Scanned by	Date	Document ID No.
A Gaither	**June 18, 2008**	**4900**

CDM
5400 Glenwood Avenue, Suite 300
Raleigh, North Carolina 27612
tel: 919 787-5620
fax: 919 781-5730

RECEIVED
JUN 17 2008
SOLID WASTE SECTION
ASHEVILLE REGIONAL OFFICE

June 16, 2008

Mr. Allen Gaither
Permit Engineer
North Carolina Department of Environment and Natural Resources
Division of Waste Management
Solid Waste Section
2090 US Highway 70
Swannanoa, NC 28778

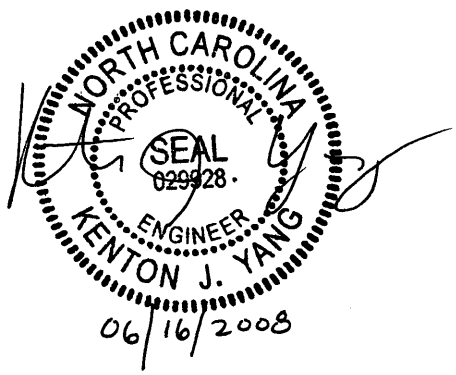
Subject: Buncombe County, North Carolina
Buncombe County Solid Waste Management Facility
C&D Landfill Permit Modification
Permit No. 11-07

Dear Allen:

On behalf of Buncombe County (County), Camp Dresser & McKee (CDM) is pleased to submit two (2) copies of the Construction and Demolition (C&D) Landfill Permit Modification for your review. Also included is a PDF on compact disc. The Permit Modification includes closure and post-closure plans prepared in accordance with Rules .0547(2)(a) and .0543. Also included, as required by Rule .0547(2)(b), are closure and post-closure care cost estimates. Based on conversations with Ms. Amy Kadrie (NCDENR SWS), the County is required to incorporate these cost estimates into their annual financial assurance documentation submitted after their fiscal year is closed and prior to November 1.

Please do not hesitate to contact me at (919) 325-3574 if you have any questions or if there is anything I can do to facilitate the review and approval of this permit modification.

Very truly yours,



Kenton J. Yang, P.E.
Camp Dresser & McKee

attachments: as noted

xc: E. Mussler, NCDENR SWS
J. Creighton/J. Mears/K. Smith, BCGSD
J. Wiseman/J. Boyer, CDM

Buncombe County,
North Carolina

Buncombe County
Solid Waste Management Facility

Construction and Demolition Debris Landfill Permit Modification

June 2008

Report

C&D Landfill Permit Modification Contents

Section 1
Closure Plan

The North Carolina Solid Waste Regulation Section Rule 15A NCAC 13B .0543(a) requires construction and demolition (C&D) landfill owners/operators to prepare a closure plan that describes the steps necessary to close a C&D landfill at any point during its active life. This closure plan establishes: design criteria for the closure cap system and the gas collection system, a closure sequence and construction schedule, construction cost estimates, and other important information relating to closure.

1.1 Construction of Cap System

1.1.1 Final Cover System

The final cover system has been designed to minimize the amount of storm water infiltration into the landfill and to resist erosive forces. The final cover system consists of the following layers (listed from top to bottom), which meet the requirements of Rule 0.543(c)(1):

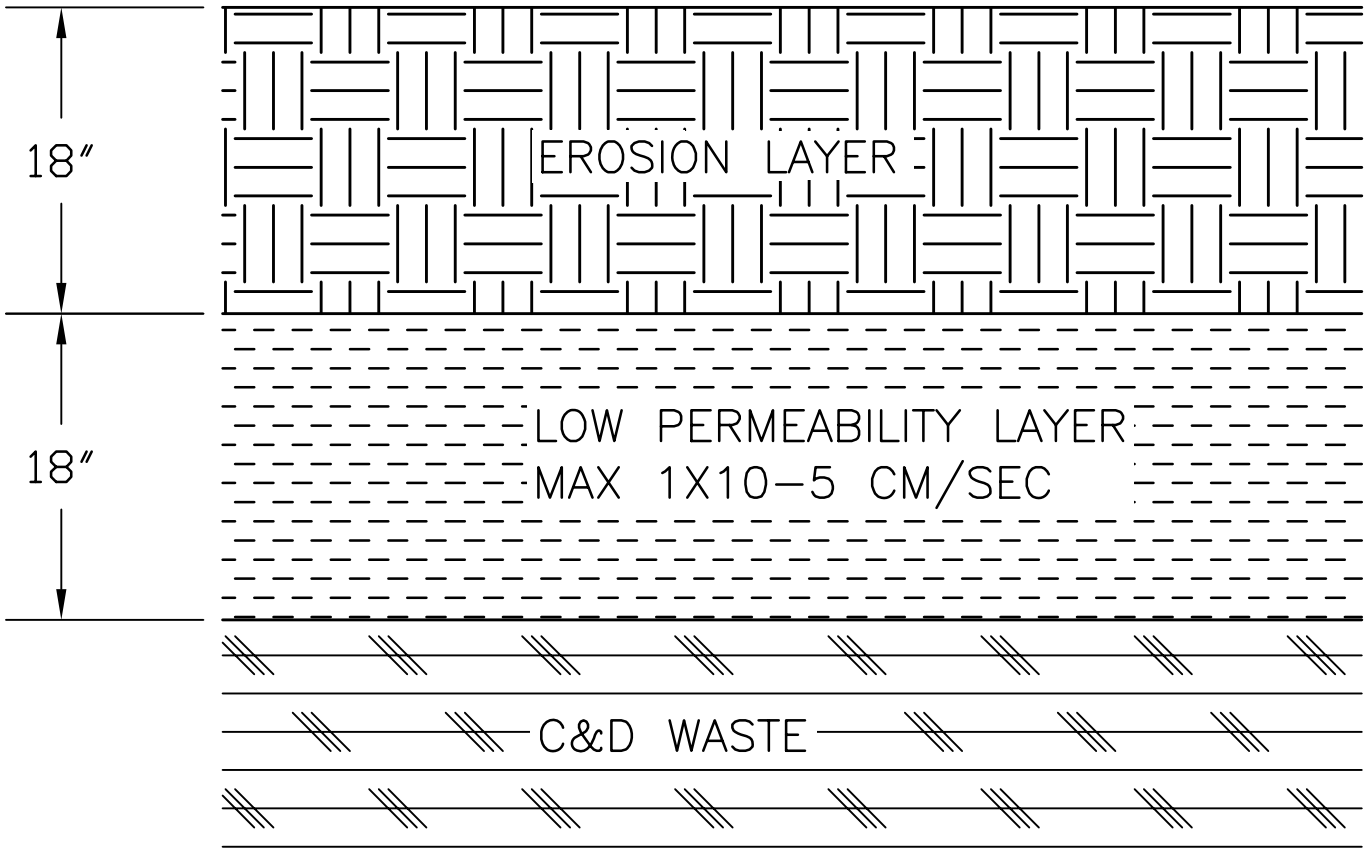
- An 18-inch erosion layer consisting of earthen material that is capable of sustaining native plant growth; and
- An 18-inch low permeability barrier of earthen material with a permeability no greater than $1.0x10^{-5}$ cm per second.

The post-settlement grades of the top surface slopes will not be less than 5 percent (to prevent ponding). Figure No. 1-1 provides a section detail of the proposed final cover system.

Closure side slopes will be 3:1, per the approved Phase 4 Expansion Permit Application dated June 2, 2005. Post-settlement slopes are expected to be less than 3:1. Rule 0.543(c)(3)(C) allows for alternative side slopes (those greater than 25%) to be approved by the North Carolina Department of Environment and Natural Resources Solid Waste Section (NCDENR SWS) if the design is certified (by a licensed professional engineer in the State of North Carolina) to be stable, encourage runoff, and be safe to construct, operate and maintain. The certified post-settlement slope design memorandum dated June 1, 2005 and included in the Phase 4 Expansion Permit Application demonstrates these requirements. It is included as Appendix A of this Permit Modification. Although the previous post-settlement slope design analysis assumed a 2-foot earthen cap, as opposed to what is described above, the additional 12 inches of cap material has been determined to be inconsequential with regard to slope stability.

1.1.2 Gas Collection System

The placement of a low-permeability final cover system will prevent the release of landfill gas generated during the post-closure period. To minimize pressures exerted on the barrier, passively vented gas wells will be used. The exact location of the



DATE 5-22-2008

FINAL COVER SYSTEM

FIGURE NO.

1-1

CDM Camp Dresser & McKee

vertical gas wells will be determined at the time of closure. Generally, one vertical well per acre is anticipated to be installed. A bentonite seal and synthetic boot will be installed around the vertical gas well to prevent storm water infiltration. The depth of the vertical gas wells will extend from final grade to less than 10 feet into waste. Figure No. 1-2 provides a section detail of the proposed vertical gas well design.

1.2 Estimate of Largest Closure

The construction of the landfill has occurred in four phases. The current active phase (Phase 4) piggy-backs the existing phases and includes ±2.9 acres of newly constructed disposal area. Phase 4 includes an entire disposal area of ±8.8 acres and increases the overall footprint of the C&D landfill to 12.2 acres; thusly, 12.2 acres would be the largest closure.

1.3 Estimate of Maximum Inventory of Waste On-Site

The maximum amount of waste that is expected to be disposed at the C&D landfill was calculated using the Earthworks Module of Softdesk. The total gross airspace available between the proposed top of final cover and top of base grade is approximately 704,800 cubic yards (CY). The final cover material required to construct the 3-foot thick cover system for the C&D Landfill (12.2 acres total surface area) is 59,000 CY. It is anticipated that a 4:1 waste to cover ratio will be achieved; therefore, (704,800 CY – 59,000 CY) x 20% cover = 129,200 CY daily and intermediate cover will be required. Deducting the volume of the final cover system (59,000 CY) and daily/intermediate cover materials (129,200 CY) from the total gross airspace, the maximum available net airspace for waste to be disposed is projected to be 516,600 CY.

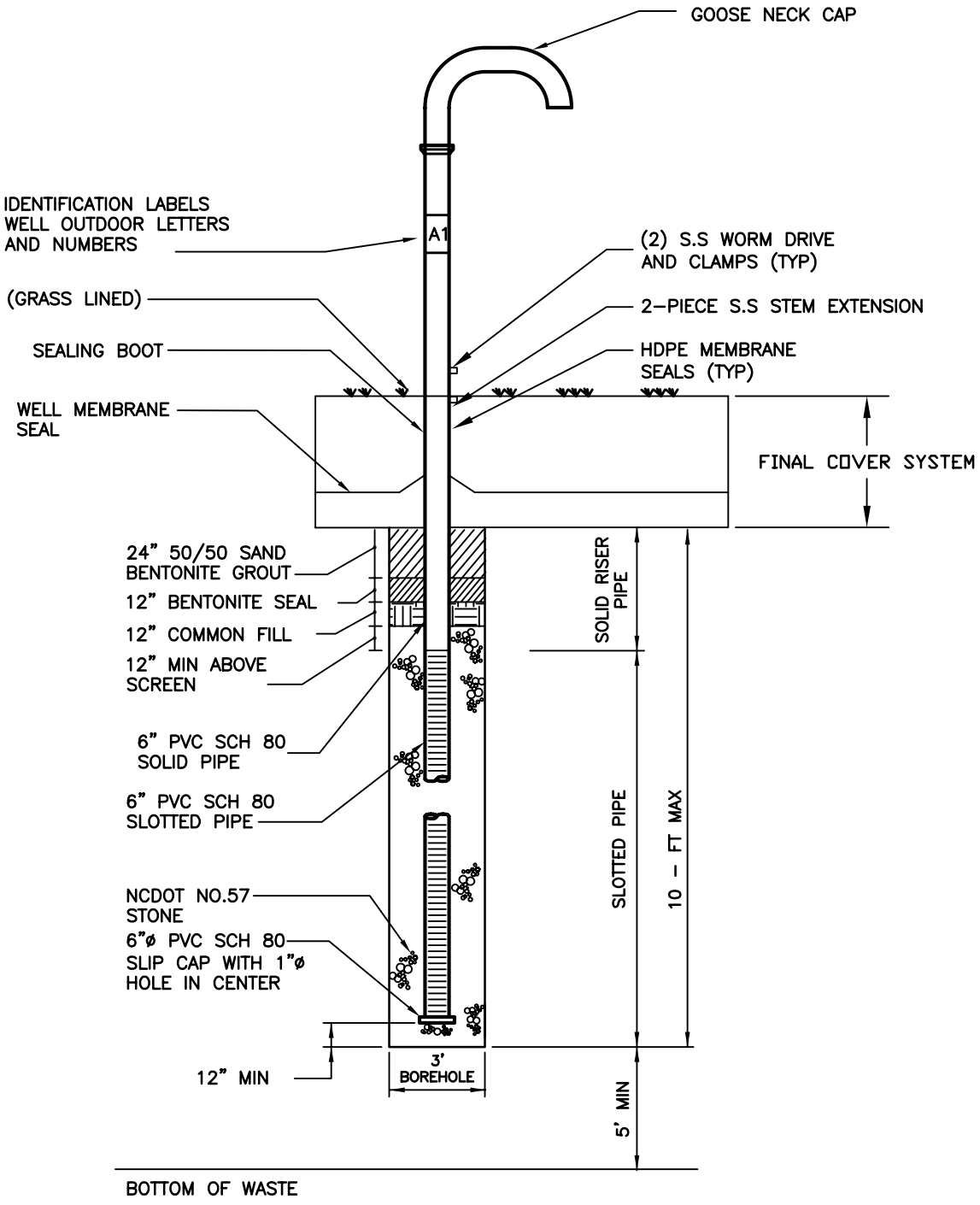
1.4 Landfill Closure Sequence

The landfill closure sequence is summarized in the following table and described in the following sections.

1.4.1 Determination of Closure Area

The County will determine the location and acreage of areas to be closed. Closure procedures will not be instituted until an adequate area (approximately 10 acres or more) of the landfill is within 15 feet of final grade. An estimate of landfill area that is within 15 feet of final grade should be determined periodically by the surveyor for the site during the active life of the facility.

When an area has reached final grades, the County must initiate the closure process no later than 30 days after the final receipt of waste. However, if the area has not reached final grades and there is reasonable likelihood that additional waste will be received in the near future, then closure activities must begin no later than one year after the most recent receipt of wastes.



	DATE 5-21-2008	VERTICAL GAS WELL	FIGURE NO. 1-2
CDM Camp Dresser & McKee			

CLOSURE SEQUENCE	
Activity	*Process Date*
Determination of Closure Area and Initiate Closure Process	No later than 30 days after the final receipt of waste
Notification of Intent to Close	Once an area has been determined to be closed
Develop Closure Schedule for Closure Activities	
Prepare Construction Contract Documents	
Develop Final Closure Schedule	Once the SWS has commented on the closure schedule
Select a General Contractor	After receiving sealed bids
Closure Construction	Closure activities must be completed within 180 days of beginning closure activities or as otherwise approved
Certification of Closure Construction	At completion of construction
Record Notation to Deed	After final closure of property

1.4.2 Notification of Intent to Close

Once the County has determined that an area will be closed, a Notice of Intent to Close must be placed in the operating record and the SWS must be notified of the action per Rule .0543(c)(4). The final cover design, area to be closed, and scheduling of closure activities presented in this Permit Amendment Application shall be reviewed and updated as necessary.

1.4.3 Develop Closure Schedule

The County will prepare a schedule for bidding and construction of the closure activities. Closure activities must be completed within 180 days of beginning closure activities unless the County gains approval from the SWS by demonstrating that the construction period, by necessity, will require an extended schedule and that measures to protect human health and the environment have been implemented in the interim.

1.4.4 Prepare Construction Contract Documents

For the purpose of bidding, construction documents will be prepared for the area to be closed. The bidding documents will allow contractors to estimate the quantity of

materials needed to properly implement the closure plan, as well as estimating the construction costs.

1.4.5 Develop Final Closure Schedule

Once the SWS has reviewed and commented on the closure schedule, the County will prepare a final schedule for bidding and construction of the closure activities.

1.4.6 Selecting a General Contractor

After receiving sealed bids, a contractor will be awarded the job of constructing the final cover according to the approved closure plan. The contractor will be required to complete all closure activities within 180 days of beginning such activities, or as otherwise approved by the SWS.

1.4.7 Securing Borrow Material for Landfill Cover

The material to be used for construction of the closure cap system will be obtained primarily from on-site sources. Off-site sources, as needed, will be selected based on proximity to the site, ability to provide material according to project specifications, and price.

1.4.8 Certification of Closure Construction

Following completion of the closure construction, a certification verifying that the closure construction was performed in accordance with the closure plan and signed by a registered professional engineer licensed in the State of North Carolina will be made part of the operating record. The County will notify the SWS that the certification has been placed in the operating record.

1.4.9 Record Notation to Deed

After final closure of the property, a notation will be placed on the deed to the property stating that the property was used as a landfill facility, and its use is restricted under the closure plan approved by the SWS.

1.5 Financial Assurance

A detailed cost estimate based on current costs has been prepared for closure of the largest active area of the landfill facility at any time during the life of the facility and is provided in Table 1-1. A copy of the cost estimate has been placed in the operating record. The cost estimate will be annually adjusted to account for inflation and any changes in conditions at the facility or in the design. If conditions call for a reduction in the amount to be financially assured, approval of the SWS must be obtained prior to officially reducing the amount.

Per Rule 13B .0546(c)(1)(B), the County will annually adjust the closure cost estimate for inflation within 60 days prior to the anniversary date of the establishment of the financial instrument. Buncombe County uses the local financial government test, and therefore is required to update the closure cost estimate for inflation within 30 days

after the close of the fiscal year and before submission of updated information to the Division.

Table 1-1

Closure Cost Estimate
Buncombe County C&D Landfill
Buncombe County, North Carolina
June 2008

	Quantity	Unit	Cost	Total
Final Cover System				
Grade Intermediate Cover/Strip Existing Vegetation	12.2	ac	$1,500.00	$18,300
Cap System Components:				
a. 18″ Erosion Layer	29,524	cy	$13.30	$392,669
b. 18″ Low-Permeability Layer	29,524	cy	$13.30	$392,669
Seeding, Fertilizing & Mulching	12.2	ac	$1,850.00	$22,570
Temporary Erosion Control	12.2	ac	$4,000.00	$48,800
Permanent Erosion Control				
Diversion Berms/Downdrains	12.2	ac	$33,300.00	$406,260
Landfill Gas Management				
Vertical Gas Vents (12 @ Avg. Depth of 10′)	120	vf	$108.50	$13,020
Gas Monitoring Wells (7 @ Avg. Depth of 15′)	105	vf	$50.00	$5,250
Surveys	12.2	ac	$333.33	$4,067
Final Landscaping				
Seeding, Fertilizing & Mulching	12.2	ac	$1,850.00	$22,570
Indemnification	1	ls	$5,000.00	$5,000
Subtotal				$1,331,175
Bonds and Mobilization/Demobilization (5% of Subtotal)				$66,559
Engineering Services, CQA/CQC (12% of Subtotal)				$159,741
Contingency (15% of Subtotal)				$199,676
		TOTAL		**$1,757,151**
		COST PER ACRE		**$144,029**

Section 2
Post-Closure Plan

The North Carolina Solid Waste Regulation Section Rule 15A NCAC 13B .0543(a) requires owners/operators of C&D landfills to prepare a post-closure plan. The purpose of the plan is to provide the necessary information for preserving the integrity of the landfill facility in its post-closure life. This post-closure plan specifically addresses maintenance activities for the closure cap, landfill gas monitoring system, groundwater monitoring wells, and erosion and sedimentation control system to be installed at the C&D landfill. This plan also addresses certification and financial assurance requirements.

Post-closure care will begin immediately following final closure of the landfill. Post-closure care may be decreased from the minimum time period of 30 years specified in the regulations if the County can demonstrate that the reduced period will pose no threat to human health or the environment. However, the SWS reserves the right to increase the post-closure care period if it is deemed necessary to protect human health and the environment.

2.1 Maintenance and Monitoring Activities

Post-closure maintenance and monitoring activities for the C&D landfill are described in the following sections.

2.1.1 Final Cover System

Inspection of the final cover system will take place quarterly and encompass the entire landfill. Items of concern to be noted by the inspector include but are not limited to: signs of erosion (ruts, sediment deposits, etc.), patches of stressed or dead vegetation, animal burrows, recessed areas or ponding, upheaving, leachate seepage stains and/or flowing leachate, cracks in the cap, damaged gas vents and tree saplings (especially species with tap roots). Following each inspection, a summary report of the condition of the cover and the items of concern should be recorded in the post-closure log book of the facility. Areas that require further attention should be photographed and delineated on a map of the facility. These items should also be entered in the log book. Since post-closure inspection personnel will most likely change during the post-closure period, the post-closure log book should be kept in a standardized format that allows for new inspection personnel to easily review the results of past post-closure inspections of the site.

Action should be taken immediately to address any items of concern identified during the inspection. Obvious repair items should be performed under the supervision of the post-closure maintenance manager. If an item of concern requires further study to determine a course of action, the engineering firm responsible for closure design should be contacted for consultation.

As part of general maintenance, the vegetative cover should be mowed at least twice a year to suppress weed and brush growth. If vegetative cover is not adequate in any particular area, soil amendments should be applied as necessary and the area re-seeded in order to re-establish vegetation. Insecticides may be used to eliminate insect populations that are detrimental to the vegetation. Animal burrows and eroded or depressed areas should be filled in with compacted soil and reseeded.

2.1.2 Groundwater Monitoring Wells

Inspection of the groundwater monitoring wells will take place semi-annually during sampling events. The inspection will consist of verifying the condition of the monitoring wells to ensure that they are providing representative samples of the ground water being collected. The inspector should note the following:

1) The total depth of the well should be recorded every time a water sample is collected or a water level reading is taken to check if sediment has accumulated at the bottom. If sediment build-up has occurred, the sediment should be removed by pumping or bailing.
2) If turbid samples are collected from a well, redevelopment of the well will be necessary.
3) The above-ground protective casing should be inspected for damage. The protective casing should be of good structural integrity and free of any cracks or corrosion. The lockable cover and lock should also be checked at this time.
4) The surface seals should be inspected for settling and cracking. If the seal is damaged in any way, the seal should be replaced.
5) The well casing and cap should be inspected. The casing and cap should be of good structural integrity and free of any cracks or corrosion. Any debris should be removed from around the cap to prevent it from entering the well.

The condition of the groundwater monitoring system should be recorded in the post-closure log book following each sampling event. Monitoring of the groundwater wells shall be conducted as described in the groundwater monitoring plan.

2.1.3 Landfill Gas Monitoring System

Inspection of the landfill gas monitoring system should take place at least quarterly. The inspection should consist of verifying the condition and operation of the passive gas vents and gas monitoring wells. The full depth of all vents and monitoring wells should be checked for blockage that may be caused by settlement or cracks in the casing. At least once a year, all vents and wells should be tested with an air pump to ensure they are free-flowing. The summary of each inspection of the landfill gas monitoring system should be recorded in the post-closure log book along with photographs of any items of concern.

Testing of the gas monitoring wells shall be conducted quarterly, or as otherwise approved by the Division.

If any vents or wells are not properly working, they should be flushed and pressure cleaned. If all attempts to repair a vent or well are unsuccessful, a replacement will be installed.

2.2 Erosion and Sedimentation Control System

Inspection of the erosion and sedimentation control system should occur semi-annually and after major storm events. During each inspection, the elements of the system including drainage ditches, drainage pipes, sedimentation pond, and inlet/outlet structures should be checked for obstructions and damage. The drainage ditches should be inspected for obstructions, erosion of side slopes, loss of vegetative cover, shifting of riprap, excessive buildup of sediment, or any other item that may prevent the proper functioning of the ditch. Drainage piping should be checked for blockages and the inlets/outlets should be inspected for undercutting and rutting. The sediment level in the sedimentation ponds should be measured to determine if removal is required. The condition of the riser/barrel should be checked to ensure that adequate gravel surrounds the riser and that the barrel is not filled with sediment. The berms of each pond should be inspected for stability. Following each inspection, a summary report should be entered in the post-closure log book along with photographs of any items of concern.

Maintenance and/or repairs should be performed immediately as prescribed by the inspectors review.

2.3 Certification of Post-Closure

Following completion of the post-closure care period, a certification verifying that post-closure care was performed in accordance with the post-closure plan and signed by a registered professional engineer licensed in the State of North Carolina will be made part of the operating record. The County will notify the SWS that the certification has been placed in the operating record.

2.4 Name of Individual Responsible for Post-Closure Maintenance of the Site

Mr. Jon Creighton of Buncombe County is currently responsible for operations and maintenance of the site. Mr. Creighton can be reached at the following address:

Mr. John Creighton, Assistant County Manager
Buncombe County
46 Valley Street
Asheville, North Carolina 28801

Mr. Creighton most likely will not be employed with Buncombe County throughout the entire 30 year post-closure period. A new individual will be appointed at the time Mr. Creighton's employment with the County ends.

2.5 Planned Use of Landfill After Closure

There are no current planned uses for the landfill site after closure. The property will remain County property, maintained by the County, with public access prohibited.

2.6 Financial Assurance

Buncombe County will submit a financial assurance package to SWS in accordance with the criteria set forth under Rule .0546. A detailed cost estimate for post-closure care has been prepared and is provided herein (Table 2-1) and a copy has been placed in the operating record. The cost estimate is based on 30 years of post-closure care.

Per Rule 13B .0546(c)(3)(B), the County will annually adjust the post-closure cost estimate for inflation within 60 days prior to the anniversary date of the establishment of the financial instrument. Buncombe County uses the local financial government test, and therefore is required to update the post-closure cost estimate for inflation within 30 days after the close of the fiscal year and before submission of updated information to the Division.

Table 2-1

Post-Closure Cost Estimate
Buncombe County C&D Landfill
Buncombe County, North Carolina
June 2008

	Quantity	Unit	Cost	Total
Administration	30	yr	$5,000	$150,000
Engineering	30	yr	$10,000	$300,000
Monitoring				
7 Groundwater Monitoring Well and QA/QC Samples Analyzed Semi-Annually for 30 years	60	events	$2,475	$148,500
1 Surface Water Sample Analyzed Semi-Annually for 30 years	60	events	$325	$19,500
7 Landfill Gas Wells Sampled and Analyzed Quarterly for 30 years	120	events	$400	$48,000
Maintenance				
Fencing, Gates, Signs, etc.	30	yr	$1,000	$30,000
Access Roads	30	yr	$3,000	$90,000
Mowing	30	yr	$5,000	$150,000
Stormwater Structures	30	yr	$3,000	$90,000
Final Cover System Inspection & Repair	30	yr	$9,000	$270,000
Groundwater and Gas Monitoring Wells	30	yr	$4,000	$120,000
Subtotal				$1,416,000
Contingency (15%)				$212,400

TOTAL	**$1,628,400**
ANNUAL COST	**$54,280**

C&D Landfill Permit Modification Appendix

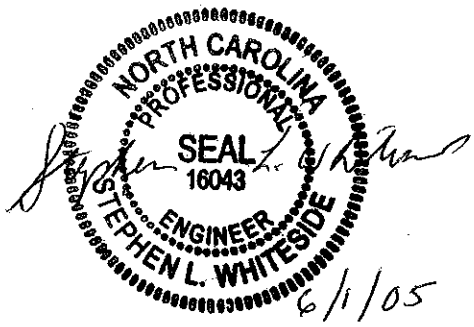
Phase 4 C&D Landfill Stability and Settlement Analysis (June 1, 2005)

APPENDIX B

GEOTECHNICAL CALCULATIONS

CDM

Memorandum



To: *Martin Sanford*

From: *Steve Whiteside*

Date: *June 1, 2005*

Subject: *Buncombe County Phase 4 C & D Landfill*

Purpose

The purpose of this memorandum is to provide the results of CDM's of stability and settlement analyses for the proposed construction and demolition (C & D) debris landfill Phase 4 Expansion in Buncombe County, North Carolina.

Project Information and Site Conditions

The Buncombe County Solid Waste Management Facility currently has a C & D debris disposal landfill portion. The total area of the landfill site is approximately 557 acres. The Phase 4 expansion will include approximately 2.9 acres of newly constructed disposal area, increasing the entire disposal area to approximately 8.8 acres (piggy-backing the existing Phase 1 and 2). The proposed C & D landfill expansion will have a maximum vertical slope height of 50 feet with side slopes graded at 3H:1V. The landfill design cross-section is presented in **Figure 1.**

The existing disposal facility is located off of Panther Branch Road in Buncombe County, North Carolina.

Subsurface Conditions

The subsurface data utilized in the geotechnical analyses are based upon CDM's site investigations conducted in March 1997 and October 2004. The CDM Design Hydrogeologic Report for Buncombe C & D Phase 4 Expansion dated June 2005 contains subsurface data and a discussion of regional geology and subsurface conditions. Information contained in these reports is not re-iterated herein. **Attachment A** and **Attachment B** contain applicable boring logs and laboratory test results from previous reports.

Design Parameters

The landfill components will consist of the following in order of their occurrence below final closure grade;

- 2-foot-thick protective soil layer,
- C & D waste.

A summary of design properties for each of these components is presented in **Table 1** below.

Table 1: Summary of Landfill Component Design Properties

Layer No.	Materials	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)	Basis for Parameter Selection
1	Protective Soil Layer	120	32	0	Literature Search
2.	C & D Waste	65	27.5	0	Literature Search

The subsurface conditions and design properties assumed for design analyses are summarized in **Table 2**:

Table 2: Summary of Subsurface Design Properties

Layer No.	Materials	Layer Thickness (ft)	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)	Basis for Parameter Selection
1	Soil Layer 1 – Silt	3	110	28	0	N SPT Values Lab Test from CDM Design Hydrogeologic Report (June 2005) Buncombe County Solid Waste Management Facility-Phase III Report Literature Search
2	Soil Layer 2 – Clay	5	110	0	1,000	
3	Soil Layer 3 – Sand	8-15	118	35	0	
4	Soil Layer 4 – Partially Weathered Rock		135	35	500	

Groundwater levels within the landfill footprint are based upon Potentiometric Contour Map sheet no. 3-2 presented in **Attachment C**. The potentiometric contour map is based on groundwater levels collected from monitoring wells around the existing C & D landfill on March 3rd, 2005.

Slope Stability Analyses

Analyses for overall (global) stability were performed using the XSTABL computer program, version 5.203. This computer program calculates a factor of safety against failure of the overall landfill mass. Based upon the inputted slope geometry, soil and waste properties, and groundwater conditions, the minimum acceptable factor of safety for the stability of the landfill mass is 1.5 under static loading conditions.

The XSTABL computer program was used to perform a circular failure surface search through the C & D waste and foundation soils at Cross Section 1 from north to south (Appendix A Engineering Drawing Sheet C-3). The computed factor of safety for overall global stability is 1.6. The computed factor of safety for a shallow failure through the C & D waste is 1.5.

The XSTABL output files are presented in **Attachment D.**

Settlement Analyses

CDM performed settlement analyses for the proposed landfill geometry to estimate the magnitude of settlement of foundation soils due to the loads from C & D waste and protective cover soil.

Foundation settlement under the weight of the proposed C & D landfill was analyzed at two locations. Point A is located at the top edge of the landfill slope with the C & D waste thickness of 45 feet and point B is located beneath the landfill centerline of the crest with the maximum C & D waste thickness of approximately 50 feet. The locations of point A and point B are shown in Figure 1.

The results of the analyses are presented in **Attachment E** and estimated to be in the range as summarized below depending on the existence of a clay layer:

Point A – EL 2047

Total settlement = 0.5 to 5.9 inches

Point B – EL 2040

Total settlement = 0.8 to 7.9 inches

Limitations

This memorandum has been prepared for specific application to the subject project in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made. In the event that any changes in the nature, design, or location of the proposed landfill cell are planned, the conclusions and preliminary recommendations

presented in this report should not be considered valid, unless changes are reviewed and conclusions of this memorandum are modified or verified in writing.

The preliminary recommendations submitted in this report are based in part upon the data obtained from the referenced borings. The nature and extent of variations between the explorations may not become evident until construction. If variations then appear evident, it may be necessary to re-evaluate the recommendations of the report.

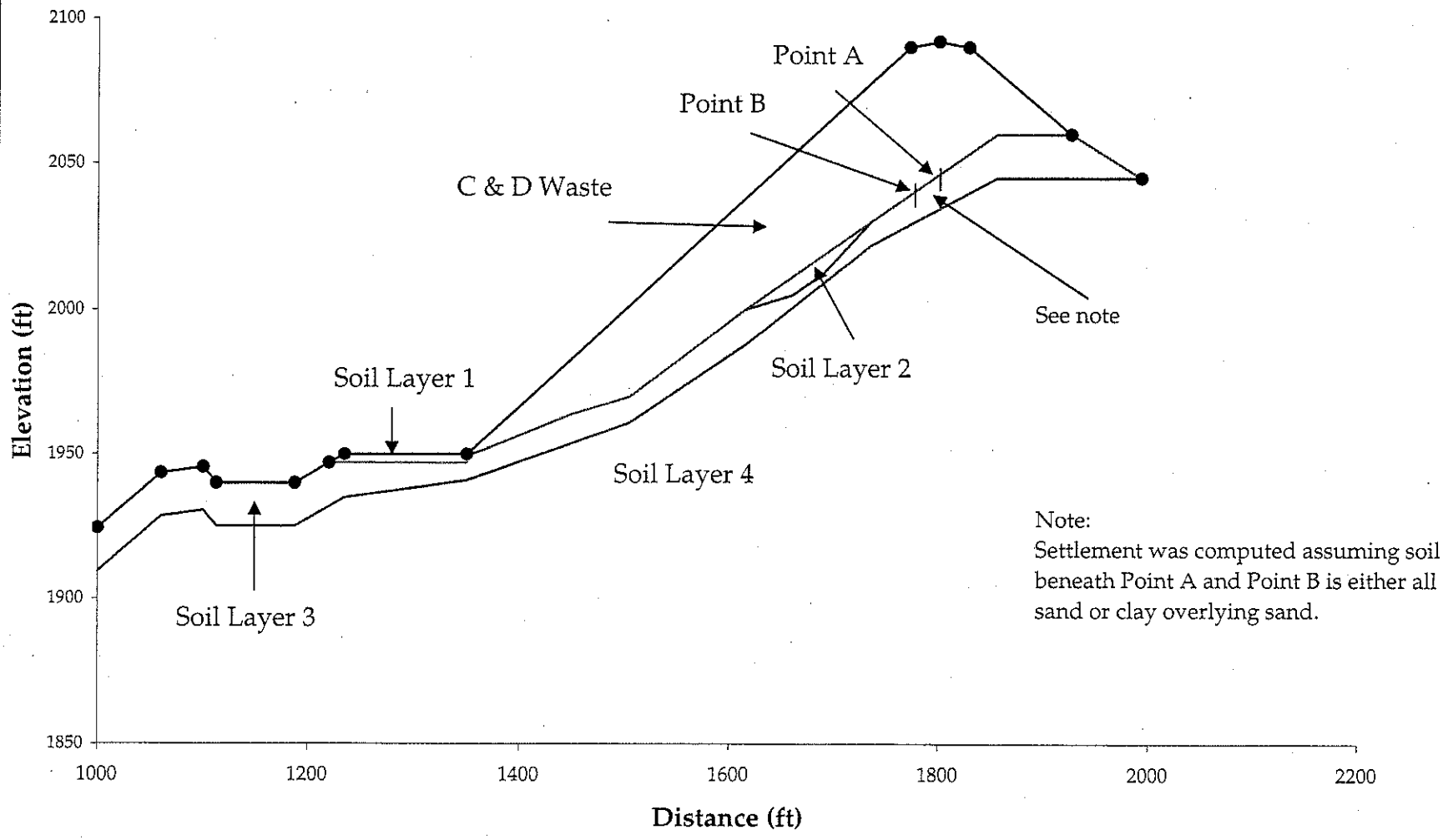


Figure 1: Typical Landfill Cross Section (Cross Section 1)

Attachment A:

Boring Logs

CDM

LOG OF BORING

Project Buncombe Phase IV C&D Exp. Location Alexander, North Carolina
Date Drilled 12-Oct-04 Drilling Co.: MDI, Inc./Reuben Caldwell Drilling, Inc.
Total Depth 46 ft. bls Method Used: 4.25" ID Hollow Stem Auger/6" Air Rotary
Inspector Brian Goodman

BORING **B-602**
Page 1 of 1
Job #: 6447-
Water elev: 42 ft (0 hr)

Depth (feet)	Sample No.	Blows/6" 140 lbs.	Sample Inter.	Recover (inches)	Org. Vap (ppm)	Sample Description	Strata Change	Remarks (time)
5	1	17-20-27	3.5-5	18	NA	-Dry, dark brown/orange/black, silty sand saprolite.		
10	2	41-50/3	8.5-10	9	NA	-Dry, dark brown/orange/black, silty sand		
15						**Auger Refusal at 10.5' bls** Boring completed with Air Rotary Boring terminated below water bearing fracture at 46' bls.		
20								
25								
30								
35								
40								
45								
50								
55								
60								
65								

CDM

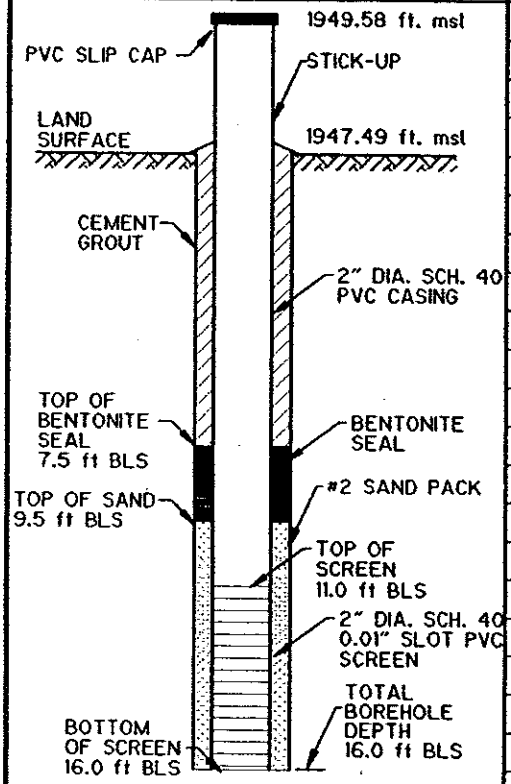
LOG OF BORING

Project Buncombe Phase IV C&D Exp. Location Alexander, North Carolina
Date Drilled 12-Oct-04 Drilling Co.: MDI, Inc.
Total Depth 5.5 ft. bls Method Used: 4.25" ID Hollow Stem Auger
Inspector Brian Goodman

BORING **B-604**
Page 1 of 1
Job #: 6447-
Water elev: dry (0 hr)

Depth (feet)	Sample No.	Blows/6" 140 lbs.	Sample Inter.	Recover (inches)	Org. Vap (ppm)	Sample Description	Strata Change	Remarks (time)
5	1	18-31-50/3	3.5-5	15	NA	-Dry, tan to white, silty sand (PWR) some micaceous material		
10						**Auger Refusal at 5.5' bls** Abandoned boring with cuttings.		
15								
20								
25								
30								
35								
40								
45								
50								
55								
60								
65								

PROJECT		INSTALLATION DATE	SHEET
BUNCOMBE COUNTY C & D LANDFILL		03-13-97	1 OF 1
		DRILLING CONTRACTOR	
		RUBEN CALDWELL DRILLING	
PIEZOMETER/BORING No.	DRILLING METHOD	DRILLER	
B-401	AIR ROTARY	JEFF WALDROUP	
GEOLOGIST	CONSULTANT	SAMPLING METHOD	
DAVID R. ROJAS	CAMP DRESSER & McKEE INC	DRILL CUTTINGS	



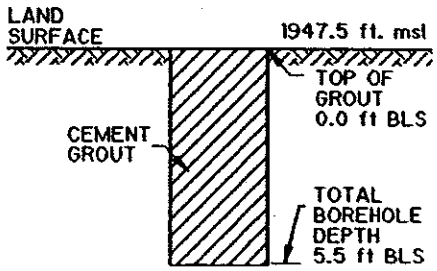
DEPTH FEET	Lithology	Split Spoon Sample	Blow Counts	Recovery Ft./Ft.	SAMPLE DESCRIPTION
0					
		DRILL CUTTINGS			0'-3' CLAYEY SILT, MEDIUM BROWN TO ORANGISH BROWN, SOFT, CRUMBLY, MOIST, SLIGHTLY MICACEOUS.
5		DRILL CUTTINGS			3'-6' SILTY SAND, BROWNISH GRAY TO BROWN, FINE- TO MEDIUM-GRAINED, OCASIONAL PINK FELDSPAR AND QUARTZ ROCK FRAGMENTS, WET
		DRILL CUTTINGS			6'-9' SAND, MEDIUM BROWN, FINE- TO MEDIUM-GRAINED, COMMON ROCK FRAGMENTS. MOIST TO WET.
10		DRILL CUTTINGS			9'-16' SAND (GRANITIC GNEISS), LIGHT GRAY, FINE- TO COARSE-GRAINED, COMMON ROCK FRAGMENTS INCREASING IN OCCURANCE AT DRILLING BREAK FROM 11.5' TO 12' BLS. WATER SPRAY AND WET CUTTINGS TO SURFACE DURING DRILLING BREAK.
15					
20					
25					
30					

TOP OF CASING	1949.58 FEET ABOVE MEAN SEA LEVEL	BOREHOLE DIAMETER	6.125 Inches
CASING	2 Inch DIAMETER SCHEDULE 40 PVC	STATIC WATER LEVEL	03-14-97 8.44 ft BTOC 6.35 ft BLS
SCREEN LENGTH	5 feet		
SCREEN SLOT SIZE	0.01 Inch		

David Rojas 0:40:22 03/24/97 01B-401 N:\BUNCOMBE\

PROJECT	INSTALLATION DATE	SHEET
BUNCOMBE COUNTY C & D LANDFILL	03-17-97	1 OF 1
	DRILLING CONTRACTOR: GEOLOGIC EXPLORATION	
PIEZOMETER/BORING No.: B-401H	DRILLING METHOD: HOLLOW STEM AUGER	DRILLER: MIKE MCCONAHEY
GEOLOGIST: DAVID R. ROJAS	CONSULTANT: CAMP DRESSER & McKEE INC	SAMPLING METHOD: SPLIT SPOON SAMPLING

PIEZOMETER DETAIL

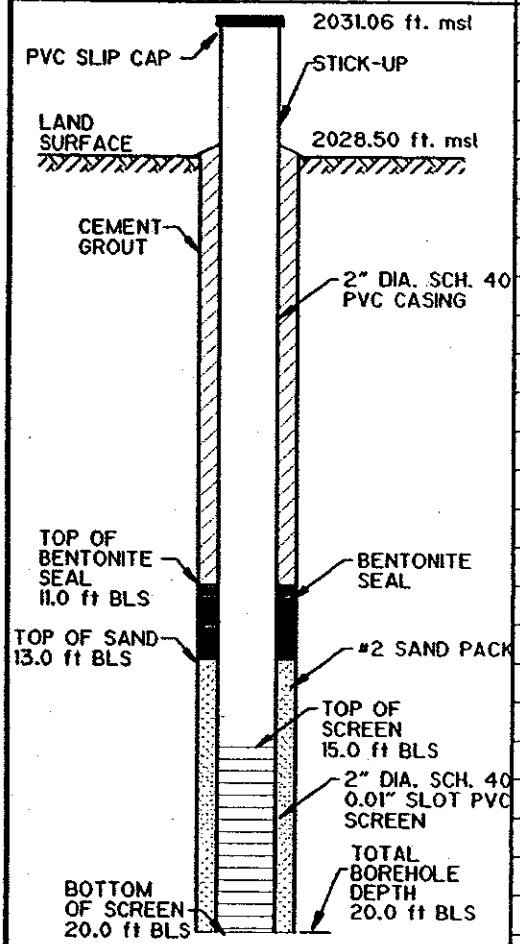


DEPTH FEET	Lithology	Split Spoon Sample	Blow Counts	Recovery Ft./Ft.	SAMPLE DESCRIPTION
0					
		DRILL CUTTINGS	- -	- -	0'-3' CLAYEY SILT, MEDIUM BROWN TO ORANGISH BROWN, SOFT, SLIGHTLY MICACEOUS, SLIGHTLY MOIST TO WET.
			1.1.3. 50/.3'	1.4'/1.8'	3'-4.5' SILTY SAND, YELLOWISH BROWN TO ORANGISH BROWN, FINE- TO MEDIUM-GRAINED, SLIGHTLY MICACEOUS, WET TO VERY DAMP.
5		D.C.	- -	- -	4.5'-5.5' SAND (PARTIALLY WEATHERED ROCK), REDDISH BROWN TO ORANGISH BROWN, FINE- TO MEDIUM-GRAINED, RELIC ROCK TEXTURE, SLIGHTLY MICACEOUS, GRANITIC GNEISS ROCK FRAGMENTS AT BASE OF ZONE.
					HOLLOW STEM AUGER REFUSAL AT 5.5' BLS. (BEDROCK)
10					
15					
20					
25					
30					

TOP OF CASING	BOREHOLE DIAMETER	SCREEN LENGTH
NOT APPLICABLE	8 Inches	NOT APPLICABLE
CASING	STATIC WATER LEVEL	SCREEN SLOT SIZE
NONE INSTALLED	NOT APPLICABLE	NOT APPLICABLE

David Rojas 03/26/97 1:42:44 01B-401H N:\BU...\MBE\

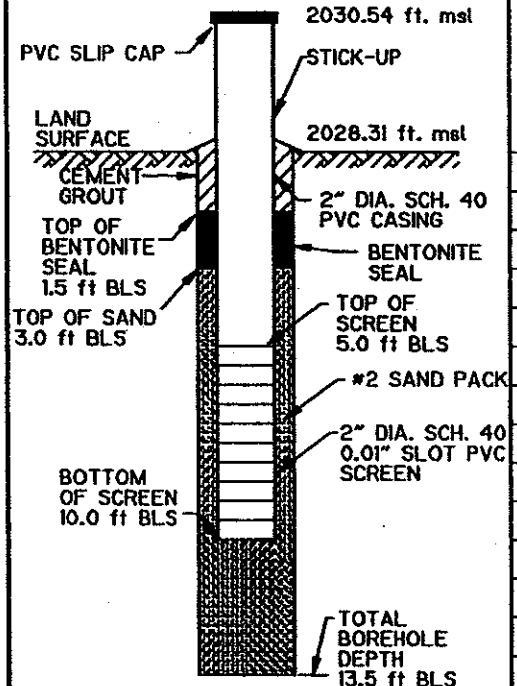
PROJECT	INSTALLATION DATE	SHEET
BUNCOMBE COUNTY C & D LANDFILL	03-12-97	1 OF 1
	DRILLING CONTRACTOR: RUBEN CALDWELL DRILLING	
PIEZOMETER/BORING No.: B-404	DRILLING METHOD: AIR ROTARY	DRILLER: JEFF WALDROUP
GEOLOGIST: DAVID R. ROJAS	CONSULTANT: CAMP DRESSER & McKEE INC	SAMPLING METHOD: DRILL CUTTINGS



DEPTH FEET	Lithology	Split Spoon Sample	Blow Counts	Recovery Ft./Ft.	SAMPLE DESCRIPTION
0					
		DRILL CUTTINGS			0'-5' SILTY CLAY, ORANGISH BROWN TO MEDIUM BROWN, MODERATELY COHESIVE, SLIGHTLY MICACEOUS, OCCASIONAL ROCK FRAGMENTS, MOIST.
5		DRILL CUTTINGS			5'-12' SILTY SAND, DARK YELLOWISH BROWN TO MEDIUM GREENISH BROWN, FINE- TO COARSE-GRAINED, SLIGHTLY CLAYEY, DAMP TO SLIGHTLY MOIST.
10					
15		DRILL CUTTINGS			12'-18' SILT (GRANITIC GNEISS), LIGHT GRAY, OCCASIONAL GNEISS ROCK FRAGMENT, DAMP, NO WET CUTTINGS TO SURFACE. DRILLING BREAKS AT 15' AND 16.1'.
20		D.C.			18'-20' SILT (GRANITIC GNEISS), LIGHT TO MEDIUM GRAY, WET SOUPY CUTTINGS AND WATER TO SURFACE. NO DRILLING BREAKS.
25					
30					

TOP OF CASING: 2031.06 FEET ABOVE MEAN SEA LEVEL	BOREHOLE DIAMETER: 6.125 Inches	SCREEN LENGTH: 5 feet
CASING: 2 Inch DIAMETER SCHEDULE 40 PVC	STATIC WATER LEVEL: 03-13-97 8.73 ft BTOC 6.17 ft BLS	SCREEN SLOT SIZE: 0.01 Inch

PROJECT	INSTALLATION DATE	SHEET
BUNCOMBE COUNTY C & D LANDFILL	03-18-97	1 OF 1
	DRILLING CONTRACTOR: GEOLOGIC EXPLORATION	
PIEZOMETER/BORING No.: B-404H	DRILLING METHOD: HOLLOW STEM AUGER	DRILLER: MIKE MCCONAHEY
GEOLOGIST: DAVID R. ROJAS	CONSULTANT: CAMP DRESSER & McKEE INC	SAMPLING METHOD: SPLIT SPOON SAMPLING



DEPTH FEET	Lithology	Split Spoon Sample	Blow Counts	Recovery Ft./Ft.	SAMPLE DESCRIPTION
0		DRILL CUTTINGS	--	--	0'-3.5' SILTY CLAY, ORANGISH BROWN TO MEDIUM BROWN, MODERATELY COHESIVE, SLIGHTLY MICACEOUS, OCCASIONAL ROCK FRAGMENTS, MOIST.
5			9,10, 10,16	1.4'/2.0'	3.5'-7.5' SILTY SAND, ORANGISH BROWN BECOMING GOLDEN BROWN WITH DEPTH, SLIGHTLY TO MODERATELY MICACEOUS, FINE- TO COARSE-GRAINED, SLIGHTLY CLAYEY, RELIC FOLIATED ROCK TEXTURE BECOMING MORE PROMINENT WITH DEPTH, MODERATELY MOIST.
			10,16, 21,42	1.7'/2.0'	
			18,29, 50/.3'	2'/1.3'	7.5'-8.0' SAND, DARK GOLDEN BROWN, FINE- TO MEDIUM-GRAINED, OCCASIONAL ROCK FRAGMENTS, RELIC FOLIATED GNEISS ROCK TEXTURE, MODERATELY MICACEOUS, MODERATELY MOIST.
10		DRILL CUTTINGS	--	--	8'-13.5' PARTIALLY WEATHERED GRANITIC GNEISS, GOLDEN BROWN, COMMON ROCK FRAGMENTS, RELIC FOLIATED GNEISS ROCK TEXTURE, SLIGHTLY TO MODERATELY MICACEOUS, MODERATELY MOIST.
15					HOLLOW STEM AUGER REFUSAL AT 13.5' BLS (BEDROCK)
20					
25					
30					

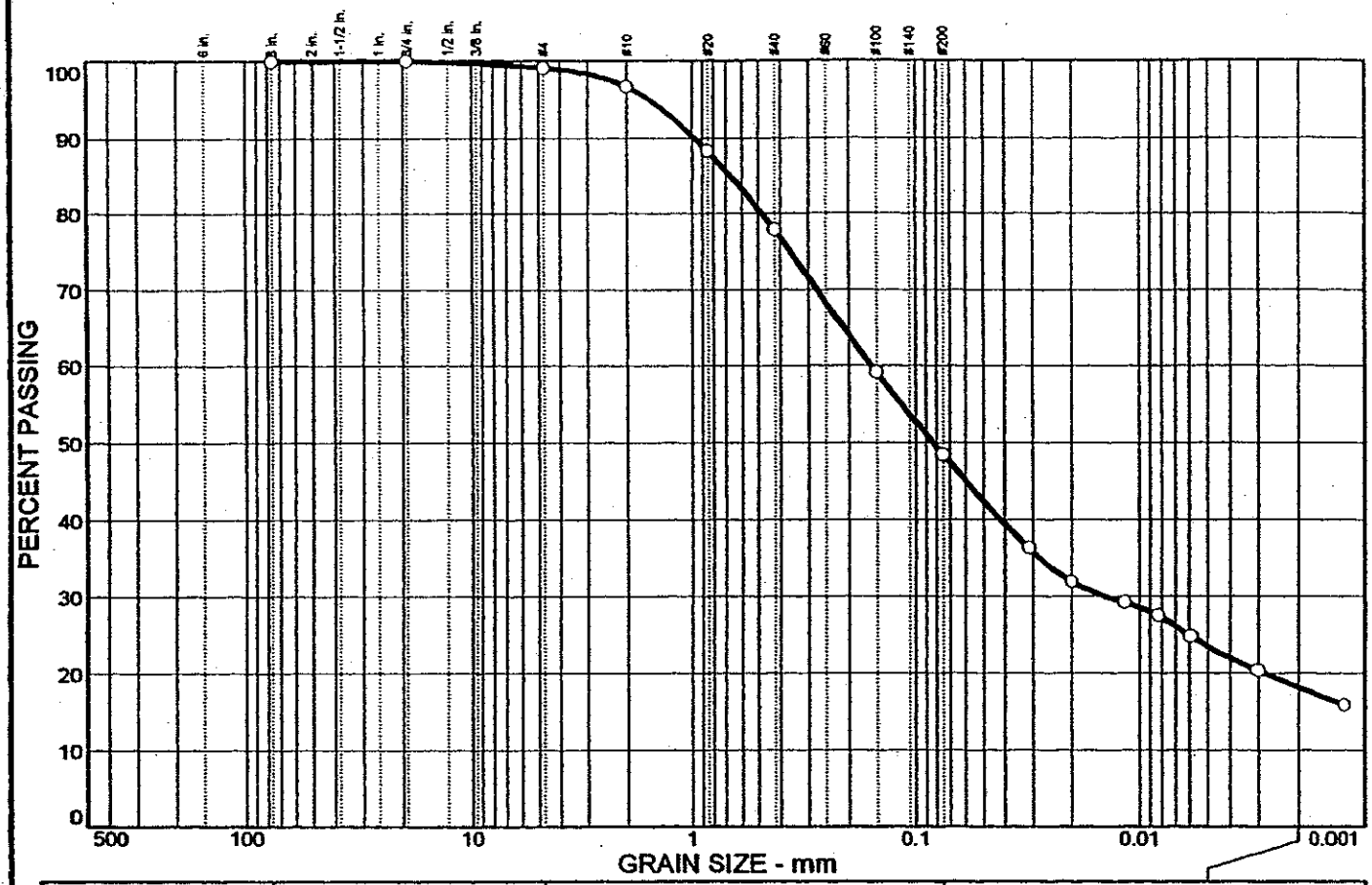
TOP OF CASING: 2030.54 FEET ABOVE MEAN SEA LEVEL	BOREHOLE DIAMETER: 8 inches		SCREEN LENGTH: 5 feet
CASING: 2 inch DIAMETER SCHEDULE 40 PVC	STATIC WATER LEVEL: 03-20-97 5.35 ft BTOC 3.12 ft BLS		SCREEN SLOT SIZE: 0.01 inch

David Rojas 1:20:42 03/27/97 07:28:14 01B-404H N:\BU...dE\

Attachment B:

Laboratory Test Results

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.9	2.4	18.8	29.4	30.3	18.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100.0		
3/4"	100.0		
#4	99.1		
#10	96.7		
#20	88.3		
#40	77.9		
#100	59.2		
#200	48.5		

* (no specification provided)

Soil Description

Clayey sand (SC)

Atterberg Limits

PL= 18 LL= 34 PI= 16

Coefficients

D_{85}= 0.668 D_{60}= 0.157 D_{50}= 0.0830
D_{30}= 0.0143 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SC AASHTO= A-6(4)

Remarks

As Received Moisture Content = 19.9%

Sample No.: P-407 **Source of Sample:** **Test Date:** 4/3/97

Location: **Elev./Depth:** 0ft-10ft

Camp Dresser & McKee Inc. **Geotechnical Engineering Laboratory**	**Client:** Buncombe County **Project:** C & D Landfill **Project No:** 6447-13772-010.RT4.ODC **Plate**

Attachment C:

Historic Groundwater Reading

Groundwater Elevations
Buncombe County Construction and Demolition Landfill

Well	Top of PVC Elevation (feet msl)	Ground Surface Elevation (feet msl)	Groundwater Elevation @TOB (feet msl)	Groundwater Elevation @ 24 hours (feet msl)	Groundwater Elevation 4/30/1997 (feet msl)	Groundwater Elevation 5/5/1999 (feet msl)	Groundwater Elevation 9/13/1999 (feet msl)	Groundwater Elevation 10/29/2001 (feet msl)	Groundwater Elevation 3/7/2002 (feet msl)	Groundwater Elevation 6/26/2002 (feet msl)	Groundwater Elevation 10/14/2004 (feet msl)	Groundwater Elevation 3/3/2005 (feet msl)	Estimated Seasonal High Elevation	Estimated Long-Term Seasonal High
B-227	1853.80	1851.8			1845.48	1845.01	1843.55		1843.75				1846.8	1849.8
B-234	2094.66	2092.7			2044.55	2044.51	2042.41		2034.18				2046.5	2049.5
B-335	2074.68	2071.6			2016.77	NM	NM		NM				2017.8**	2020.8
B-236	2051.88	2050.0			2008.84	NM	NM		NM				2009.4	2012.4
B-361	2018.19	2015.3			1961.70	1961.61	1961.33		NM				1961.70	1964.7
MW-4	1944.35	1942.5			1932.50	1930.92	1929.88		1928.86	1929.94		1935.49	1935.49	1938.5
MW-4d	1944.64	1942.8			1931.69	1929.90	1927.67		1926.96	1928.68		1934.60	1934.60	1937.6
MW-5	1977.12	1975.4			1939.89	1939.61	NM		1937.97	1938.44		1942.05	1942.05	1945.1
MW-5d	1976.92	1975.3			1939.56	1938.37	NM		1936.41	1936.93		1940.48	1940.48	1943.5
MW-6	1987.34	1985.4			1957.68	1957.43	1957.07		1954.18	1954.80		1960.13	1960.13	1963.1
MW-7	2022.83	2020.7			1974.33	1974.47	1974.11		1970.20	1970.59		1974.45	1975.1	1978.1
MW-9	1966.54	1963.5				1950.97	1950.25		1951.65	1951.14		1953.28	1953.28	1956.3
MW-9d	1966.34	1963.3				1950.80	1950.08		1951.52	1951.03		1953.15	1953.15	1956.2
MW-12	1947.39	1944.7	1931.7							1933.54		1940.41	1940.41	1943.4
MW-12d	1947.10	1944.3	1918.3							1930.98		1939.67	1939.67	1942.7
B-401	1949.58	1947.9	1936.0	1941.14	1940.22	NM	NM						1940.22**	1943.2**
B-402	1972.29	1970.0	ND	1964.96	1964.48	NM	NM						1964.48**	1967.5**
B-402H	1972.78	1970.4	ND	1967.66	1967.56	NM	NM						1967.56**	1970.6**
B-403	2019.14	2016.5	1988.5	1988.62	1988.75	NM	NM						1988.75**	1991.8**
B-404	2031.06	2028.5	2010.5	2022.33	2024.02	NM	NM						2024.02**	2027.0**
B-404H	2030.54	2028.5	ND	2025.19	2022.97	NM	NM						2022.97**	2026.0**
B-405	2048.57	2045.5	2011.5	2023.81	2024.21	NM	NM						2024.21	2027.2
B-406	2040.69	2037.0	ND	1971.36	1968.44	NM	NM						1968.44**	1971.4**
B-407	2051.25	2048.5	2020.5	2045.38	2045.45	NM	NM						2045.45	2048.5
B-407H	2051.22	2048.0	ND	2044.64	2045.79	NM	NM						2045.79	2048.8
B-408	2099.07	2096.4	2019.4	2027.70	2027.04	2020.80	NM						2027.04	2030
B-409	2067.87	2065.4	2010.4	2014.62	2015.53	2014.97	2014.36					2012.39	2015.53	2018.5
B-515	2031.78	2028.4	1997.4	2007.11		2007.12	2007.16	2005.61	2003.53			2007.28	2007.28	2010.2
B-516	1993.68	1990.7	1966.1	1965.73		1988.57	1988.46	1980.76	1979.08			1983.49	1988.57	1991.6
B-517	2079.04	2076.2	2009.2	2010.47		2010.47	2022.41	2019.96	2018.45			NM	2022.41	2025.4
B-517d	2078.80	2075.6	1991.6	2007.68		2007.68	2022.16	2019.33	2017.90			NM	2022.16	2025.2
B-518	2005.54	2002.5	1994.5	1999.49		1999.49	1999.11	1999.26	1998.10			1999.05	1999.49	2002.5
B-518d	2005.21	2002.5	1987.5	1988.53				1987.62	1985.71			1990.24	1990.24	1993.2
B-519	1958.36	1955.5	1948.4	1946.25		1951.17	1947.62	1947.65	1947.46			1951.90	1951.17	1954.2
B-519d	1959.11	1956.2	[1]	[1]		[1]	[1]	1956.97	1956.53			1956.61	[1*]	[1*]
B-520	2044.17	2041.5	1959.5	1980.91				1983.27	1982.02			1986.77	1986.77	1989.3
B-521	2005.18	2002.6	1952.6	1964.71				1965.18	1964.88			1973.21	1973.21	1976.2
B-522	2058.81	2055.1	DRY	1995.11				2012.98	2010.61			2014.88	2014.88	2017.9
B-523	2080.42	2077.8	DRY	1987.42				2022.28	2021.03			2022.26	2022.28	2025.3
B-524	2101.58	2098.6	2012.6	2024.30				2023.88	2022.69			NM	2024.3	2027.3
B-525	2061.44	2058.7	2005.7	2019.39				2020.15	2017.01			NM	2020.15	2023.2
B-526	1972.51	1969.5	1931.5	1959.06				1959.43	1958.51			1964.93	1964.93	1967.9
B-527	1976.56	1973.7	1943.7	1951.40				1951.29	1950.34			1958.17	1958.17	1961.2
B-528	1950.28	1947.7	1886.7	1906.93				1909.57	1908.90			1911.26	1911.26	1914.3
B-529	1962.31	1959.6	1933.6	1938.61				1938.79	1937.36			1938.01	1938.79	1941.8
B-530	2045.01	2042.2	DRY	1964.41				1980.46	1977.87			1983.19	1983.19	1986.2
Pumping Well	1955.22	1953.5	1855.5	[1]				[1]	[1]			[1]	[1]	[1]
B-600	2055.38	2052.7	1992.7								2011.61	2010.90	2011.61	2014.6
B-601	2056.24	2053.6	1953.6								1962.15	1963.26	1963.26	1966.3
B-602	1978.36	1975.5	1933.5								1951.83	1955.74	1955.74	1958.7
B-603	2013.61	2011.0	1936.0								1953.21	1953.48	1953.48	1956.5
B-605	1956.60	1954.0	1931.0								1939.20	1942.76	1942.76	1945.8
B-606	2027.09	2024.3	1952.3								1953.48	1952.62	1953.48	1956.5
B-609	1955.19	1952.2	1884.2								1921.83	1923.44	1923.44	1926.4

ND - Not Determined

NM - Not Measured (well abandoned)

TOB - Time of boring

* - Groundwater elevation measured during previous investigations.

** - Groundwater elevation represents highest elevation after well stabilization.

[1] - Piezometer demonstrates artesian characteristics.

[1*] - Piezometer demonstrated artesian characteristics until the installation of the 6" pumping well, approximately 50 feet downgradient.

DENSE FOLIAGE

CELL 1

CELL 2

1" = 100'
50 0 100

LEGEND:

MW-2	MONITORING WELL
B-8	BOREHOLE
B-601	EXISTING PIEZOMETER
B-254	ABANDONED PIEZOMETER
GW-1953.74	GROUNDWATER ELEVATION (DATA COLLECTED 3/3/2005)
CD-1	BOREHOLE INSTALLED MARCH 2002

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: M. COLONE
DRAWN BY: J. KILLINGSWORTH
SHEET CHK'D BY: T. GRANT
CROSS CHK'D BY:
APPROVED BY:
DATE: APRIL 2005

CDM Camp Dresser & McKee
consulting engineering construction operations
5400 Glenwood Avenue, Suite 300
Raleigh, North Carolina 27612
Tel: 919-787-5620 Fax: 919-781-5730

BUNCOMBE COUNTY
NORTH CAROLINA

CONSTRUCTION AND DEMOLITION LANDFILL PHASE IV EXPANSION GEOLOGICAL AND HYDROGEOLOGICAL STUDY

POTENTIOMETRIC CONTOUR MAP

PROJECT NO. 6447-45521
FILE NAME: bunc-cd-potent.dwg

SHEET NO.
3-2

Attachment D:

XSTABL Program Output

Client: Buncombe County
Project: Phase IV C&D
Job Number: 6447-45139

Computed By: ISA
Date: 5/20/2005
Checked By: EDM
Date: 06/01/05

Buncombe County Phase 4 C & D Landfill

Summary of Computed Factors of Safety using XSTABL Program

Computed Factors of Safety	
Cross Section 1 (North to South)	
Failure Surface Type	**Factor of Safety**
Deep Surface Through Foundation Soils	1.6
Shallow Surface Through C & D Waste	1.5

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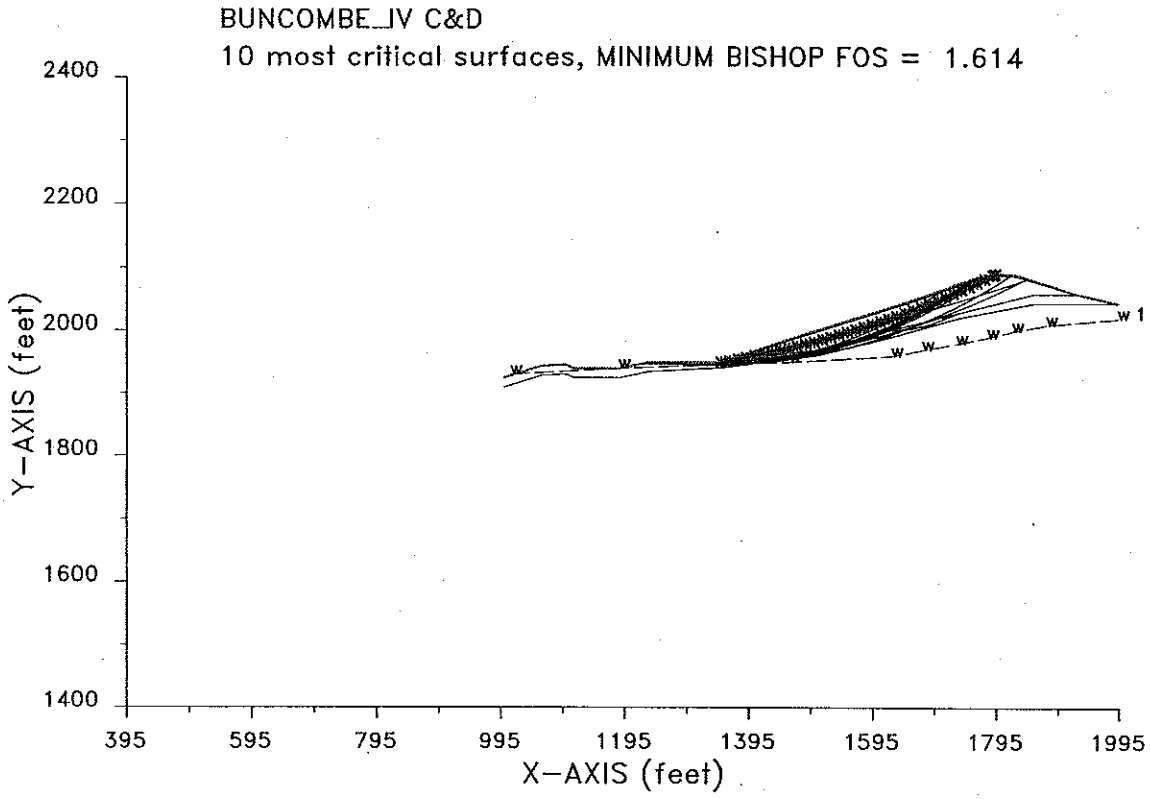

XSTABL File: BUN5 5-27-05 16:22

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*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
*                                       *
*         Copyright (C) 1992 - 99       *
*   Interactive Software Designs, Inc.  *
*        Moscow, ID 83843, U.S.A.       *
*                                       *
*          All Rights Reserved          *
*                                       *
*  Ver. 5.203                96 Ä 1718  *
*****************************************
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Problem Description : BUNCOMBE_IV C&D

SEGMENT BOUNDARY COORDINATES

---

14 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	1000.0	1925.0	1060.0	1943.5	1
2	1060.0	1943.5	1100.0	1945.5	1
3	1100.0	1945.5	1112.5	1940.0	1
4	1112.5	1940.0	1187.5	1940.0	1
5	1187.5	1940.0	1220.0	1947.0	1
6	1220.0	1947.0	1235.0	1950.0	3
7	1235.0	1950.0	1350.0	1950.0	3
8	1350.0	1950.0	1475.0	1992.0	5
9	1475.0	1992.0	1650.0	2047.0	5
10	1650.0	2047.0	1772.0	2090.0	5
11	1772.0	2090.0	1800.0	2092.0	5
12	1800.0	2092.0	1828.0	2090.0	5
13	1828.0	2090.0	1925.0	2060.0	5
14	1925.0	2060.0	1992.0	2045.0	1

30 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	1220.0	1947.0	1350.0	1947.0	1
2	1350.0	1947.0	1352.0	1950.0	1
3	1352.0	1950.0	1475.0	1990.0	6
4	1475.0	1990.0	1650.0	2045.0	6
5	1650.0	2045.0	1772.0	2088.0	6
6	1772.0	2088.0	1800.0	2090.0	6
7	1800.0	2090.0	1828.0	2088.0	6
8	1828.0	2088.0	1923.0	2060.0	6
9	1923.0	2060.0	1925.0	2060.0	6

10	1352.0	1950.0	1362.0	1951.0	1
11	1362.0	1951.0	1450.0	1964.0	1
12	1450.0	1964.0	1505.0	1970.0	1
13	1505.0	1970.0	1615.0	2000.0	1
14	1615.0	2000.0	1735.0	2030.0	4
15	1735.0	2030.0	1855.0	2060.0	1
16	1855.0	2060.0	1923.0	2060.0	1
17	1615.0	2000.0	1660.0	2005.0	1
18	1660.0	2005.0	1690.0	2012.5	1
19	1690.0	2012.5	1735.0	2030.0	1
20	1000.0	1909.5	1060.0	1928.5	2
21	1060.0	1928.5	1100.0	1930.5	2
22	1100.0	1930.5	1112.5	1925.0	2
23	1112.5	1925.0	1187.5	1925.0	2
24	1187.5	1925.0	1235.0	1935.0	2
25	1235.0	1935.0	1350.0	1941.0	2
26	1350.0	1941.0	1505.0	1961.0	2
27	1505.0	1961.0	1615.0	1988.0	2
28	1615.0	1988.0	1735.0	2022.0	2
29	1735.0	2022.0	1855.0	2045.0	2
30	1855.0	2045.0	1992.0	2045.0	2

ISOTROPIC Soil Parameters
---

6 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	118.0	118.0	.0	35.00	.000	.0	1
2	135.0	135.0	500.0	35.00	.000	.0	1
3	110.0	110.0	.0	28.00	.000	.0	1
4	110.0	110.0	1000.0	.00	.000	.0	1
5	120.0	120.0	.0	32.00	.000	.0	1
6	65.0	65.0	.0	27.50	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 10 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	1010.00	1930.00
2	1185.00	1940.00
3	1460.00	1950.00
4	1625.00	1960.00
5	1675.00	1970.00
6	1730.00	1980.00
7	1780.00	1990.00

8	1820.00	2000.00
9	1875.00	2010.00
10	1992.00	2020.00

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

1000 trial surfaces will be generated and analyzed.

10 Surfaces initiate from each of 100 points equally spaced along the ground surface between x = 1235.0 ft
and x = 1350.0 ft

Each surface terminates between x = 1700.0 ft
and x = 1850.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = 1900.0 ft

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

14.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -40.0 degrees
Upper angular limit := (slope angle - 5.0) degrees

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 35 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	1350.00	1950.00
2	1363.79	1952.42
3	1377.56	1954.95
4	1391.31	1957.60

		BUN5
5	1405.03	1960.36
6	1418.73	1963.24
7	1432.41	1966.23
8	1446.06	1969.34
9	1459.68	1972.57
10	1473.28	1975.91
11	1486.85	1979.36
12	1500.38	1982.93
13	1513.89	1986.61
14	1527.37	1990.41
15	1540.81	1994.32
16	1554.22	1998.34
17	1567.59	2002.47
18	1580.93	2006.72
19	1594.24	2011.08
20	1607.51	2015.55
21	1620.73	2020.13
22	1633.92	2024.83
23	1647.07	2029.63
24	1660.18	2034.55
25	1673.25	2039.57
26	1686.27	2044.71
27	1699.25	2049.95
28	1712.19	2055.31
29	1725.08	2060.77
30	1737.92	2066.34
31	1750.72	2072.02
32	1763.47	2077.81
33	1776.17	2083.70
34	1788.81	2089.70
35	1792.43	2091.46

**** Simplified BISHOP FOS = 1.614 ****

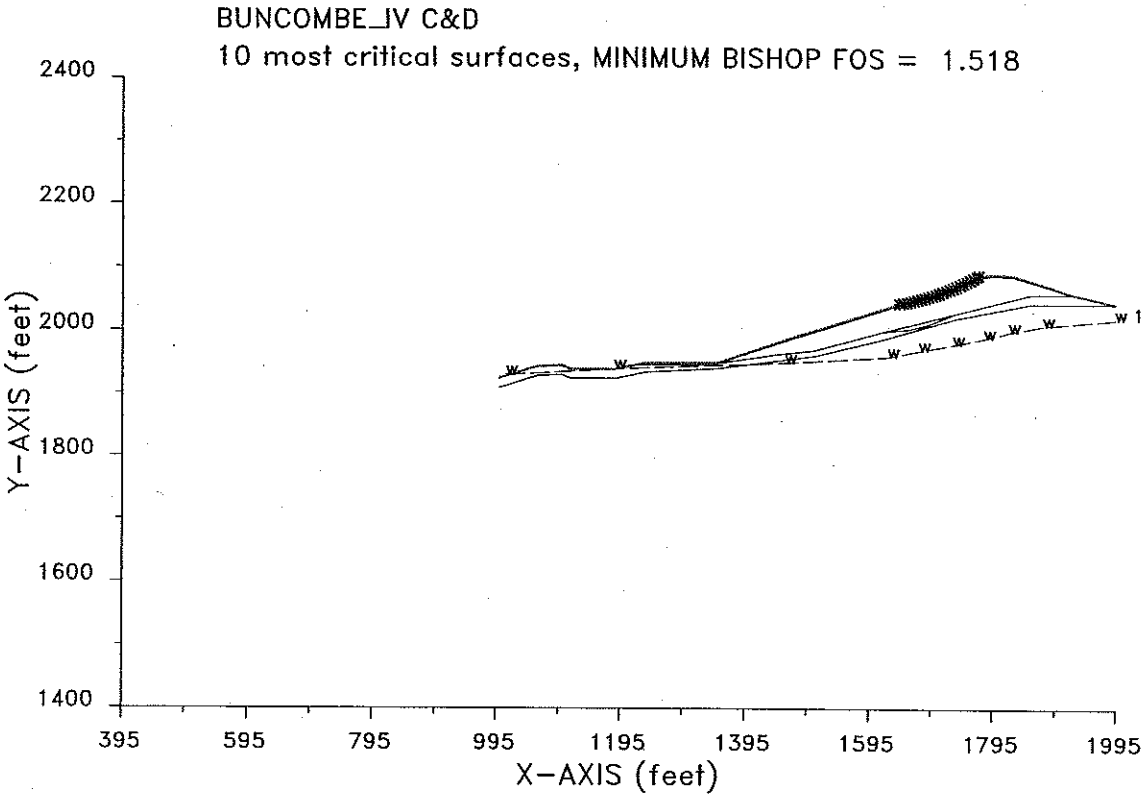
The following is a summary of the TEN most critical surfaces

Problem Description : BUNCOMBE_IV C&D

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.614	1070.09	3588.12	1661.87	1350.00	1792.43	3.515E+08
2.	1.858	375.98	6533.68	4686.02	1350.00	1846.43	1.453E+09
3.	2.106	1279.36	3180.38	1232.40	1350.00	1844.13	7.825E+08
4.	2.108	1329.62	2600.24	653.66	1262.88	1708.42	2.271E+08
5.	2.218	1320.65	2691.59	746.00	1239.65	1751.98	3.354E+08
6.	2.262	1336.88	2693.68	748.08	1255.91	1779.30	4.366E+08
7.	2.286	1327.86	2677.00	732.06	1241.97	1759.15	3.734E+08
8.	2.298	1340.00	2649.54	704.03	1260.56	1763.16	3.853E+08
9.	2.355	1337.56	2817.69	871.86	1252.42	1818.73	6.896E+08
10.	2.367	1330.64	2838.00	892.77	1238.48	1818.85	7.021E+08

* * * END OF FILE * * *

BUN13 5-27-05 16:23



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*****************************************
*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
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```

Problem Description : BUNCOMBE_IV C&D

SEGMENT BOUNDARY COORDINATES

---

14 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	1000.0	1925.0	1060.0	1943.5	1
2	1060.0	1943.5	1100.0	1945.5	1
3	1100.0	1945.5	1112.5	1940.0	1
4	1112.5	1940.0	1187.5	1940.0	1
5	1187.5	1940.0	1220.0	1947.0	1
6	1220.0	1947.0	1235.0	1950.0	3
7	1235.0	1950.0	1350.0	1950.0	3
8	1350.0	1950.0	1475.0	1992.0	5
9	1475.0	1992.0	1650.0	2047.0	5
10	1650.0	2047.0	1772.0	2090.0	5
11	1772.0	2090.0	1800.0	2092.0	5
12	1800.0	2092.0	1828.0	2090.0	5
13	1828.0	2090.0	1925.0	2060.0	5
14	1925.0	2060.0	1992.0	2045.0	1

30 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	1220.0	1947.0	1350.0	1947.0	1
2	1350.0	1947.0	1352.0	1950.0	1
3	1352.0	1950.0	1475.0	1990.0	6
4	1475.0	1990.0	1650.0	2045.0	6
5	1650.0	2045.0	1772.0	2088.0	6
6	1772.0	2088.0	1800.0	2090.0	6
7	1800.0	2090.0	1828.0	2088.0	6
8	1828.0	2088.0	1923.0	2060.0	6
9	1923.0	2060.0	1925.0	2060.0	6

10	1352.0	1950.0	1362.0	1951.0	1
11	1362.0	1951.0	1450.0	1964.0	1
12	1450.0	1964.0	1505.0	1970.0	1
13	1505.0	1970.0	1615.0	2000.0	1
14	1615.0	2000.0	1735.0	2030.0	4
15	1735.0	2030.0	1855.0	2060.0	1
16	1855.0	2060.0	1923.0	2060.0	1
17	1615.0	2000.0	1660.0	2005.0	1
18	1660.0	2005.0	1690.0	2012.5	1
19	1690.0	2012.5	1735.0	2030.0	1
20	1000.0	1909.5	1060.0	1928.5	2
21	1060.0	1928.5	1100.0	1930.5	2
22	1100.0	1930.5	1112.5	1925.0	2
23	1112.5	1925.0	1187.5	1925.0	2
24	1187.5	1925.0	1235.0	1935.0	2
25	1235.0	1935.0	1350.0	1941.0	2
26	1350.0	1941.0	1505.0	1961.0	2
27	1505.0	1961.0	1615.0	1988.0	2
28	1615.0	1988.0	1735.0	2022.0	2
29	1735.0	2022.0	1855.0	2045.0	2
30	1855.0	2045.0	1992.0	2045.0	2

ISOTROPIC Soil Parameters
---

6 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	118.0	118.0	.0	35.00	.000	.0	1
2	135.0	135.0	500.0	35.00	.000	.0	1
3	110.0	110.0	.0	28.00	.000	.0	1
4	110.0	110.0	1000.0	.00	.000	.0	1
5	120.0	120.0	.0	32.00	.000	.0	1
6	65.0	65.0	.0	27.50	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 10 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	1010.00	1930.00
2	1185.00	1940.00
3	1460.00	1950.00
4	1625.00	1960.00
5	1675.00	1970.00
6	1730.00	1980.00
7	1780.00	1990.00

8	1820.00	2000.00
9	1875.00	2010.00
10	1992.00	2020.00

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

1000 trial surfaces will be generated and analyzed.

10 Surfaces initiate from each of 100 points equally spaced along the ground surface between x = 1600.0 ft
and x = 1670.0 ft

Each surface terminates between x = 1750.0 ft
and x = 1780.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = 1900.0 ft

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

6.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := (slope angle - 5.0) degrees

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 24 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	1643.84	2045.06
2	1649.74	2046.12
3	1655.63	2047.27
4	1661.50	2048.50

		BUN13
5	1667.36	2049.82
6	1673.19	2051.23
7	1679.00	2052.72
8	1684.79	2054.30
9	1690.55	2055.96
10	1696.29	2057.71
11	1702.01	2059.54
12	1707.69	2061.46
13	1713.35	2063.46
14	1718.98	2065.54
15	1724.57	2067.71
16	1730.14	2069.96
17	1735.66	2072.28
18	1741.16	2074.70
19	1746.62	2077.19
20	1752.04	2079.76
21	1757.42	2082.41
22	1762.76	2085.14
23	1768.06	2087.95
24	1771.43	2089.80

**** Simplified BISHOP FOS = 1.518 ****

The following is a summary of the TEN most critical surfaces

Problem Description : BUNCOMBE_IV C&D

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.518	1574.83	2446.46	407.29	1643.84	1771.43	9.140E+06
2.	1.519	1584.85	2417.77	376.92	1646.66	1769.01	8.165E+06
3.	1.521	1536.98	2573.36	538.62	1647.37	1775.05	1.099E+07
4.	1.521	1602.83	2370.84	327.46	1648.79	1770.18	7.799E+06
5.	1.522	1607.23	2380.93	335.13	1657.27	1773.91	7.457E+06
6.	1.522	1553.70	2496.04	460.75	1636.77	1770.64	1.034E+07
7.	1.523	1570.21	2477.80	437.10	1656.56	1772.01	7.462E+06
8.	1.524	1611.27	2354.67	310.19	1649.49	1773.30	8.339E+06
9.	1.525	1602.44	2387.29	341.38	1661.51	1767.02	5.614E+06
10.	1.525	1592.51	2432.69	387.24	1665.05	1772.88	6.320E+06

* * * END OF FILE * * *

Attachment E:

Settlement

Client: Buncombe County
Project: Phase IV C&D
Job Number: 6447-45139

Computed By: ISA
Date: 5/20/2005
Checked By: EDM
Date: 06/01/05

Buncombe County Phase 4 C & D County Landfill
Summary of Settlement Calculations

Location	Waste Thickness (ft)	Settlement (in)	
		With clay layer	Without clay layer
Point A	45	5.9	0.5
Point B	50	7.9	0.8

CDM

CLIENT Buncombe County | JOB NO. 6447-45139 | COMPUTED BY I.S.A.
PROJECT Phase IV C&D Design | DATE CHECKED 06/01/05 | DATE 05/20/05
DETAIL Clay layer Settlement | CHECKED BY EDM | PAGE NO. 1/2

Primary Consolidation Settlements:

Point A:

Clay layer is assumed to be normally consolidated.

$\sigma_0 = \frac{1}{2} \times 3.5 \times 110 = 192.5$ psf

$\Delta\sigma = 45 \times 65 = 2925$ psf

$C_c = 0.009\,(LL-10)$ (Skempton, 1944; Das, 1997) $\Rightarrow C_c = 0.009(34-10) = 0.22$

$C_c = 0.3(e_0 - 0.27)$ (Hough, 1957; Das 1997) $\Rightarrow$ $e_0 = \frac{0.22}{0.3} + 0.27 = 0.99$

$S_c = \frac{C_c}{1+e_0} \times H_0 \times \log \frac{\sigma_0 + \Delta\sigma}{\sigma_0}$

$= 0.11 \times 3.5 \times \log \frac{192.5+2925}{192.5}$

$= 0.47$ ft $= 5.6$ in

Point B:

$\sigma_0 = \frac{1}{2} \times 5 \times 110 = 275$ psf

$\Delta\sigma = 50 \times 65 = 3250$ psf

$S_c = 0.11 \times 5 \times \log \frac{275+3250}{275}$

$= 0.61$ ft $= 7.3$ in

CDM

CLIENT Buncombe County
PROJECT Phase IV, C&D Design
DETAIL Total Settlements

JOB NO. 6447-45139
DATE CHECKED 06/01/09
CHECKED BY EDM

COMPUTED BY I.S.A.
DATE 05/20/05
PAGE NO. 2/2

Total Settlements: See attached calculations for sand layer settlement.

Point A: $\delta_T = \delta_c + \delta_i$

$= 5.6 + 0.3$

$= 5.9$ in

Point B: $\delta_T = 7.3 + 0.6$

$= 7.9$ in

CLIENT:	Buncombe County	JOB NO:	6447-45139	COMP BY:	ISA
PROJECT:	Buncombe County C & D Landfill	DATE CHK:	06/01/05	DATE:	5/20/05
DETAIL:	Schmertmann Settlement Analysis	CHECK BY:	EDM	PAGE NO:	1 of 7
FILE NAME:	Point A- Assuming 3.5 ft clay layer				

Purpose: To estimate the amount of foundation settlement due to waste loading.

Problem: Model foundation settlement due to increase in load on foundation soils at point A

Reference: 1. Schmertmann, John "Static Cone To Compare Static Settlement Over Sands", Journal of the Soil Mechanics and Foundations Division, ASCE, May 1970.

2. Schmertmann, John; Hartman, John Paul; Brown, Philip, "Improved Strain Influence Factor Diagrams", Journal of the Soil Mechanics and Foundations Division, ASCE, August 1978.

General Equation:

Soil Information: Summary of Soil Borings

Assumptions: - Triangular strain factor distribution within subsurface soils, i.e. strain = 0 at incompressible boundary.
- Square footing analysis used.
- Depth to embedment = 0, i.e. no stress/strain relief at C1 = 1.
- Assume all split spoon sampling was carried out according to ASTM D1556.
- Soils below the foundation are cohesionless.

CLIENT:	Buncombe County	JOB NO: 6447-45139	COMP BY: ISA
PROJECT:	Buncombe County C & D Landfill	DATE CHK: 06/01/05	DATE: 5/20/05
DETAIL:	Sand Layer Settlement	CHECK BY: EDM	PAGE NO: 2 of 7
FILE NAME:	Point A- Assuming 3.5 ft clay layer		

B-404H		closest boring
N SPT Value	Depth (ft)	
10000	3.5	Clay (Calculated separately)
20	4	
79	0.5	
100	5.5	PWR
D (ft.) =	13.5	

CLIENT:	Buncombe County	JOB NO: 6447-45139	COMP BY: ISA
PROJECT:	Buncombe County C & D Landfill	DATE CHK: 06/01/05	DATE: 5/20/05
DETAIL:	Schmertmann Settlement Analysis	CHECK BY: EDM	PAGE NO: 3 of 7
FILE NAME:	Point A- Assuming 3.5 ft clay layer		

Soil Type:	Silty Sand	(See Reference Page, more conservative to assume all the layers as silty sa
Total Unit Weight:	118	pcf
Effective Unit Weight:	55.6	pcf
Length of Foundation (L) ft.	1000	
Width of Foundation (B) ft.	1000	
L/B	1	
Strain Condition	Axisymmetric	
Compressible Layer Thickness (H) ft.	13.5	(From Boring Logs)
Depth of Influence based on Strain Condition ft.	2000	
Depth of Influence Used for Calculations ft.	13.5	
Max Izp @	3.375	(H/4)
Existing overburden (tsf)	0.19	(clay layer)
Additional Loading (tsf)	1.46	(Based on Additional Load @ Foundation Level)
Izp =	0.78	
Height of C & D	45	ft
Unit Weight of C & D	65	pcf

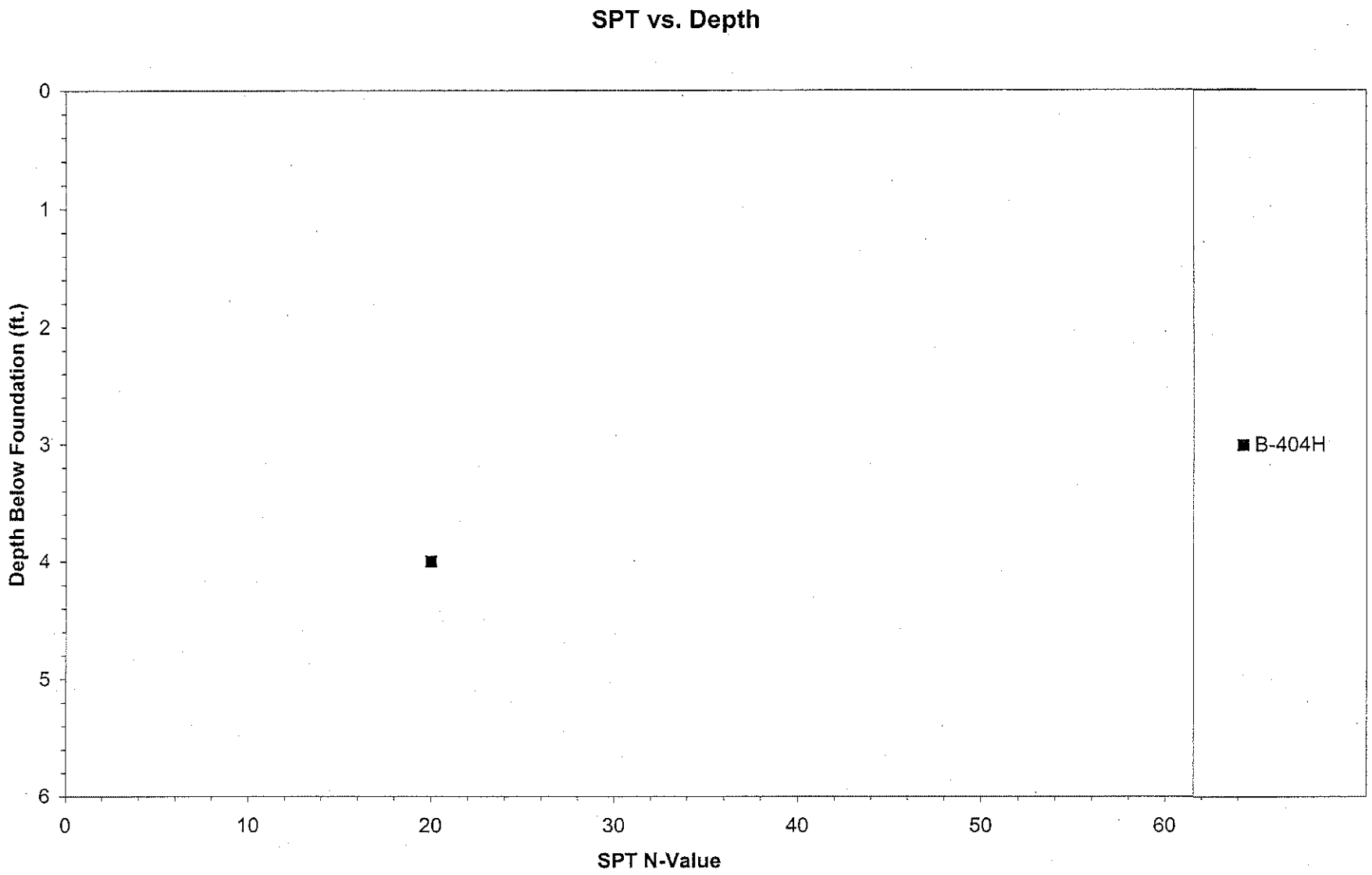
CLIENT:	Buncombe County	**JOB NO:** 6447-45139	**COMP BY:** ISA
PROJECT:	Buncombe County C & D Landfill	**DATE CHK:** 06/01/05	**DATE:** 5/20/05
DETAIL:	Schmertmann Settlement Analysis	**CHECK BY:** EDM	**PAGE NO:** 4 of 7
FILE NAME:	Point A- Assuming 3.5 ft clay layer		

Axisymmetric Strain	
slope =	0.200
slope =	0.077

Plane Strain	
slope =	0.171
slope =	0.077

Increments	Depth (ft.)	Strain Influence
1	1.8	0.45
2	5.5	0.61
3	7.8	0.44
4	10.8	0.21

Plane	Axisymmetric
0.50	0.45
0.61	0.61
0.44	0.44
0.21	0.21


SPT vs. Depth
Depth Below Foundation (ft.)
0
1
2
3
4
5
6
0
10
20
30
40
50
60
SPT N-Value
B-404H

CLIENT:	Buncombe County	**JOB NO:** 6447-45139	**COMP BY:** ISA
PROJECT:	Buncombe County C & D Landfill	**DATE CHK:** 06/01/05	**DATE:** 5/20/05
DETAIL:	Schmertmann Settlement Analysis	**CHECK BY:** EDM	**PAGE NO:** 6 of 7
FILE NAME:	Point A		

Layer	Delta Z	Avg. SPT (1)	Corrected qc (tsf) (2)	Es (tsf) (3)	Depth to Mid Layer	Iz (4)	(Iz/Es)*Delta Z) (5)
1	3.5	10000	27500.00	68750.00	1.75	0.45	0.0000
2	4	20	55.00	137.50	5.50	0.61	0.0178
3	0.5	79	217.25	543.13	7.75	0.44	0.0004
4	5.5	100	275.00	687.50	10.75	0.21	0.0017

Total Settlement/tsf 0.0199 ft/tsf

Notes:

1 Refer to SPT vs. Depth for average N values (not corrected).
2 Refer to reference page for values.
3 Schmertmann correlations modified by Ladd, E_s = average equivalent modulus over depth z for foundation type.
4 Iz obtained from strain influence spreadsheet.
5 Represents the settlement attributed to each layer assuming C_{1and} C_2 equal 1.

Settlements

t =1 years	e =	**0.33**	Inches
t = 10 years	e =	**0.46**	Inches
t = 30 years	e =	**0.49**	Inches

CLIENT:	Buncombe County	JOB NO: 6447-45139	COMP BY: ISA
PROJECT:	Buncombe County C & D Landfill	DATE CHK: 06/01/05	DATE: 5/20/2005
DETAIL:	Schmertmann Settlement Analysis	CHECK BY: EDM	PAGE NO: 7 of 7
FILE NAME:	Point A- Assuming 3.5 ft clay layer		

Soil Type:		
Soil	*q_c/N*	*Description*
Silt	2	Combination of silts, sandy silts, slightly cohesive silts.
Silty Sand	2.75	
Sand	3.5	Slightly silt sand, clean fine to medium sand.

Where: q_c = Average dutch Cone Resistance
N = SPT N value

Strain Condition:		
Strain	*q_c/N*	*Description*
Axisymmetric	2.5	L/B = 1
Plane	3.5	L/B > 10

CLIENT:	Buncombe County	JOB NO:	6447-45139	COMP BY:	ISA
PROJECT:	Buncombe County C & D Landfill	DATE CHK:	06/01/05	DATE:	5/20/05
DETAIL:	Schmertmann Settlement Analysis	CHECK BY:	EDM	PAGE NO:	1 of 7
FILE NAME:	Point B- Assuming 5 ft of clay layer				

Purpose: To estimate the amount of foundation settlement due to waste loading.

Problem: Model foundation settlement due to increase in load on foundation soils at point B

Reference: 1. Schmertmann, John "Static Cone To Compare Static Settlement Over Sands", Journal of the Soil Mechanics and Foundations Division, ASCE, May 1970.

2. Schmertmann, John; Hartman, John Paul; Brown, Philip, "Improved Strain Influence Factor Diagrams", Journal of the Soil Mechanics and Foundations Division, ASCE, August 1978.

General Equation:

Soil Information: Summary of Soil Borings

Assumptions:
- Triangular strain factor distribution within subsurface soils, i.e. strain = 0 at incompressible boundary.
- Square footing analysis used.
- Depth to embedment = 0, i.e. no stress/strain relief at C1 = 1.
- Assume all split spoon sampling was carried out according to ASTM D1556.
- Soils below the foundation are cohesionless.

CLIENT:	Buncombe County	JOB NO: 6447-45139	COMP BY: ISA
PROJECT:	Buncombe County C & D Landfill	DATE CHK: 06/01/05	DATE: 5/20/05
DETAIL:	Sand Layer Settlement	CHECK BY: EDM	PAGE NO: 2 of 7
FILE NAME:	Point B- Assuming 5 ft of clay layer		

B-404		
N SPT Value	Depth (ft)	closest boring
10000	5	Clay (Calculated separately)
20	7	
79	6	
100	2	PWR
D (ft.) =	20.0	

CLIENT:	Buncombe County	JOB NO: 6447-45139	COMP BY: ISA
PROJECT:	Buncombe County C & D Landfill	DATE CHK: 06/01/06	DATE: 5/20/05
DETAIL:	Schmertmann Settlement Analysis	CHECK BY: EDM	PAGE NO: 3 of 7
FILE NAME:	Point B- Assuming 5 ft of clay layer		

Soil Type:	Silty Sand	(See Reference Page, more conservative to assume all the layers as silty sa:
Total Unit Weight:	118	pcf
Effective Unit Weight:	55.6	pcf
Length of Foundation (L) ft.	1000	
Width of Foundation (B) ft.	1000	
L/B	1	
Strain Condition	Axisymmetric	
Compressible Layer Thickness (H) ft.	20	(From Boring Logs)
Depth of Influence based on Strain Condition ft.	2000	
Depth of Influence Used for Calculations ft.	20	
Max Izp @	5	(H/4)
Existing overburden (tsf)	0.28	(clay layer)
Additional Loading (tsf)	1.63	(Based on Additional Load @ Foundation Level)
Izp =	0.74	
Height of C & D	50	ft
Unit Weight of C & D	65	pcf

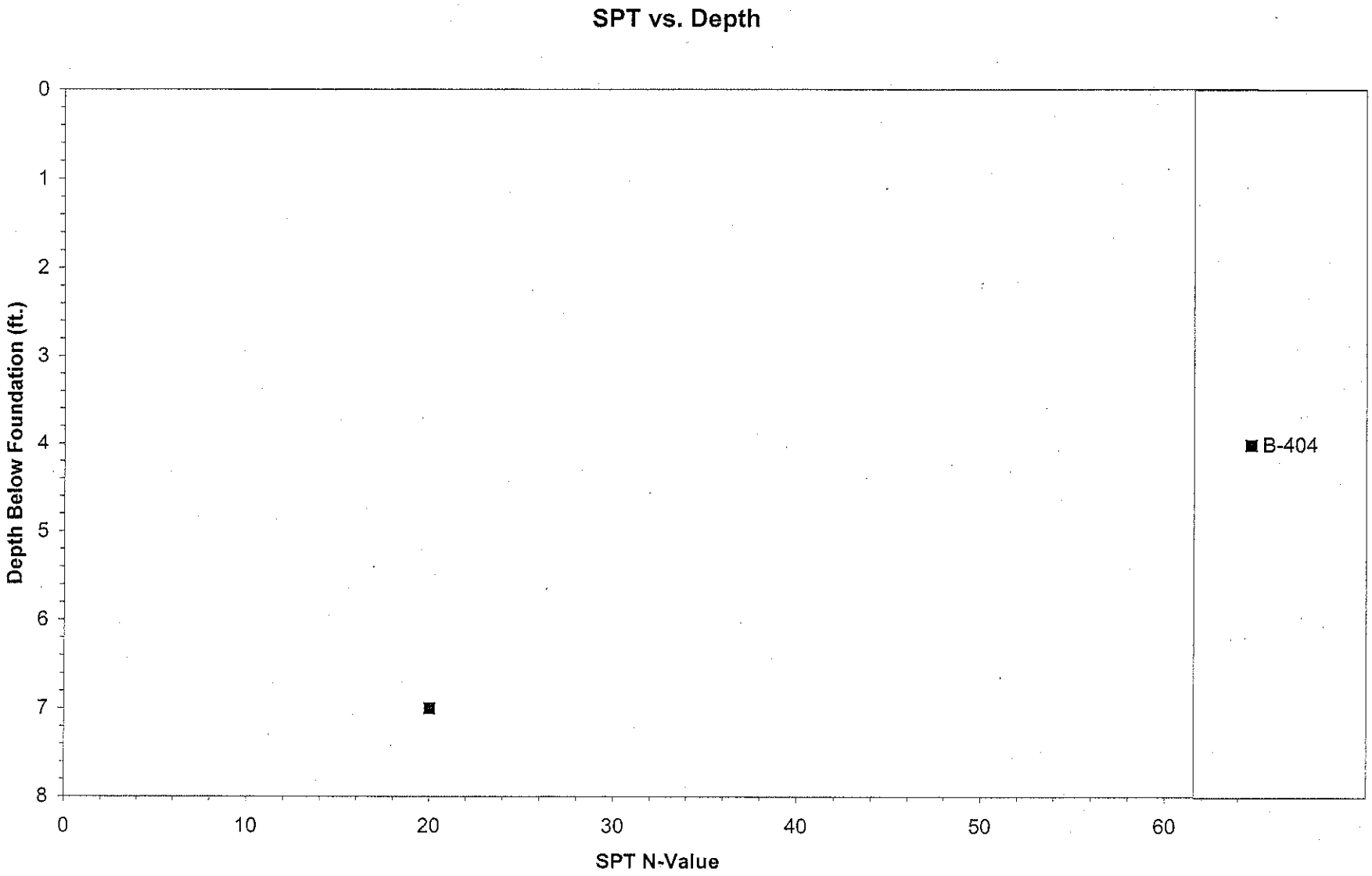
CLIENT:	Buncombe County	**JOB NO:** 6447-45139	**COMP BY:** ISA
PROJECT:	Buncombe County C & D Landfill	**DATE CHK:** 06/01/05	**DATE:** 5/20/05
DETAIL:	Schmertmann Settlement Analysis	**CHECK BY:** EDM	**PAGE NO:** 4 of 7
FILE NAME:	Point B- Assuming 5 ft of clay layer		

Axisymmetric Strain	
slope =	0.129
slope =	0.050

Plane Strain	
slope =	0.109
slope =	0.050

Increments	Depth (ft.)	Strain Influence
1	2.5	0.42
2	8.5	0.57
3	15.0	0.25
4	19.0	0.05

Plane	Axisymmetric
0.47	0.42
0.57	0.57
0.25	0.25
0.05	0.05


SPT vs. Depth
Depth Below Foundation (ft.)
0
1
2
3
4
5
6
7
8
0
10
20
30
40
50
60
SPT N-Value
B-404

Layer	Delta Z	Avg. SPT (1)	Corrected qc (tsf) (2)	Es (tsf) (3)	Depth to Mid Layer	Iz (4)	(Iz/Es)*Delta Z) (5)
1	5	10000	27500.00	68750.00	2.50	0.42	0.0000
2	7	20	55.00	137.50	8.50	0.57	0.0290
3	6	79	217.25	543.13	15.00	0.25	0.0027
4	2	100	275.00	687.50	19.00	0.05	0.0001

Total Settlement/tsf 0.0319 ft/tsf

Notes:

1 Refer to SPT vs. Depth for average N values (not corrected).
2 Refer to reference page for values.
3 Schmertmann correlations modified by Ladd, E_s = average equivalent modulus over depth z for foundation type.
4 Iz obtained from strain influence spreadsheet.
5 Represents the settlement attributed to each layer assuming C_{1and} C_2 equal 1.

Settlements

t = 1 years e = **0.57** Inches

t = 10 years e = **0.80** Inches

t = 30 years e = **0.85** Inches

CLIENT:	Buncombe County	JOB NO: 6447-45139	COMP BY: ISA
PROJECT:	Buncombe County C & D Landfill	DATE CHK: 06/01/05	DATE: 5/20/2005
DETAIL:	Schmertmann Settlement Analysis	CHECK BY: EDM	PAGE NO: 7 of 7
FILE NAME:	Point B- Assuming 5 ft of clay layer		

Soil Type:		
Soil	*q_c/N*	*Description*
Silt	2	Combination of silts, sandy silts, slightly cohesive silts.
Silty Sand	2.75	
Sand	3.5	Slightly silt sand, clean fine to medium sand.

Where: q_c = Average dutch Cone Resistance
N = SPT N value

Strain Condition:		
Strain	*q_c/N*	*Description*
Axisymmetric	2.5	L/B = 1
Plane	3.5	L/B > 10

CLIENT:	Buncombe County	JOB NO:	6447-45139	COMP BY:	ISA
PROJECT:	Buncombe County C & D Landfill	DATE CHK:	06/01/05	DATE:	5/20/05
DETAIL:	Schmertmann Settlement Analysis	CHECK BY:	EDM	PAGE NO:	1 of 7
FILE NAME:	Point A- Without clay layer				

Purpose: To estimate the amount of foundation settlement due to waste loading.

Problem: Model foundation settlement due to increase in load on foundation soils at point A

Reference: 1. Schmertmann, John "Static Cone To Compare Static Settlement Over Sands", Journal of the Soil Mechanics and Foundations Division, ASCE, May 1970.

2. Schmertmann, John; Hartman, John Paul; Brown, Philip, "Improved Strain Influence Factor Diagrams", Journal of the Soil Mechanics and Foundations Division, ASCE, August 1978.

General Equation:

Soil Information: Summary of Soil Borings

Assumptions:
- Triangular strain factor distribution within subsurface soils, i.e. strain = 0 at incompressible boundary.
- Square footing analysis used.
- Depth to embedment = 0, i.e. no stress/strain relief at C1 = 1.
- Assume all split spoon sampling was carried out according to ASTM D1556.
- Soils below the foundation are cohesionless.

CLIENT:	Buncombe County	JOB NO: 6447-45139	COMP BY: ISA
PROJECT:	Buncombe County C & D Landfill	DATE CHK: 06/01/05	DATE: 5/20/05
DETAIL:	Sand Layer Settlement	CHECK BY: EDM	PAGE NO: 2 of 7
FILE NAME:	Point A- Without clay layer		

B-404H		closest boring
N SPT Value	Depth (ft)	
20	3.5	
20	4	
79	0.5	
100	5.5	PWR
D (ft.) =	13.5	

CLIENT:	Buncombe County	**JOB NO:** 6447-45139	**COMP BY:** ISA
PROJECT:	Buncombe County C & D Landfill	**DATE CHK:** 06/01/05	**DATE:** 5/20/05
DETAIL:	Schmertmann Settlement Analysis	**CHECK BY:** EDM	**PAGE NO:** 3 of 7
FILE NAME:	Point A- Without clay layer		

Soil Type:	Silty Sand	(See Reference Page, more conservative to assume all the layers as silty sa
Total Unit Weight:	118	pcf
Effective Unit Weight:	55.6	pcf
Length of Foundation (L) ft.	1000	
Width of Foundation (B) ft.	1000	
L/B	1	
Strain Condition	Axisymmetric	
Compressible Layer Thickness (H) ft.	13.5	(From Boring Logs)
Depth of Influence based on Strain Condition ft.	2000	
Depth of Influence Used for Calculations ft.	13.5	
Max Izp @	3.375	(H/4)
Existing overburden (tsf)	0.22	
Additional Loading (tsf)	1.46	(Based on Additional Load @ Foundation Level)
Izp =	0.76	
Height of C & D	45	ft
Unit Weight of C & D	65	pcf

CLIENT:	Buncombe County	**JOB NO:**	6447-45139	**COMP BY:**	ISA
PROJECT:	Buncombe County C & D Landfill	**DATE CHK:**	06/01/05	**DATE:**	5/20/05
DETAIL:	Schmertmann Settlement Analysis	**CHECK BY:**	EDM	**PAGE NO:**	4 of 7
FILE NAME:	Point A- Without clay layer				

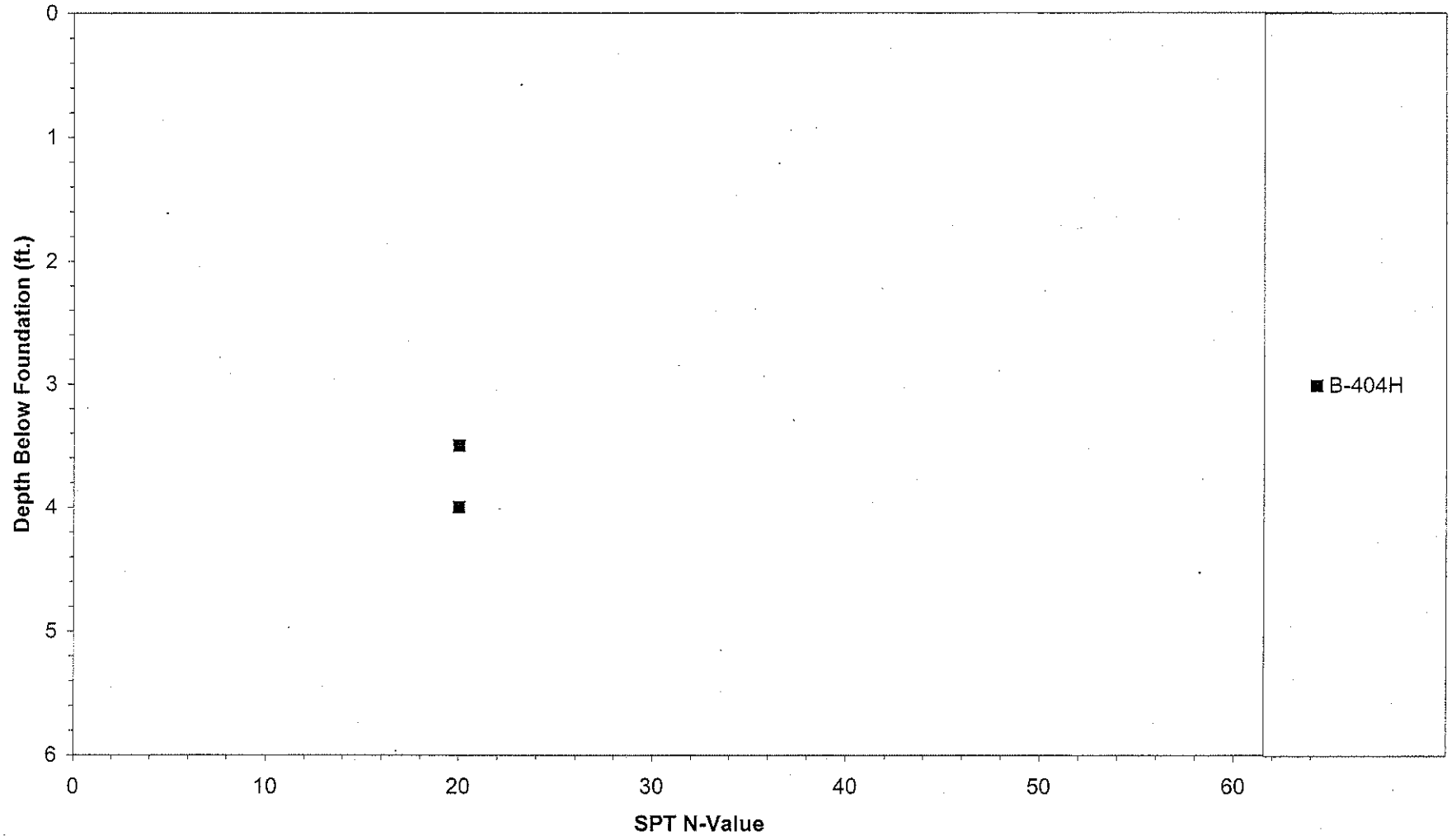
Axisymmetric Strain	
slope =	0.195
slope =	0.075

Plane Strain	
slope =	0.165
slope =	0.075

Increments	Depth (ft.)	Strain Influence
1	1.8	0.44
2	5.5	0.60
3	7.8	0.43
4	10.8	0.21

Plane	Axisymmetric
0.49	0.44
0.60	0.60
0.43	0.43
0.21	0.21

SPT vs. Depth


Depth Below Foundation (ft.)
0
1
2
3
4
5
6
0
10
20
30
40
50
60
SPT N-Value
B-404H

CLIENT:	Buncombe County	**JOB NO:** 6447-45139	**COMP BY:** ISA
PROJECT:	Buncombe County C & D Landfill	**DATE CHK:** 06/01/05	**DATE:** 5/20/05
DETAIL:	Schmertmann Settlement Analysis	**CHECK BY:** EDM	**PAGE NO:** 6 of 7
FILE NAME:	Point A- Without clay layer		

Layer	Delta Z	Avg. SPT (1)	Corrected qc (tsf) (2)	Es (tsf) (3)	Depth to Mid Layer	Iz (4)	(Iz/Es)*Delta Z) (5)
1	3.5	20	55.00	137.50	1.75	0.44	0.0112
2	4	20	55.00	137.50	5.50	0.60	0.0174
3	0.5	79	217.25	543.13	7.75	0.43	0.0004
4	5.5	100	275.00	687.50	10.75	0.21	0.0016

Total Settlement/tsf 0.0307 ft/tsf

Notes:

1 Refer to SPT vs. Depth for average N values (not corrected).
2 Refer to reference page for values.
3 Schmertmann correlations modified by Ladd, E_s = average equivalent modulus over depth z for foundation type.
4 Iz obtained from strain influence spreadsheet.
5 Represents the settlement attributed to each layer assuming C_{1and} C_2 equal 1.

Settlements

t = 1 years e = **0.50** Inches

t = 10 years e = **0.70** Inches

t = 30 years e = **0.75** Inches

CLIENT:	Buncombe County	JOB NO: 6447-45139	COMP BY: ISA
PROJECT:	Buncombe County C & D Landfill	DATE CHK: 06/01/05	DATE: 5/20/2005
DETAIL:	Schmertmann Settlement Analysis	CHECK BY: EDM	PAGE NO: 7 of 7
FILE NAME:	Point A- Without clay layer		

Soil Type:		
Soil	*q_c/N*	*Description*
Silt	2	Combination of silts, sandy silts, slightly cohesive silts.
Silty Sand	2.75	
Sand	3.5	Slightly silt sand, clean fine to medium sand.

Where: q_c = Average dutch Cone Resistance
N = SPT N value

Strain Condition:		
Strain	*q_c/N*	*Description*
Axisymmetric	2.5	L/B = 1
Plane	3.5	L/B > 10

CLIENT:	Buncombe County	JOB NO:	6447-45139	COMP BY:	ISA
PROJECT:	Buncombe County C & D Landfill	DATE CHK:	06/01/05	DATE:	5/20/05
DETAIL:	Schmertmann Settlement Analysis	CHECK BY:	EDM	PAGE NO:	1 of 7
FILE NAME:	Point B- Without clay layer				

Purpose: To estimate the amount of foundation settlement due to waste loading.

Problem: Model foundation settlement due to increase in load on foundation soils at point B

Reference: 1. Schmertmann, John "Static Cone To Compare Static Settlement Over Sands", Journal of the Soil Mechanics and Foundations Division, ASCE, May 1970.

2. Schmertmann, John; Hartman, John Paul; Brown, Philip, "Improved Strain Influence Factor Diagrams", Journal of the Soil Mechanics and Foundations Division, ASCE, August 1978.

General Equation:

Soil Information: Summary of Soil Borings

Assumptions: - Triangular strain factor distribution within subsurface soils, i.e. strain = 0 at incompressible boundary.
- Square footing analysis used.
- Depth to embedment = 0, i.e. no stress/strain relief at C1 = 1.
- Assume all split spoon sampling was carried out according to ASTM D1556.
- Soils below the foundation are cohesionless.

CLIENT:	Buncombe County	JOB NO: 6447-45139	COMP BY: ISA
PROJECT:	Buncombe County C & D Landfill	DATE CHK: 06/01/05	DATE: 5/20/05
DETAIL:	Sand Layer Settlement	CHECK BY: EDM	PAGE NO: 2 of 7
FILE NAME:	Point B- Without clay layer		

B-404		
N SPT Value	Depth (ft)	
20	5	
20	7	
79	6	
100	2	PWR
D (ft.) =	20.0	

closest boring

CLIENT:	Buncombe County	JOB NO: 6447-45139	COMP BY: ISA
PROJECT:	Buncombe County C & D Landfill	DATE CHK: 06/01/05	DATE: 5/20/05
DETAIL:	Schmertmann Settlement Analysis	CHECK BY: EDM	PAGE NO: 3 of 7
FILE NAME:	Point B- Without clay layer		

Soil Type:	Silty Sand	(See Reference Page, more conservative to assume all the layers as silty sa
Total Unit Weight:	118	pcf
Effective Unit Weight:	55.6	pcf
Length of Foundation (L) ft.	1000	
Width of Foundation (B) ft.	1000	
L/B	1	
Strain Condition	Axisymmetric	
Compressible Layer Thickness (H) ft.	20	(From Boring Logs)
Depth of Influence based on Strain Condition ft.	2000	
Depth of Influence Used for Calculations ft.	20	
Max Izp @	5	(H/4)
Existing overburden (tsf)	0.35	(clay layer)
Additional Loading (tsf)	1.63	(Based on Additional Load @ Foundation Level)
Izp =	0.71	
Height of C & D	50	ft
Unit Weight of C & D	65	pcf

CLIENT:	Buncombe County	**JOB NO:**	6447-45139	**COMP BY:**	ISA
PROJECT:	Buncombe County C & D Landfill	**DATE CHK:**	06/01/05	**DATE:**	5/20/05
DETAIL:	Schmertmann Settlement Analysis	**CHECK BY:**	EDM	**PAGE NO:**	4 of 7
FILE NAME:	Point B- Without clay layer				

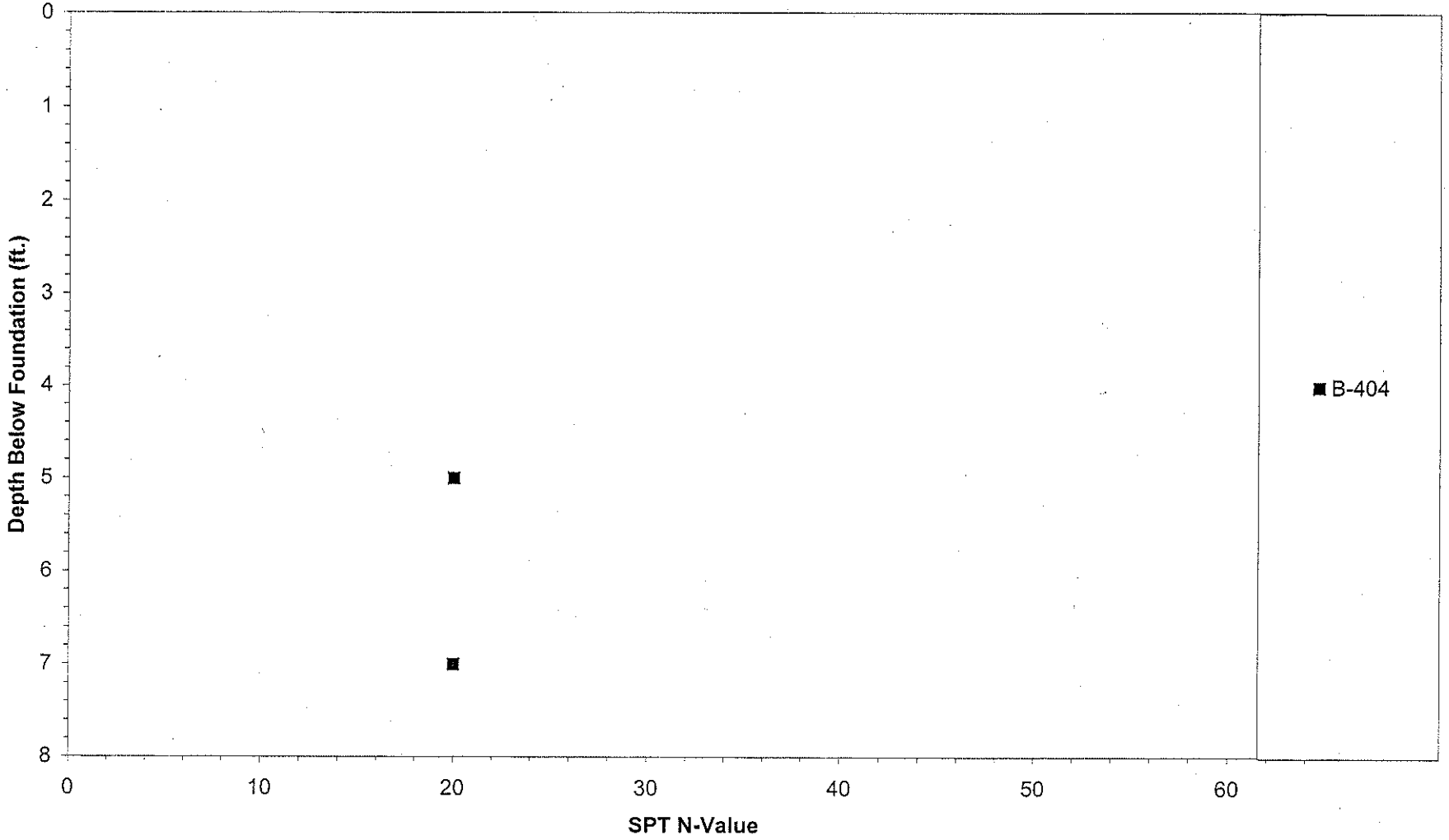
Axisymmetric Strain	
slope =	0.123
slope =	0.048

Plane Strain	
slope =	0.103
slope =	0.048

Increments	Depth (ft.)	Strain Influence
1	2.5	0.41
2	8.5	0.55
3	15.0	0.24
4	19.0	0.05

Plane	Axisymmetric
0.46	0.41
0.55	0.55
0.24	0.24
0.05	0.05

SPT vs. Depth


Depth Below Foundation (ft.)
0
1
2
3
4
5
6
7
8
0
10
20
30
40
50
60
SPT N-Value
B-404

CLIENT:	Buncombe County	**JOB NO:** 6447-45139	**COMP BY:** ISA
PROJECT:	Buncombe County C & D Landfill	**DATE CHK:** 06/01/05	**DATE:** 5/20/05
DETAIL:	Schmertmann Settlement Analysis	**CHECK BY:** EDM	**PAGE NO:** 6 of 7
FILE NAME:	Point B- Without clay layer		

Layer	Delta Z	Avg. SPT (1)	Corrected qc (tsf) (2)	Es (tsf) (3)	Depth to Mid Layer	Iz (4)	(Iz/Es)*Delta Z) (5)
1	5	20	55.00	137.50	2.50	0.41	0.0148
2	7	20	55.00	137.50	8.50	0.55	0.0279
3	6	79	217.25	543.13	15.00	0.24	0.0026
4	2	100	275.00	687.50	19.00	0.05	0.0001

Total Settlement/tsf 0.0455 ft/tsf

Notes:

1 Refer to SPT vs. Depth for average N values (not corrected).
2 Refer to reference page for values.
3 Schmertmann correlations modified by Ladd, E_s = average equivalent modulus over depth z for foundation type.
4 Iz obtained from strain influence spreadsheet.
5 Represents the settlement attributed to each layer assuming C_{1and} C_2 equal 1.

Settlements

t = 1 years e = **0.79** Inches

t = 10 years e = **1.11** Inches

t = 30 years e = **1.18** Inches

CLIENT:	Buncombe County	JOB NO: 6447-45139	COMP BY: ISA
PROJECT:	Buncombe County C & D Landfill	DATE CHK: 06/01/05	DATE: 5/20/2005
DETAIL:	Schmertmann Settlement Analysis	CHECK BY: EDM	PAGE NO: 7 of 7
FILE NAME:	Point B- Without clay layer		

Soil Type:		
Soil	*q_c/N*	*Description*
Silt	2	Combination of silts, sandy silts, slightly cohesive silts.
Silty Sand	2.75	
Sand	3.5	Slightly silt sand, clean fine to medium sand.

Where: q_c = Average dutch Cone Resistance
N = SPT N value

Strain Condition:		
Strain	*q_c/N*	*Description*
Axisymmetric	2.5	L/B = 1
Plane	3.5	L/B > 10