and .0538 (b) (2) (G)

Hydrogeologic profiles are presented in **Figure 5**. As shown, the bedrock in this area is granite that is highly weathered at the surface and more competent below. Bedrock at this site is intrusive granite and diorite. Above the bedrock there is a thin mantle of weathered saprolitic soils and partially weathered rock.

5.0 REGIONAL AND LOCAL HYDROGEOLOGY .0538 (b) (2) (H)

5.1 Water Table Information .0538 (a) (7 through 10)

The hydrogeologic system in the Piedmont is essentailly a two-part system comprised of regolith and underlying bedrock.[4] Typically regolith is defined as the soil zone and the saprolite zone. The regolith is the zone where ground water is typically stored in aquifers that are recharged by infiltration. This zone is usually connected to the underlying fractured bedrock where fractures meet the surface of the bedrock. Primarily ground water flows moves through the regolith toward a discharge point such as a stream or river. In general, the aquifers are anisotropic with variations of clay, silt and sand as the media for the aquifer.

Short term water level observations (taken at the time of boring and 24 hours after boring) are tabulated in **Table 1**. Seven day water levels were not acquired, however, water levels were monitored 4 and 12 days after completion of the first piezometers and monthly thereafter. Long term water level measurements are summarized in **Tables 3 and 3A**. A Hydrograph of these water levels is also included with **Table 3.** Although ground water is used at the Martin Marietta Quarry for stone washing, there has been no evidence of this pumping affecting ground water levels in any of the monitoring wells on-site associated with the MSW landfills. This lack of influence is likely due to the distance between the landfill and quarry (~3000 ft.).

5.1.1 Seasonal High Potentiometric Surface

A potentiometric surface map from April 2006 is included as **Figure 7**. This is the highest potentiometric surface measured in the current monitoring well network. A potentiometric map from June 2000 summarizes the highest measurements recorded at the site. This map is included as **Figure 8**.

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[4] LeGrand, Harry E., Sr., A Master Conceptual Model for Hydrogeological Site Characterization in the Piedmont and Mountain Region of North Carolina, February 2004.

Based upon data gathered during the investigation and published literature, the bedrock aquifer at this site likely extends to a depth of approximately 100 feet below land surface. The bedrock aquifer was not completely penetrated during this site investigation.

The potentiometric surface reflects a subdued expression of the surface topography, which is typical of the Piedmont, and indicates a generally north, west and south radial ground water flow pattern. It should be noted that monitoring wells MW-1 and MW-1d shown on the potentiometric map are upgradient wells for the Davidson County lined Subtitle-D landfill as well as for the Holly Grove Landfill. Since that time, the majority of the piezometers have been properly abandoned due to site construction. However, this potentiometric surface map details the location of the ground water divide at the site better than more recent maps, and is there included.

5.1.2 Groundwater Flow Path .0538 (b) (2)(H)

Ground water flow is generally toward the north and south/southeast, toward the unnamed tributaries of Jimmy's Creek. The uppermost aquifer in the footprint of the site is located within the bedrock of the site. Although four of the borings drilled on-site had surficial soils above bedrock (B-1, and B-6 through B-8), ground water across most of the site was not encountered in the unconsolidated surficial soils. The ground water under most of the site flows within the fractures in the bedrock. Given the highly fractured nature of the bedrock in this area, the groundwater flow is considered to be similar to flow within unconsolidated sediments. Therefore there is one hydrogeological unit at the site, Unit 1, which is the bedrock aquifer.

5.1.3 Groundwater Recharge and Discharge .0538 (b)(2)(H)

In the area of B-3 ground water has been encountered at a depth of approximately four (4) feet below constructed grade. This is due to artificial recharge from the sedimentation basin located nearby which increases the ground water elevation in this immediate area. The recharge is "artificial" since the run-off water in the area is directed to the sedimentation basin from its normal path. This means more water is recharging in a smaller area, thus changing normal conditions. Recharge occurs over most of the site and land upgradient from the site where water infiltrates into the soils and then into the bedrock at the site. Discharge occurs at the unnamed tributaries that flow into Jimmy's Creek.

5.2 Ground Water Gradients and Velocities .0538 (b)(2)(H)

A summary of measured hydraulic conductivities (based on slug tests in wells and published data for unsaturated soils) and apparent horizontal hydraulic gradients and velocities is presented in **Table 4** and the slug test data is included in **Appendix D**. Additionally, the results of the remolded permeability sample are included in **Table 4**. Horizontal hydraulic gradients were estimated based on potentiometric contours. Ground water velocities at each piezometer were calculated using apparent horizontal hydraulic gradients, hydraulic conductivity values and empirical effective porosity values according to the equation:

$$V = KI/n:$$

Where: V = Ground Water Velocity
K = Hydraulic Conductivity (from rising head slug tests)
I = Hydraulic Gradient (from water table elevations)
n = Porosity (based on referenced values)

Hydraulic conductivity values for the bedrock aquifer range from 5.5×10^{-5} ft/min (B-5) to 3.36 X 10^{-3} ft/min (B-2). Horizontal ground water gradients range from 0.023 ft/ft (B-1) to 0.104 ft/ft (B-6). Ground water velocities range from 1.62×10^{-3} ft/min to 5.5×10^{-5} ft/min.

5.3 Factors that Influence Water Levels

Although groundwater at this site flows within the bedrock, the bedrock exhibits significant fracturing due to previous geologic activity during the movement of the Gold Hill/Silver Hill shear zone. Therefore, the highly jointed and weathered bedrock tends to act more as an unconsolidated sediment in the movement of groundwater than a regime of single fractures carrying groundwater.

Manmade factors that influence water levels include the location of sedimentation basins outside the landfill footprint. These basins allow for the infiltration of water which can locally elevate water levels in the immediate area around the sedimentation basin.

5.4 Other Geologic and Hydrogeologic Considerations .0538 (a)(12)

The Phase 4 area is located to the south of Phases 1 and 2 down a hillside toward an unnamed tributary of Jimmy's Creek. The elevation of this area ranges from 726 to 680 feet. Generally, surface drainage flows from the northwest to the southeast across this area.

The site is located in the Gold Hill/Silver Hill shear zone. Geology of the site consists of mafic, intermediate and felsic volcanic rocks. According to the Geologic Map of Charlotte[5] a fault splay may be located in the valley between the Scarlett Landfill and the Davidson County Lined landfill, to the south east of the proposed C&D landfill. Faulting in this area has not been active since before the Holocene. No unusual geologic features or conditions, including seismic hazards or unstable areas, have been identified on the site.

Generally, bedrock is found at shallow depths within the soil profile. A detailed auger probe evaluation of the Phase 4 area was performed to evaluate the depth to bedrock across this entire Phase. Bedrock at the site consists of rippable and highly fractured granite and diorite. The primary bedrock type in the proposed C&D area is granite.

[5] R.G. Goldsmith, D.J. Milton and J.W. Horton, Geologic Map of Charlotte 1º x 2º quadrangle, North Caorlina and South Carolina, 1988.

There are no springs, seeps or groundwater discharge features within the footprint of this Phase. However, wetlands are located downgradient of the C&D landfill to the west as shown on **Figure 3**. The wetlands are located outside of any area proposed for construction include the Phase 4 cell and all sedimentation basins associated with it.

5.5 Local Well and Water Use Information .0538 (a) (11)

A potable well survey was completed in December 2008. This survey indicates there are no potable well users within a 2000-foot radius of the C&D landfill. The nearest surface water intakes are over 2-miles from the site in Tom-A-Lex lake. The remaining homes in the area receive water supplied by the County.

5.6 Vertical Separation Requirements .0538 (b) (1) (A)

The Phase 4 area meets the 4-foot vertical separation requirement. In this case, bedrock is the constraining factor rather than water table elevation as groundwater flows within the bedrock. A detailed auger probe study indicates that bedrock is greater than 4 feet below grade in Phase 4. Measurements of groundwater in the Phase 4 area indicate the water table is greater than 15 feet below grade.

5.7 Site Monitorability .0538 (b) (2) (B &C)

Based upon the geologic information gathered at the site, the site is deemed monitorable. Generally, groundwater flows within the bedrock to the northwest and southeast with an apparent groundwater divide located near the top of the hill located beneath Phases 1 and 2 of the C&D landfill. Groundwater underneath Phase 4 flows to the southeast. A Water Quality Monitoring Plan (WQMP) for the C&D landfill is included in **Appendix E**.

5.8 Well Abandonment .0538 (b) (2) (J)

All piezometers/borings/wells that are located within the proposed footprint will be abandoned in accordance with 15A NCAC 2C.0100 by a licensed driller. The only wells remaining at the C&D landfill will be permanent groundwater monitoring wells. These are described in detail in the WQMP in **Appendix E**.

6.0 CONCLUSIONS

The planned C&D landfill will be situated over a portion of the recharge area, affecting a minor reduction in ground water recharge within the facility boundary. The area in which ground water recharge will be reduced is small in comparison to the drainage basin feeding the permanent stream (Jimmy's Creek). No ground water receptors (water wells) are located between the planned C&D landfill and the nearest ground water discharge feature.

Based on the investigation of the C&D study area and previous studies conducted at the site, geologic and hydrogeologic conditions are consistent throughout this portion of the site and the

study area appears to be well suited to development of a C&D landfill. Based upon the information gathered from these studies a WQMP has been developed that will provide effective monitoring of ground water beneath this site. The WQMP is included in **Appendix E** for your review.

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By: JAS
Date: 4/10/2009

Table 1
Test Boring Data and Short-Term Ground Water Level Observations
Davidson County C & D Landfill
April 2009

Boring No.	Date Drilled	TOC Elev.	Ground Elev.	PWR Depth	PWR Elev.	Refusal Depth	Refusal Elev.	Total Depth	Bottom Elevation	Screened Interval	Top of Screen Elevation
B-1	7/13/1998	726.79	724.3	25	701.79	27	697.3	53	671.3	43 - 53	681.3
B-2	7/14/1998	709.48	708	0	--	8	700	48	660	38 - 48	670
B-3	7/14/1998	680.49	678.3	0	--	0.5	677.8	18	660.3	8.0 - 18	670.3
B-4	7/15/1998	708.57	705.6	0	--	0	705.6	31	674.6	21 - 31	684.6
B-5	7/15/1998	708.11	705.6	0	--	0	705.6	41	664.6	31 - 41	674.6
B-6	7/16/1998	704.8	702.3	13	689.3	23	679.3	51	651.3	41 - 51	661.3
B-7	1/20/2000	735.2	733	0	733	16.5	716.5	66	667	41 - 51	692
B-8	1/21/2000	720.5	718	0	718	6	712	51	667	56 - 66	662

Where:

TOC = Top of Casing
PWR = Partially Weathered Rock defined as 50 blows/6-inch standard penetration test
Refusal = Air rotary refusal

Boring No.	Water Depth After Drilling	Water Elev. After Drilling	24 Hour Water Depth	24 Hour Water Elev.	7/17/1998 Water Depth	7/17/1998 Water Elev.
B-1	42.8	683.99	42	684.79	42.05	684.74
B-2	46.9	662.58	39.65	669.83	31.59	677.89
B-3	15.9	664.59	3.65	676.84	3.55	676.94
B-4	17.15	691.42	16.05	692.52	16.94	691.63
B-5	39.23	668.88	19.61	688.5	19.55	688.56
B-6	39.55	665.25	38.45	666.35	38.45	666.35
B-7	64	671.2	55	680.2	N/A	N/A
B-8	48	672.5	44.2	676.3	N/A	N/A

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By: JAS
Date: 4/10/2009

Table 1 (continued)
Auger Probe Data
Davidson County C & D Landfill
April 2009

Boring No.	Ground Elev.	Depth to Refusal	Bedrock Elev.
AP-1	698.11	7	691.11
AP-2	713.78	7	706.78
AP-3	723.44	18	705.44
AP-4	713.54	17	696.54
AP-5	725.36	6	719.36
AP-6	720.07	7	713.07
AP-7	716.4	4	712.4
AP-8	713.35	6.5	706.85
AP-9	724.41	8.5	715.91
AP-10	720.73	9	711.73
AP-11	720	6	714
AP-12	717.93	21	696.93
AP-13	720.83	16	704.83
AP-14	721.03	18.5	702.53
AP-15	721.52	4	717.52
AP-16	721.75	12	709.75
AP-17	723.35	18.5	704.85
AP-18	721.96	6	715.96
AP-19	718.35	8.5	709.85
AP-20	718.78	19	699.78
AP-21	721.41	12	709.41
AP-22	719.79	18	701.79
AP-23	714.64	7	707.64
AP-24	714.71	3	711.71
AP-25	715.66	12	703.66
AP-26	712.59	14.5	698.09
AP-27	710.81	12.5	698.31
AP-28	707.81	4	703.81

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RICHARDSON SMITH GARDNER & ASSOCIATES
ENGINEERING & GEOLOGICAL SERVICES

By: JAS
Date: 4/10/2009

Table 2
Geotechnical Laboratory Test Data
Davidson County C & D Landfill
April 2009

Boring Number	Sample Depth	Sample Description	Optimum Moisture	Maximum Density	USCS Classification
B-6	5' - 7.5'	Tan Sand	11.90%	118.5	SM

Boring Number	Grain Size Distribution				Atterberg Limit	Total Porosity (%)	Effective Porosity (%)	Estimated Conductivity (cm/sec)
	% Gravel	% Sand	% Silt	% Clay				
B-1	NA	NA	NA	NA	NA	NA	NA	NA
B-2	NA	NA	NA	NA	NA	NA	NA	NA
B-3	NA	NA	NA	NA	NA	NA	NA	NA
B-4	NA	NA	NA	NA	NA	NA	NA	NA
B-5	NA	NA	NA	NA	NA	NA	NA	NA
B-6	0	73.9	11.3	14.8	NA	25	15	1×10^{-4}
B-7	NA	NA	NA	NA	NA	NA	NA	NA
B-8	NA	NA	NA	NA	NA	NA	NA	NA
PT-1	39.03	41.99	15.3	3.68	NP	40	35	1×10^{-3}
PT-2	7.54	62.69	26.34	3.42	NP	35	25	1×10^{-4}
PT-3	0.03	60.54	34	5.43	NP	40	30	1×10^{-3}
PT-4	63.07	13.16	22.26	1.52	NP	40	38	$1 X 10^{-3}$
Remolded	NA	NA	NA	NA	NA	NA	NA	7×10^{-5}

Notes:
NA = Not Analyzed
NP = Non-plastic
PT-1 through PT-4 were collected inside the proposed Phase 2 footprint.
These grain size distributions shown are from the USDA classification chart
included in the Geotechnics laboratory report
Effective porosities based upon plotting of sieve analysis on the Textural Classification Triangle.
However, to account for elevated gravel percentages (which for the Textural Classification Triangle were combined
with sand percentages) the effective porosity numbers are slightly increased.
Estimated hydraulic conductivity is from published values from Applied Hydrogeology, C. W. Fetter, 2001, pg.85
Remolded sample is remolded material from Pt #1 - 4 on which a permeability analysis was run.

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By: JAS
Date: 4/10/2009

Table 3
Long Term Ground Water Levels Observations
Davidson County C & D Landfill
April 2009

Boring Number	TOC Elev.	7/28/1998		9/11/1998		10/15/1998		11/12/1998		12/10/1998		1/21/1999		2/10/1999		3/15/1999	
		DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.
B-1	726.79	42.85	683.94	44.52	682.27	45.43	681.36	46.00	680.79	46.46	680.33	36.15	690.64	44.96	681.83	44.54	682.25
B-2	709.48	40.10	669.38	39.30	670.18	38.25	671.23	37.47	672.01	36.64	672.84	35.17	674.31	34.27	675.21	33.24	676.24
B-3	680.49	5.64	674.85	5.56	674.93	6.73	673.76	6.95	673.54	6.77	673.72	2.25	678.24	2.30	678.19	2.71	677.78
B-4	708.57	21.92	686.65	24.11	684.46	36.10	672.47	27.36	681.21	28.25	680.32	20.80	687.77	19.31	689.26	20.40	688.17
B-5	708.11	22.90	685.21	24.50	683.61	26.49	681.62	27.98	680.13	29.00	679.11	23.39	684.72	21.41	686.70	23.59	684.52
B-6	704.80	41.42	663.38	43.23	661.57	44.22	660.58	44.99	659.81	45.44	659.36	43.38	661.42	41.60	663.20	41.38	663.42
B-7	735.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
B-8	720.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MW-1s	736.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	58.81	677.39
MW-1d	737.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	59.63	677.57

Boring Number	TOC Elev.	4/20/1999		6/18/1999		7/15/1999		9/13/1999		6/12/2000		7/1/2000	
		DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.
B-1	726.79	44.71	682.08	45.02	681.77	44.51	682.28	45.26	681.53	41.07	685.72	42.90	683.89
B-2	709.48	32.03	677.45	30.43	679.05	29.80	679.68	29.20	680.28	22.44	687.04	22.11	687.37
B-3	680.49	3.48	677.01	4.65	675.84	3.61	676.88	6.10	674.39	4.88	675.61	5.99	674.5
B-4	708.57	21.14	687.43	20.86	687.71	20.81	687.76	23.40	685.17	18.49	690.08	20.97	687.6
B-5	708.11	25.55	682.56	23.12	684.99	20.00	688.11	24.89	683.22	21.92	686.19	23.73	684.38
B-6	704.80	41.91	662.89	43.54	661.26	43.27	661.53	43.98	660.82	40.47	664.33	42.20	662.6
B-7	735.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	62.43	672.77	64.09	671.11
B-8	720.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	47.65	672.85	49.48	671.02
MW-1s	737.2	59.80	677.40	60.13	677.07	60.25	676.95	60.32	676.88	60.18	677.02	NA	NA
MW-1d	736.2	58.95	677.25	59.28	676.92	59.50	676.70	59.50	676.70	59.37	676.83	NA	NA

N/A = Water Levels not available for these wells as they were installed in January 2000.

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By: JAS
Date: 4/10/2009

Table 3A
Long Term Water Table Elevations
Davidson County C&D Landfill

Well	11/11/2002 Elev (feet)	6/24/2003 Elev (feet)	10/7/2003 Elev (feet)	4/8/2004 Elev (feet)	10/20/2004 Elev (feet)	4/15/2005 Elev (feet)	10/3/2005 Elev (feet)
CDMW-2	660.85	669.46	667.20	668.20	664.49	667.8	662.61
CDMW-3	666.71	670.68	669.08	671.10	669.54	672	668.71
CDMW-4	672.19	680.36	678.18	678.03	674.94	677	671.88

Well	4/25/06 Elev (feet)	10/19/06 Elev (feet)	4/18/07 Elev (feet)	10/11/07 Elev (feet)	4/28/08 Elev (feet)	10/9/08 Elev (feet)
CDMW-2	664.68	663.30	667.15	660.34	665.7	662.62
CDMW-3	670.12	669.44	671.60	666.89	671.5	669.73
CDMW-4A	672.67	668.42	674.39	667.67	672.36	669.76
CDMW-5	671.55	667.19	670.70	672.01	674.8	673.15

Elev = Water Table Elevation
TOC = Top of Casing
gray shading indicates lowest water table elevation
blue shading indicates highest water table elevation

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By: JAS
Date: 4/10/2009

Table 4
Horizontal Gradient and Velocity Calculations
Davidson County C & D Landfill
April 2009

Boring Number	Horizontal Gradient	Hydraulic Conductivity (ft/min)	Effective Porosity	Ground Water Velocity (ft/min)	Lithologic Unit	Hydrologic Unit	Aquifer Thickness
B-1	0.024	1.62×10^{-3}	0.17	0.00023	Bedrock	1	100 feet
B-2	0.023	3.36×10^{-3}	0.17	0.00045	Bedrock	1	100 feet
B-3	0.049	2.40×10^{-4}	0.16	0.00007	Bedrock	1	100 feet
B-4	0.091	2.67×10^{-4}	0.16	0.00015	Bedrock	1	100 feet
B-5	0.061	5.50×10^{-5}	0.14	0.00002	Bedrock	1	100 feet
B-6	0.104	3.70×10^{-4}	0.16	0.00024	Bedrock	1	100 feet
B-7		N/A	0.12	N/A	Bedrock	1	100 feet
B-8		N/A	0.12	N/A	Bedrock	1	100 feet

Ground Water Velocity is calculated as $V = KI/n$

Where: K = hydraulic conductivity (ft/day) from slug testing data
and I = hydraulic gradient (ft/ft)
and n = effective porosity (unitless)

Effective Porosity is from published literature -
Ground Water and Wells by Driscoll - Page 67

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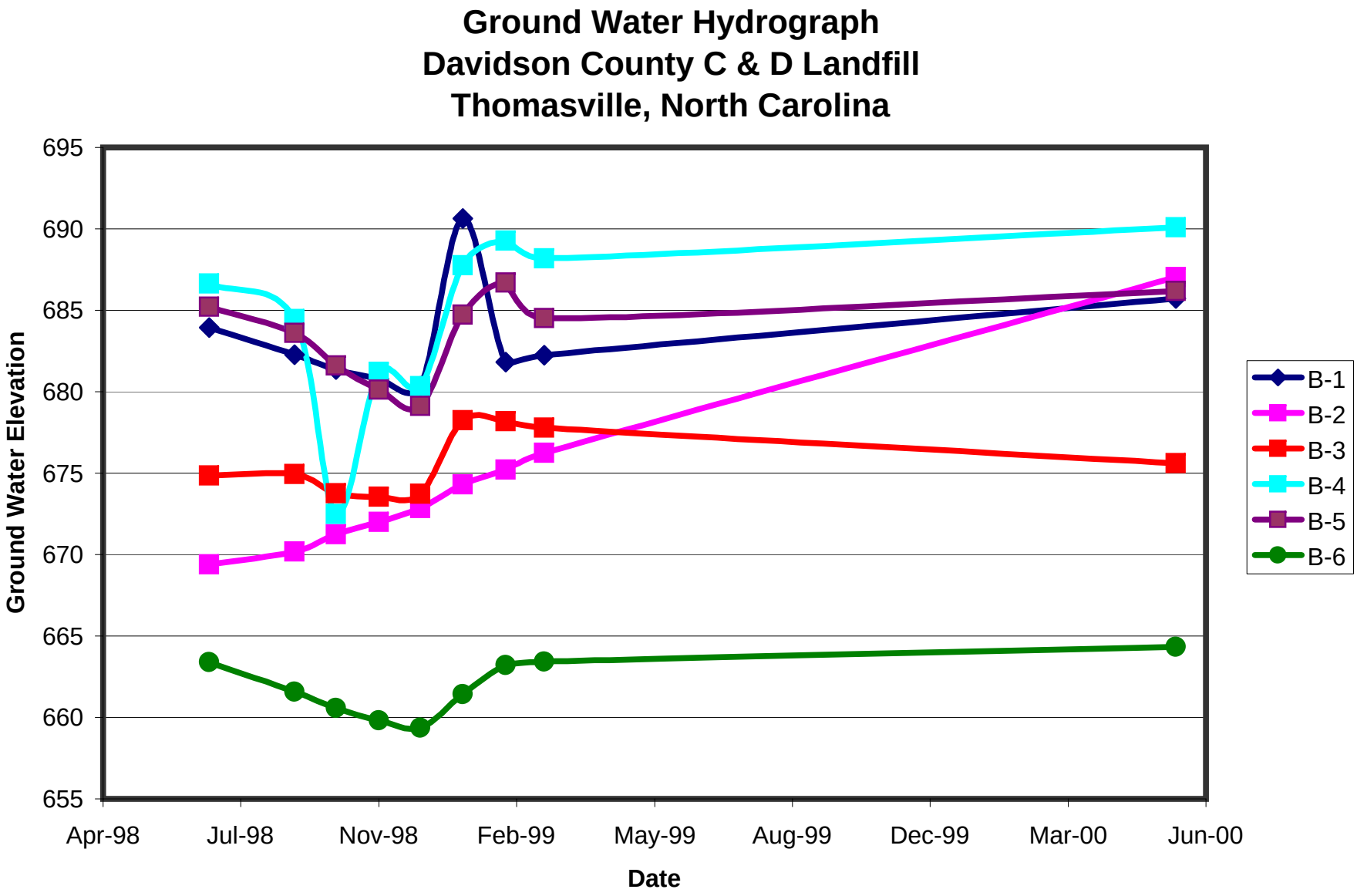
Ground Water Hydrograph
Davidson County C & D Landfill
Thomasville, North Carolina
Ground Water Elevation
695
690
685
680
675
670
665
660
655
Apr-98
Jul-98
Nov-98
Feb-99
May-99
Aug-99
Dec-99
Mar-00
Jun-00
Date
B-1
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B-6

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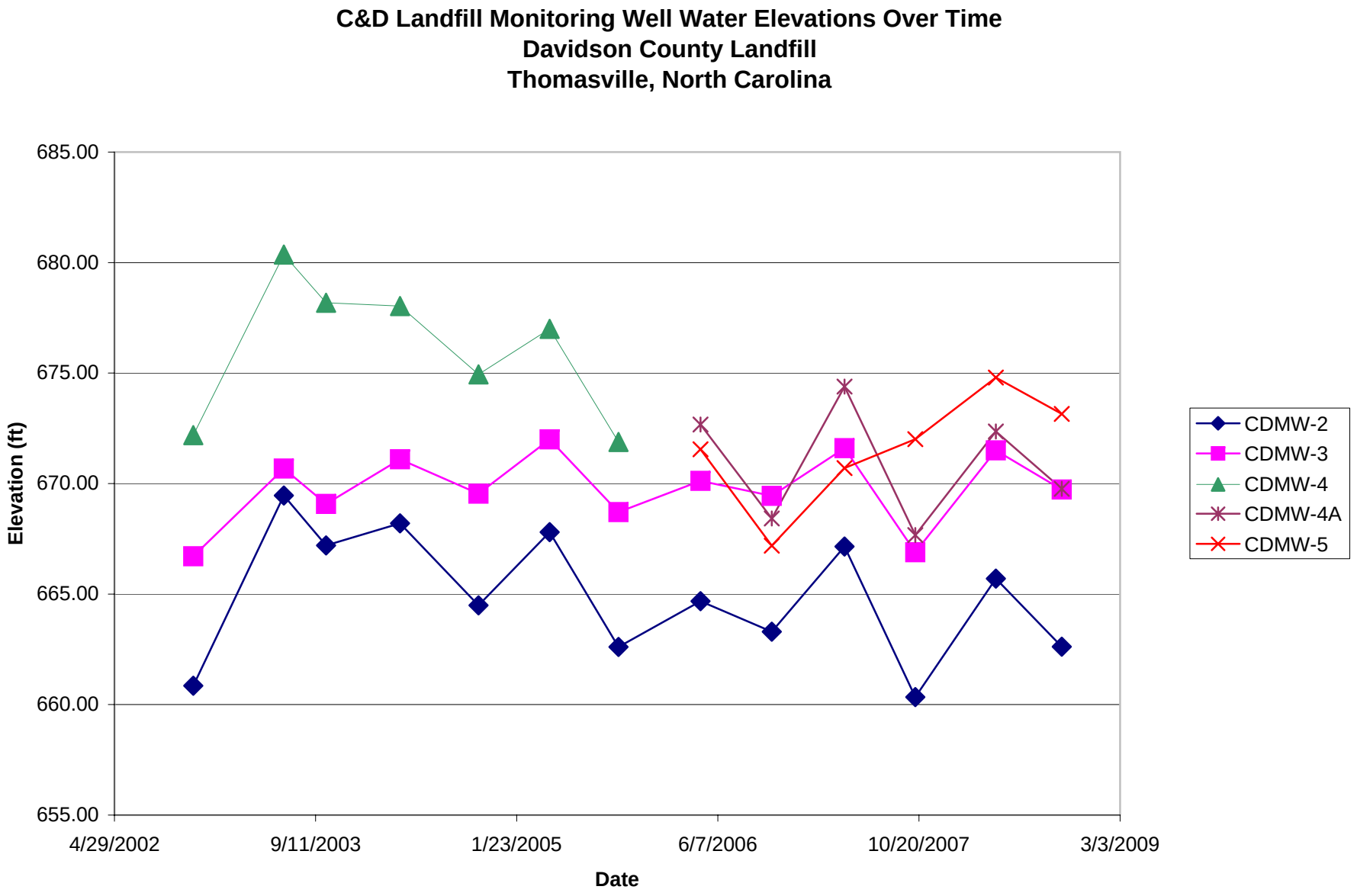
C&D Landfill Monitoring Well Water Elevations Over Time
Davidson County Landfill
Thomasville, North Carolina
685.00
680.00
675.00
670.00
665.00
660.00
655.00
Elevation (ft)
4/29/2002
9/11/2003
1/23/2005
6/7/2006
10/20/2007
3/3/2009
Date
CDMW-2
CDMW-3
CDMW-4
CDMW-4A
CDMW-5

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POTENTIAL BORROW SITE

OLD HIGHWAY 29

OFFICE

ACCESS POINT

RICH FORK CREEK

PROPERTY LINE (TYP.)

PHASE 2 AREA 1

200' EXISTING RAILROAD RIGHT OF WAY (SOUTHERN RAILWAY)

CITIZEN'S CONVENIENCE CENTER

LEACHATE STORAGE POND

DUKE POWER TRANSMISSION LINE RIGHT OF WAY

AREA 3

WEST BORROW AREA

ACTIVE MSW LANDFILL (PHASE 1)

ACTIVE C&D LANDFILL (PHASES 1 & 2)

AREA 2

AREA 1

PROPOSED PHASE 4

WHITE GOODS/SCRAP METAL/TIRES HANDLING AREA

SCALES/SCALEHOUSE

HOUSEHOLD HAZARDOUS WASTE (HHW) BUILDING

RECYCLING BUILDING

OFFICE/MAINTENANCE BUILDING

FORMER SCARLETT LANDFILL (OWNED AND OPERATED BY OTHERS)

CLOSED HOLLY GROVE LANDFILL

HAMBY CREEK

ROY LOPP ROAD

DAVIDSON COUNTY LANDFILL ROAD

CONVENIENCE CENTER

N 768000
N 767500
N 767000
N 766500
N 766000
N 765500
N 765000
N 764500
N 764000
N 763500
N 763000
N 762500
N 762000
N 761500
N 761000
N 760500
N 760000

E 1645500
E 1646000
E 1646500
E 1647000
E 1647500
E 1648000
E 1648500
E 1649000
E 1649500
E 1650000
E 1650500
E 1651000
E 1651500
E 1652000
E 1652500
E 1653000
E 1653500
E 1654000

LEGEND

- PROPERTY LINE
- 100-YEAR FLOODPLAIN (APPROXIMATE)
- DELINEATED WETLANDS
- WETLAND BOUNDARY (SEE REFERENCE 2)
- STREAM (SEE REFERENCE 2)
- MW-5 EXISTING MONITORED WELL/PIEZOMETER
- LFG-5 EXISTING LANDFILL GAS WELL
- P2-2 MONITORING WELL/PIEZOMETER NOT CURRENTLY MONITORED (ABANDONED)
- SW-4 EXISTING SURFACE WATER SAMPLING POINT

REFERENCES

1. OVERALL TOPOGRAPHY PER NORTH CAROLINA DEPARTMENT OF TRANSPORTATION, CONTOUR AND ELEVATION DATA GENERATED FROM LIGHT DETECTION AND RANGING (LIDAR) DATA OBTAINED FROM THE NORTH CAROLINA FLOOD MAPPING PROGRAM AND DATED SEPTEMBER 2004. TOPOGRAPHY IN ACTIVE WASTE DISPOSAL AREAS, BORROW AREAS AND PHASE 2 AREA 1 FROM SPATIAL DATA, AERIAL DATED 4/30/08.
2. WETLAND SURVEY BY LEXINGTON LAND SURVEYING, DATED DATED 3/28/01. UPDATED WETLANDS AND STREAM LOCATIONS FROM DELINEATION PERFORMED BY CAROLINA ECOSYSTEMS, INC., FEBRUARY 2009, AND SURVEYED BY MICHAEL GREEN ASSOCIATES, P.A., FEBRUARY 2009.

0 400' 800' 1200'

NO.	DATE	REVISION

RICHARDSON SMITH GARDNER & ASSOCIATES
14 N. Boylan Ave.
Raleigh, N.C. 27603
ph: 919-828-0577
fax: 919-828-3899
www.rsgengineers.com

SEAL

SEAL

PROJECT TITLE:
DAVIDSON COUNTY
C&D LANDFILL
LEXINGTON, NORTH CAROLINA

DRAWING TITLE:
EXISTING CONDITIONS

DESIGNED BY: J.A.S.	DRAWN BY: J.A.L.
CHECKED BY:	PROJECT NO.: DAVDCO 08-5
SCALE: AS SHOWN	DATE: MARCH 2009
FILE NAME: DAVDCO-D0489	
SHEET NO.	DRAWING NO. FIG.1

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N
W E
S

REFERENCES

1. AERIAL PHOTOGRAPHY DATED APRIL 30, 2008 BY SPATIAL DATA CONSULTANTS, INC., HIGH POINT, NC.

0 250' 500' 750'

NO.	DATE	REVISION

RICHARDSON SMITH GARDNER & ASSOCIATES
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ph: 919-828-0577
fax: 919-828-3899
www.rsgengineers.com

SEAL

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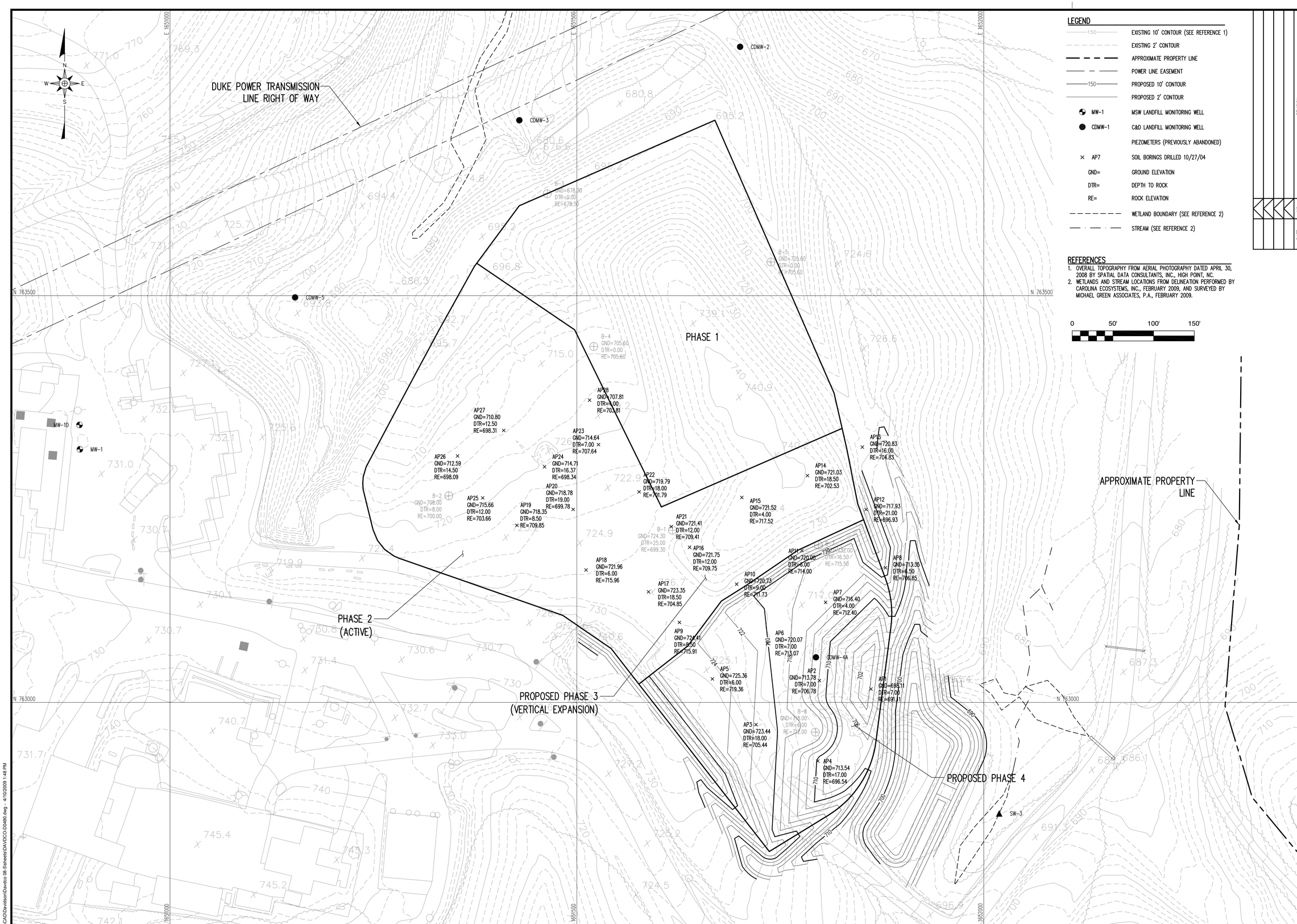
PROJECT TITLE:
DAVIDSON COUNTY
C&D LANDFILL
LEXINGTON, NOTH CAROLINA

DRAWING TITLE:
AERIAL PHOTO WITH
2000 FOOT RADIUS

DESIGNED BY: J.A.S.	DRAWN BY: J.A.L.
CHECKED BY:	PROJECT NO.: DAVDCO 08-5
SCALE: AS SHOWN	DATE: MARCH 2009
FILE NAME: DAVDCO-D0492	
SHEET NO.	DRAWING NO. FIG. 2

G:\CADD\Davidson\Davdco 08-5\sheets\DAVIDCO-D0492.dwg - 4/13/2009 9:38 AM



LEGEND

150	EXISTING 10' CONTOUR (SEE REFERENCE 1)
	EXISTING 2' CONTOUR
	APPROXIMATE PROPERTY LINE
	POWER LINE EASEMENT
150	PROPOSED 10' CONTOUR
	PROPOSED 2' CONTOUR
MW-1	MSW LANDFILL MONITORING WELL
CDMW-1	C&D LANDFILL MONITORING WELL
	PIEZOMETERS (PREVIOUSLY ABANDONED)
× AP7	SOIL BORINGS DRILLED 10/27/04
GND=	GROUND ELEVATION
DTR=	DEPTH TO ROCK
RE=	ROCK ELEVATION
	WETLAND BOUNDARY (SEE REFERENCE 2)
	STREAM (SEE REFERENCE 2)

REFERENCES

1. OVERALL TOPOGRAPHY FROM AERIAL PHOTOGRAPHY DATED APRIL 30, 2008 BY SPATIAL DATA CONSULTANTS, INC., HIGH POINT, NC.
2. WETLANDS AND STREAM LOCATIONS FROM DELINEATION PERFORMED BY CAROLINA ECOSYSTEMS, INC., FEBRUARY 2009, AND SURVEYED BY MICHAEL GREEN ASSOCIATES, P.A., FEBRUARY 2009.

0 50' 100' 150'

NO.	DATE	REVISION

RICHARDSON SMITH GARDNER & ASSOCIATES
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fax: 919-828-3899
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SEAL

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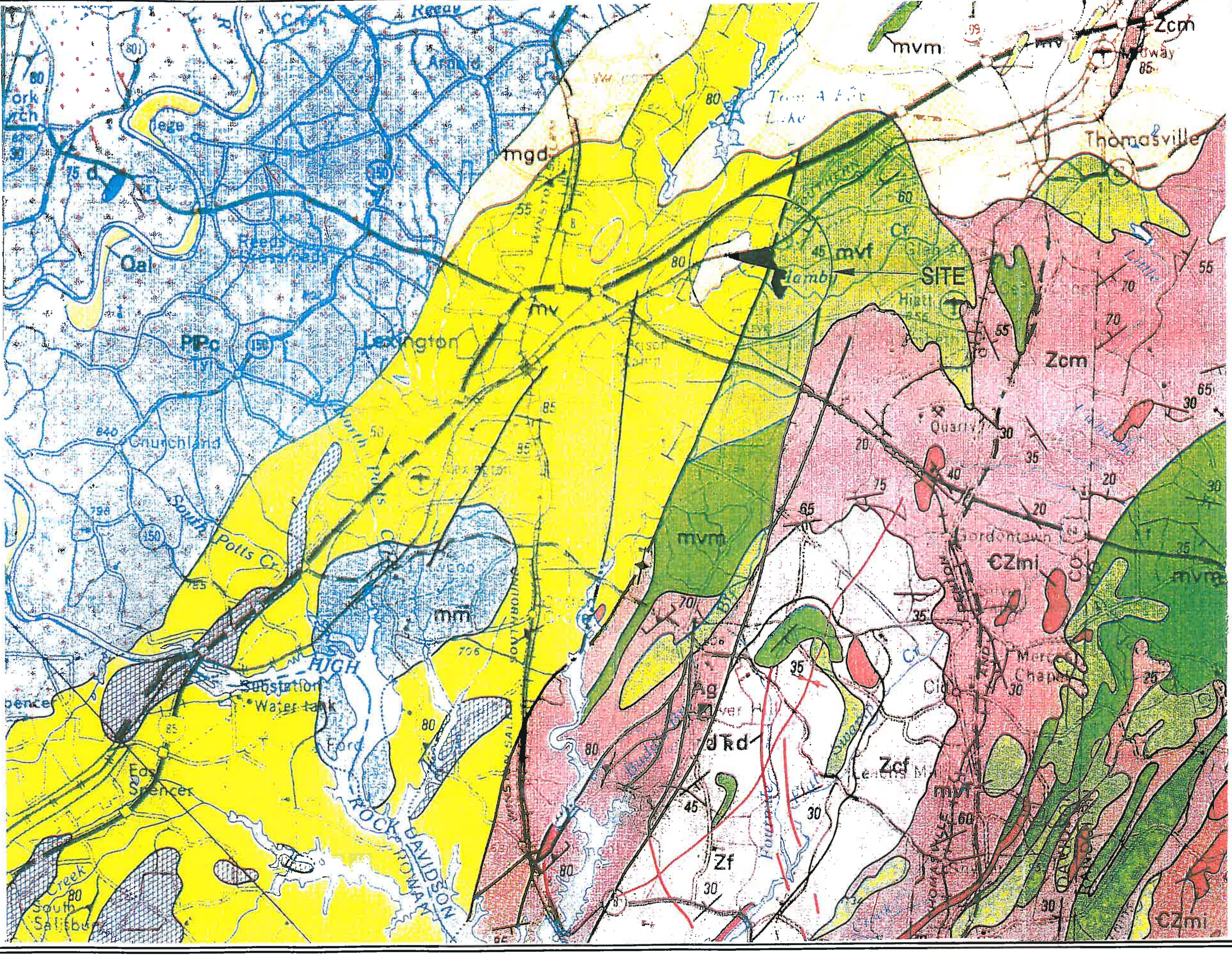
PROJECT TITLE:
DAVIDSON COUNTY
C&D LANDFILL
LEXINGTON, NORTH CAROLINA

DRAWING TITLE:
TEST BORING AND
PIEZOMETER LOCATION MAP

DESIGNED BY: J.A.S.	DRAWN BY: C.T.J.
CHECKED BY:	PROJECT NO.: DAVDCO 08-5
SCALE: AS SHOWN	DATE: NOV. 2008
FILE NAME: DAVDCO-D0490	
SHEET NO.	DRAWING NO. FIG. 3

G:\CAD\Davidson\Davdco 08-5\sheets\DAVIDCO-D0490.dwg - 4/10/2009 1:48 PM



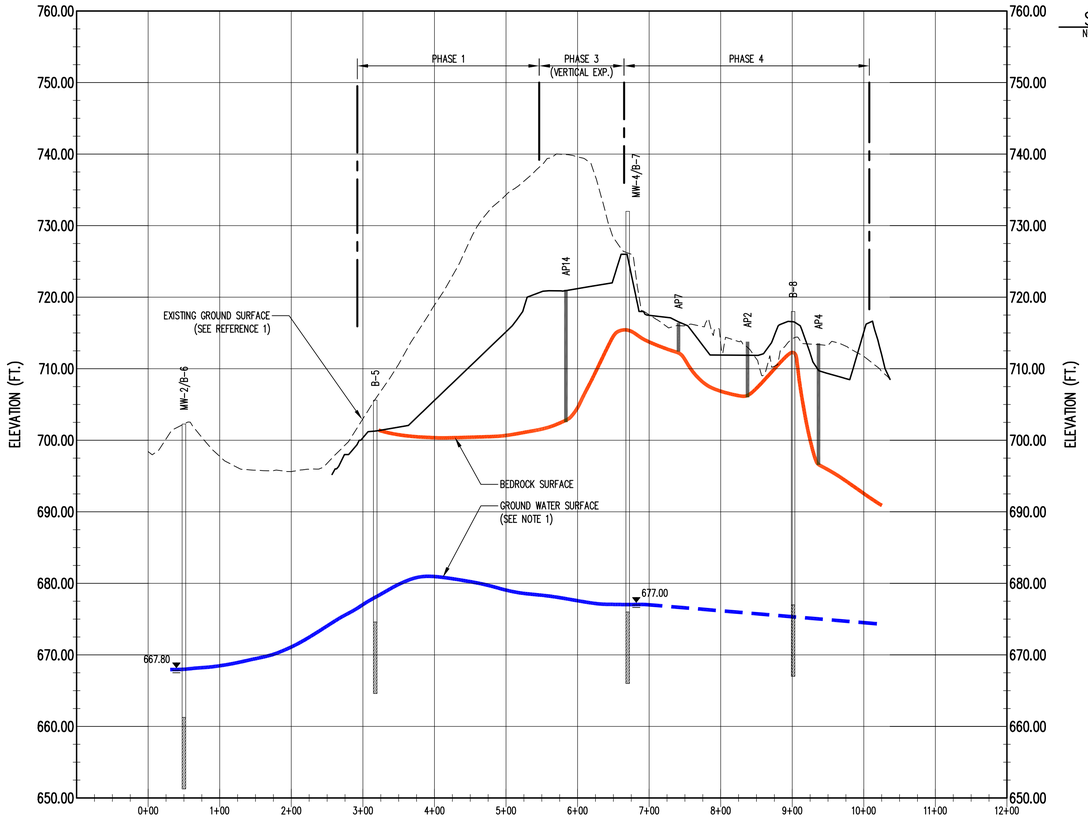
RICHARDSON SMITH GARDNER & ASSOCIATES

14 N. Boylan Ave.
Raleigh, N.C. 27603
ph: 919-828-0577
fax: 919-828-3899
www.rsgengineers.com

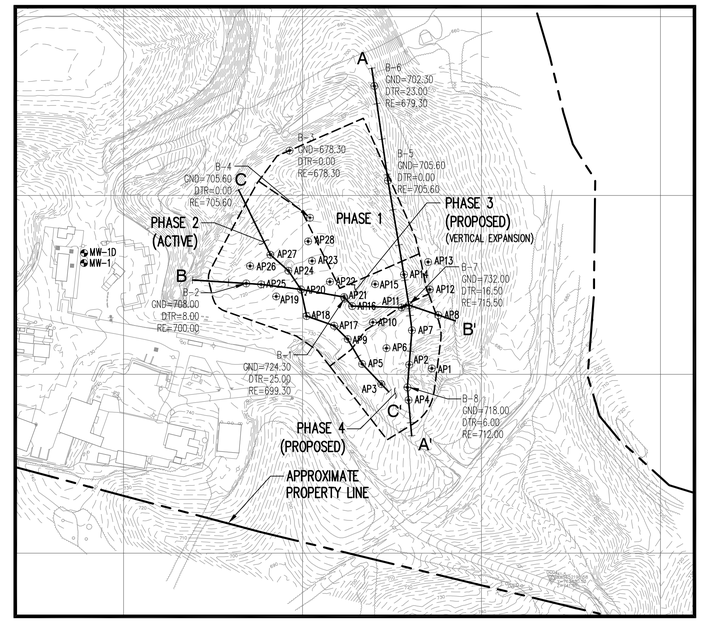
DRAWN BY:	CHECKED BY:	SCALE:	FIGURE NO.
J.A.L.		1:125,000	4
DATE:		PROJECT NO.	FILE NAME
DEC. 2008		DAVDCO 08-5	DAVDCO-B0483

TITLE:
REGIONAL GEOLOGIC MAP FROM "GEOLOGIC MAP OF CHARLOTTE" 1988 BY GOLDSMITH, MILTON AND HORTON

G:\CAD\Davidson\Davdco 08-5\sheets\DAVDCO-B0483.dwg - 12/12/2008 3:45 PM



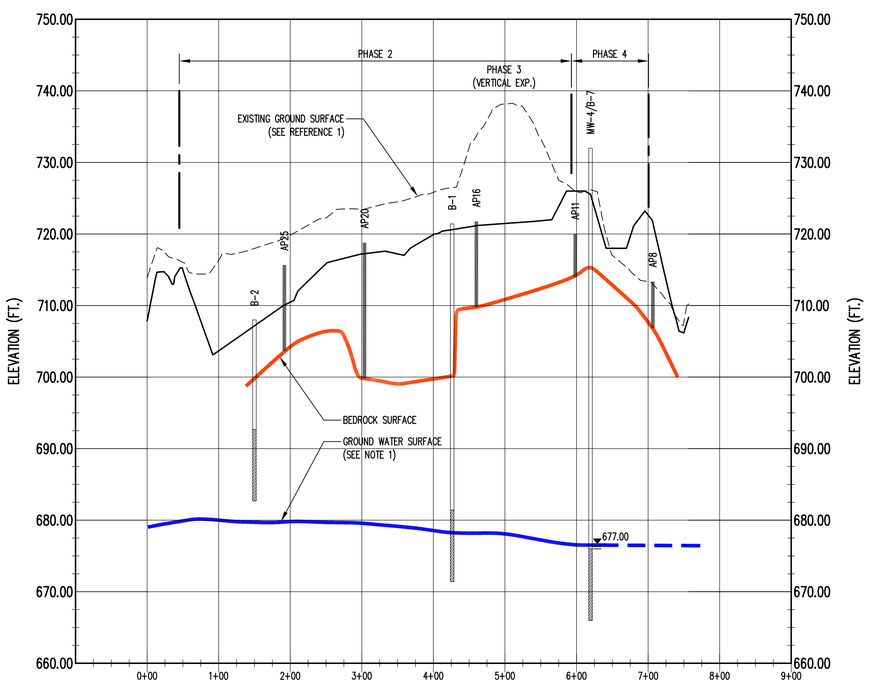
SECTION A
NOT TO SCALE
FIG.6



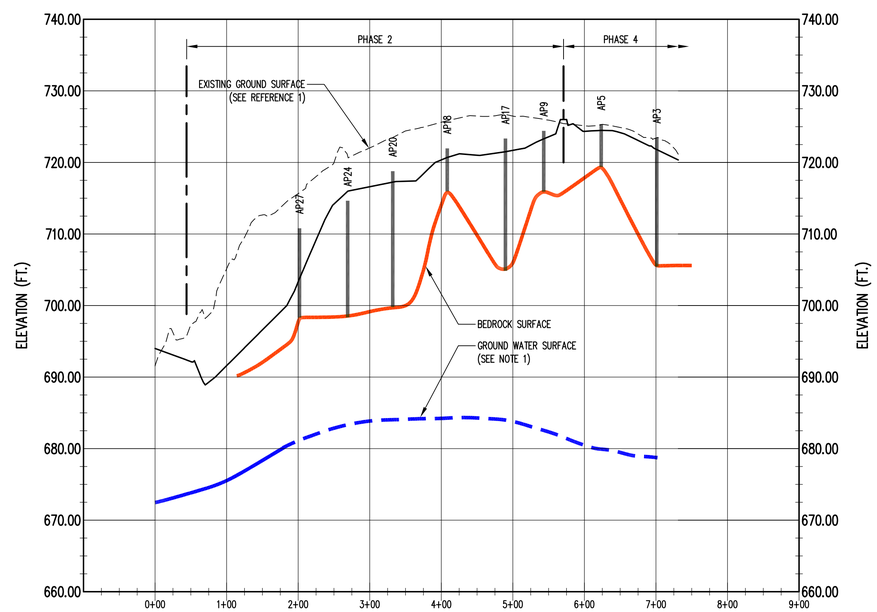
LEGEND

- 660 — EXISTING 10' CONTOUR (SEE REFERENCE 1)
- EXISTING 2' CONTOUR
- PROPERTY LINE
- APPROXIMATE EXISTING AND PROPOSED WASTE LIMITS
- CROSS-SECTION LOCATION
- BOUNDARY BETWEEN PHASES (SHOWN IN CROSS-SECTION)
- AP20 — SOIL BORING (DEPTH INDICATES EXTENT)
- B-1 — PIEZOMETER/WELL -SCREENED INTERVAL SHOWN BY PATTERNED AREA

SECTION B
NOT TO SCALE
FIG.6



SECTION C
NOT TO SCALE
FIG.6



NOTES

1. GROUND WATER ELEVATION SHOWN IS BASED ON THE SITE POTENTIOMETRIC MAP DATED APRIL 15, 2005.

REFERENCES

1. OVERALL TOPOGRAPHY FROM AERIAL PHOTOGRAPHY DATED APRIL 30, 2008 BY SPATIAL DATA CONSULTANTS, INC., HIGH POINT, NC.

30' 20' 10' 0

VERTICAL EXAGGERATION = 10x

0 100' 200' 300'

REVISION | NO. | DATE

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fax: 919-828-3899
www.rsgengineers.com

SEAL

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PROJECT TITLE:
DAVIDSON COUNTY
C&D LANDFILL
LEXINGTON, NORTH CAROLINA

DRAWING TITLE:
HYDROGEOLOGIC CROSS SECTIONS

DESIGNED BY: J.A.S.	DRAWN BY: J.A.L.
CHECKED BY:	PROJECT NO.: DAVDCO 08-5
SCALE: AS SHOWN	DATE: APRIL 2009
FILE NAME: DAVDCO-D0493	
SHEET NO.	DRAWING NO. FIG. 5

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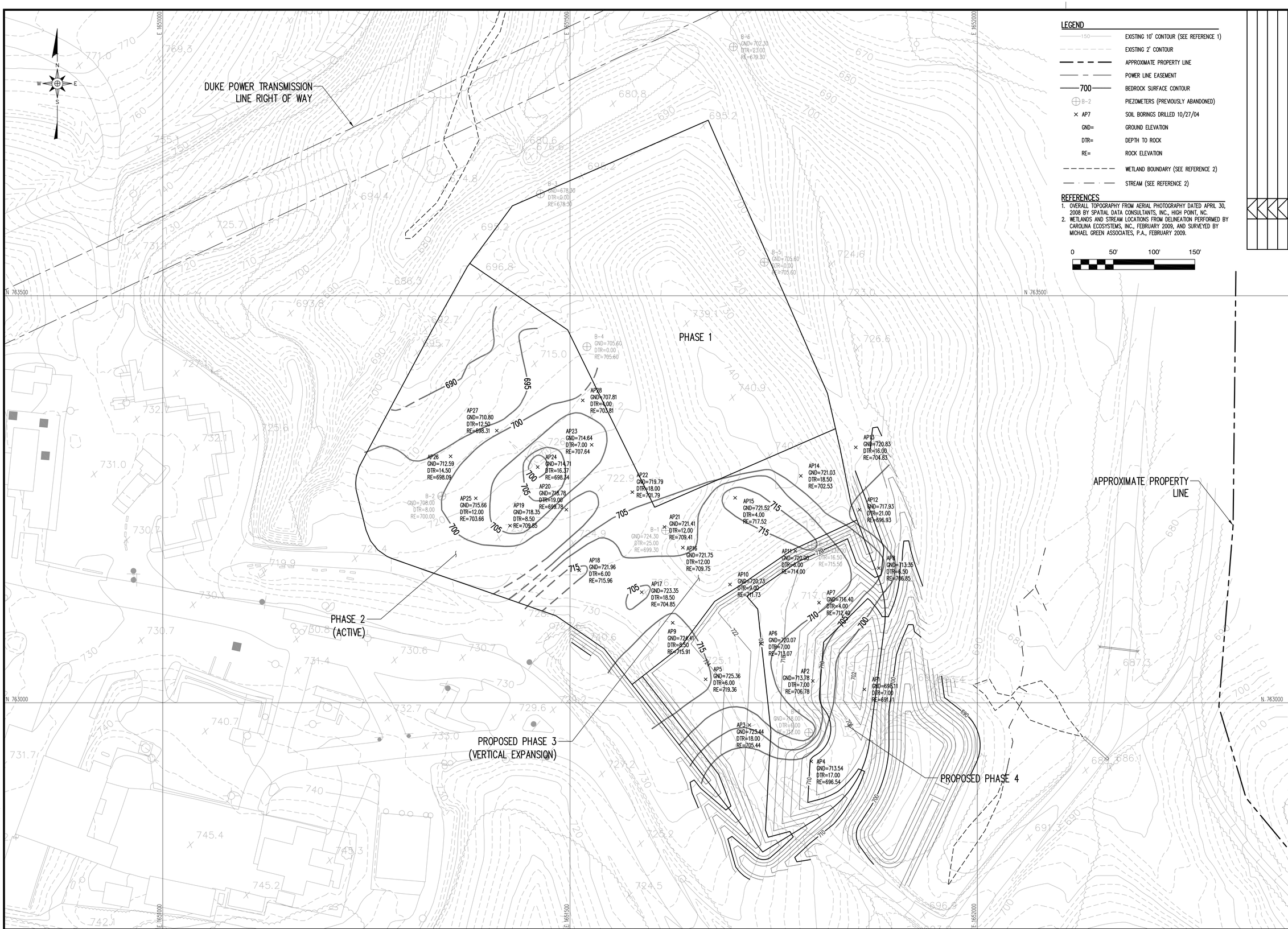

LEGEND

150	EXISTING 10' CONTOUR (SEE REFERENCE 1)
	EXISTING 2' CONTOUR
	APPROXIMATE PROPERTY LINE
	POWER LINE EASEMENT
700	BEDROCK SURFACE CONTOUR
B-2	PIEZOMETERS (PREVIOUSLY ABANDONED)
× AP7	SOIL BORINGS DRILLED 10/27/04
GND=	GROUND ELEVATION
DTR=	DEPTH TO ROCK
RE=	ROCK ELEVATION
	WETLAND BOUNDARY (SEE REFERENCE 2)
	STREAM (SEE REFERENCE 2)

REFERENCES

1. OVERALL TOPOGRAPHY FROM AERIAL PHOTOGRAPHY DATED APRIL 30, 2008 BY SPATIAL DATA CONSULTANTS, INC., HIGH POINT, NC.
2. WETLANDS AND STREAM LOCATIONS FROM DELINEATION PERFORMED BY CAROLINA ECOSYSTEMS, INC., FEBRUARY 2009, AND SURVEYED BY MICHAEL GREEN ASSOCIATES, P.A., FEBRUARY 2009.

0 50' 100' 150'

NO.	DATE	REVISION

RICHARDSON SMITH GARDNER & ASSOCIATES
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Raleigh, N.C. 27603
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fax: 919-828-3899
www.rsgengineers.com

SEAL

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PROJECT TITLE:

DAVIDSON COUNTY
C&D LANDFILL
LEXINGTON, NORTH CAROLINA

DRAWING TITLE:

BEDROCK SURFACE

DESIGNED BY: J.A.S.	DRAWN BY: J.A.L.
CHECKED BY:	PROJECT NO.: DAVDCO 08-5
SCALE: AS SHOWN	DATE: APRIL 2009
FILE NAME: DAVDCO-D0491	
SHEET NO.	DRAWING NO. FIG. 6

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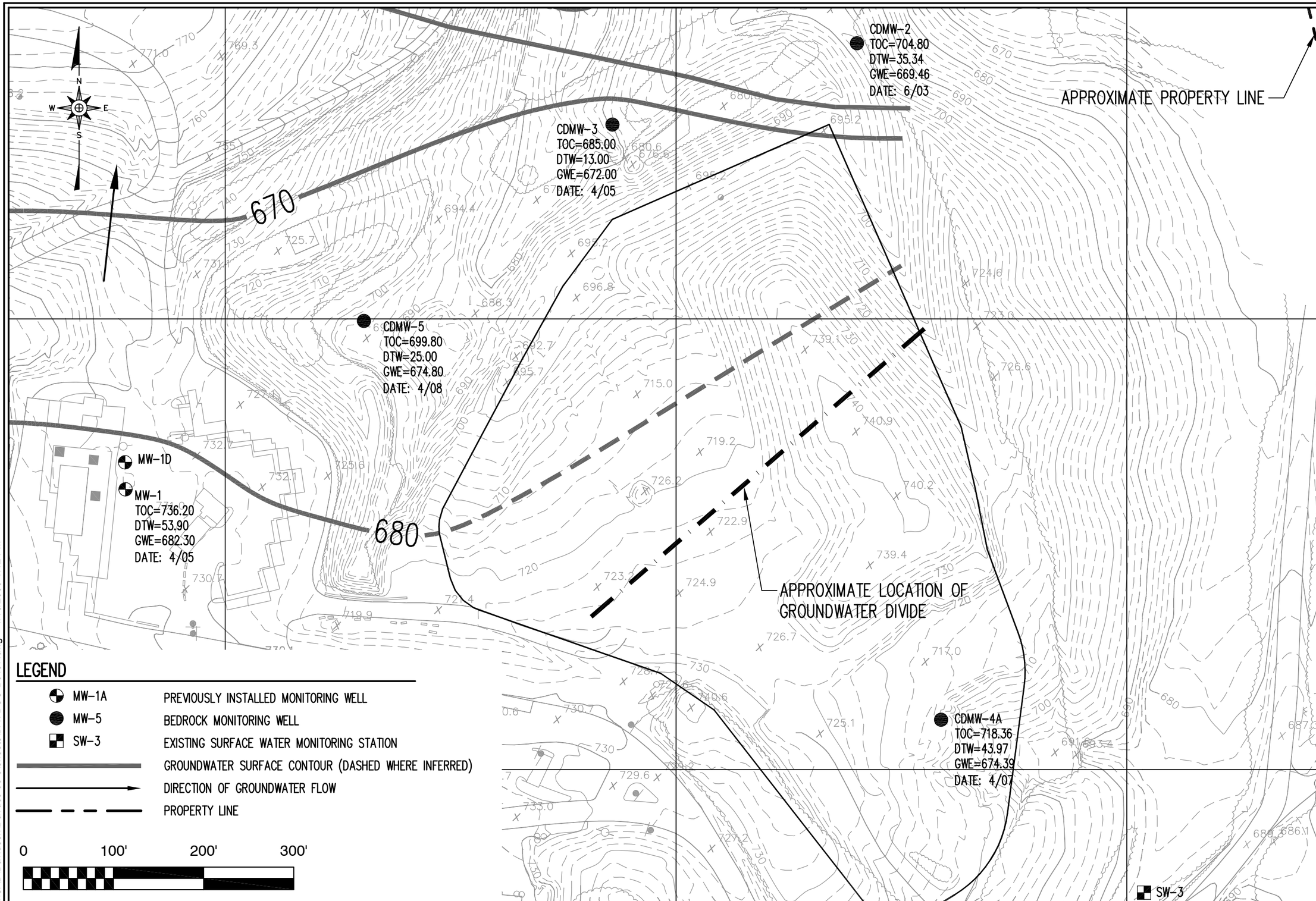

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Raleigh, N.C. 27603
ph: 919-828-0577
fax: 919-828-3899
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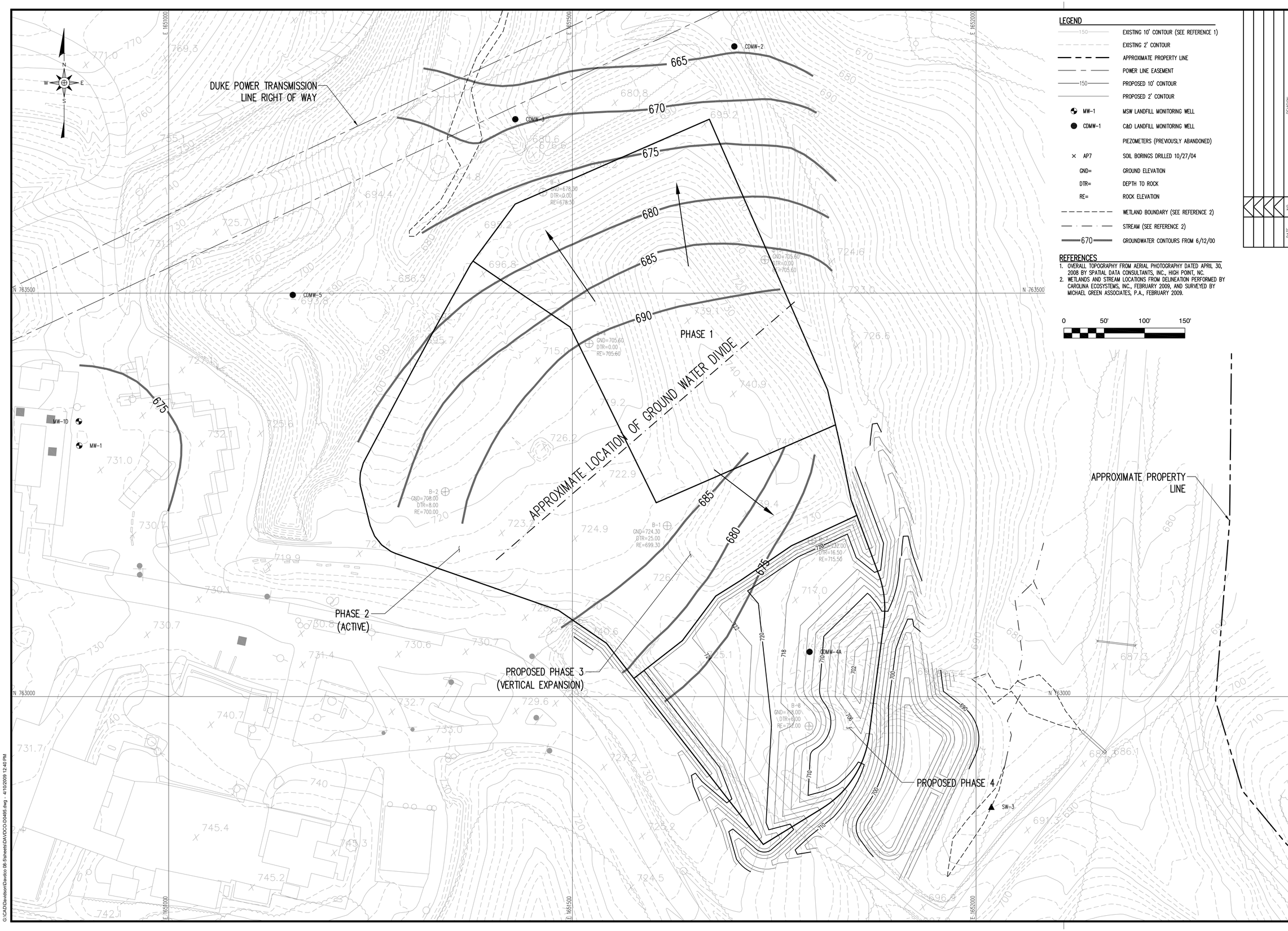
FIGURE NO.	7
FILE NAME	DAVDCO-B0497
SCALE:	AS NOTED
CHECKED BY:	J.A.S.
PROJECT NO.	DAVDCO 08-5
DRAWN BY:	W.R.B.
DATE:	APRIL 2009

TITLE: DAVIDSON COUNTY C&D LANDFILL COMPOSITE HIGH POTENTIOMETRIC SURFACE

G:\CAD\Davidson\Davdco 08-5\sheets\DAVDCO-B0497.dwg - 4/16/2009 1:12 PM



LEGEND

150	EXISTING 10' CONTOUR (SEE REFERENCE 1)
	EXISTING 2' CONTOUR
	APPROXIMATE PROPERTY LINE
	POWER LINE EASEMENT
150	PROPOSED 10' CONTOUR
	PROPOSED 2' CONTOUR
MW-1	MSW LANDFILL MONITORING WELL
CDMW-1	C&D LANDFILL MONITORING WELL
	PIEZOMETERS (PREVIOUSLY ABANDONED)
× AP7	SOIL BORINGS DRILLED 10/27/04
GND=	GROUND ELEVATION
DTR=	DEPTH TO ROCK
RE=	ROCK ELEVATION
	WETLAND BOUNDARY (SEE REFERENCE 2)
	STREAM (SEE REFERENCE 2)
670	GROUNDWATER CONTOURS FROM 6/12/00

REFERENCES

1. OVERALL TOPOGRAPHY FROM AERIAL PHOTOGRAPHY DATED APRIL 30, 2008 BY SPATIAL DATA CONSULTANTS, INC., HIGH POINT, NC.
2. WETLANDS AND STREAM LOCATIONS FROM DELINEATION PERFORMED BY CAROLINA ECOSYSTEMS, INC., FEBRUARY 2009, AND SURVEYED BY MICHAEL GREEN ASSOCIATES, P.A., FEBRUARY 2009.

0 50' 100' 150'

NO.	DATE	REVISION

RICHARDSON SMITH GARDNER & ASSOCIATES
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Raleigh, N.C. 27603
ph: 919-828-0577
fax: 919-828-3899
www.rsgengineers.com

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PROJECT TITLE:
DAVIDSON COUNTY
C&D LANDFILL
LEXINGTON, NORTH CAROLINA

DRAWING TITLE:
POTENTIOMETRIC MAP
JUNE 12, 2000

DESIGNED BY: J.A.S.	DRAWN BY: W.R.B.
CHECKED BY:	PROJECT NO.: DAVDCO 08-5
SCALE: AS SHOWN	DATE: APRIL 2009
FILE NAME DAVDCO-D0495	
SHEET NO.	DRAWING NO. FIG. 8

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Appendix A

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CAROLINA
ECOSYSTEMS, INC.

8208 Brian Ct.; Garner, NC 27529
P:919-606-1065 – F:919-341-4474

March 25, 2009

Ms. Joan Smyth, P.G.
Richardson, Smith, Gardner & Associates, Inc.
14 North Boylan Avenue
Raleigh, NC 27612

RE: Clean Water Act Jurisdiction and Requirements
Construction and Demolition (C&D) Landfill Expansion
Davidson County Landfil
Lexington, NC

Dear Joan;

As requested, Carolina Ecosystems, Inc. (CEI) is providing this letter to document the work we performed on the above referenced site, along with our review and determination of the jurisdiction and requirements of the Clean Water Act as it relates to this project.

Davidson County Integrated Solid Waste, a public service of Davidson County, is planning to expand its existing C&D landfill located near Lexington, NC. In support of this activity Richardson Smith Gardner and Associates, Inc. have prepared plans for this landfill expansion. The site is located south of Jimmy's Creek in the Yadkin River basin and has stream channels and associated wetlands on the northwest and east sides of the facility. The expansion is proposed to the south-southeast of the existing cells. Therefore, a wetland delineation was requested to determine the extent and location of areas under the jurisdiction of the Clean Water Act.

CEI staff visited the site in December 2008 and identified both wetlands and streams under jurisdiction of the CWA. These resources are located adjacent to the proposed landfill expansion, and therefore were flagged and surveyed to ensure accurate location.

An intermittent stream channel is present, beginning at flag SA-101 until its confluence with another intermittent stream at flag SB-103. From that point downstream, the channel is perennial. Wetlands are associated with stream SA at the uppermost portion of the channel, north of the gravel entrance to the C&D site, and at the outlet of the existing sediment basin from the landfill. The channel between the sediment basin and the wetland does not have sufficient indicators to be considered a stream, and is primarily caused by the periodic release of water from the basin after a rain event.

The wetland areas exhibited all three wetland criteria of hydrology, hydric soils, and hydrophytic vegetation. The boundary was flagged using methodology outlined in the 1987 US Army Corps of Engineers (USACE) Wetland Delineation Manual and subsequent guidance, including the 2007 Rapanos ruling. The wetland areas contain low chroma soils with mottling indicative of prolonged saturation during the growing season. Saturation and free water were present in representative soil pits, along with sediment deposits, water stained leaves, and drift lines. Vegetation within the wetland was limited due to the season, but included common wetland plants such as black willow (*Salix nigra*), red maple (*Acer rubrum*), sycamore (*Platanus occidentalis*), and greenbrier (*Smilax rotundifolia*).

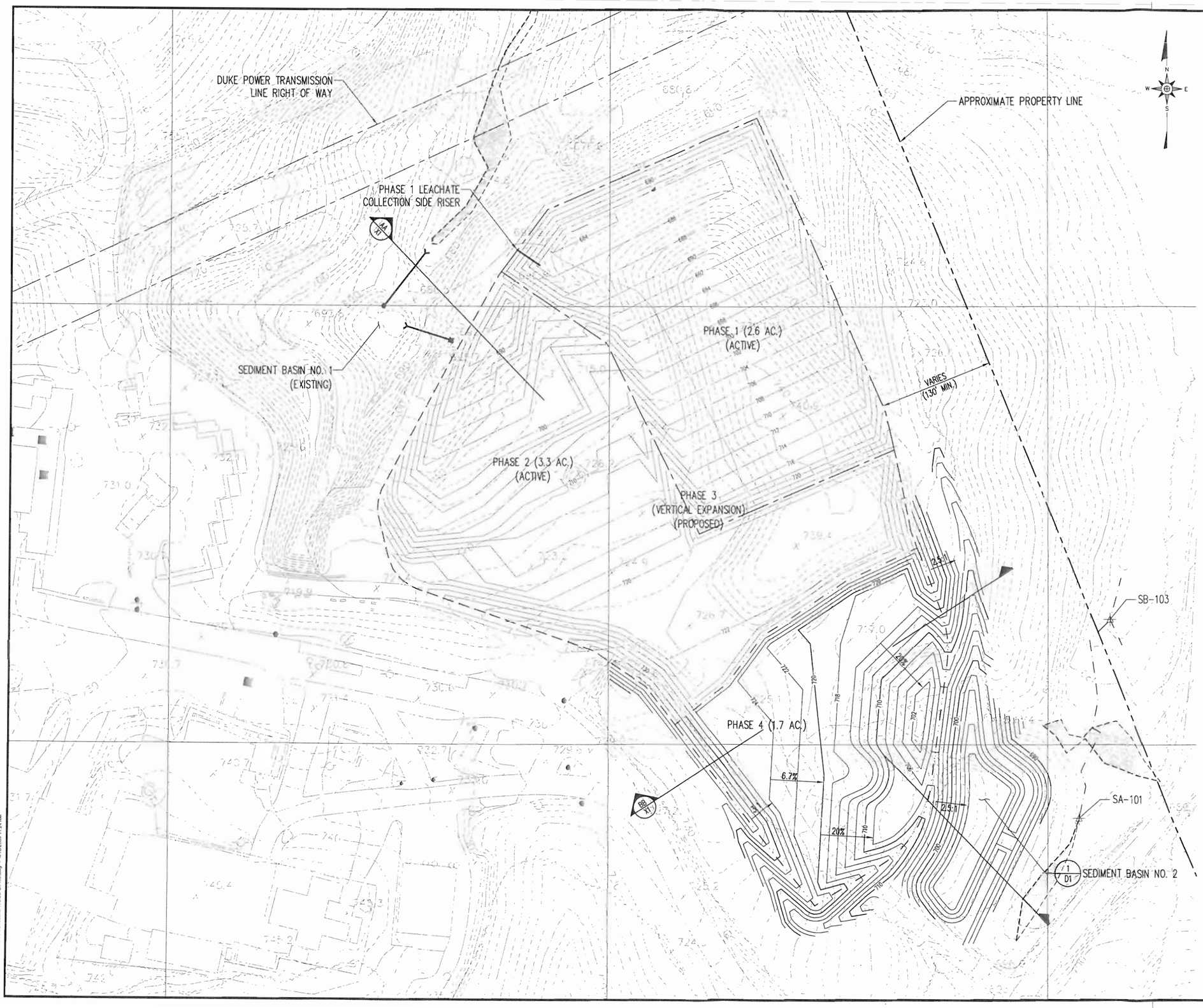
I have reviewed the provided drawing S2: Site Development Plan Base Grades (RSG File D0473), as well as the site survey data of our wetland and stream flagging. Based on this information, the proposed C&D landfill will not impact wetlands or streams under the jurisdiction of the CWA or other federal or state regulations. Fill slopes are a sufficient distance from the jurisdictional areas that no impact should occur, provided sediment and erosion control measures are in place. Therefore, no permits are required from the USACE or NC Division of Water Quality. Other permits, such as those of the NC Division of Land Resources, would still be required if applicable. We recommend that the wetland areas closest to the proposed expansion be outlined in the field using orange tree protection fencing prior to commencement of construction activities to ensure no inadvertent encroachment occurs in these areas.

Please note that the wetland delineation is not official without a verification from the USACE. If you would like us to submit the wetland delineation information and associated forms, and request a jurisdictional determination, please notify me at your convenience.

If you have any questions regarding this information, please call me at your earliest convenience at 919-606-1065. We appreciate the opportunity to work on this project.

Sincerely,
Carolina Ecosystems, Inc.

Philip May
Senior Environmental Scientist



LEGEND

- EXISTING 10' CONTOUR (SEE REFERENCE 1)
- EXISTING 2' CONTOUR
- 710 PROPOSED 10' CONTOUR (SEE NOTE 1)
- PROPOSED 2' CONTOUR
- PROPERTY LINE
- LIMIT OF LINER (EXISTING LINED UNITS)
- APPROXIMATE EXISTING WASTE LIMITS (UNLINED UNITS)
- PROPOSED LANDFILL AREAS
- WETLAND BOUNDARY (SEE REFERENCE 2)
- STREAM (SEE REFERENCE 2)

NOTES

1. GRADES SHOWN REPRESENT SUBGRADE ELEVATIONS.

REFERENCES

1. OVERALL TOPOGRAPHY FROM AERIAL PHOTOGRAPHY DATED APRIL 30, 2006 BY SPATIAL DATA CONSULTANTS, INC., HIGH POINT, NC.
2. WETLANDS AND STREAM LOCATIONS ON SOUTHEAST SIDE OF C&D LANDFILL FROM DELINEATION PERFORMED BY CAROLINA ECOSYSTEMS, INC., FEBRUARY 2009, AND SURVEYED BY MICHAEL GREEN ASSOCIATES, P.A., FEBRUARY 2009.

NO.	DATE	REVISION

RICHARDSON SMITH GARDNER & ASSOCIATES
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Raleigh, N.C. 27603
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fax: 919-828-3899
www.rsgengineers.com

SEAL

SEAL

PROJECT TITLE
DAVIDSON COUNTY
C&D LANDFILL - PHASES 3 & 4
PERMIT AMENDMENT DRAWINGS

DRAWING TITLE
SITE DEVELOPMENT PLAN
BASE GRADES

DESIGNED BY: P.K.S.	DRAWN BY: J.A.L.
CHECKED BY:	PROJECT NO: DAVDCO 08-5
SCALE: AS SHOWN	DATE: MARCH 2009
FILE NAME: DAVDCO-D0499	
SHEET NO: 3	DRAWING NO: S2

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Appendix B

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G. N. Richardson & Associates, Inc.
14 North Boylan Avenue, Raleigh NC 27603
(919) 828-0577

FIELD BOREHOLE LOG

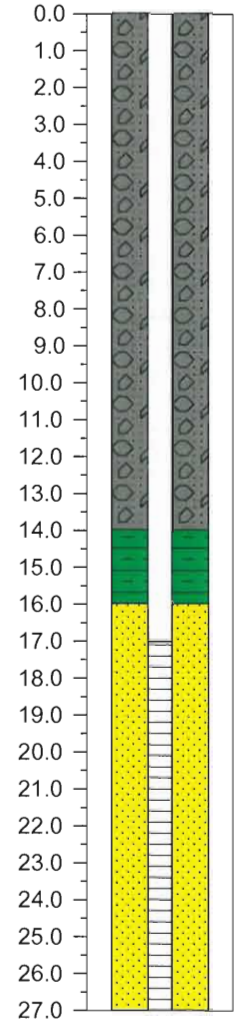
BOREHOLE NUMBER **CDMW-3**

PROJECT NAME: **Davidson County C&D Landfill**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **R. Barron**
GEOLOGIST: **P. May**
DATE BEGUN: **12/5/00** COMPLETED: **12/5/00**

TOTAL DEPTH: **27**
GROUND SURFACE ELEVATION: **NA**
TOP OF CASING ELEVATION:

STATIC WATER LEVEL (BLS)		
Depth (ft)	22.0	15.93
Time	16:00	08:00
Date	12/5/00	12/6/00

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY
0.0				HSA	SANDY SILT: Dry, tan & rust & gray fine sandy silt, some mica & manganese.	
5.0	13,12,19	SS	16"			
10.0	13,16,24	SS	12"		CLAYEY SAND: Moist, tan & white & rust mottled medium to coarse clayey sand, large quartz fragments.	
15.0	18,32,36	SS	12"		CLAYEY SAND: Same as above but medium sand with PWR and Fe/Mn streaking throughout.	
20.0	50/6"	SS	4"			
22.0				AR	PWR: Partially weathered diorite. Auger refusal at 22.0'. Air rotary to 27.0' through PWR to competent diorite. Boring terminated at 27'.	
25.0	50/0"	SS	0"			
27.0						



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G. N. Richardson & Associates, Inc.
14 North Boylan Avenue, Raleigh NC 27603
(919) 828-0577

FIELD BOREHOLE LOG

BOREHOLE NUMBER **CDMW-4a**

PROJECT NAME: **Davidson County C&D Landfill**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **AR/AH**
FIELD PARTY: **R. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **1/24/06** COMPLETED: **1/24/06**

TOTAL DEPTH: **78**
GROUND SURFACE ELEVATION: **NA**
TOP OF CASING ELEVATION:

STATIC WATER LEVEL (BLS)		
Depth (ft)		
Time		
Date		

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				AR	SAND: Highly weatherd partially weatherd rock, granitic sand rock, dry. Auger refusal at 17 feet		0.0	
1.0							1.0	
2.0							2.0	
3.0							3.0	
4.0							4.0	
5.0		Grab					5.0	
6.0							6.0	
7.0							7.0	
8.0							8.0	
9.0							9.0	
10.0		Grab					10.0	
11.0							11.0	
12.0							12.0	
13.0							13.0	
14.0							14.0	
15.0		Grab					15.0	
16.0							16.0	
17.0				AH	GRANITE: Weathered granite, dry.		17.0	
18.0							18.0	
19.0							19.0	
20.0							20.0	
21.0							21.0	
22.0		Grab					22.0	
23.0							23.0	
24.0							24.0	
25.0							25.0	
26.0							26.0	
27.0							27.0	
28.0		Grab					28.0	
29.0							29.0	
30.0		Grab			SANDY SILT: Soil seam of sandy silt, dry.		30.0	
31.0							31.0	
32.0							32.0	
33.0		Grab			GRANITE: Weathered granite, dry.		33.0	
34.0							34.0	
35.0							35.0	
36.0		Grab					36.0	
37.0							37.0	
38.0							38.0	
39.0							39.0	

G. N. Richardson & Associates, Inc.
14 North Boylan Avenue, Raleigh NC 27603
(919) 828-0577

FIELD BOREHOLE LOG

BOREHOLE NUMBER **CDMW-4a**

PROJECT NAME: **Davidson County C&D Landfill**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **AR/AH**
FIELD PARTY: **R. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **1/24/06** COMPLETED: **1/24/06**

TOTAL DEPTH: **78**
GROUND SURFACE ELEVATION: **NA**
TOP OF CASING ELEVATION:

STATIC WATER LEVEL (BLS)		
Depth (ft)		
Time		
Date		

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
39.0							39.0	
40.0							40.0	
41.0							41.0	
42.0							42.0	
43.0		Grab					43.0	
44.0							44.0	
45.0		Grab			DIORITE: Weatherd diorite, dry.		45.0	
46.0							46.0	
47.0							47.0	
48.0		Grab					48.0	
49.0							49.0	
50.0							50.0	
51.0							51.0	
52.0							52.0	
53.0		Grab					53.0	
54.0							54.0	
55.0							55.0	
56.0							56.0	
57.0		Grab					57.0	
58.0							58.0	
59.0							59.0	
60.0							60.0	
61.0							61.0	
62.0							62.0	
63.0		Grab					63.0	
64.0					GRANITE: Weathered, very competent granite, very dry.		64.0	
65.0							65.0	
66.0							66.0	
67.0							67.0	
68.0		Grab					68.0	
69.0					DIORITE: Weathered, very hard diorite, dry.		69.0	
70.0							70.0	
71.0							71.0	
72.0							72.0	
73.0		Grab					73.0	
74.0							74.0	
75.0							75.0	
76.0							76.0	
77.0							77.0	
78.0							78.0	

G. N. Richardson & Associates, Inc.
14 North Boylan Avenue, Raleigh NC 27603
(919) 828-0577

FIELD BOREHOLE LOG

BOREHOLE NUMBER **CDMW-5**

PROJECT NAME: **Davidson County C&D Landfill**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **AR/AH**
FIELD PARTY: **R. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **1/30/06** COMPLETED: **1/30/06**

TOTAL DEPTH: **47**
GROUND SURFACE ELEVATION: **NA**
TOP OF CASING ELEVATION:

STATIC WATER LEVEL (BLS)		
Depth (ft)		
Time		
Date		

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				AR	SANDY CLAY: Clayey F-C sand, well weatherd granite saprolite, dry.		0.0	
1.0							1.0	
2.0							2.0	
3.0							3.0	
4.0							4.0	
5.0	6,15,28	SS	12"				5.0	
6.0							6.0	
7.0							7.0	
8.0							8.0	
9.0							9.0	
10.0	35,50/5"	SS	8"				10.0	
11.0		Grab		AH	GRANITE: Weathered granite, dry.		11.0	
12.0							12.0	
13.0							13.0	
14.0							14.0	
15.0							15.0	
16.0		Grab					16.0	
17.0							17.0	
18.0							18.0	
19.0							19.0	
20.0							20.0	
21.0		Grab					21.0	
22.0							22.0	
23.0							23.0	
24.0							24.0	
25.0							25.0	
26.0		Grab					26.0	
27.0							27.0	
28.0							28.0	
29.0							29.0	
30.0							30.0	

G. N. Richardson & Associates, Inc.
14 North Boylan Avenue, Raleigh NC 27603
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FIELD BOREHOLE LOG

BOREHOLE NUMBER **CDMW-5**

PROJECT NAME: **Davidson County C&D Landfill**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **AR/AH**
FIELD PARTY: **R. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **1/30/06** COMPLETED: **1/30/06**

TOTAL DEPTH: **47**
GROUND SURFACE ELEVATION: **NA**
TOP OF CASING ELEVATION:

STATIC WATER LEVEL (BLS)		
Depth (ft)		
Time		
Date		

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
30.0							30.0	
31.0		Grab			GRANITE: Weathered granite to 33' where an approx. 1' moist seam was located (finer cuttings). Harder drilling begins at 38' where rock chips no longer have pink hue. Larger rock cuttings, with moisture, appear at 45'. BT at 47'		31.0	
32.0							32.0	
33.0							33.0	
34.0							34.0	
35.0							35.0	
36.0		Grab					36.0	
37.0							37.0	
38.0							38.0	
39.0							39.0	
40.0							40.0	
41.0		Grab					41.0	
42.0							42.0	
43.0							43.0	
44.0							44.0	
45.0							45.0	
46.0		Grab					46.0	
47.0							47.0	

FIELD BOREHOLE LOG

BOREHOLE NUMBER: B-1

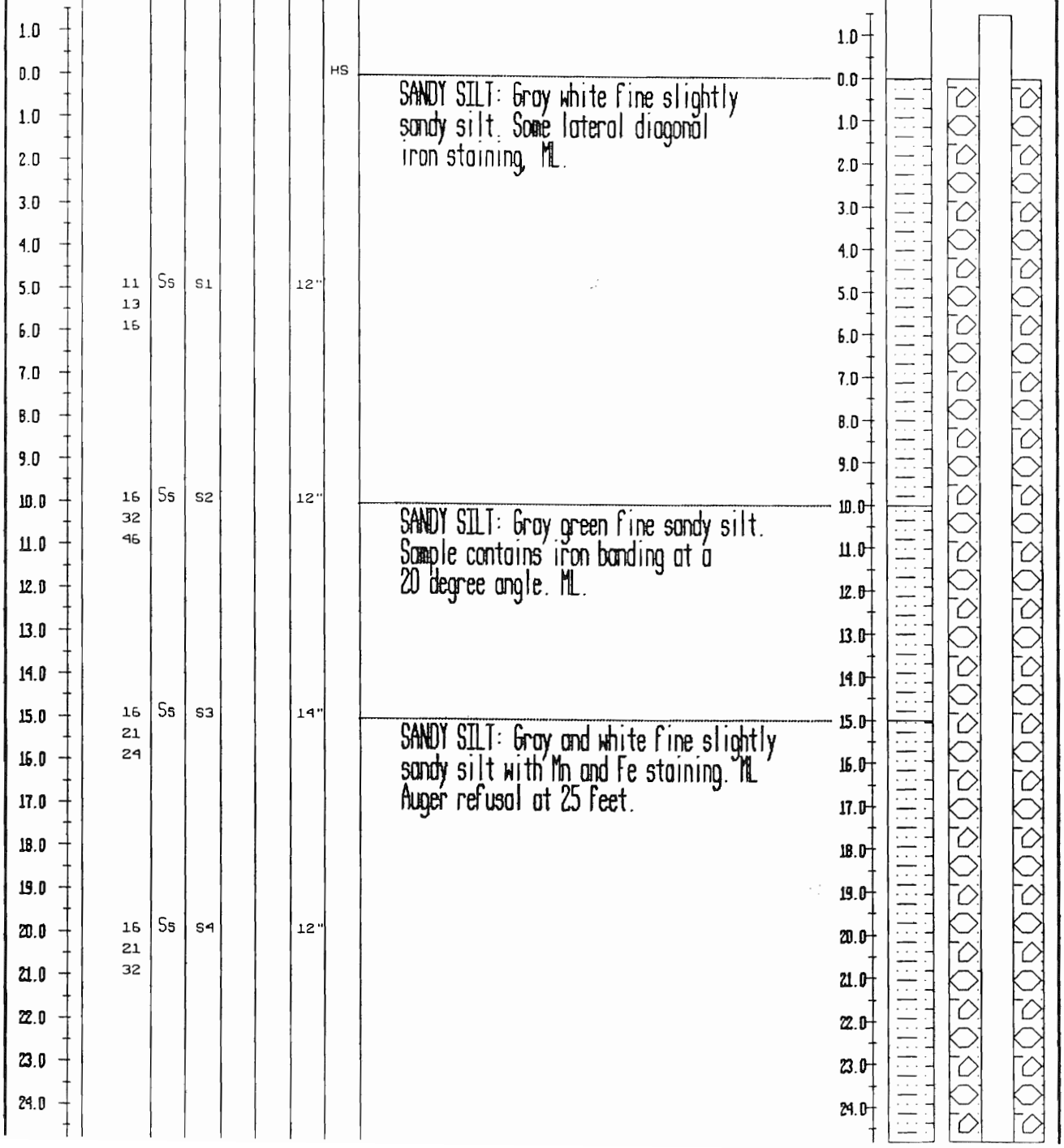
PROJECT NUMBER: Davdco-14
PROJECT NAME: Davidson County Landfill
LOCATION: Lexington, North Carolina
DRILLING COMPANY: Engineering Tectonics
RIG TYPE & NUMBER: MOBILE B-50
DRILLING METHOD: Hollow Stem/Air Rotary/Hammer
WEATHER: Sunny, 95 DEGREES
FIELD PARTY: R. Barron
GEOLOGIST: P. May
DATE BEGUN: 7/13/98 DATE COMPLETED: 7/13/98

TOP OF CASING ELEVATION: TBD
TOTAL DEPTH: 53.0 FT
GROUND SURFACE ELEVATION: TBD
SHEET: 1 OF: 2

STATIC WATER LEVEL (BLS)		
WD=While Drilling AB=After Boring		
Depth(ft)	-	-
Time	-	-
Date:	-	-

DEPTH	BLOW COUNTS	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	CONSISTANCY	SAMPLE RECOVERY	DRILL METHOD	LITHOLOGY DESCRIPTION
0.0							HS	SANDY SILT: Gray white fine slightly sandy silt. Some lateral diagonal iron staining, ML.
5.0	11 13 16	Ss	S1			12"		
10.0	16 32 46	Ss	S2			12"		SANDY SILT: Gray green fine sandy silt. Sample contains iron banding at a 20 degree angle. ML.
15.0	16 21 24	Ss	S3			14"		SANDY SILT: Gray and white fine slightly sandy silt with Mn and Fe staining. ML Auger refusal at 25 feet.
20.0	16 21 32	Ss	S4			12"		

DEPTH | LITHOLOGY | WELL INSTALLATION



FIELD BOREHOLE LOG

BOREHOLE NUMBER: B-1

PROJECT NUMBER: Davdco-14
PROJECT NAME: Davidson County LandFill
LOCATION: Lexington, North Carolina
DRILLING COMPANY: Engineering Tectonics
RIG TYPE & NUMBER: MOBILE B-50
DRILLING METHOD: Hollow Stem/Air Rotary/Hammer
WEATHER: Sunny, 95 DEGREES
FIELD PARTY: R. Barron
GEOLOGIST: P. May
DATE BEGUN: 7/13/98 DATE COMPLETED: 7/13/98

TOP OF CASING ELEVATION: TBD
TOTAL DEPTH: 53.0 FT
GROUND SURFACE ELEVATION: TBD
SHEET: 2 OF 2

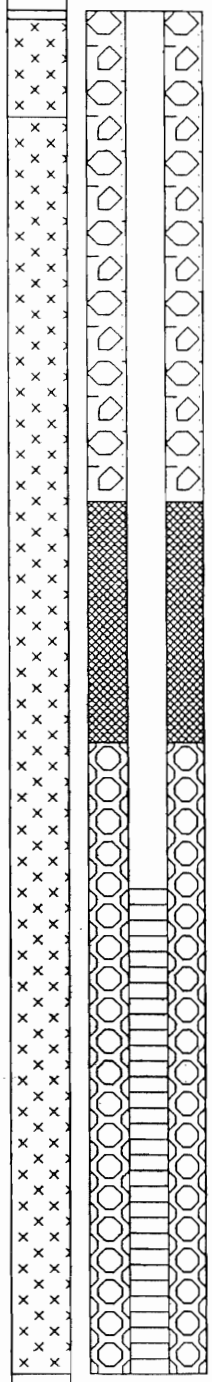
STATIC WATER LEVEL (BLS)		
WD=While Drilling AB=After Boring		
Depth(ft)	-	-
Time	-	-
Date:	-	-

DEPTH	BLOW COUNTS	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	CONSISTANCY	SAMPLE RECOVERY	DRILL METHOD	LITHOLOGY DESCRIPTION
25.0	50/6	Ss	65			4"	AR	DIORITE: Drilled by Air Rotary. Refusal at 27 feet.
27.0							AH	DIORITE: Drilled by Air Hammer. Water Bearing Fractures at 53 feet. Boring terminated at 53 feet.

DEPTH: 25.0, 26.0, 27.0, 28.0, 29.0, 30.0, 31.0, 32.0, 33.0, 34.0, 35.0, 36.0, 37.0, 38.0, 39.0, 40.0, 41.0, 42.0, 43.0, 44.0, 45.0, 46.0, 47.0, 48.0, 49.0, 50.0, 51.0, 52.0, 53.0, 54.0

LITHOLOGY

WELL INSTALLATION



FIELD BOREHOLE LOG

BOREHOLE NUMBER: B-2

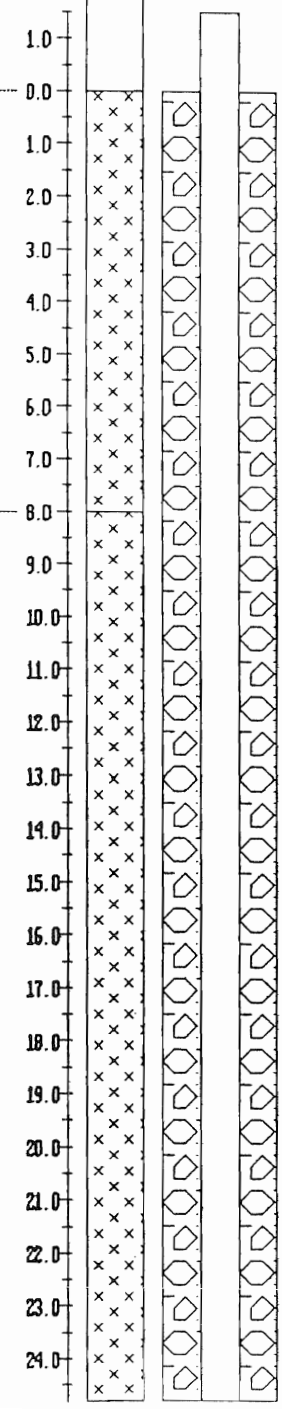
PROJECT NUMBER: Davdco-14
PROJECT NAME: Davidson County Landfill
LOCATION: Lexington, North Carolina
DRILLING COMPANY: Engineering Tectonics
RIG TYPE & NUMBER: MOBILE B-50
DRILLING METHOD: Hollow Stem/Air Rotary/Hammer
WEATHER: Sunny, 95 DEGREES
FIELD PARTY: R. Barron
GEOLOGIST: P. May
DATE BEGUN: 7/13/98 DATE COMPLETED: 7/13/98

TOP OF CASING ELEVATION: TBD
TOTAL DEPTH: 48.0 FT
GROUND SURFACE ELEVATION: TBD
SHEET: 1 OF: 2

STATIC WATER LEVEL (BLS)		
WD=While Drilling AB=After Boring		
Depth(ft)	-	-
Time	-	-
Date:	-	-

DEPTH	BLOW COUNTS	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	CONSISTANCY	SAMPLE RECOVERY	DRILL METHOD	LITHOLOGY DESCRIPTION
0.0							AR	DIORITE: Dark gray and white diorite. Air Rotary refusal at 8.0 feet.
3.0		6	S1					
8.0		6	S2				AH	DIORITE: Dark gray and white hard diorite. Drilled by air hammer. No water seams noted.
13.0		6	S3					
18.0		6	S4					
23.0		6	S5					

DEPTH | LITHOLOGY | WELL INSTALLATION



FIELD BOREHOLE LOG

BOREHOLE NUMBER: B-2

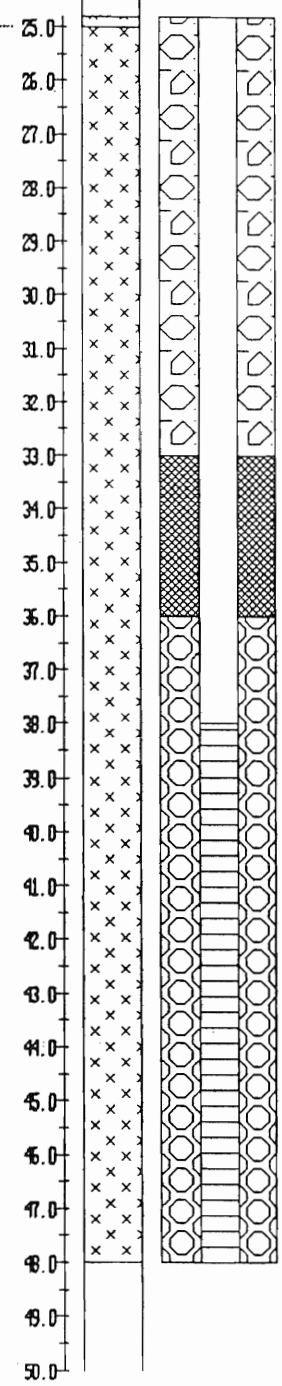
PROJECT NUMBER: Davdco-14
PROJECT NAME: Davidson County Landfill
LOCATION: Lexington, North Carolina
DRILLING COMPANY: Engineering Tectonics
RIG TYPE & NUMBER: MOBILE B-50
DRILLING METHOD: Hollow Stem/Air Rotary/Hammer
WEATHER: Sunny, 95 DEGREES
FIELD PARTY: R. Barron
GEOLOGIST: P. May
DATE BEGUN: 7/13/98 DATE COMPLETED: 7/13/98

TOP OF CASING ELEVATION: TBD
TOTAL DEPTH: 48.0 FT
GROUND SURFACE ELEVATION: TBD
SHEET: 2 OF: 2

STATIC WATER LEVEL (BLS)		
WD=While Drilling AB=After Boring		
Depth(ft)	-	-
Time	-	-
Date:	-	-

DEPTH	BLOW COUNTS	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	CONSISTANCY	SAMPLE RECOVERY	DRILL METHOD	LITHOLOGY DESCRIPTION
25.0								DIORITE: Dark gray and white hard diorite. Drilled by air hammer. Boring terminated at 48 feet below grade.
26.0								
27.0								
28.0		G	S6					
29.0								
30.0								
31.0								
32.0								
33.0		G	S7					
34.0								
35.0								
36.0								
37.0								
38.0		G	S8					
39.0								
40.0								
41.0								
42.0								
43.0		G	S9					
44.0								
45.0								
46.0								
47.0								
48.0		G	S10					
49.0								
50.0								

DEPTH | LITHOLOGY | WELL INSTALLATION



FIELD BOREHOLE LOG

BOREHOLE NUMBER: B-3

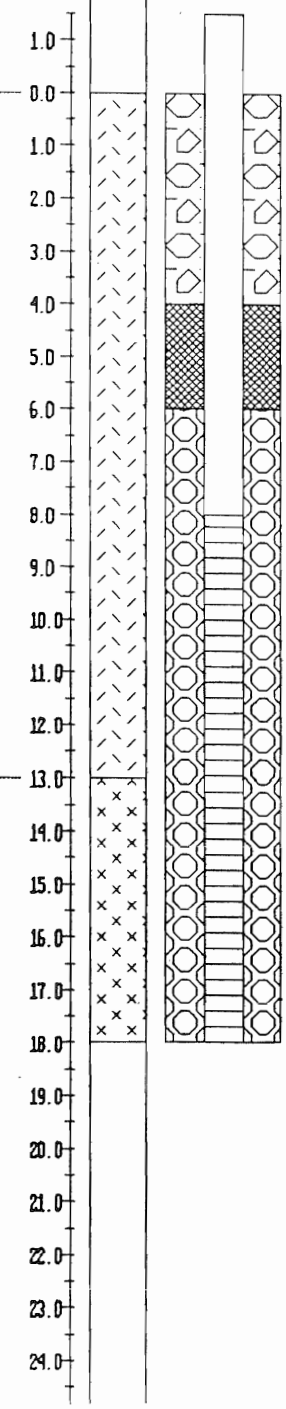
PROJECT NUMBER: Davdco-14
PROJECT NAME: Davidson County Landfill
LOCATION: Lexington, North Carolina
DRILLING COMPANY: Engineering Tectonics
RIG TYPE & NUMBER: MOBILE B-50
DRILLING METHOD: Hollow Stem/Air Rotary/Hammer
WEATHER: Sunny, 95 DEGREES
FIELD PARTY: R. Barron
GEOLOGIST: P. May
DATE BEGUN: 7/14/98 DATE COMPLETED: 7/14/98

TOP OF CASING ELEVATION: TBD
TOTAL DEPTH: 18.0 FT
GROUND SURFACE ELEVATION: TBD
SHEET: 1 OF: 1

STATIC WATER LEVEL (BLS)		
WD=While Drilling AB=After Boring		
Depth(Ft)	-	-
Time	-	-
Date:	-	-

DEPTH	BLOW COUNTS	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	CONSISTANCY	SAMPLE RECOVERY	DRILL METHOD	LITHOLOGY DESCRIPTION
1.0								
0.0							AR AH	GRANITE: Gray, red and white granite. Air Rotary refusal at 0.5 feet. Drilled with Air Hammer from 0.5 feet to 18 feet. Grab samples dry, no water seams noted.
1.0								
2.0								
3.0		6	S1					
4.0								
5.0								
6.0								
7.0								
8.0		6	S2					
9.0								
10.0								
11.0								
12.0								
13.0		6	S3					DIORITE: Dark gray and white hard diorite. Water seam noted at 18 feet below grade. Boring terminated at 18 feet below grade.
14.0								
15.0								
16.0								
17.0								
18.0		6	S4					
19.0								
20.0								
21.0								
22.0								
23.0								
24.0								

DEPTH | LITHOLOGY | WELL INSTALLATION



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FIELD BOREHOLE LOG

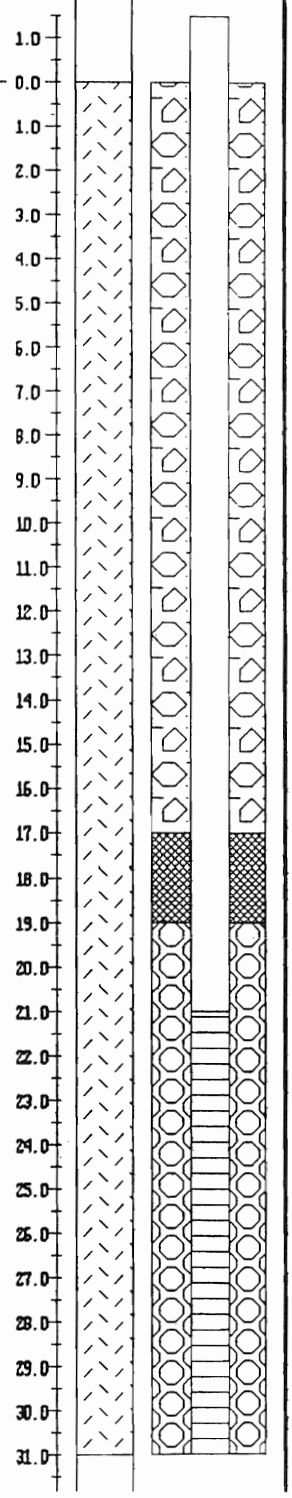
BOREHOLE NUMBER: B-4

PROJECT NUMBER: Davdco-14
PROJECT NAME: Davidson County Landfill
LOCATION: Lexington, North Carolina
DRILLING COMPANY: Engineering Tectonics
RIG TYPE & NUMBER: MOBILE B-50
DRILLING METHOD: Hollow Stem/Air Rotary/Hammer
WEATHER: Sunny, 95 DEGREES
FIELD PARTY: R. Barron
GEOLOGIST: P. May
DATE BEGUN: 7/14/98 DATE COMPLETED: 7/15/98

TOP OF CASING ELEVATION: TBD
TOTAL DEPTH: 31.0 FT
GROUND SURFACE ELEVATION: TBD
SHEET: 1 OF: 1

STATIC WATER LEVEL (BLS)		
WD=While Drilling AB=After Boring		
Depth(ft)	-	-
Time	-	-
Date:	-	-

DEPTH	BLOW COUNTS	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	CONSISTANCY	SAMPLE RECOVERY	DRILL METHOD	LITHOLOGY DESCRIPTION
0.0							AH	GRANITE: Tan granite with quartz. Some possible intrusions of diorite noted as more mafic rock fragments between 13 and 14 feet below grade. 6 inches of water noted in boring on 7/15/98 at approximately 25 feet below grade. Boring terminated at 31 feet below grade.
3.0		6	S1					
8.0		6	S2					
13.0		6	S3					
18.0		6	S4					
23.0		6	S5					
28.0		6	S6					



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FIELD BOREHOLE LOG

BOREHOLE NUMBER: B-5

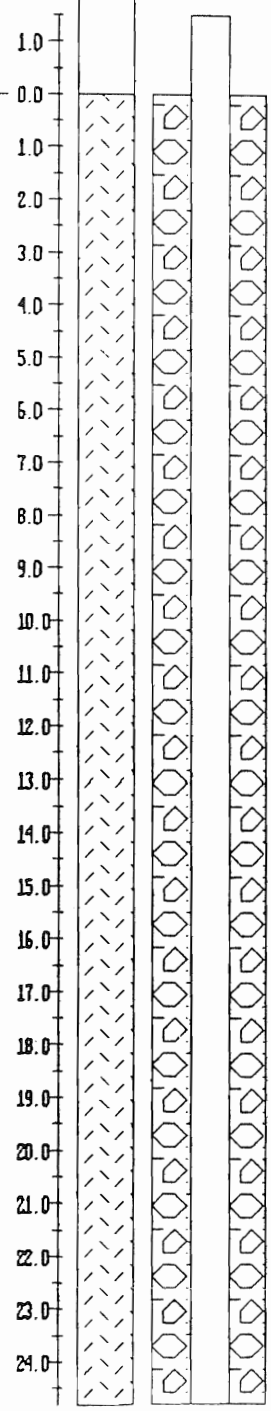
PROJECT NUMBER: Davdco-14
PROJECT NAME: Davidson County Landfill
LOCATION: Lexington, North Carolina
DRILLING COMPANY: Engineering Tectonics
RIG TYPE & NUMBER: MOBILE B-50
DRILLING METHOD: Hollow Stem/Air Rotary/Hammer
WEATHER: Sunny, 95 DEGREES
FIELD PARTY: R. Barron
GEOLOGIST: P. May
DATE BEGUN: 7/15/98 DATE COMPLETED: 7/15/98

TOP OF CASING ELEVATION: TBD
TOTAL DEPTH: 41.0 FT
GROUND SURFACE ELEVATION: TBD
SHEET: 1 OF: 2

STATIC WATER LEVEL (BLS)		
WD=While Drilling AB=After Boring		
Depth(Ft)	-	-
Time	-	-
Date:	-	-

DEPTH	BLOW COUNTS	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	CONSISTANCY	SAMPLE RECOVERY	DRILL METHOD	LITHOLOGY DESCRIPTION
1.0								
0.0							AH	GRANITE: Tan rock fragments with quartz. Hard rock. Some thin seams with more mafic rock fragments.
1.0								
2.0								
3.0		6	S1					
4.0								
5.0								
6.0								
7.0								
8.0								
9.0		6	S2					
10.0								
11.0								
12.0								
13.0								
14.0		6	S3					
15.0								
16.0								
17.0								
18.0								
19.0		6	S4					
20.0								
21.0								
22.0								
23.0		6	S5					
24.0								

DEPTH | LITHOLOGY | WELL INSTALLATION



FIELD BOREHOLE LOG

BOREHOLE NUMBER: B-5

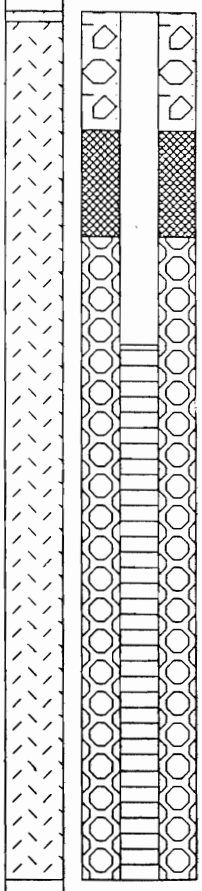
PROJECT NUMBER: Davdco-14
PROJECT NAME: Davidson County Landfill
LOCATION: Lexington, North Carolina
DRILLING COMPANY: Engineering Tectonics
RIG TYPE & NUMBER: MOBILE B-50
DRILLING METHOD: Hollow Stem/Air Rotary/Hammer
WEATHER: Sunny, 95 DEGREES
FIELD PARTY: R. Barron
GEOLOGIST: P. May
DATE BEGUN: 7/15/98 DATE COMPLETED: 7/15/98

TOP OF CASING ELEVATION: TBD
TOTAL DEPTH: 41.0 FT
GROUND SURFACE ELEVATION: TBD
SHEET: 2 OF: 2

STATIC WATER LEVEL (BLS)		
WD=While Drilling AB=After Boring		
Depth(ft)	-	-
Time	-	-
Date:	-	-

DEPTH	BLOW COUNTS	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	CONSISTANCY	SAMPLE RECOVERY	DRILL METHOD	LITHOLOGY DESCRIPTION
25.0								GRANITE: Tan rock fragments with quartz. Water seam noted at 34 feet. Boring terminated at 41 feet.
26.0								
27.0								
28.0		G	S6					
29.0								
30.0								
31.0								
32.0								
33.0								
34.0		G	S7					
35.0								
36.0								
37.0								
38.0								
39.0		G	S8					
40.0								
41.0								
42.0								
43.0								
44.0								
45.0								
46.0								
47.0								
48.0								
49.0								
50.0								

DEPTH | LITHOLOGY | WELL INSTALLATION



FIELD BOREHOLE LOG

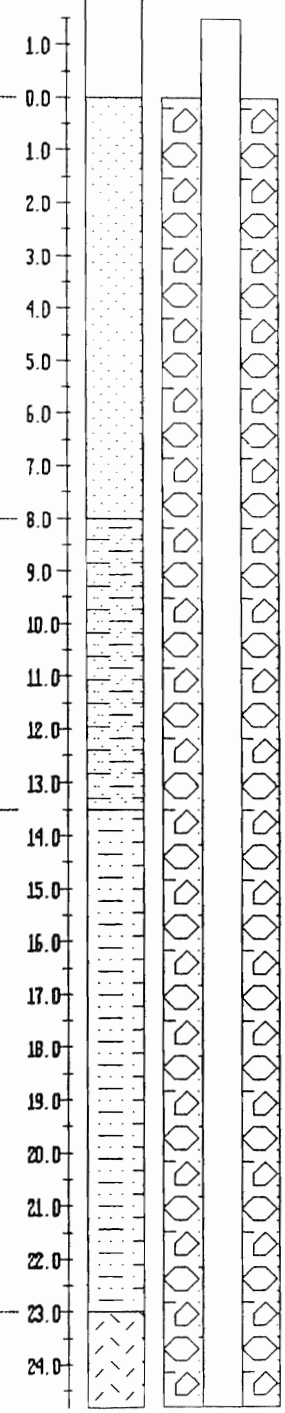
BOREHOLE NUMBER: B-6

PROJECT NUMBER: Davdco-14
PROJECT NAME: Davidson County Landfill
LOCATION: Lexington, North Carolina
DRILLING COMPANY: Engineering Tectonics
RIG TYPE & NUMBER: MOBILE B-50
DRILLING METHOD: Hollow Stem/Air Rotary/Hammer
WEATHER: Sunny, 95 DEGREES
FIELD PARTY: R. Barron
GEOLOGIST: P. May
DATE BEGUN: 7/16/98 DATE COMPLETED: 7/16/98

TOP OF CASING ELEVATION: TBD
TOTAL DEPTH: 51.0 FT
GROUND SURFACE ELEVATION: TBD
SHEET: 1 OF: 2

STATIC WATER LEVEL (BLS)		
WD=While Drilling AB=After Boring		
Depth(Ft)	-	-
Time	-	-
Date:	-	-

DEPTH	BLOW COUNTS	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	CONSISTANCY	SAMPLE RECOVERY	DRILL METHOD	LITHOLOGY DESCRIPTION
0.0							AR	SAND: Tan orange fine to medium with some coarse sand mottled with iron and manganese, SP.
3.0	10 15 18	Ss	S1					
8.0	17 26 34	Ss	S2					SILTY SAND: Mottled fine to medium with some coarse silty sand. Tan orange matrix with gray black and white mottling, ML.
13.0	50/5	Ss	S3					SANDY SILT: Tan and gray sandy silt partially weathered rock. ML. Air rotary refusal at 23 feet below grade.
18.0	50/4	Ss	S4					
23.0							AH	GRANITE: Tan and gray granite. Dry.



FIELD BOREHOLE LOG

BOREHOLE NUMBER: B-6

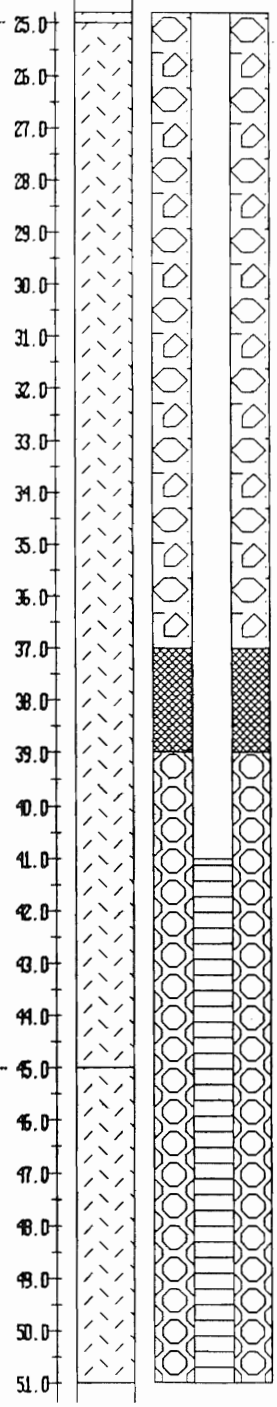
PROJECT NUMBER: Davdco-14
PROJECT NAME: Davidson County Landfill
LOCATION: Lexington, North Carolina
DRILLING COMPANY: Engineering Tectonics
RIG TYPE & NUMBER: MOBILE B-50
DRILLING METHOD: Hollow Stem/Air Rotary/Hammer
WEATHER: Sunny, 95 DEGREES
FIELD PARTY: R. Barron
GEOLOGIST: P. May
DATE BEGUN: 7/16/98 DATE COMPLETED: 7/16/98

TOP OF CASING ELEVATION: TBD
TOTAL DEPTH: 51.0 FT
GROUND SURFACE ELEVATION: TBD
SHEET: 2 OF: 2

STATIC WATER LEVEL (BLS)		
WD=While Drilling AB=After Boring		
Depth(ft)	-	-
Time	-	-
Date:	-	-

DEPTH	BLOW COUNTS	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	CONSISTANCY	SAMPLE RECOVERY	DRILL METHOD	LITHOLOGY DESCRIPTION
25.0								GRANITE: Tan and gray granite. Dry.
26.0								
27.0								
28.0		G	S5					
29.0								
30.0								
31.0								
32.0								
33.0		G	S6					
34.0								
35.0								
36.0								
37.0								
38.0		G	S7					
39.0								
40.0								
41.0								
42.0								
43.0		G	S8					
44.0								
45.0								GRANITE: Gray and tan granite. Darker than above. Water seam at 51 feet. Boring terminated.
46.0								
47.0								
48.0		G	S9					
49.0								
50.0								
51.0								

DEPTH | LITHOLOGY | WELL INSTALLATION



FIELD BOREHOLE LOG

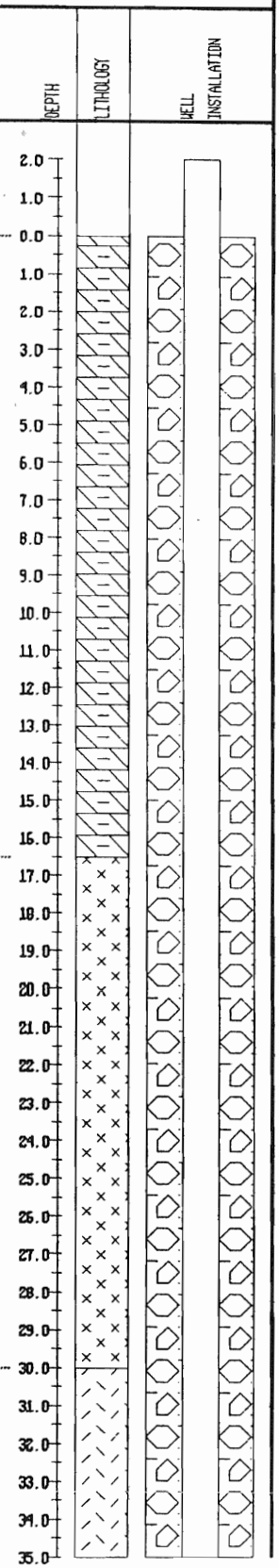
BOREHOLE NUMBER: B-7

PROJECT NUMBER: DAVCO-13
PROJECT NAME: Davidson County Landfill
LOCATION: Lexington, North Carolina
DRILLING COMPANY: Engineering Tectonics, P.A.
RIG TYPE & NUMBER: MOBILE B-80
DRILLING METHOD: HSA & Air Hammer
WEATHER: Cloudy, 30 degrees
FIELD PARTY: David Barron
GEOLOGIST: Philip May
DATE BEGUN: 1/20/00 DATE COMPLETED: 1/21/00

TOP OF CASING ELEVATION: TBD
TOTAL DEPTH: 66.0 FT
GROUND SURFACE ELEVATION: TBD
SHEET: 1 OF: 2

STATIC WATER LEVEL (BLS)		
WD=While Drilling AB=After Boring		
Depth(ft)	54.0	59.0
Time	16:30	13:00
Date:	1/21/00	1/24/00

DEPTH	BLOW COUNTS	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	CONSISTANCY	SAMPLE RECOVERY	DRILL METHOD	LITHOLOGY DESCRIPTION
5.0	50/6"	SS	61	D		2"		
10.0	50/3"	SS	62	D		2"		
15.0	50/0"	SS	63	D		1"		
								PWR: Tan sandy partially weathered rock, dry, quartz fragments.
								DIORITE: Cored from 16.5 to 26.5 feet; Recovery: 75% (100% from 16.5' to 24.0'); RQD: 16%; Predominant fracture angle 0 and 45 degrees; 18.6' 45 degree quartz seam; 19.0' 45 degree quartz seam; 20.5' 45 degree quartz seam; 23.5' quartz seams; 26.5' Core terminated-begin air hammer; 27.0' dry seam.
								GRANITE: Granite rock fragments from air hammering;



FIELD BOREHOLE LOG

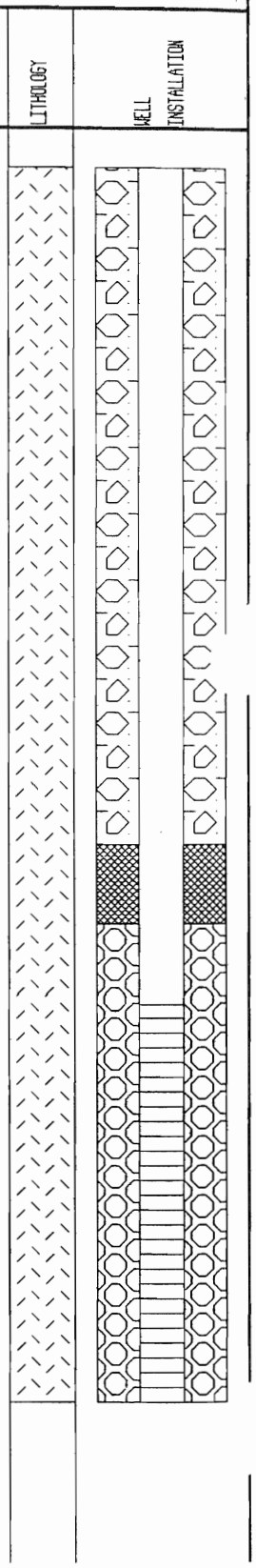
BOREHOLE NUMBER: B-7

PROJECT NUMBER: DAVCO-13
PROJECT NAME: Davidson County Landfill
LOCATION: Lexington, North Carolina
DRILLING COMPANY: Engineering Tectonics, P.A.
RIG TYPE & NUMBER: MOBILE B-80
DRILLING METHOD: HSA & Air Hammer
WEATHER: Cloudy, 30 degrees
FIELD PARTY: David Barron
GEOLOGIST: Philip May
DATE BEGUN: 1/20/00 DATE COMPLETED: 1/21/00

TOP OF CASING ELEVATION: TBD
TOTAL DEPTH: 66.0 FT
GROUND SURFACE ELEVATION: TBD
SHEET: 2 OF: 2

STATIC WATER LEVEL (BLS)		
WD=While Drilling AB=After Boring		
Depth(ft)	64.0	59.0
Time	16:30	13:00
Date:	1/21/00	1/24/00

DEPTH	BLOW COUNTS	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	CONSISTANCY	SAMPLE RECOVERY	DRILL METHOD	LITHOLOGY DESCRIPTION
35.0								
36.0		G	S4	D				
37.0								
38.0								
39.0								
40.0								
41.0								40.0' dry seam;
42.0								
43.0								
44.0		G	S5	D				
45.0								
46.0								
47								
48								
49.0								
50.0								
51.0								
52.0								
53.0								
54.0								
55.0		G	S6	D				
56.0								
57.0								
58.0								
59.0								
60.0								
61.0								60.0' 2 feet of soft seams, no water after 1 hour;
62.0								
63.0		G	S7	D				
64.0								66.0' Boring terminated.
65.0								
66.0								
67.0								
68.0								
69.0								
70.0								



FIELD BOREHOLE LOG

BOREHOLE NUMBER: B-8

PROJECT NUMBER: DAVCO-13
PROJECT NAME: Davidson County Landfill
LOCATION: Lexington, North Carolina
DRILLING COMPANY: Engineering Tectonics, P.A.
RIG TYPE & NUMBER: MOBILE B-80
DRILLING METHOD: HSA & Air Hammer
WEATHER: Cloudy, 30 degrees
FIELD PARTY: David Barron
GEOLOGIST: Philip May
DATE BEGUN: 1/21/00 DATE COMPLETED: 1/21/00

TOP OF CASING ELEVATION: TBD
TOTAL DEPTH: 51.0 FT
GROUND SURFACE ELEVATION: TBD
SHEET: 1 OF: 2

STATIC WATER LEVEL (BLS)		
WD=While Drilling AB=After Boring		
Depth(ft)	48.0	44.2
Time	16:00	13:00
Date:	1/21/00	1/24/00

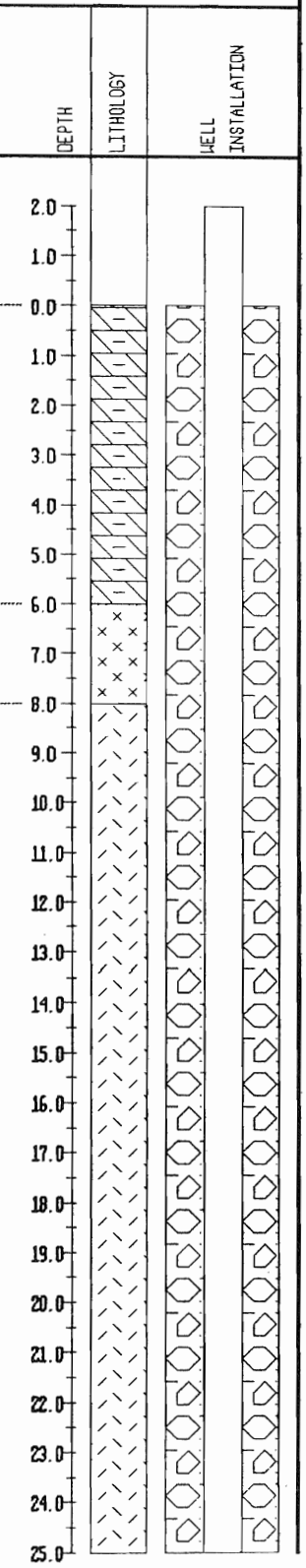
DEPTH	BLOW COUNTS	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	CONSISTANCY	SAMPLE RECOVERY	DRILL METHOD	LITHOLOGY DESCRIPTION
5.0	50/3	SS	S1	D		1"		
10.0		G	S2	D				
15.0		G	S3	D				
20.0		G	S4	D				

PWR: Grey-green mafic partially weathered rock;

6.0' auger refusal.

DIORITE: 2' diorite seam.

GRANITE: Granite rock fragments from air hammering.



FIELD BOREHOLE LOG

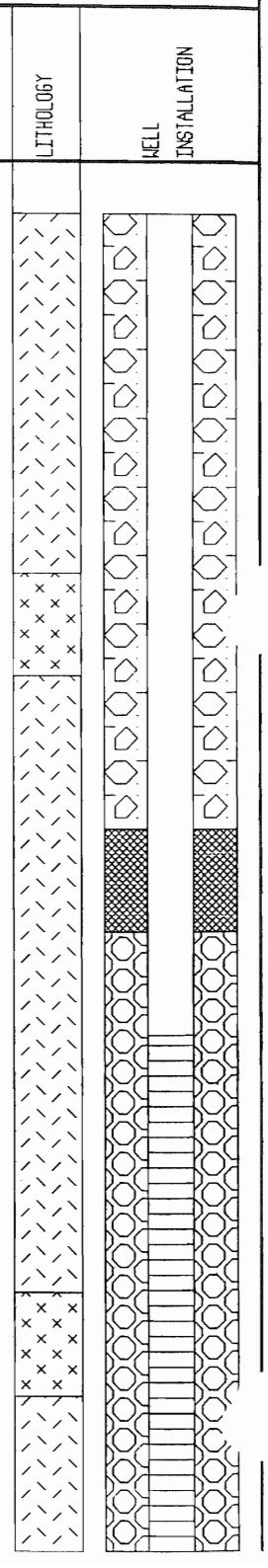
BOREHOLE NUMBER: B-8

PROJECT NUMBER: DAVCO-13
PROJECT NAME: Davidson County LandFill
LOCATION: Lexington, North Carolina
DRILLING COMPANY: Engineering Tectonics, P.A.
RIG TYPE & NUMBER: MOBILE B-80
DRILLING METHOD: HSA & Air Hammer
WEATHER: Cloudy, 30 degrees
FIELD PARTY: David Barron
GEOLOGIST: Philip May
DATE BEGUN: 1/21/00 DATE COMPLETED: 1/21/00

TOP OF CASING ELEVATION: TBD
TOTAL DEPTH: 51.0 FT
GROUND SURFACE ELEVATION: TBD
SHEET: 2 OF: 2

STATIC WATER LEVEL (BLS)		
WD=While Drilling AB=After Boring		
Depth(Ft)	48.0	44.2
Time	16:00	13:00
Date:	1/21/00	1/24/00

DEPTH	BLOW COUNTS	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	CONSISTANCY	SAMPLE RECOVERY	DRILL METHOD	LITHOLOGY DESCRIPTION
25.0								
26.0								
27.0								
28.0								
29.0								
30.0								
31.0								
32.0								DIORITE: 2 foot diorite seam.
33.0								
34.0								GRANITE: Granite rock fragments.
35.0		G	SS	D				
36.0								
37.0								
38.0								
39.0								
40.0								
41.0								
42.0								
43.0								
44.0								
45.0								DIORITE: 2 foot diorite seam.
46.0		G	SS	D				
47.0								
48.0								GRANITE: Granite rock fragments; soft seam from 48 to 50'; let sit 10 minutes - produced water; 51.0' Boring terminated.
49.0								
50.0								
51.0								



NORTH CAROLINA DEPARTMENT OF HEALTH, ENVIRONMENT, AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, NC 27611, PHONE (919) 783-50S3

FOR OFFICE USE ONLY

Quad No. _____ Serial No. _____
Lat _____ Long. _____ Pc _____
MinorBasin

WELL CONSTRUCTION RECORD

Davidson County C&D Landfill
B-7

RILLING CONTRACTOR **Engineering Tectonics, P.A.**

RILLER REGISTRATION NUMBER **835**

STATE WELL CONSTRUCTION PERMIT NUMBER: _____

. WELL LOCATION: (Show sketch of the location below)
Nearest Town: **Lexington, North Carolina**
Off Davidson County Landfill Road
(Road, Community, or Subdivision and Lot No.)

County: **Davidson**

. OWNER **Dav. Co. Integrated Solid Waste**
ADDRESS **220 Davidson County Landfill Road**
Lexington **NC** **27292**
City or Town State Zip Code

. DATE DRILLED **1/21/00** USE OF WELL **Piezometer**
. TOTAL DEPTH **66 feet** Cuttings Collected? ____ Yes **X** No
. DOES WELL REPLACE EXISTING WELL? ____ Yes **X** No
STATIC WATER LEVEL: **59.0** ft ____ above **X** below top of casing.
Top of casing is **2.5** ft above land surface.
D (gpm): _____ METHOD OF TEST _____
; Zones (depth): _____

Depth From	Depth To	Drilling Log: Formation Description
see attached boring log		

If additional space is needed, use back of form.

9. CHLORINATION: Type _____ Amount _____

0. CASING:

	Depth From	Depth To	Diameter	Wall Thickness or Weight/Ft.	Material
	0	56	2 inch		Schedule 40 PVC

1. GROUT:

	Depth From	Depth To	Material	Method
	0	52	Portlandcmnt	Tremie pipe
	52	54	Bentonite chips	

12. SCREEN:

	Depth From	Depth To	Diameter	Slot Size	Material
	56	66	2 in.	10 in.	Schedule 40
			in.	in.	
			in.	in.	

3. GRAVEL PACK

	Depth From	Depth To	Size	Material
	54	56	No 2	Filter sand

LOCATION SKETCH

(Show directions and distance from at least two State Roads. or other map reference points.)

see attached map

EMARKS: _____

, DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 14 NCAC 2C, WELL CONSTRUCTION RECORDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Signature of Contractor or Agent Date

NORTH CAROLINA DEPARTMENT OF HEALTH, ENVIRONMENT, AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, NC 27611, PHONE (919) 783-50S3

FOR OFFICE USE ONLY

Quad No. _____ Serial No. _____
Lat _____ Long. _____ Pc _____
MinorBasin _____

WELL CONSTRUCTION RECORD

Davidson County C&D Landfill

B-8

RILLING CONTRACTOR **Engineering Tectonics, P.A.**

RILLER REGISTRATION NUMBER **835**

STATE WELL CONSTRUCTION PERMIT NUMBER: _____

. WELL LOCATION: (Show sketch of the location below)

Nearest Town: **Lexington, North Carolina**

Off Davidson County Landfill Road
(Road, Community, or Subdivision and Lot No.)

County: **Davidson**

. OWNER **Dav. Co. Integrated Solid Waste**

ADDRESS **220 Davidson County Landfill Road**

Lexington — City or Town
NC — State
27292 — Zip Code

DATE DRILLED **1/21/00** USE OF WELL **Piezometer**

TOTAL DEPTH **51 feet** Cuttings Collected? ____ Yes **X** No

DOES WELL REPLACE EXISTING WELL? ____ Yes **X** No

STATIC WATER LEVEL: **44.2** ft ____ above **X** below top of casing.

Top of casing is **2.5** ft above land surface.

. YIELD (gpm): _____ METHOD OF TEST _____

er Zones (depth): _____

Depth From	Depth To	Drilling Log: Formation Description
see attached boring log		

If additional space is needed, use back of form.

. CHLORINATION: Type _____ Amount _____

0. CASING:

	Depth From	Depth To	Ft	Diameter	Wall Thickness or Weight/Ft.	Material
	0	41		2 inch		Schedule 40 PVC

1. GROUT:

	Depth From	Depth To	Ft.	Material	Method
	0	37		Portlandcmnt	Tremie pipe
	37	39		Bentonite chips	

2. SCREEN:

	Depth From	Depth To	Ft	Diameter	Slot Size	Material
	41	51		2 in.	10 in.	Schedule 40
				in.	in.	
				in.	in.	

3. GRAVEL PACK

	Depth From	Depth To	Ft	Size	Material
	39	51		No 2	Filter sand

LOCATION SKETCH

(Show directions and distance from at least two State Roads. or other map reference points.)

see attached map

REMARKS: _____

, DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 14 NCAC 2C, WELL CONSTRUCTION RECORDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Signature of Contractor or Agent Date

Submitted to Division of Environmental Management & copy to well owner

Appendix C

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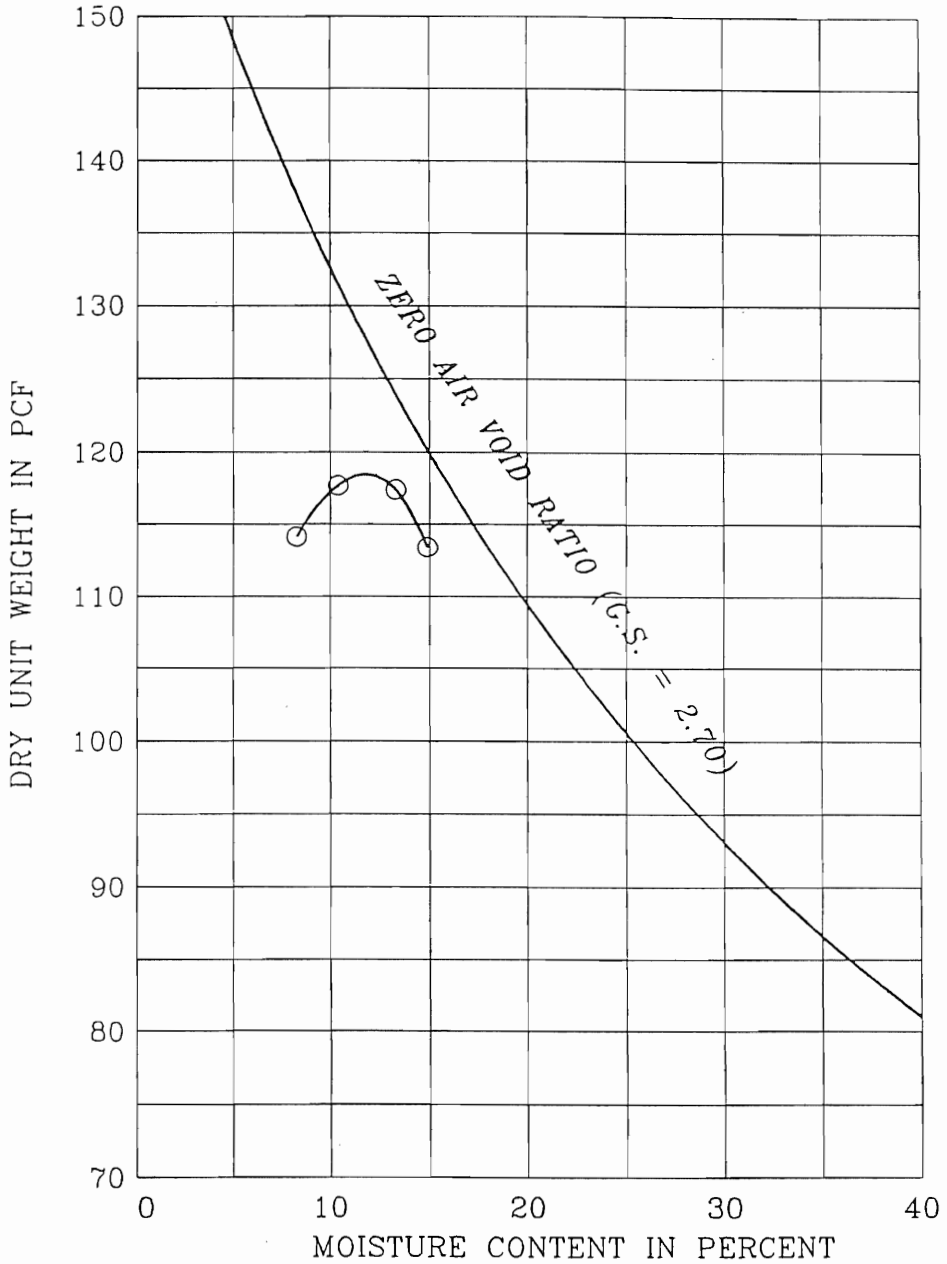
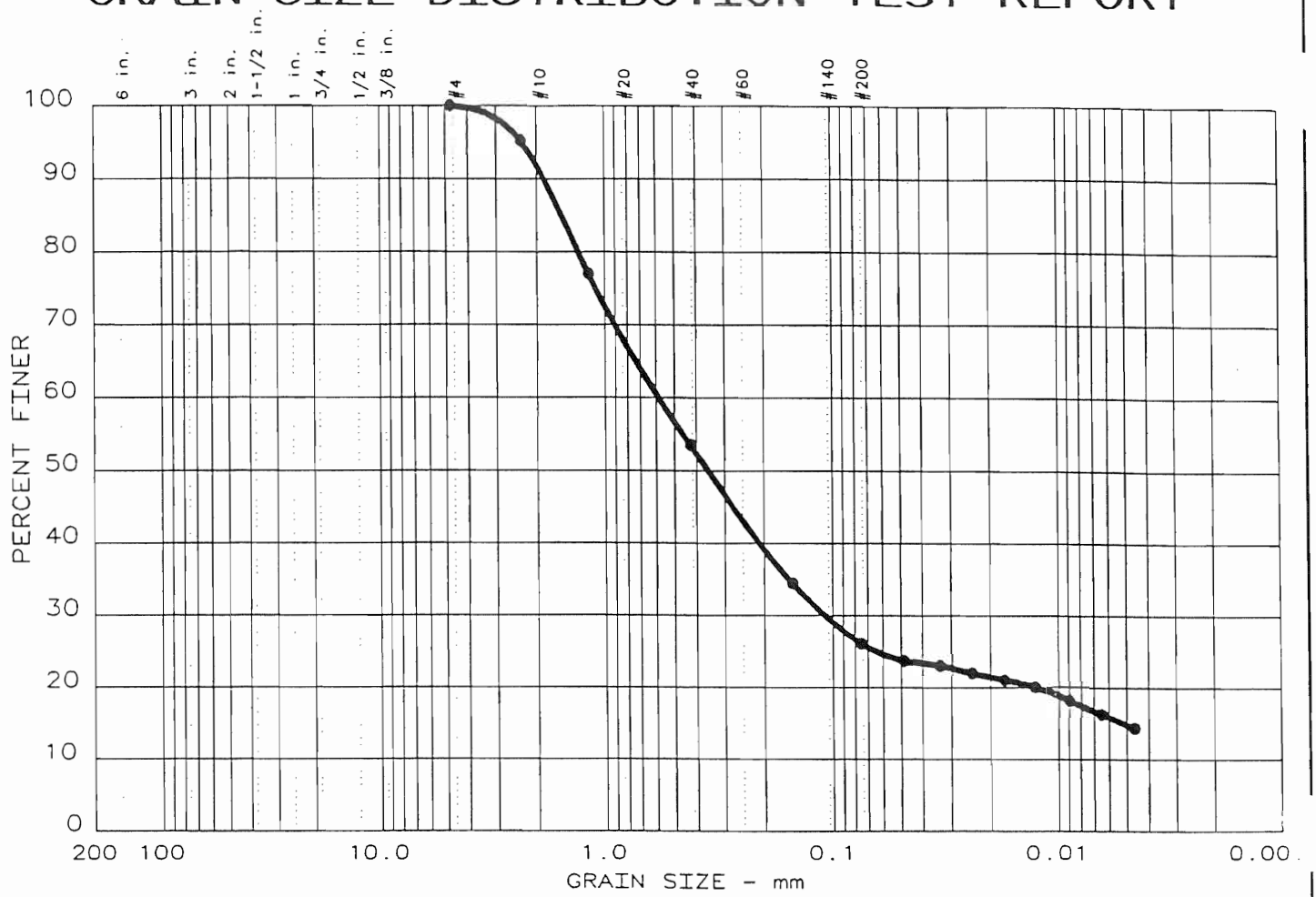


SYMBOL	SAMPLE LOCATION	DEPTH (ft)	DESCRIPTION	TEST METHOD	OPTIMUM MOISTURE (%)	MAXIMUM DRY DENSITY (pcf)
O	n/a B-6	n/a	Tan sand	D-698	11.9	118.5

Remark :

Project No.98-496D	Davidson County Landfill
Engineering Tectonics	COMPACTION TEST Figure No.1

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	1	0.0	0.0	73.9	11.3	14.8

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	15.3	NP	1.55	0.582	0.355	0.108	0.0051			

MATERIAL DESCRIPTION	USCS	AASHTO
● TAN SAND	SM	A-2

Project No.: 98-496-B

Project: DAVIDSON COUNTY LANDFILL

● Location: ~~PZ-6~~ B-6

Date: 07-27-98

Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT

ENGINEERING TECTONICS

Fig. No.: 2

Appendix D

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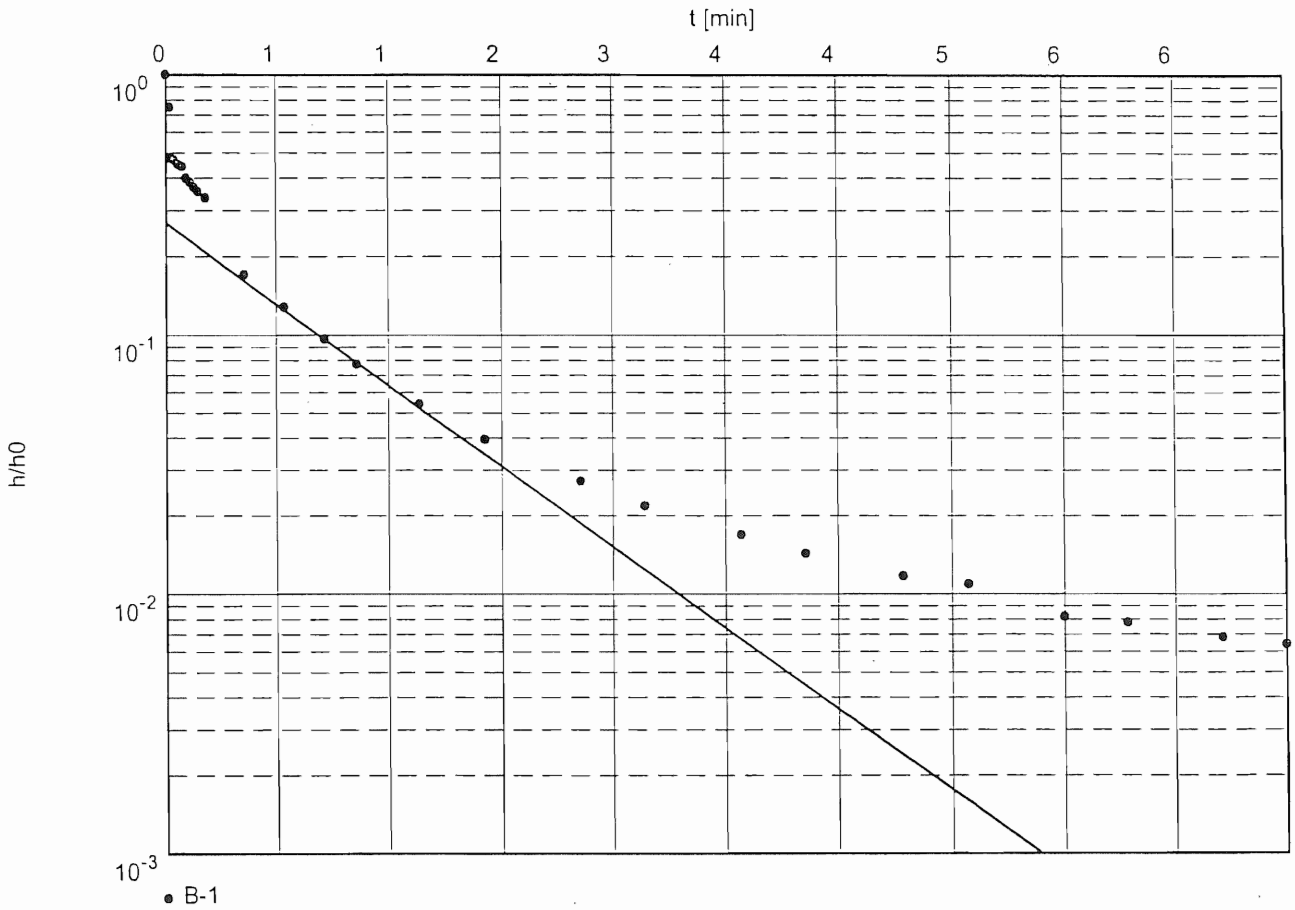
G. N. Richardson and Associates 425 N. Boylan Avenue Raleigh, North Carolina ph.(919) 828-0577	slug/bail test analysis BOUWER-RICE's method	Date: 7/31/98	C & D Landfill, Page 1
		Project: Davidson County	
		Evaluated by: JAF	

Slug Test No.	Test conducted on: 7/29/98
B-1	



Hydraulic conductivity [ft/min]: 1.62×10^{-3}

G. N. Richardson and Associates
425 N. Boylan Avenue
Raleigh, North Carolina
ph.(919) 828-0577

slug/bail test analysis
BOUWER-RICE's method

Date: 7/31/98

Project: Davidson County

Evaluated by: JAF

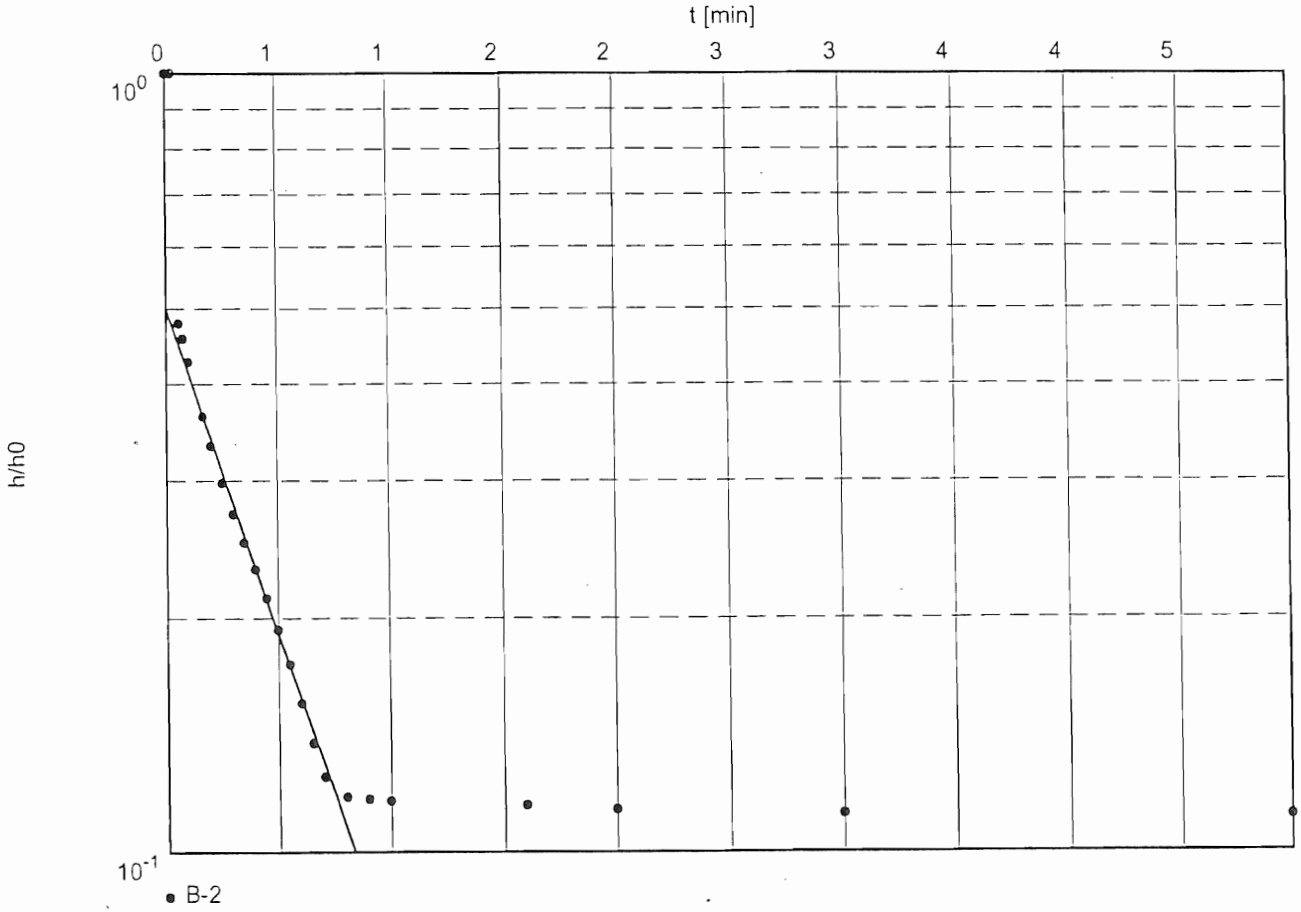
Slug Test No.	Test conducted on: 7/29/98
B-1	B-1

Static water level: 42.85 ft below datum

	Pumping test duration [min]	Water level [ft]	Drawdown [ft]
1	0.00	50.19	7.34
2	0.02	48.35	5.50
3	0.03	46.35	3.50
4	0.05	46.30	3.45
5	0.08	46.17	3.32
6	0.10	46.10	3.25
7	0.13	45.78	2.93
8	0.15	45.68	2.83
9	0.18	45.55	2.70
10	0.20	45.46	2.61
11	0.25	45.32	2.47
12	0.50	44.10	1.25
13	0.75	43.79	0.94
14	1.00	43.56	0.71
15	1.20	43.42	0.57
16	1.60	43.25	0.40
17	2.00	43.14	0.29
18	2.60	43.05	0.20
19	3.00	43.01	0.16
20	3.60	42.97	0.12
21	4.00	42.96	0.11
22	4.60	42.94	0.09
23	5.00	42.93	0.08
24	5.60	42.91	0.06
25	6.00	42.91	0.06
26	6.60	42.90	0.05
27	7.00	42.90	0.05

G. N. Richardson and Associates 425 N. Boylan Avenue Raleigh, North Carolina ph.(919) 828-0577	slug/bail test analysis BOUWER-RICE's method	Date: 7/31/98	C & D Landfill, Page 1
		Project: Davidson County	
		Evaluated by: JAF	

Slug Test No.	Test conducted on: 7/29/98
B-2	



Hydraulic conductivity [ft/min]: 3.36×10^{-3}

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425 N. Boylan Avenue
Raleigh, North Carolina
ph.(919) 828-0577

slug/bail test analysis
BOUWER-RICE's method

Date: 7/31/98 | C & D Landfill, Page 2

Project: Davidson County

Evaluated by: JAF

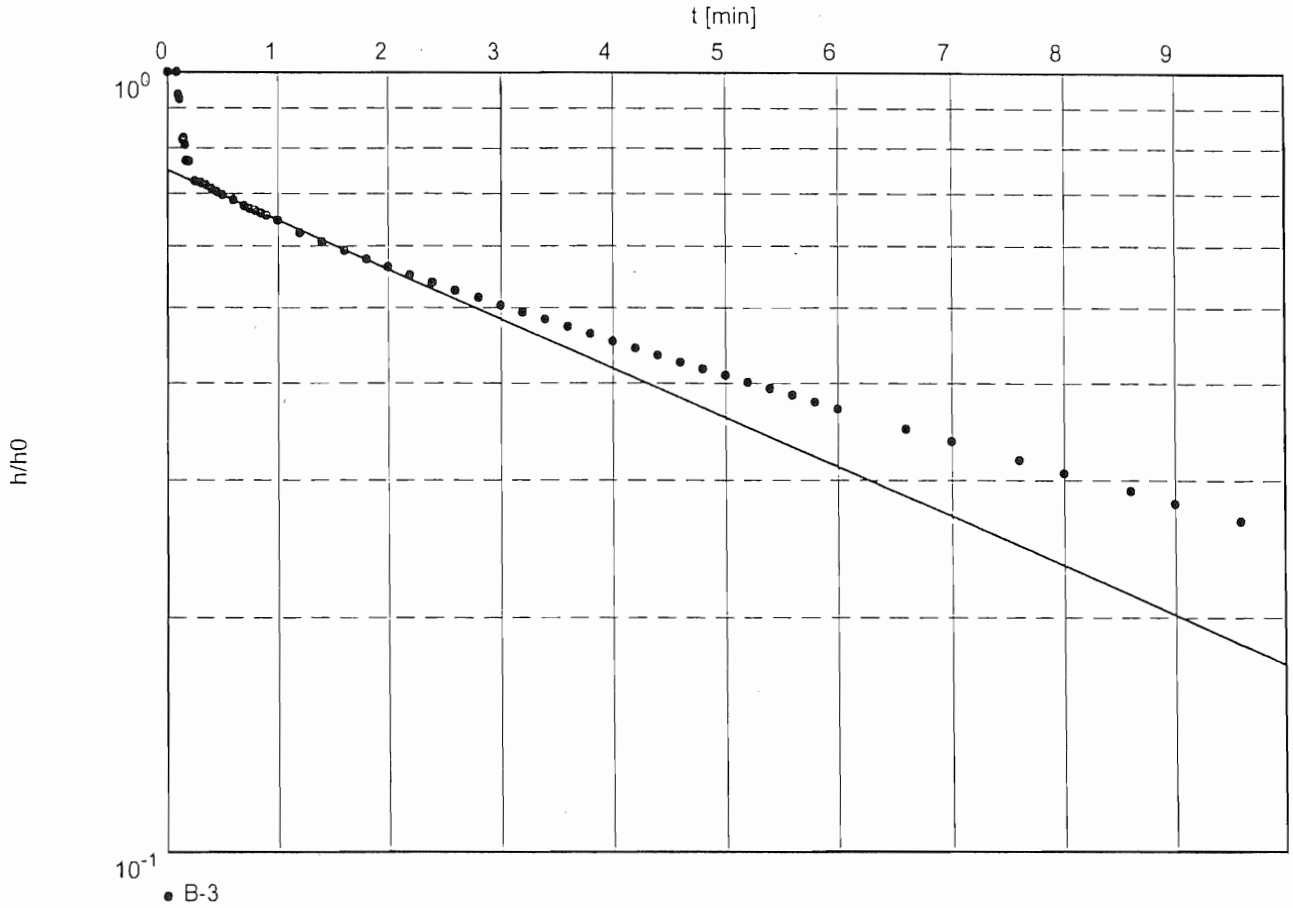
Slug Test No.	Test conducted on: 7/29/98
B-2	B-2

Static water level: 39.77 ft below datum

	Pumping test duration [min]	Water level [ft]	Drawdown [ft]
1	0.00	46.66	6.89
2	0.03	46.66	6.89
3	0.06	43.07	3.30
4	0.08	42.92	3.15
5	0.10	42.71	2.94
6	0.17	42.27	2.50
7	0.20	42.06	2.29
8	0.25	41.82	2.05
9	0.30	41.64	1.87
10	0.35	41.49	1.72
11	0.40	41.36	1.59
12	0.45	41.23	1.46
13	0.50	41.10	1.33
14	0.55	40.97	1.20
15	0.60	40.84	1.07
16	0.65	40.72	0.95
17	0.70	40.63	0.86
18	0.80	40.58	0.81
19	0.90	40.58	0.80
20	1.00	40.57	0.80
21	1.60	40.56	0.79
22	2.00	40.55	0.78
23	3.00	40.54	0.77
24	5.00	40.53	0.76

G. N. Richardson and Associates 425 N. Boylan Avenue Raleigh, North Carolina ph.(919) 828-0577	slug/bail test analysis BOUWER-RICE's method	Date: 8/3/98	C & D Landfill, Page 1
		Project: Davidson County Landfill	
		Evaluated by: JAF	

Slug Test No.	Test conducted on: 7/29/98
B-3	



Hydraulic conductivity [ft/min]: 2.40×10^{-4}

G. N. Richardson and Associates
425 N. Boylan Avenue
Raleigh, North Carolina
ph.(919) 828-0577

slug/bail test analysis
BOUWER-RICE's method

Date: 8/3/98 | C & D Landfill, Page 2

Project: Davidson County Landfill

Evaluated by: JAF

Slug Test No.	Test conducted on: 7/29/98
B-3	B-3

Static water level: 5.35 ft below datum

	Pumping test duration [min]	Water level [ft]	Drawdown [ft]
1	0.00	9.22	3.87
2	0.08	9.22	3.87
3	0.09	8.97	3.62
4	0.11	8.92	3.57
5	0.13	8.52	3.17
6	0.14	8.54	3.19
7	0.16	8.47	3.12
8	0.17	8.33	2.98
9	0.19	8.33	2.98
10	0.25	8.16	2.81
11	0.30	8.15	2.80
12	0.35	8.13	2.78
13	0.40	8.10	2.75
14	0.45	8.07	2.72
15	0.50	8.05	2.70
16	0.60	8.01	2.66
17	0.70	7.96	2.61
18	0.75	7.94	2.59
19	0.80	7.93	2.58
20	0.85	7.91	2.56
21	0.90	7.89	2.54
22	1.00	7.85	2.50
23	1.20	7.76	2.41
24	1.40	7.70	2.35
25	1.60	7.64	2.29
26	1.80	7.58	2.23
27	2.00	7.53	2.18
28	2.20	7.48	2.13
29	2.40	7.43	2.08
30	2.60	7.39	2.04
31	2.80	7.34	1.99
32	3.00	7.30	1.95
33	3.20	7.26	1.91
34	3.40	7.22	1.87
35	3.60	7.18	1.83
36	3.80	7.14	1.79
37	4.00	7.10	1.75
38	4.20	7.07	1.72
39	4.40	7.03	1.68
40	4.60	7.00	1.65
41	4.80	6.96	1.61
42	5.00	6.93	1.58
43	5.20	6.90	1.55
44	5.40	6.87	1.52
45	5.60	6.84	1.49
46	5.80	6.81	1.46
47	6.00	6.78	1.43
48	6.60	6.70	1.35
49	7.00	6.65	1.30

G. N. Richardson and Associates
425 N. Boylan Avenue
Raleigh, North Carolina
ph.(919) 828-0577

slug/bail test analysis
BOUWER-RICE's method

Date: 8/3/98

Project: Davidson County Landfill

Evaluated by: JAF

Slug Test No.	Test conducted on: 7/29/98
B-3	B-3

Static water level: 5.35 ft below datum

	Pumping test duration [min]	Water level [ft]	Drawdown [ft]
51	8.00	6.53	1.18
52	8.60	6.47	1.12
53	9.00	6.43	1.08
54	9.60	6.38	1.03

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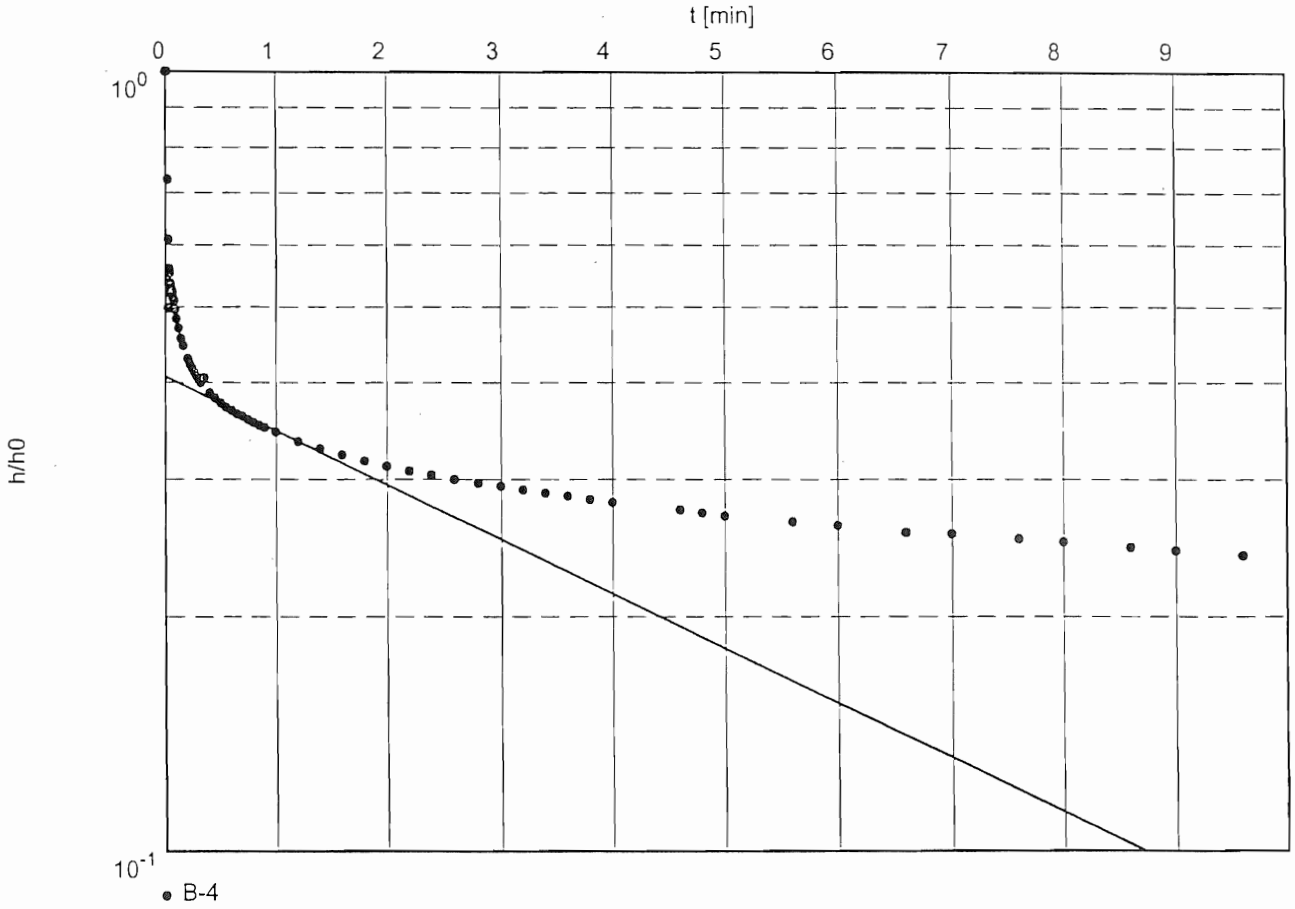
G. N. Richardson and Associates 425 N. Boylan Avenue Raleigh, North Carolina ph.(919) 828-0577	slug/bail test analysis BOUWER-RICE's method	Date: 8/3/98	C & D Landfill, Page 1
		Project: Davidson County Landfill	
		Evaluated by: JAF	

Slug Test No.	Test conducted on: 7/29/98
B-4	



Hydraulic conductivity [ft/min]: 2.67×10^{-4}

G. N. Richardson and Associates
425 N. Boylan Avenue
Raleigh, North Carolina
ph.(919) 828-0577

slug/bail test analysis
BOUWER-RICE's method

Date: 8/3/98

Project: Davidson County Landfill

Evaluated by: JAF

Slug Test No.	Test conducted on: 7/29/98
B-4	B-4

Static water level: 21.68 ft below datum

	Pumping test duration [min]	Water level [ft]	Drawdown [ft]
1	0.00	27.11	5.43
2	0.02	27.11	5.43
3	0.02	25.63	3.95
4	0.03	24.38	2.70
5	0.03	24.99	3.31
6	0.04	24.72	3.04
7	0.04	24.68	3.00
8	0.05	24.59	2.91
9	0.05	24.57	2.89
10	0.06	24.54	2.86
11	0.06	24.50	2.82
12	0.07	24.52	2.84
13	0.07	24.47	2.79
14	0.08	24.45	2.77
15	0.09	24.37	2.69
16	0.10	24.30	2.62
17	0.12	24.23	2.55
18	0.14	24.15	2.47
19	0.16	24.10	2.42
20	0.20	24.01	2.33
21	0.22	23.97	2.29
22	0.24	23.94	2.26
23	0.26	23.92	2.24
24	0.28	23.89	2.21
25	0.30	23.87	2.19
26	0.32	23.85	2.17
27	0.35	23.88	2.20
28	0.40	23.78	2.10
29	0.45	23.75	2.07
30	0.50	23.72	2.04
31	0.55	23.70	2.02
32	0.60	23.68	2.00
33	0.65	23.66	1.98
34	0.70	23.64	1.96
35	0.75	23.63	1.95
36	0.80	23.61	1.93
37	0.85	23.59	1.91
38	0.90	23.58	1.90
39	1.00	23.55	1.88
40	1.20	23.50	1.82
41	1.40	23.46	1.78
42	1.60	23.43	1.75
43	1.80	23.40	1.72
44	2.00	23.37	1.69
45	2.20	23.35	1.67
46	2.40	23.33	1.65
47	2.60	23.31	1.63
48	2.80	23.29	1.61
49	3.00	23.27	1.60

G. N. Richardson and Associates 425 N. Boylan Avenue Raleigh, North Carolina ph.(919) 828-0577	slug/bail test analysis BOUWER-RICE's method	Date: 8/3/98	C & D Landfill, Page 3
		Project: Davidson County Landfill	
		Evaluated by: JAF	

Slug Test No.	Test conducted on: 7/29/98
B-4	B-4

Static water level: 21.68 ft below datum

	Pumping test duration [min]	Water level [ft]	Drawdown [ft]
51	3.40	23.24	1.56
52	3.60	23.23	1.55
53	3.80	23.21	1.53
54	4.00	23.20	1.52
55	4.60	23.17	1.49
56	4.80	23.15	1.47
57	5.00	23.14	1.46
58	5.60	23.12	1.44
59	6.00	23.10	1.42
60	6.60	23.07	1.39
61	7.00	23.07	1.39
62	7.60	23.05	1.37
63	8.00	23.03	1.35
64	8.60	23.01	1.33
65	9.00	23.00	1.32
66	9.60	22.98	1.30

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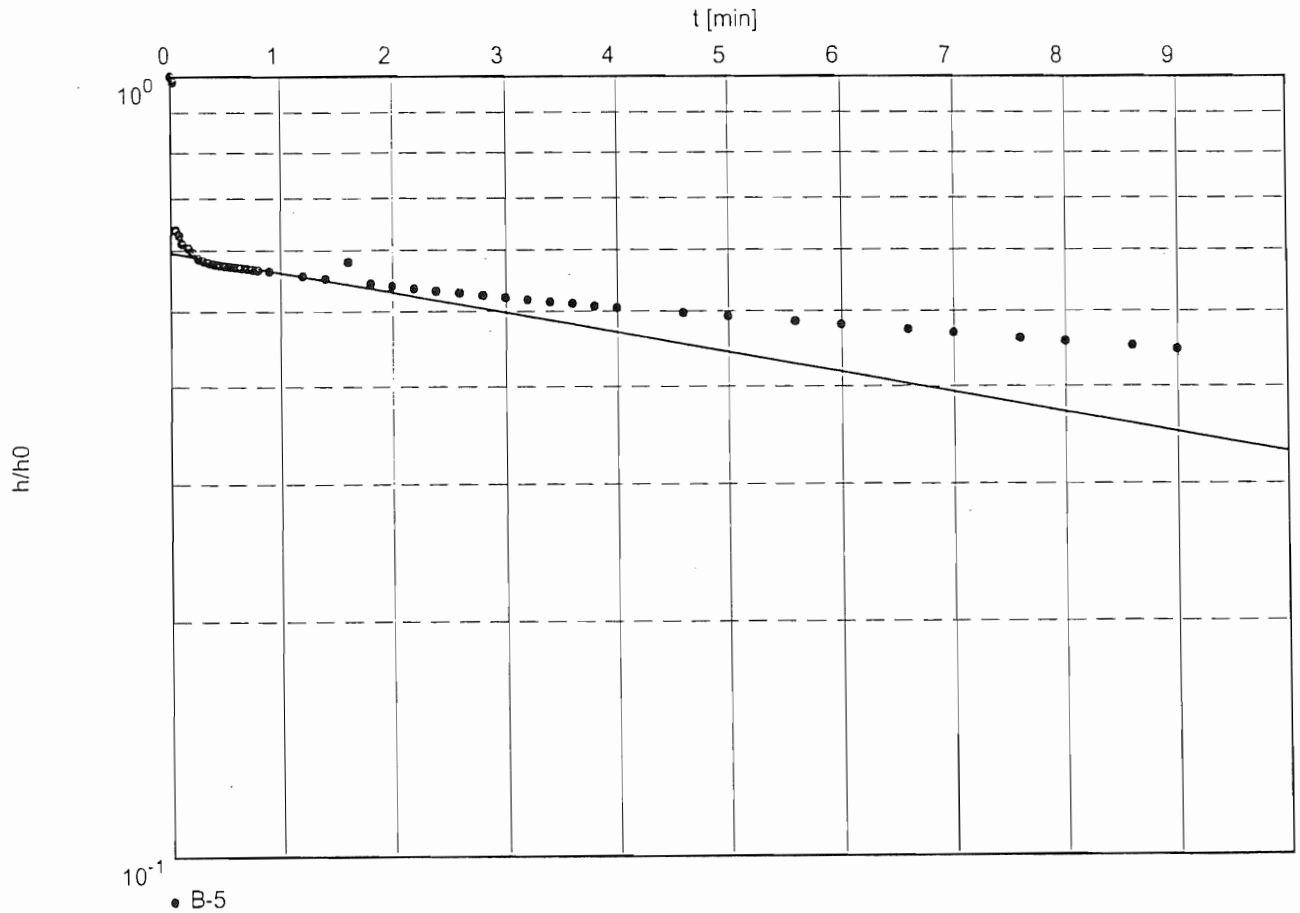
		Project: Davidson County Landfill	
		Evaluated by: JAF	

Slug Test No.	Test conducted on: 7/29/98
B-5	



Hydraulic conductivity [ft/min]: 5.50×10^{-5}

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slug/bail test analysis
BOUWER-RICE's method

Date: 7/31/98 | C & D Landfill, Page 2

Project: Davidson County Landfill

Evaluated by: JAF

Slug Test No.	Test conducted on: 7/29/98
B-5	B-5

Static water level: 22.29 ft below datum

	Pumping test duration [min]	Water level [ft]	Drawdown [ft]
1	0.00	27.89	5.60
2	0.02	27.80	5.51
3	0.05	25.86	3.57
4	0.08	25.80	3.51
5	0.10	25.72	3.43
6	0.16	25.67	3.38
7	0.20	25.63	3.34
8	0.25	25.57	3.27
9	0.30	25.55	3.25
10	0.35	25.53	3.24
11	0.40	25.52	3.23
12	0.45	25.51	3.22
13	0.50	25.50	3.21
14	0.55	25.49	3.20
15	0.60	25.48	3.19
16	0.65	25.48	3.19
17	0.70	25.47	3.18
18	0.75	25.46	3.17
19	0.80	25.46	3.17
20	0.90	25.45	3.15
21	1.20	25.40	3.11
22	1.40	25.38	3.09
23	1.60	25.53	3.24
24	1.80	25.33	3.04
25	2.00	25.31	3.01
26	2.20	25.29	3.00
27	2.40	25.27	2.97
28	2.60	25.25	2.95
29	2.80	25.23	2.94
30	3.00	25.21	2.92
31	3.20	25.19	2.90
32	3.40	25.17	2.88
33	3.60	25.15	2.86
34	3.80	25.13	2.84
35	4.00	25.12	2.83
36	4.60	25.08	2.79
37	5.00	25.05	2.76
38	5.60	25.01	2.72
39	6.00	24.98	2.69
40	6.60	24.94	2.65
41	7.00	24.92	2.62
42	7.60	24.87	2.58
43	8.00	24.85	2.56
44	8.60	24.82	2.52
45	9.00	24.79	2.50

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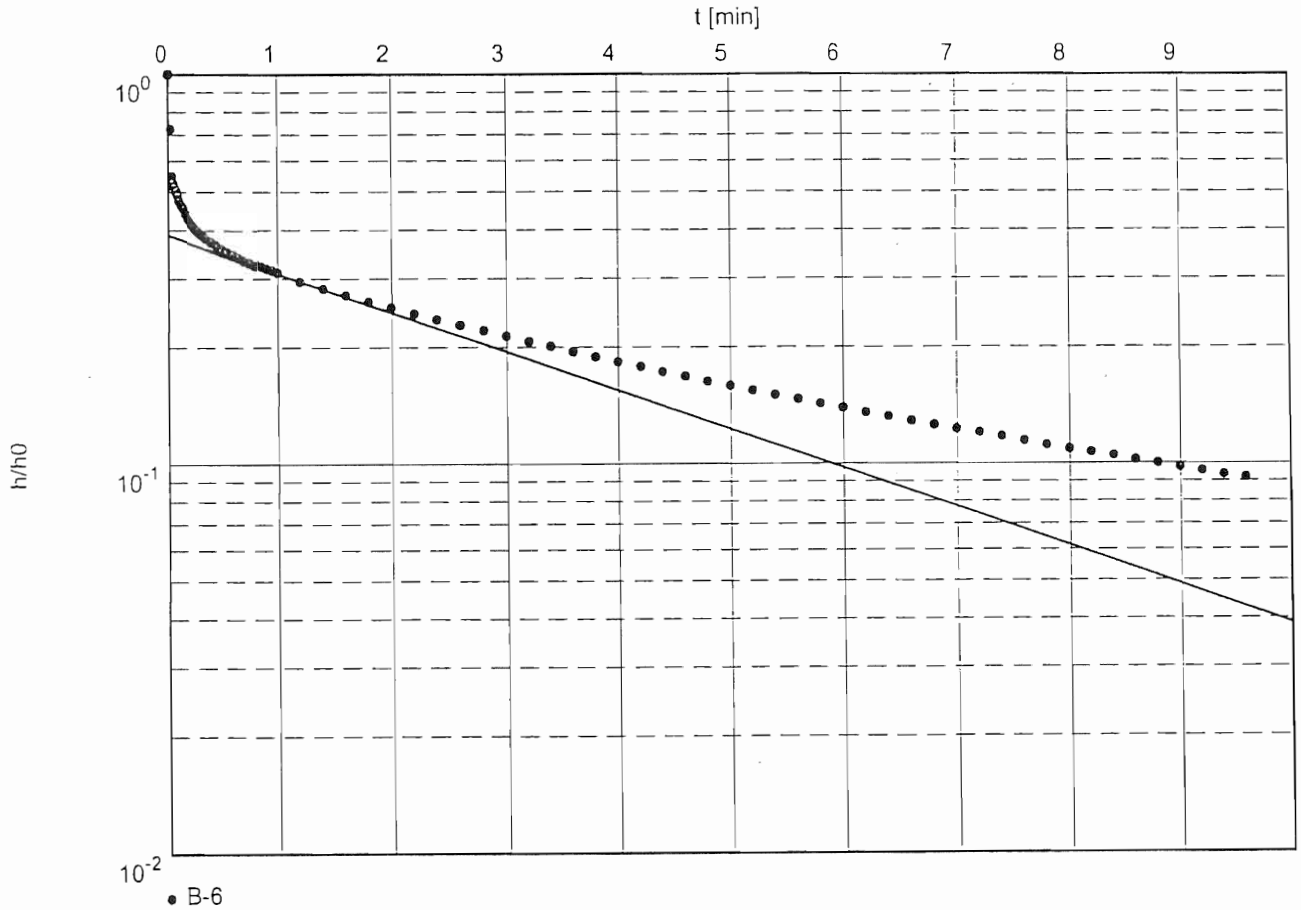
		Project: Davidson County Landfill	
		Evaluated by: JAF	

Slug Test No.	Test conducted on: 7/29/98
B-6	



Hydraulic conductivity [ft/min]: 3.70×10^{-4}

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slug/bail test analysis
BOUWER-RICE's method

Date: 8/3/98

Project: Davidson County Landfill

Evaluated by: JAF

Slug Test No.	Test conducted on: 7/29/98
B-6	B-6

Static water level: 41.23 ft below datum

	Pumping test duration [min]	Water level [ft]	Drawdown [ft]
1	0.00	47.23	6.00
2	0.01	47.23	6.00
3	0.02	47.73	6.50
4	0.03	45.56	4.33
5	0.04	44.52	3.29
6	0.05	44.40	3.17
7	0.06	44.32	3.09
8	0.07	44.24	3.01
9	0.08	44.24	3.01
10	0.09	44.17	2.94
11	0.10	44.08	2.85
12	0.12	44.01	2.78
13	0.14	43.96	2.73
14	0.16	43.87	2.64
15	0.18	43.80	2.57
16	0.20	43.75	2.52
17	0.22	43.71	2.48
18	0.24	43.67	2.44
19	0.26	43.64	2.41
20	0.28	43.61	2.38
21	0.30	43.58	2.35
22	0.32	43.56	2.33
23	0.35	43.52	2.29
24	0.40	43.47	2.24
25	0.45	43.43	2.20
26	0.50	43.38	2.15
27	0.55	43.35	2.12
28	0.60	43.31	2.08
29	0.65	43.28	2.05
30	0.70	43.25	2.02
31	0.75	43.22	1.99
32	0.80	43.19	1.96
33	0.85	43.16	1.93
34	0.90	43.14	1.91
35	0.95	43.12	1.89
36	1.00	43.09	1.86
37	1.20	43.00	1.77
38	1.40	42.92	1.69
39	1.60	42.86	1.63
40	1.80	42.80	1.57
41	2.00	42.74	1.52
42	2.20	42.69	1.46
43	2.40	42.64	1.41
44	2.60	42.60	1.37
45	2.80	42.55	1.32
46	3.00	42.51	1.28
47	3.20	42.47	1.24
48	3.40	42.43	1.20
49	3.60	42.40	1.17

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slug/bail test analysis
BOUWER-RICE's method

Date: 8/3/98

Project: Davidson County Landfill

Evaluated by: JAF

Slug Test No.	Test conducted on: 7/29/98
B-6	B-6

Static water level: 41.23 ft below datum

	Pumping test duration [min]	Water level [ft]	Drawdown [ft]
51	4.00	42.33	1.10
52	4.20	42.30	1.07
53	4.40	42.26	1.03
54	4.60	42.24	1.01
55	4.80	42.21	0.98
56	5.00	42.18	0.95
57	5.20	42.16	0.93
58	5.40	42.13	0.90
59	5.60	42.11	0.88
60	5.80	42.09	0.86
61	6.00	42.06	0.83
62	6.20	42.04	0.81
63	6.40	42.02	0.79
64	6.60	42.00	0.77
65	6.80	41.98	0.75
66	7.00	41.97	0.74
67	7.20	41.95	0.72
68	7.40	41.93	0.70
69	7.60	41.91	0.68
70	7.80	41.90	0.67
71	8.00	41.88	0.65
72	8.20	41.87	0.64
73	8.40	41.86	0.63
74	8.60	41.84	0.61
75	8.80	41.83	0.60
76	9.00	41.82	0.59
77	9.20	41.80	0.57
78	9.40	41.79	0.56
79	9.60	41.78	0.55

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Appendix E

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Water Quality Monitoring Plan

Davidson County C&D Landfill
Phases 1 through 4
Thomasville, North Carolina

NC Solid Waste Permit No. 29-06 CDLF

Prepared For:

Davidson County Integrated Solid Waste
1242 Old Hwy 29
Thomasville, North Carolina 27360

Prepared By:

RICHARDSON SMITH GARDNER
& ASSOCIATES
ENGINEERING & GEOLOGICAL
SERVICES

April 2009

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Water Quality Monitoring Plan

Davidson County C&D Landfill - Phases 3 & 4
Davidson County, North Carolina

Prepared for:
Davidson County Integrated Solid Waste Management Department
Thomasville, North Carolina

RSG Project No. DAVDCO-08-5

Joan A. Smyth, P.G.
Principal, Senior Hydrogeologist

April 2009

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Thomasville, North Carolina

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Table 1: Ground and Surface Water Monitoring Locations and Frequency
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Figure 1: Proposed Water Quality Monitoring Locations

Appendix A – Monitoring Well Boring Logs

Appendix B – Solid Waste Environmental Monitoring Data Form

1.0 INTRODUCTION

1.1 Plan Background

The Davidson County, North Carolina, owns and operates a C&D landfill. This landfill has been operational (in two phases) since 2001 under Solid Waste Facility Permit Number 29-06. The C&D landfill is located approximately five (5) miles northeast of the City of Lexington, North Carolina. The Phase 1 area of this C&D landfill was installed with a GCL liner system, while no liner system was required for Phase 2. The site is shown on **Figure 1**. Phase 3 is a vertical expansion while Phase 4 is a lateral expansion to the southeast

Site investigations prior to permitting demonstrated that the site was underlain by silty sands and partially weathered rock. Bedrock at the C&D site is primarily granite with some diorite. The ridge between Phases 1 and 2 and Phase 4 represents the approximate location of a groundwater divide noted during site permitting. Groundwater flow from Phases 1 and 2 is primarily to the north/northwest, while groundwater flow for Phase 4 will be to the east/southeast. Both areas drain to unnamed tributaries of Jimmy's Creek located on the landfill property.

Davidson County has monitored groundwater quality at the C&D site since 2001. One of the original groundwater monitoring wells was replaced in 2006 due to the construction of Phase 2. No constituents with the exception of some naturally occurring metals have been detected at the C&D landfill.

This Water Quality Monitoring Plan (WQMP) has been prepared to meet the field sampling and laboratory analysis requirements of ongoing monitoring at the site. The WQMP details field and laboratory protocols that must be followed to meet the data objectives of groundwater monitoring.

1.2 Purpose & Scope

This WQMP has been designed to insure that accurate and representative field and laboratory results are obtained for all ground and surface water quality monitoring points.

The WQMP addresses the following subjects:

- Groundwater sample collection
- Surface water sample collection
- Sample preservation and shipment
- Laboratory analytical procedures
- Sample Chain-of-custody control
- Quality assurance/quality control programs

The methods and procedures described in the following sections are intended to facilitate the collection of true and representative samples and test data. Field procedures are presented in **Sections 2.0 through 7.0** in their general order of implementation. Equipment requirements for each field task are presented within the applicable section. Laboratory procedures, quality assurance methods and record keeping requirements are presented in **Sections 8.0 through 10.0**.

Strict adherence to these procedures stipulated in this plan is required. Any variations from these procedures should be thoroughly documented.

1.3 Monitoring Well Network and Analytical Parameters

There are currently four (4) monitoring wells associated with the C&D site that are used for the collection of groundwater samples on a regular basis. All wells are monitored semi-annually The groundwater monitoring well network is shown on **Figure 1**, the monitoring locations, sampling frequency and analytical parameters are included in **Table 1**, and well completion information is included in **Table 2**.

Three wells (CDMW-2, CDMW-3 and CDMW-5) will continue to be monitored on a semi-annual schedule. CDMW-4A (currently being monitored) will be properly abandoned with the construction of Phase 4 and replaced with two wells located downgradient of Phase 4 (CDMW-6 and CDMW-7). These wells are shown on the attached **Figure 1** and their boring logs are included in **Appendix A.** These wells will be part of the detection

monitoring regimen (Appendix I constituents) on a semi-annual basis. Monitoring well MW-1 (located southwest of CDMW-5) serves as the upgradient well for the C&D site. This well also serves as the upgradient well for the Lined landfill unit located to the northwest of the C&D landfill. Analytical parameters for each well are outlined in **Table 1**.

Additionally, one surface water point, SW-5 will be added to replace location SW-3 which has been repeatedly dry during monitoring events. The location of this sampling location is shown on **Figure 1**.

2.0 GROUNDWATER SAMPLE COLLECTION

This section presents details of the procedures and equipment required to perform groundwater field measurements and sampling from monitoring wells during each monitoring event. **All sampling, analysis and submittals shall be performed in accordance with this plan and the following guidance documents:**

- Groundwater, Surface Water and Soil Sampling for Landfills – NCDENR Guidance updated April 2008
- October 26, 2006 Memo from NCDENR entitled "New Guidelines for Electronic Submittal of Environmental Monitoring Data"
- February 23, 2007 Memo from NCDENR entitled Addendum to October 27, 2006, North Carolina Solid Waste Section Memorandum Regarding New Guidelines for Electronic Submittal of Environmental Data
- October 16, 2007 Memo from NCDENR entitled Environmental Monitoring Data for North Carolina Solid Waste Management Facilities

Additionally, all local, state, and federal health and safety requirements, as applicable, will be followed. Additionally, all requirements for the disposal of any investigation derived wastes will also be followed. **Where possible, all phases of work will proceed from the upgradient, or clean, wells to downgradient, or impacted, wells.**

All fuel-powered equipment such as generators for pumps, must be placed away from

and downwind from all site activities (i.e. purging and sampling). If field conditions prevent such placement, then the fuel source must be placed as far away as possible from the sampling activities and the conditions of sampling must be described in detail in the field notes. If fuel must be handled, it should be done the day before sampling. All effort should be made to avoid handling fuels on the day of sampling. If fuels must be dispensed during sampling activities, dispense fuel downwind and well away from any sampling locations. Wear gloves while working with fuel and dispose of the gloves away from sampling activities.

2.1 Water Level Measurements

Static water level and depth to the well bottom will be measured in each well prior to any purging or sampling activities. Static water level and well depth measurements are necessary to calculate the volume of stagnant water in the well prior to purging. Additionally these measurements provide a field check on well integrity, degree of siltation, and are used to prepare potentiometric maps, calculate aquifer flow velocities and monitor changes in site hydrogeologic conditions.

Upon opening each well, new latex or nitrile surgical gloves will be donned. New gloves will be worn when taking water level measurements at each well. Appropriate measures will be taken during all measurement activities to prevent soils, decontamination supplies, precipitation, and other potential contaminants from entering the well or contacting clean equipment.

An electronic water level indicator will be used to accurately measure depth to groundwater in each well and/or piezometer. Groundwater depths will be measured to a vertical accuracy of 0.01 feet relative to established wellhead elevations. Each well will have a permanent, easily identified reference point on the lip of the well riser from which all water level measurements will be taken. The elevation of the reference point will be established by a Registered Land Surveyor.

The electronic water level indicator will be constructed of inert materials such as stainless steel and Teflon. **Between well measurements the device will be thoroughly**

decontaminated by washing with non-phosphate (Liqui-Nox) soap and rinsing with organic-free water to prevent cross contamination from one well to another.

The following measurements will be recorded in a dedicated field book prior to sample collection:

- Depth to static water level and well bottom (to the nearest 0.01 foot)
- Height of water column in the riser (based upon known depth of well)
- Condition of wellhead protective casing, base pad and riser
- Changes in condition of well and surroundings.

2.2 Equipment Decontamination

All non-dedicated equipment that will come in contact with the well casing and water will be decontaminated between wells. The procedure for decontaminating non-dedicated equipment is as follows:

1. Don new powder-free Nitrile gloves
2. Clean item with tap water and phosphate-free laboratory detergent (Liqui-Nox or equivalent), using a brush if necessary to remove particulate matter and surface films.
3. Rinse thoroughly with pesticide grade isopropanol and allow to air dry.
4. Rinse with organic-free water (Milli-Q water or other ultra-pure water) and allow to air dry.
6. Wrap with commercial-grade aluminum foil, if necessary, to prevent contamination of equipment during storage or transport.

It should be noted that Liqui-Nox detergent solutions will be stored in a clearly marked HDPE or PP container. Containers for pesticide –grade isopropanol will be made of inert materials such as Teflon, stainless steel, or glass.

Sampling will be planned and conducted in such a way as to minimize the need for decontamination in the field through the use of dedicated sampling equipment, etc.

Unclean equipment will be segregated from clean equipment during all field activities. All clean equipment will remain in the manufacturer's packaging until use, or will be wrapped in commercial-grade aluminum foil or untreated butcher paper.

2.3 Monitor Well Evacuation

Water accumulated in each well may be stagnant and unrepresentative of surrounding aquifer conditions, and therefore must be removed to insure that fresh formation water is sampled. Each well will be purged of standing water in the well casing following the measurement of the static water level. As stated above, monitoring well evacuation should be performed in upgradient wells first, and moving to downgradient wells.

New latex or nitrile surgical gloves will be donned for all well purging and sampling activities and whenever handling decontaminated field equipment. Appropriate measures will be taken during all measurement, purging and sampling activities to prevent surface soils, decontamination supplies, precipitation, and other potential contaminants from entering the well or contacting cleaned equipment.

The volume of standing water in the well riser and screen will be calculated immediately before well evacuation during each monitoring event. A standing water volume will be calculated for each well using measured static water level, well depth and well casing diameter according to the following equation:

$$V = (TD - SWL) \times C$$

Where: V = One well volume

TD = Total depth of the well (in feet)

SWL = Static water level (in feet)

C = Volume constant for given well diameter (gallons/foot)

C = 0.163 gal/ft for two-inch wells.

C = 0.653 gal/ft for four-inch wells.

After the volume of standing water within the casing is established, a minimum of three and a maximum of five well casing volumes of water will be evacuated from each well. New, disposable bailers with either double or bottom check-valves will be used to purge each well. Disposable purge bailers will be constructed of fluorocarbon resin (Teflon) or

inert plastic suitable for the well and ground conditions. Each bailer will be factory-clean and remain sealed in a plastic sleeve until use. A new Teflon-coated stainless steel, inert mono-filament line or nylon cord will be used for each well to retrieve the bailers.

Wells will be purged at a rate that will not cause recharge water to be excessively agitated or cascade through the screen. Care will also be taken to minimize disturbance to the well sidewalls and bottom which could result in the suspension of silt and fine particulate matter. The volume of water purged from each well and the relative rate of recharge will be documented in sampling field notes. Wells which are of very low recharge rates will be purged once until dry. Damaged, dry or low yielding, and high turbidity wells will noted for reconsideration before the next sampling event.

Purge water will be managed to prevent possible soil and surface water contamination. Well site management options may include temporary containment and disposal as leachate or portable activated carbon filtration.

Durable, non-dedicated equipment to be lowered into the well or which may contact the water samples will be thoroughly decontaminated before each use. Equipment shall be disassembled to the degree practical, washed with (non-phosphate) soapy potable tap water, and triple rinsed using de-ionized water. Detailed equipment decontamination procedures are detailed in **Section 2.6**.

2.4 Groundwater Sample Collection

After purging activities are complete, groundwater samples will be collected for laboratory analysis. Sampling is undoubtedly the most critical stage and the focus of the water quality monitoring program. Samples should be collected from least contaminated location(s) first, followed by locations of increasing contamination across the site. Prior to sample collection, all sample labels should be properly filled-out with indelible ink, such as Sharpie Pen. At a minimum, the label should identify the sample with the following information:

- Sample Location or Well Number

- Sample Identification Number
- Date and Time of Collection
- Analysis Required
- Sampler's Initials
- Preservative Used (if any)
- Other Pertinent Information As Necessary

Upon completion of the sample label, the label should be affixed to the sample bottle prior to sampling.

Sampling will occur within 24 hours of the purging of each well and as soon after well recovery as possible. Wells which fail to recharge or produce an adequate sample volume within 24 hours of purging will not be sampled.

Field measurements of temperature, pH, and specific conductivity will be made immediately prior to sampling each monitoring point. The field test specimens will be collected with the sampling bailer and placed in a clean, non-conductive glass or plastic container for observation. The calibration of the pH, temperature, conductivity and turbidity meters will be completed according to the manufacturers' specifications and consistent with Test Methods for Evaluating Solid Waste -Physical/Chemical Methods (SW-846). A pocket thermometer and litmus paper will be available in case of meter malfunction.

Each well will be sampled using a new, factory-cleaned, disposable Teflon bailer with bottom check-valve and sample discharge mechanism. A new segment of Teflon-coated stainless steel wire, inert mono-filament line or nylon cord will be used to lower and retrieve each bailer. The bailer will be lowered into each well to the point of groundwater contact, then allowed to fill as it sinks below the water table. Bottom contact will be avoided in order to avoid suspending sediment in the samples. The bailer will be retrieved and emptied in a manner which minimizes sample agitation.

Samples will be transferred directly from the Teflon bailer into a sample container that has been specifically prepared for the preservation and storage of compatible parameters. A bottom emptying device provided will be used to transfer samples from bailer to sample container. The generation air bubbles and sample agitation will be minimized during bailer discharge. Groundwater samples will be collected and contained in the order of volatilization sensitivity.

Initially, only purgeable organics and total metals samples will be collected for laboratory analysis. Subsequently, other analytical methods may be required. When collected, the following order of sampling will be observed:

- Volatile Organics and Volatile Inorganics
- Extractable Organics, Petroleum Hydrocarbons, Aggregate Organics and Oil and Grease
- Total Metals
- Inorganic Nonmetallics, Physical and Aggregate Properties and Biologicals
- Microbiologicals
- Measurements of pH, temperature, DO, ORP, conductivity and turbidity

Note: If the pump used to collect groundwater samples can not be used to collect volatile or extractable organics then collect all other parameters and withdraw the pump and tubing. Then collect the volatile and extractable organics.

All samples will be collected and analyzed in an **unfiltered** state during sampling events. Samples for dissolved metal analysis, if subsequently required, will be prepared by field filtration using a decontaminated peristaltic pump and a disposable 0.45 micron filter cartridge specifically manufactured for this purpose.

All reusable sampling equipment including water level probes, pH/conductivity meters, interface probes, and filtering pumps which might contact aquifer water or samples will be thoroughly decontaminated between wells by washing with non-phosphate soapy, de-ionized water and rinsing with isopropanol and organic-free water. Detailed equipment decontamination procedures are detailed in **Section 2.2**.

Upon completion of sampling at each location, the sample bottles will be place in a clean, untreated, plastic Ziploc bag and placed into the cooler with ice for preservation.

2.5 Field Quality Assurance

Field and trip blanks will be prepared, handled and analyzed as groundwater samples to ensure cross-contamination has not occurred. One set of trip blanks, as described later in this document, will be prepared before leaving the laboratory to ensure that the sample containers or handling processes have not affected the quality of the samples. One set of field (equipment) blanks will be created in the field at the time of sampling to ensure that the field conditions, equipment, and handling during sampling collection have not affected the quality of the samples. A duplicate groundwater sample may be collected from a single well as a check of laboratory accuracy. Blanks and duplicate containers, preservatives, handling, and transport procedures for surface water samples will be identical to those noted for groundwater samples.

2.6 Sample Containers

Sample containers will be provided by the laboratory for each sampling event. Containers must be either new and factory-certified analytically clean by the manufacturer, or cleaned by the laboratory prior to shipment for sampling. Laboratory cleaning methods will be based on the bottle type and analyte of interest. Metal containers are thoroughly washed with non-phosphate detergent and tap water, and rinsed with (1:1) nitric acid, tap water, (1:1) hydrochloric acid, tap water, and deionized water, in that order. Organic sample containers are thoroughly washed with non-phosphate detergent in hot water and rinsed with tap water, distilled water, acetone, and pesticide quality hexane, in that order. Other sample containers are thoroughly washed with non-phosphate detergent and tap water, rinsed with tap water, and rinsed with deionized water. The laboratory shall provide proper preservatives in the sample containers prior to shipment (see Section 7.0).

3.0 SURFACE WATER SAMPLE COLLECTION

This section presents details of the procedures and equipment required to perform surface water field measurements and sampling from springs, streams and ponds during

each monitoring event.

3.1 Surface Water Level Observations

Surface water quality analyses are particularly sensitive to site hydrologic conditions and recent precipitation events. Water levels may fluctuate drastically in comparison the groundwater table and may result in either diluting or increasing contaminant loadings. The scheduling of sampling events and the interpretation surface water data must take into account climatic, recent weather and sampling station conditions.

Surface water level and sampling station conditions will be observed one day prior to, and during each sampling event. Surface water observations will include the flood stage in streams, seasonal base flow conditions, and confirm location and timing for meaningful surface water quality sampling. The following objective observations will be recorded in a dedicated field book prior to sample collection:

- Relative stream water level
- Surface water clarity
- Changes in surface monitoring station conditions and surroundings.

Modifications to surface sampling station conditions may be required prior to each sampling event. These modifications may include the removal of surface and submerged debris, slightly deepening the station to allow sample container immersion, or channeling/piping to consolidate local discharge. When modifications are required, sufficient time will be allowed for settlement of suspended solids between the disturbance and sample collection. A minimum settling period of four hours prior to sampling will be observed.

3.2 Surface Water Sample Collection

Surface water samples will be obtained from areas of minimal turbulence and aeration. New latex or nitrile surgical gloves will be donned prior to sample collection. The following procedure will be implemented regarding sampling of surface waters:

1. Put on new latex or nitrile surgical gloves.
2. Hold the bottle in the bottom with one hand, and with the other, remove the cap.
3. Push the sample container slowly into the water and tilt up towards the current to fill. A water depth of six inches is generally satisfactory. Care will be taken to avoid breaching the surface or losing sample preservatives while filling the container.
4. If there is little current movement, the container should be moved slowly, in a lateral, side to side direction, with the mouth of the container pointing upstream.

Temperature, pH, specific conductivity and turbidity will be taken at the start of sampling as a measure of field conditions and check on the stability of the water samples over time. Measurements of temperature, pH, specific conductivity and turbidity will be recorded for all surface water samples. The calibration of the pH, temperature, conductivity , and turbidity meters will be completed at the beginning of each sampling event, according to the manufacturers' specifications and consistent with Test Methods for Evaluating Solid Waste - Physical/Chemical Methods (SW-846).

Surface water samples will be collected and contained in the order of volatilization sensitivity of the parameters as follows:

- Volatile Organics and Volatile Inorganics
- Extractable Organics, Petroleum Hydrocarbons, Aggregate Organics and Oil and Grease
- Total Metals
- Inorganic Nonmetallics, Physical and Aggregate Properties and Biologicals
- Microbiologicals
- Measurements of pH, temperature, DO, ORP, conductivity and turbidity

All surface water samples will be collected unfiltered during the initial assessment sampling event. If future dissolved metal analysis is required, samples will be prepared by field filtration using a decontaminated peristaltic filtering pump (or equivalent) and a disposable 0.45 micron filter cartridge specifically manufactured for this purpose.

All field meters which might contact surface water samples will be thoroughly

decontaminated between stations by washing with non-phosphate soapy, de-ionized water and rinsed with isopropanol and organic-free water.

Surface water samples will be collected from surface water monitoring points shown on the attached **Figure 2**. Samples will be collected directly from the station in the container that has been specifically prepared for the preservation and storage of compatible parameters. Samples will be collected in a manner that assures minimum agitation. Additional blanks and duplicate samples will not be taken with the surface water samples.

Sample containers shall be prepared and provided by the laboratory for each surface water sampling event. Each sample containers= preparation and preservatives shall be the same as those utilized for groundwater sampling and addressed previously in **Section 2.5**.

4.0 LEACHATE SAMPLING AND ANALYSIS

This site contains a closed unlined MSW landfill and a C&D landfill constructed over the unlined MSW. There are no leachate collection systems and therefore no leachate sampling will be performed.

5.0 FIELD QA/QC PROGRAM

Field Quality Assurance/Quality Control (QA/QC) requires the routine collection and analysis of trip blanks to verify that the handling process has not affected the quality of the samples. Any contaminants found in the trip blanks could be attributed to:

1) interaction between the sample and the container,
2) contaminated source water, or
3) a handling procedure that alters the sample.

The laboratory will prepare a trip blank by filling each type of sample bottle with laboratory grade distilled or deionized water. Trip blanks will be placed in bottles of the specific type required for the analyzed parameters and taken from a bottle pack specifically assembled by the laboratory for each groundwater sampling event. Trip blanks will be taken prior to

the sampling event and transported with the empty bottle packs. The blanks will be analyzed for volatile and purgeable organics only.

The concentration levels of any contaminants found in the trip blank will be reported but will not be used to correct the groundwater data. In the event that elevated parameter concentrations are found in a blank, the analysis will be flagged for future evaluation and possible re-sampling.

All field instruments utilized to measure groundwater characteristics will be calibrated prior to entering the field, and recalibrated in the field as required, to insure accurate measurement for each sample. The specific conductivity and pH meter shall be recalibrated utilizing two prepared solutions of known concentration in the range of anticipated values (between 4 and 10). A permanent thermometer, calibrated against a National Bureau of Standards Certified thermometer, will be used for temperature meter calibration.

6.0 SAMPLE PRESERVATION AND SHIPMENT

Methods of sample preservation, shipment, and chain-of-custody procedures to be observed between sampling and laboratory analysis are presented in the following sections.

Proper storage and transport conditions must be maintained in order to preserve the integrity of samples between collection and analysis. Ice and chemical cold packs will be used to cool and preserve samples, as directed by the analytical laboratory. Samples will be maintained at a temperature of 4° C. Dry ice is not to be used.

Pre-measured chemical preservatives will be provided in the sample containers provided by the analytical laboratory. Hydrochloric acid will be used as a chemical stabilizer and preservative for volatile and purgeable organic specimens. Nitric acid will be used as the preservative for samples for metals analysis.

Upon collection, samples will be placed on ice in high impact polystyrene coolers and

cooled to a temperature of 4°C. Samples will be packed and/or wrapped in plastic bubble wrap to inhibit breakage or accidental spills. Chain-of-Custody control documents will be placed in a waterproof pouch and sealed inside the cooler with the samples for shipping. Tape and/or custody seals shall be placed on the outside of the shipping coolers, in a manner to prevent and detect tampering with the samples.

Samples shall be delivered to the analytical laboratory within a 24-hour period in person or using an overnight delivery service to insure holding times are not exceeded. Shipment and receipt of samples will be coordinated with the laboratory. **Do NOT store or ship highly contaminated samples (concentrated wastes, free product, etc.) or samples suspected of containing high concentrations of contaminants in the same cooler or shipping container with other environmental samples.**

Chain-of-Custody control will be maintained from sampling through analysis to prevent tampering with analytical specimens. Chain-of-Custody control procedures for all samples will consist of the following:

1. Chain-of-Custody will originate at the laboratory with the shipment of prepared sample bottles and a sealed trip blank. Identical container kits will be shipped by express carrier to the sampler or site or picked up at the laboratory in sealed coolers.

2. Upon receipt of the sample kit, the sampler will inventory the container kit and check its consistency with number and types of containers indicated in the Chain-of-Custody forms and required for the sampling event.

3. Labels for individual sample containers will be completed in the field, indicating the site, time of sampling, date of sampling, sample location/well number, and preservation methods used for the sample.

4. Collected specimens will be placed in the iced coolers and will remain in the continuous possession of the field technician until shipment or transferral as provided by the Chain-of-Custody form has occurred. If continuous possession can not be maintained by the field technician, the coolers will be temporarily sealed and placed in a secured area.

5. Upon delivery to the laboratory, samples will be given laboratory sample numbers and recorded into a logbook indicating client, well number, and date and time of delivery. The laboratory director or his designee will sign the Chain-of-Custody control forms and formally receive the samples. The

field technician, project manager and the laboratory director will work together to insure that proper refrigeration of the samples is maintained.

6. Copies of the complete Chain-of-Custody forms will be placed in the laboratory's analytical project file and attached to the laboratory analysis report upon completion.

Chain-of-Custody forms will be used to transfer direct deliveries from the sampler to the laboratory. A coded, express delivery shipping bill shall constitute the Chain-of Custody between the sampler and laboratory for overnight courier deliveries.

7.0 FIELD LOGBOOK

The field technician will keep an up-to-date logbook documenting important information pertaining to the technician's field activities. The field logbook will document the following:

- Site Name and Location
- Date and Time of Sampling
- Climatic Conditions During Sampling Event
- Sampling Point/Well Identification Number
- Well Static Water Level
- Height of Water Column in Well
- Purged Water Volume and Well Yield (High or Low)
- Presence of Immiscible Layers and Detection Method
- Observations on Purging and Sampling Event
- Time of Sample Collection
- Temperature, pH, Temperature, DO, ORP, Turbidity, and Conductivity Readings
- Signature of Field Technician.

8.0 LABORATORY ANALYSIS

The ground and surface water parameters to be analyzed will be detection monitoring parameters. These will include field indicators of water quality (pH, conductivity, temperature and turbidity) and selected purgeable organic as listed in Appendix I of 40

CFR.258 and eight RCRA metals constituents (total metals analysis). All analytical methods are taken from Test Methods For Evaluating Solid Waste - Physical/Chemical Methods (SW-846) or Methods For the Chemical Analysis of Water and Wastes and will be consistent with DSWM=s policies regarding analytical methods and PQLs. Analysis will be performed by a laboratory certified by the North Carolina DENR for the analyzed parameters.

Formal environmental laboratory Quality Assurance/Quality Control (QA/QC) procedures are to be utilized at all times. The owner/operator of the landfill is responsible for selecting a laboratory contractor and insuring that the laboratory is utilizing proper QA/QC procedures. The laboratory must have a QA/QC program based upon specific routine procedures outlined in a written laboratory Quality Assurance/Quality Control Manual. The QA/QC procedures listed in the manual shall provide the lab with the necessary assurances and documentation that accuracy and precision goals are achieved in all analytical determinations. Internal quality control checks shall be undertaken regularly by the lab to assess the precision and accuracy of analytical procedures.

The internal quality control checks include the use of calibration standards, standard references, duplicate samples and spiked or fortified samples. Calibration standards shall be verified against a standard reference obtained from an outside source. Calibration curves shall be developed using at least one blank and three standards. Samples shall be diluted if necessary to insure that analytical measurements fall on the linear portion of the calibration curve. Duplicate samples shall be processed at an average frequency of 10 percent to assess the precision of testing methods, and standard references shall be processed monthly to assess accuracy of analytical procedures. Spiked or fortified samples shall be carried through all stages of sample preparation and measurement to validate the accuracy of the analysis.

During the course of the analyses, quality control data and sample data shall be reviewed by the laboratory manager to identify questionable data and determine if the necessary QA/QC requirements are being followed. If a portion of the lab work is subcontracted, it is the responsibility of the contracted laboratory to verify that all subcontracted work is completed by certified laboratories, using identical QA/QC procedures.

9.0 DATA EVALUATION

Copies of all laboratory results and water quality reports for the Davidson County Landfill will be kept at the Davidson County Landfill office. Reports summarizing all groundwater quality results and data evaluation will be submitted to the Division of Waste Management for each sampling event. Each events data will be evaluated compared to the groundwater and surface water standards and graphing of data over the long term may be used to evaluate trends in the data.

10.0 RECORD KEEPING AND REPORTING

10.1 Monitoring Reports

After each groundwater monitoring event, the potentiometric surface will be evaluated to determine whether the monitoring system remains adequate and to determine the rate and direction of groundwater flow at the site.

The direction of groundwater flow will be determined by a comparison of groundwater surface elevations across the site through the construction of a potentiometric surface map. Groundwater flow rate will be determined using the following equation:

$V=KI/n$

Where: V = Velocity (feet/day)

K = Hydraulic Conductivity (feet/day)

I = Hydraulic Gradient (foot/foot)

n = Effective Porosity of aquifer soils (unitless)

If these evaluations indicate the groundwater monitoring system is insufficient in meeting the requirements of the Rules, the monitoring system will be modified accordingly and a work plan will be submitted to NCDENR for review prior to modifications to enhance the monitoring system.

Copies of all laboratory analytical data will be forwarded to the SWS within 45 calendar

days of the sample collection date. The analytical data submitted will specify the date of sample collection, the sampling point identification and include a map of sampling locations. Should a significant concentration of contaminants be detected in ground and surface water, as defined in North Carolina Solid Waste Rules, Groundwater Quality Standards, or Surface Water Quality Standards, the owner/operator of the landfill shall notify the SWS and will place a notice in the landfill records as to which constituents were detected.

All monitoring reports will be submitted with the following:

- An evaluation of potentiometric surface
- Analytical laboratory reports and summary tables
- A Solid Waste Environmental Monitoring Data Form (included in **Appendix B**)
- Laboratory Data submitted in accordance with the Electronic Data Deliverable Template.

Monitoring reports may be submitted electronically by e-mail or in paper copy form.

10.2 Well Abandonment/Rehabilitation

Should wells become irreversibly damaged or require rehabilitation, the SWS shall be notified. If monitoring wells and/or piezometers are damaged irreversibly they shall be abandoned under the direction of the SWS. The abandonment procedure in unconsolidated materials will consist of over-drilling and/or pulling the well casing and plugging the well with an impermeable, chemically-inert sealant such as neat cement grout and/or bentonite clay. For bedrock well completions the abandonment will consist of plugging the interior well riser and screen with an impermeable neat cement grout and/or bentonite clay sealant.

10.3 Additional Well Installations

Any additional well installations will be carried out in accordance with SWS directives. If the potentiometric maps reveal that the depths, location, or number of wells is insufficient to monitor potential releases of solid waste constituents from the solid waste management area, new well locations and depths will be submitted to the SWS for approval.

All monitoring wells shall be installed under the supervision of a geologist or engineer who is registered in North Carolina and who will certify to the SWS that the installation complies with the North Carolina Regulations. Upon installation of future wells the documentation for the construction of each well will be submitted by the registered geologist or engineer within 30 days after well construction.

10.4 Implementation Schedule

The groundwater monitoring program will be implemented upon construction of Phase 4.

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Table 1
Monitoring Frequency
Davidson County Landfill
Thomasville, North Carolina

Monitoring Well	Location	Monitoring Program	Monitoring Frequency
MW-1	Upgradient	Detection	Semi-Annually
CDMW-2	Downgradient of Phase 1/2	Detection	Semi-Annually
CDMW-3	Downgradient of Phase 1/2	Detection	Semi-Annually
CDMW-4A*	Downgradient Phase 2	Detection	Semi-Annually
CDMW-5	Downgradient Phase 1/2	Detection	Semi-Annually
CDMW-6	Downgradient Phase 3	Detection	Semi-Annually
CDMW-7	Downgradient Phase 3	Detection	Semi-Annually

Detection = Detection Monitoring parameters (Appendix I)
* = Monitoring well CDMW-4a will be abandoned prior to the construction of Phase 3 due to its location within the Phase 3 footprint. .

Monitoring wells CDMW-6 and CDMW-7 will be installed during the construction of Phase 3.

Table 2

Monitoring Well Completion Data
Davidson County C&D Landfill
Thomasville, North Carolina

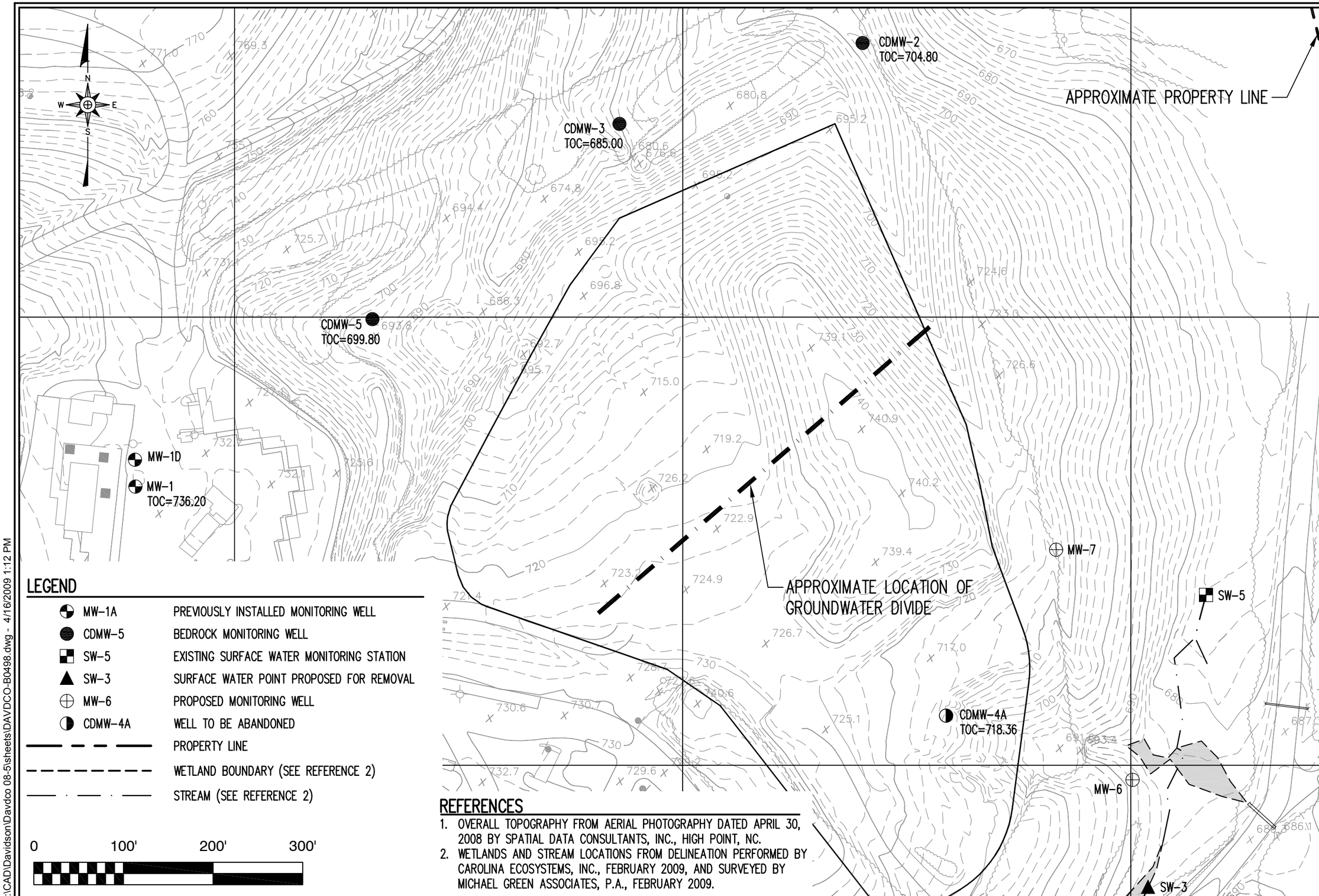
Monitoring Well	Top of Casing Elevation	Depth to Bottom of Well	Screened Interval
MW-1	736.20	62.5 ft	47.5 – 62.5 ft
CDMW-2	704.80	51 ft	41 – 51 ft
CDMW-3	685.00	18 ft	8 – 18 ft
CDMW-4a*	718.36	60 ft	45 – 60 ft
CDMW-5	699.80	47 ft	32 – 47 ft
CDMW-6	TBD	TBD	TBD
CDMW-7	TBD	TBD	TBD

TBD = To Be Determined upon installation. Wells will be installed to intersect the upper-most aquifer.

* = CDMW-4A will be abandoned prior to construction of Phase 3.

Surface Water Monitoring Locations
Davidson County C&D Landfill

Surface Water Monitoring Point	Location	Monitoring Frequency
SW-5	Downgradient of C&D	Semi-Annually



LEGEND

MW-1A	PREVIOUSLY INSTALLED MONITORING WELL
CDMW-5	BEDROCK MONITORING WELL
SW-5	EXISTING SURFACE WATER MONITORING STATION
SW-3	SURFACE WATER POINT PROPOSED FOR REMOVAL
MW-6	PROPOSED MONITORING WELL
CDMW-4A	WELL TO BE ABANDONED
	PROPERTY LINE
	WETLAND BOUNDARY (SEE REFERENCE 2)
	STREAM (SEE REFERENCE 2)

0 100' 200' 300'

REFERENCES

1. OVERALL TOPOGRAPHY FROM AERIAL PHOTOGRAPHY DATED APRIL 30, 2008 BY SPATIAL DATA CONSULTANTS, INC., HIGH POINT, NC.
2. WETLANDS AND STREAM LOCATIONS FROM DELINEATION PERFORMED BY CAROLINA ECOSYSTEMS, INC., FEBRUARY 2009, AND SURVEYED BY MICHAEL GREEN ASSOCIATES, P.A., FEBRUARY 2009.

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FIGURE NO.	1
FILE NAME	DAVDCO-B0498
SCALE:	AS NOTED
CHECKED BY:	J.A.S.
PROJECT NO.	DAVDCO 08-5
DRAWN BY:	W.R.B.
DATE:	APRIL 2009

TITLE: DAVIDSON COUNTY C&D LANDFILL PROPOSED MONITORING SYSTEM

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Appendix A
Boring Logs

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FIELD BOREHOLE LOG

BOREHOLE NUMBER: B-2

PROJECT NUMBER: Davdco-14
PROJECT NAME: Davidson County Landfill
LOCATION: Lexington, North Carolina
DRILLING COMPANY: Engineering Tectonics
RIG TYPE & NUMBER: MOBILE B-50
DRILLING METHOD: Hollow Stem/Air Rotary/Hammer
WEATHER: Sunny, 95 DEGREES
FIELD PARTY: R. Barron
GEOLOGIST: P. May
DATE BEGUN: 7/13/98 DATE COMPLETED: 7/13/98

TOP OF CASING ELEVATION: TBD
TOTAL DEPTH: 98.0 FT
GROUND SURFACE ELEVATION: TBD
SHEET: 1 OF: 2

STATIC WATER LEVEL (BLS)		
WD=While Drilling AB=After Boring		
Depth(ft)	-	-
Time	-	-
Date:	-	-

DEPTH	BLOW COUNTS	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	CONSISTANCY	SAMPLE RECOVERY	DRILL METHOD	LITHOLOGY DESCRIPTION
1.0								
0.0							AR	DIORITE: Dark gray and white diorite. Air Rotary refusal at 8.0 feet.
1.0								
2.0								
3.0		6	S1					
4.0								
5.0								
6.0								
7.0								
8.0		6	S2				AH	DIORITE: Dark gray and white hard diorite. Drilled by air hammer. No water seams noted.
9.0								
10.0								
11.0								
12.0								
13.0		6	S3					
14.0								
15.0								
16.0								
17.0								
18.0		6	S4					
19.0								
20.0								
21.0								
22.0								
23.0		6	S5					
24.0								

DEPTH | LITHOLOGY | WELL INSTALLATION

FIELD BOREHOLE LOG

BOREHOLE NUMBER: B-2

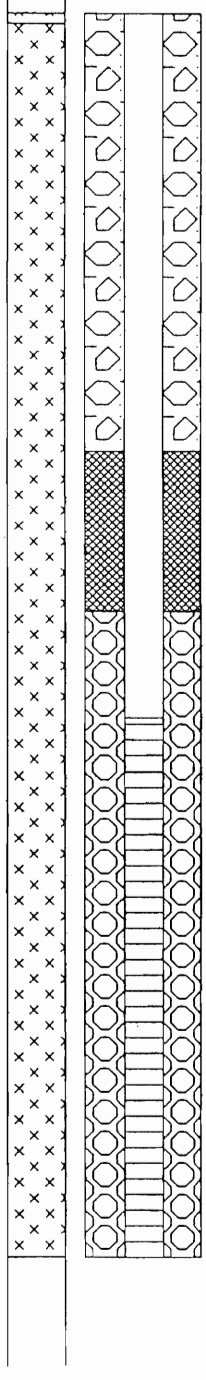
PROJECT NUMBER: Davdco-14
PROJECT NAME: Davidson County Landfill
LOCATION: Lexington, North Carolina
DRILLING COMPANY: Engineering Tectonics
RIG TYPE & NUMBER: MOBILE B-50
DRILLING METHOD: Hollow Stem/Air Rotary/Hammer
WEATHER: Bunny, 95 DEGREES
FIELD PARTY: R. Barron
GEOLOGIST: P. May
DATE BEGUN: 7/13/98 DATE COMPLETED: 7/13/98

TOP OF CASING ELEVATION: TBD
TOTAL DEPTH: 48.0 FT
GROUND SURFACE ELEVATION: TBD
SHEET: 2 OF: 2

STATIC WATER LEVEL (BLS)		
WD=While Drilling AB=After Boring		
Depth(ft)	-	-
Time	-	-
Date:	-	-

DEPTH	BLOW COUNTS	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	CONSISTANCY	SAMPLE RECOVERY	DRILL METHOD	LITHOLOGY DESCRIPTION
25.0								DIORITE: Dark gray and white hard diorite. Drilled by air hammer. Boring terminated at 48 feet below grade.
26.0								
27.0								
28.0		G	S6					
29.0								
30.0								
31.0								
32.0								
33.0		G	S7					
34.0								
35.0								
36.0								
37.0								
38.0		G	S8					
39.0								
40.0								
41.0								
42.0								
43.0		G	S9					
44.0								
45.0								
46.0								
47.0								
48.0		G	S10					
49.0								
50.0								

DEPTH | LITHOLOGY | WELL INSTALLATION



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FIELD BOREHOLE LOG

BOREHOLE NUMBER **CDMW-3** Page 1 of 1

PROJECT NAME: **Davidson County C&D Landfill**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **HSA**
FIELD PARTY: **R. Barron**
GEOLOGIST: **P. May**
DATE BEGUN: **12/5/00** COMPLETED: **12/5/00**

TOTAL DEPTH: **27**
GROUND SURFACE ELEVATION: **NA**
TOP OF CASING ELEVATION:

STATIC WATER LEVEL (BLS)		
Depth (ft)	22.0	15.93
Time	16:00	08:00
Date	12/5/00	12/6/00

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				HSA	SANDY SILT: Dry, tan & rust & gray fine sandy silt, some mica & manganese.		0.0	
1.0							1.0	
2.0							2.0	
3.0							3.0	
4.0							4.0	
5.0	13,12,19	SS	16"				5.0	
6.0							6.0	
7.0							7.0	
8.0							8.0	
9.0							9.0	
10.0	13,16,24	SS	12"		CLAYEY SAND: Moist, tan & white & rust mottled medium to coarse clayey sand, large quartz fragments.		10.0	
11.0							11.0	
12.0							12.0	
13.0							13.0	
14.0							14.0	
15.0	18,32,36	SS	12"		CLAYEY SAND: Same as above but medium sand with PWR and Fe/Mn streaking throughout.		15.0	
16.0							16.0	
17.0							17.0	
18.0							18.0	
19.0							19.0	
20.0	50/6"	SS	4"				20.0	
21.0							21.0	
22.0				AR	PWR: Partially weathered diorite. Auger refusal at 22.0'. Air rotary to 27.0' through PWR to competent diorite. Boring terminated at 27'.		22.0	
23.0							23.0	
24.0							24.0	
25.0	50/0"	SS	0"				25.0	
26.0							26.0	
27.0							27.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **CDMW-4a**

PROJECT NAME: **Davidson County C&D Landfill**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **AR/AH**
FIELD PARTY: **R. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **1/24/06** COMPLETED: **1/24/06**

TOTAL DEPTH: **78**
GROUND SURFACE ELEVATION: **NA**
TOP OF CASING ELEVATION:

STATIC WATER LEVEL (BLS)		
Depth (ft)		
Time		
Date		

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				AR	SAND: Highly weatherd partially weatherd rock, granitic sand rock, dry. Auger refusal at 17 feet		0.0	
1.0							1.0	
2.0							2.0	
3.0							3.0	
4.0							4.0	
5.0		Grab					5.0	
6.0							6.0	
7.0							7.0	
8.0							8.0	
9.0							9.0	
10.0		Grab					10.0	
11.0							11.0	
12.0							12.0	
13.0							13.0	
14.0							14.0	
15.0		Grab					15.0	
16.0							16.0	
17.0				AH	GRANITE: Weathered granite, dry.		17.0	
18.0							18.0	
19.0							19.0	
20.0							20.0	
21.0							21.0	
22.0		Grab					22.0	
23.0							23.0	
24.0							24.0	
25.0							25.0	
26.0							26.0	
27.0							27.0	
28.0		Grab					28.0	
29.0							29.0	
30.0		Grab			SANDY SILT: Soil seam of sandy silt, dry.		30.0	
31.0							31.0	
32.0							32.0	
33.0		Grab			GRANITE: Weathered granite, dry.		33.0	
34.0							34.0	
35.0							35.0	
36.0		Grab					36.0	
37.0							37.0	
38.0							38.0	
39.0							39.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **CDMW-4a**

PROJECT NAME: **Davidson County C&D Landfill**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **AR/AH**
FIELD PARTY: **R. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **1/24/06** COMPLETED: **1/24/06**

TOTAL DEPTH: **78**
GROUND SURFACE ELEVATION: **NA**
TOP OF CASING ELEVATION:

STATIC WATER LEVEL (BLS)		
Depth (ft)		
Time		
Date		

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
39.0							39.0	
40.0							40.0	
41.0							41.0	
42.0							42.0	
43.0		Grab					43.0	
44.0							44.0	
45.0		Grab			DIORITE: Weatherd diorite, dry.		45.0	
46.0							46.0	
47.0							47.0	
48.0		Grab					48.0	
49.0							49.0	
50.0							50.0	
51.0							51.0	
52.0							52.0	
53.0		Grab					53.0	
54.0							54.0	
55.0							55.0	
56.0							56.0	
57.0		Grab					57.0	
58.0							58.0	
59.0							59.0	
60.0							60.0	
61.0							61.0	
62.0							62.0	
63.0		Grab			GRANITE: Weathered, very competent granite, very dry.		63.0	
64.0							64.0	
65.0							65.0	
66.0							66.0	
67.0							67.0	
68.0		Grab			DIORITE: Weathered, very hard diorite, dry.		68.0	
69.0							69.0	
70.0							70.0	
71.0							71.0	
72.0							72.0	
73.0		Grab					73.0	
74.0							74.0	
75.0							75.0	
76.0							76.0	
77.0							77.0	
78.0							78.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **CDMW-5**

PROJECT NAME: **Davidson County C&D Landfill**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **AR/AH**
FIELD PARTY: **R. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **1/30/06** COMPLETED: **1/30/06**

TOTAL DEPTH: **47**
GROUND SURFACE ELEVATION: **NA**
TOP OF CASING ELEVATION:

STATIC WATER LEVEL (BLS)		
Depth (ft)		
Time		
Date		

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
0.0				AR	SANDY CLAY: Clayey F-C sand, well weatherd granite saprolite, dry.		0.0	
1.0							1.0	
2.0							2.0	
3.0							3.0	
4.0							4.0	
5.0	6,15,28	SS	12"				5.0	
6.0							6.0	
7.0							7.0	
8.0							8.0	
9.0							9.0	
10.0	35,50/5"	SS	8"				10.0	
11.0		Grab		AH	GRANITE: Weathered granite, dry.		11.0	
12.0							12.0	
13.0							13.0	
14.0							14.0	
15.0							15.0	
16.0		Grab					16.0	
17.0							17.0	
18.0							18.0	
19.0							19.0	
20.0							20.0	
21.0		Grab					21.0	
22.0							22.0	
23.0							23.0	
24.0							24.0	
25.0							25.0	
26.0		Grab					26.0	
27.0							27.0	
28.0							28.0	
29.0							29.0	
30.0							30.0	

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FIELD BOREHOLE LOG

BOREHOLE NUMBER **CDMW-5**

PROJECT NAME: **Davidson County C&D Landfill**
LOACATION: **Lexington, NC**
DRILLING CO: **Engineering Tectonics, P.A.**
DRILLING METHOD: **AR/AH**
FIELD PARTY: **R. Barron**
GEOLOGIST: **J. Smyth**
DATE BEGUN: **1/30/06** COMPLETED: **1/30/06**

TOTAL DEPTH: **47**
GROUND SURFACE ELEVATION: **NA**
TOP OF CASING ELEVATION:

STATIC WATER LEVEL (BLS)		
Depth (ft)		
Time		
Date		

DEPTH	BLOW COUNT	SAMPLING METHOD	RECOVERY	DRILL METHOD	DESCRIPTION	LITHOLOGY	DEPTH	WELL INSTALLATION
30.0							30.0	
31.0		Grab			GRANITE: Weathered granite to 33' where an approx. 1' moist seam was located (finer cuttings). Harder drilling begins at 38' where rock chips no longer have pink hue. Larger rock cuttings, with moisture, appear at 45'. BT at 47'		31.0	
32.0							32.0	
33.0							33.0	
34.0							34.0	
35.0							35.0	
36.0		Grab					36.0	
37.0							37.0	
38.0							38.0	
39.0							39.0	
40.0							40.0	
41.0		Grab					41.0	
42.0							42.0	
43.0							43.0	
44.0							44.0	
45.0							45.0	
46.0		Grab					46.0	
47.0							47.0	

Appendix B
Environmental Monitoring Form

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DENR USE ONLY: ☐ Paper Report ☐ Electronic Data - Email CD (data loaded: Yes / No) Doc/Event #:

NC DENR
Division of Waste Management - Solid Waste

Environmental Monitoring Reporting Form

Notice: This form and any information attached to it are "Public Records" as defined in NC General Statute 132-1. As such, these documents are available for inspection and examination by any person upon request (NC General Statute 132-6).

Instructions:

- **Prepare one form for each individually monitored unit.**
- **Please type or print legibly.**
- Attach a notification table with values that attain or exceed NC 2L groundwater standards or NC 2B surface water standards. The notification must include a preliminary analysis of the cause and significance of each value. (e.g. naturally occurring, off-site source, pre-existing condition, etc.).
- Attach a notification table of any groundwater or surface water values that equal or exceed the reporting limits.
- Attach a notification table of any methane gas values that attain or exceed explosive gas levels. This includes any structures on or nearby the facility (NCAC 13B .1629 (4)(a)(i).
- In accordance with NC General Statutes Chapter 89C and 89E and NC Solid Waste Management Rules 15A NCAC 13B, be sure to affix a seal to the bottom of this page, when applicable.
- Send the original signed and sealed form, any tables, and Electronic Data Deliverable to: Compliance Unit, NCDENR-DWM, Solid Waste Section, 1646 Mail Service Center, Raleigh, NC 27699-1646.

Solid Waste Monitoring Data Submittal Information

Name of entity submitting data (laboratory, consultant, facility owner):

Contact for questions about data formatting. Include data preparer's name, telephone number and E-mail address:

Name: _____ Phone: _____

E-mail: _____

Facility name:	Facility Address:	Facility Permit #	NC Landfill Rule: (.0500 or .1600)	Actual sampling dates (e.g., October 20-24, 2006)

Environmental Status: (Check all that apply)

☐ Initial/Background Monitoring ☐ Detection Monitoring ☐ Assessment Monitoring ☐ Corrective Action

Type of data submitted: (Check all that apply)

☐ Groundwater monitoring data from monitoring wells
☐ Groundwater monitoring data from private water supply wells
☐ Leachate monitoring data
☐ Surface water monitoring data
☐ Methane gas monitoring data
☐ Corrective action data (specify) _____
☐ Other(specify)

Notification attached?

☐ No. No groundwater or surface water standards were exceeded.
☐ Yes, a notification of values exceeding a groundwater or surface water standard is attached. It includes a list of groundwater and surface water monitoring points, dates, analytical values, NC 2L groundwater standard, NC 2B surface water standard or NC Solid Waste GWPS and preliminary analysis of the cause and significance of any concentration.
☐ Yes, a notification of values exceeding an explosive methane gas limit is attached. It includes the methane monitoring points, dates, sample values and explosive methane gas limits.

Certification

To the best of my knowledge, the information reported and statements made on this data submittal and attachments are true and correct. Furthermore, I have attached complete notification of any sampling values meeting or exceeding groundwater standards or explosive gas levels, and a preliminary analysis of the cause and significance of concentrations exceeding groundwater standards. I am aware that there are significant penalties for making any false statement, representation, or certification including the possibility of a fine and imprisonment.

Facility Representative Name (Print) Title (Area Code) Telephone Number

Signature Date

Affix NC Licensed/ Professional Geologist/Engineer Seal here:

Revised 01/2007

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