SMITH+GARDNER
ENGINEERS

ADDRESS 14 N. Boylan Avenue, Raleigh NC 27603
TEL 919.828.0577
WEB www.smithgardnerinc.com

Permit No.	Date	Document ID No.
43-03	**April 24, 2015**	**24196**

April 24, 2015

Mr. Ming-Tai Chao, P.E.
Environmental Engineer
NC DENR - Division of Waste Management
1646 Mail Service Center
Raleigh, North Carolina 27699

Received by an e-mail
Date: **April 24, 2015**
Solid Waste Section
Raleigh Central Office

RE: Harnett County Anderson Creek C&DLF (Permit No. 43-03)
Permit to Construct Application
Revised Documents

Dear Mr. Chao:

On behalf of Harnett County and per our meeting on March 24th, Smith Gardner, Inc. (S+G) would like to submit the enclosed revised documents for the referenced permit application. These documents include the following, which are intended to replace the earlier versions of the same documents in their entirety:

- Application Table of Contents and Executive Summary;
- Attachment B: Facility and Engineering Plan;
- Attachment F: Closure and Post-Closure Plan; and
- Attachment J: Permit Drawings.

The revised documents reflect a modified phasing plan for Phase III of the landfill such that the capacity of Phases IIIA through IIID is within the capacity approved in the 2010 local government approval process.

Please contact me at your earliest convenience if you should have any questions or comments on this submittal.

Sincerely,
SMITH GARDNER, INC.

Pieter K. Scheer, P.E.
Vice President, Senior Engineer
pieter@smithgardnerinc.com

Enclosure: Revised Documents

cc: Amanda Bader, P.E., Harnett County
Randy Smith, Harnett County
Andrew Holland, Harnett County

From: Pieter Scheer
To: Chao, Ming-tai
Cc: Amanda Bader; Mussler, Ed; Werner, Elizabeth
Subject: RE: Harnett County - Anderson Creek C&DLF - 2010 Local Govt Approval Documentation
Date: Thursday, March 19, 2015 1:23:15 PM

Ming:

Thanks for the quick feedback. I think we should meet to discuss the best path forward. Amanda and I have some availability next Monday through Wednesday. Is there a best day and time that fits your schedule?

Pieter

Pieter K. Scheer, P.E.
Vice President, Senior Engineer

SMITH + GARDNER

14 N. Boylan Avenue
Raleigh, NC 27603

P (919) **828.0577**
F (919) **828.3899**
C (919) **815.9377**

www.smithgardnerinc.com

From: Chao, Ming-tai [mailto:ming.chao@ncdenr.gov]
Sent: Thursday, March 19, 2015 12:56 PM
To: Pieter Scheer; Amanda Bader (abader@harnett.org)
Cc: Mussler, Ed; Werner, Elizabeth
Subject: RE: Harnett County - Anderson Creek C&DLF - 2010 Local Govt Approval Documentation

Hi Pieter & Amanda:

Thanks for help on this matter. I got a quick review of the attached documents and new PTC-Phase 3 application (DIN 23989)and concluded as follow:

1. The 2010 local government approval of the CDLF (Phase 3) expansion: 20-yr life, additional waste capacity of 377,000 CY with the closure cap elevation of 338 feet amsl.
2. The Facility Plan for the PTC phase 3 in the new submittal date February 2015 (DIN 23989) requests Phase 3 (subdivided into 4 cells –A thru D) with a gross capacity of 652,394 CY with the closure cap elevation of 380 feet amsl (Drawing No. S5).

Evidently, the new PTC is a substantial amendment to the existing permit which will take us a while to get it done properly. The Executive Summary of the new PTC (DIN 23989) indicated that the CDLF will reach its approved capacity in mid of 2015. Now it is the County decision how to proceed the PTC application. Below are my thoughts, please add in any you thoughts so we can come out a solution that is best fit for the County's need.

If we go back the same requests approved in the 2010 local government resolution – item 1 .

- The design hydro is approved in 2013 for the PTC-Phase 3 (DIN 19542). (I assume the waste footprint is the same as 7.5 acres)
- The local government approval is completed.
- The Phase 3 is located in the previously approved facility plan so the processes of public comment on the draft permit is not required.
- The County needs pay the permit amendment fee of $9,000.00 for one PTC & One PTO. The invoice is ready to send pending on the County's decision.
- The County & S+G need to modify the PTC-Phase 3 accordingly, (a lot of material had been done in previously submittal for Phase 2 addition expansion in 2014 can be reused for the new submittal) so that the SWS can conduct a review of the engineering portions of the PTC application in a reasonable short period. Upon completing the review, a PTC-Phase 3 can be issued. CHR approval is required when the PTO is issued.

If the County intends to stay the path and requests a new local government resolutions for both Phases 3 & 4 (item2). Please let me know. The SWS will proceed your request accordingly.

Thanks.

Ming Chao
Ming-Tai Chao, P.E.
Environmental Engineer
Permitting Branch, Solid Waste Section
Division of Waste Management
(Mailing Address)
1646 Mail Service Center
Raleigh, NC 27699-1646
(Street Address)
Green Square, 217 West Jones Street
Raleigh, NC 27603
Tel. 919-707-8251
ming.chao@ncdenr.gov
http://portal.ncdenr.org/web/wm/sw

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From: Pieter Scheer [mailto:pieter@smithgardnerinc.com]
Sent: Thursday, March 19, 2015 11:52 AM
To: Chao, Ming-tai
Cc: Amanda Bader; Scheer, Pieter
Subject: Harnett County - Anderson Creek C&DLF - 2010 Local Govt Approval Documentation

Ming:

Per our discussion, attached is the information from the County's 2010 local government approval process which covered the Phase III expansion which was contained in Appendix I and Appendix IV of CT Clayton's Site Suitability Update and PTC Application for Phase III (Doc ID 19382).

The 2010 approved expansion capacity more than covers IIIA which we would like to construct this year. If we need to amend our request to make it quicker and more cost effective let me know. Of course our intent would be that the planned local government approval process will both update the Phase III capacity as well as approve a future Phase IV.

Let me know what you think once you have reviewed and discussed internally.

Thanks.

Pieter

Pieter K. Scheer, P.E.
Vice President, Senior Engineer

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F (919) **828.3899**
C (919) **815.9377**

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Permit to Construct Application

Harnett County Anderson Creek Landfill Facility
C&D Landfill - Phase IIIA
Harnett County, North Carolina

Prepared for:

Harnett County Solid Waste Department
Lillington, North Carolina

February 2015
Revised: April 2015

Prepared by:

NC LIC. NO. C-0828 (ENGINEERING)

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Permit to Construct Application

Harnett County Anderson Creek Landfill Facility
C&D Landfill - Phase IIIA
Harnett County, North Carolina

Prepared For:

Harnett County Solid Waste Department
Lillington, North Carolina

S+G Project No. HARNETT-AC-14-1

NORTH CAROLINA LICENSED SEAL 1369 GEOLOGIST JOAN A. SMYTH

4/24/15

Joan A. Smyth, P.G.
Senior Hydrogeologist

Pieter K. Scheer, P.E.
Vice President, Senior Engineer

NORTH CAROLINA PROFESSIONAL SEAL 021666 ENGINEER PIETER K. SCHEER

4/24/15

February 2015
Revised: April 2015

NC LIC. NO. C-0828 (ENGINEERING)

SMITH+GARDNER

14 N. Boylan Avenue, Raleigh NC 27603 | 919.828.0577

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Harnett County Anderson Creek Landfill Facility
C&D Landfill - Phase IIIA
Harnett County, North Carolina

Permit to Construct Application

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Attachment B Facility and Engineering Plan
(15A NCAC 13B.0537 and .0539)

Attachment C Technical Specifications
(15A NCAC 13B.0539 and .0540)

Attachment D Construction Quality Assurance Manual
(15A NCAC 13B.0541)

Attachment E Operations Manual
(15A NCAC 13B.0402 and .0542)

Attachment F Closure and Post-Closure Plan
(15A NCAC 13B.0543)

Attachment G Erosion and Sedimentation Control Plan
(15A NCAC 13B.0540 and 15A NCAC 4)

Attachment H Water Quality Monitoring Plan
(15A NCAC 13B.0544)

Attachment I Landfill Gas Monitoring Plan
(15A NCAC 13B.0544)

Attachment J Permit Drawings
(15A NCAC 13B.0537, .0539, .0540, .0542, and .0543)

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EXECUTIVE SUMMARY

General

The following is a Permit to Construct Application submitted on behalf of Harnett County for the construction of Phase IIIA of the County's construction and demolition debris (C&D) landfill at the County's Anderson Creek Landfill facility. This facility is permitted for the disposal of construction and demolition debris (C&D) and the transfer of municipal solid waste (MSW) under Solid Waste Permit Nos. 43-03 (C&D Landfill) and 43-09T (Transfer Station). The County also conducts several other solid waste management activities at the facility.

The existing Phases I & II C&D landfill unit currently occupies approximately 7.5 acres (waste footprint) including a 0.5 acre extension constructed in 2014. Phases I & II are anticipated to have capacity through mid-2015 assuming a disposal rate of 10,000 tons per year (see calculations in Facility and Engineering Plan (**Attachment A**)).

As Phases I & II near capacity, the County plans to develop the Phases III and IV C&D landfill units to the north of Phases I & II and within the current facility boundary. The Phase IIIA landfill unit to be initially developed will occupy approximately 2.1 acres and have a life expectancy of 3.0 years assuming an annual disposal rate of 15,000 tons (see calculations in Facility and Engineering Plan (**Attachment A**)). Note that the gross capacity of Phases III A through D (307,868 CY) proposed in this application is within the gross capacity for Phase III (377,000 CY) approved in the County's most recent local government approval process (2010). Development of additional capacity available in future Phases IIIE (vertical expansion) and IV (lateral expansion) will require a new local government approval. Note also that, although this application shows conceptual base and final grades for Phase IV, a site study and permit to construct application will be submitted in the future for this landfill unit.

Note that characterization of the site was previously performed in 1996 and 2004 and updated by C.T. Clayton, Sr., P.E., Inc. as part of the following document, which was approved on July 31, 2013. This document also includes documentation of the 2010 local government approval for Phase III.

> Site Suitability Update & Permit to Construct Application
> Anderson Creek Landfill Facility - C&D Landfill - Phase III
> NC SWS Permit No. 43-03
> Harnett County, North Carolina
> Dated: June 2013

Additionally, a design hydrogeologic report for Phase III was prepared by C.T. Clayton, Sr., P.E., Inc. as part of the following document, which was approved on August 16, 2013:

> Geologic and Hydrogeologic Report for
> Construction and Demolition Phase III Landfill Expansion
> Anderson Creek Landfill - NC SWS Permit No. 43-03

Harnett County, North Carolina
Dated: March 2013

Attachments

This submittal has been prepared in accordance with the requirements of the North Carolina Solid Waste Management Rules for transfer stations (15A NCAC 13B.0400 et seq.) and C&D landfills (15A NCAC 13B.0531 et seq.), which are enforced by the Division of Waste Management (DWM) of the North Carolina Department of Environment and Natural Resources (DENR). Included in this submittal are the following documents *(with applicable rule(s) in italics)*:

A. General Information

This attachment includes general information related to the facility including contacts, a description of the facility, and property information.

B. Facility and Engineering Plan *(.0537 and .0539)*

The Facility and Engineering Plan presents plans for the development and the engineering design of Phases I-III of the C&D landfill and the conceptual design of future Phase IV. Along with the Technical Specifications and Project Drawings, has been prepared to comply with the requirements of 15A NCAC 13B.0537 and .0539.

C. Technical Specifications *(.0539 and .0540)*

The Technical Specifications provide a detailed description of the materials and construction requirements for components of the subgrade and final cover system for the C&D landfill, and related site development and infrastructure. This document has been prepared to comply with the requirements of 15A NCAC 13B.0539 and .0540.

D. Construction Quality Assurance (CQA) Manual *(.0541)*

The Construction Quality Assurance (CQA) Manual has been prepared to provide the Owner, Engineer, and CQA Engineer the means to govern the construction quality and to satisfy landfill certification requirements under current North Carolina Solid Waste Management rules. This document has been prepared to comply with the requirements of 15A NCAC 13B.0541.

E. Operations Manual *(.0402 and .0542)*

The Operations Manual outlines and describes protocols for facility operation and maintenance and was prepared to provide facility personnel with a clear understanding of how the Design Engineer assumed that the completed facility would be operated. Along with the Project Drawings, the Operations Manual has been prepared to comply

with the requirements of 15A NCAC 13B.0402 and 0542. Note that the operations manual includes information related to all activities at the facility.

F. Closure and Post-Closure Plan *(.0543 and .0546)*

The Closure and Post-Closure Plan was prepared to outline the requirements for closure and post-closure activities at the landfill and includes a cost analysis for each. Along with the Project Drawings, this document has been prepared to comply with the requirements of 15A NCAC 13B.0543 and .0546.

G. Erosion and Sedimentation Control Plan *(.0540 and 15A NCAC 4)*

The Erosion and Sedimentation Control Plan was prepared to describe both initial and long term (final) erosion and sedimentation control measures used at the site. Along with the Project Drawings, this document was prepared to satisfy the requirements of 15A NCAC 13B.0540 and 15A NCAC 4.

H. Water Quality Monitoring Plan *(.0544)*

The Water Quality Monitoring Plan (WQMP) has been updated to reflect current conditions and specifies the procedures and requirements to satisfy the requirements of 15A NCAC 13B.0544. The WQMP has been certified by a Licensed Geologist and includes information related to groundwater monitoring system, sampling and analysis protocols and requirements, and detection monitoring requirements.

I. Landfill Gas Monitoring Plan *(.0544)*

The Landfill Gas (LFG) Monitoring Plan was prepared to specifies the procedures and requirements to satisfy the requirements of 15A NCAC 13B.0544. The LFG Monitoring Plan includes information related to the LFG monitoring system including general monitoring and contingency requirements.

J. Permit Drawings *(.0537, .0539, .0540, .0542, and .0543)*

The Permit Drawings include a site plan, grading plans, phasing plans, cross sections, and details related to the C&D landfill. These drawings have been prepared to comply with the requirements of 15A NCAC 13B.0537, .0539, .0540, and .0543.

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Facility and Engineering Plan

Harnett County Anderson Creek Landfill Facility
Harnett County, North Carolina

Prepared for:

Harnett County Solid Waste Department
Lillington, North Carolina

February 2015
Revised: April 2015

NC LIC. NO. C-0828 (ENGINEERING)

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14 N. Boylan Avenue, Raleigh NC 27603 | 919.828.0577

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Harnett County Anderson Creek Landfill Facility
Harnett County, North Carolina

Facility and Engineering Plan

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APPENDIX

Appendix A Landfill Design Calculations

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1.0 INTRODUCTION

Harnett County, North Carolina (County) currently owns and operates the Anderson Creek Landfill facility at 1086 Poplar Drive in Spring Lake. Access for the facility is and will continue to be off of Poplar Drive. The facility is permitted for the disposal of construction and demolition debris (C&D) and the transfer of municipal solid waste (MSW) under Solid Waste Permit Nos. 43-03 (C&D Landfill) and 43-09T (Transfer Station). The County also conducts several other solid waste management activities at the facility. Refer to **Drawing S1** (Existing Conditions) (**Attachment J**) which shows the existing conditions and **Section 2.1**, which describes facility services.

The County has operated the landfill facility since 1980 (a solid waste permit was issued in 1984). From 1980 up until sometime prior to October 9, 1993, the County disposed of MSW at the site. MSW and C&D waste was disposed of in several unlined disposal units in the southern portion of the site which were closed in accordance with the then current rules.

The existing active C&D landfill unit (Phases I & II) initially received a permit to operate on April 17, 1997. Prior to that time, an unknown quantity of land clearing and inert debris (LCID) generated from Hurricane Fran (September 1996) was disposed of in this area. The Phases I & II C&D landfill unit currently occupies approximately 7.5 acres (waste footprint) which includes a small 0.5 acre lateral expansion which was constructed in 2014. It is the intent of Harnett County to continue to expand the C&D landfill with the development of Phases IIIA and IIIB upon approval of this application (reference **Drawing S2** (Site Development Plan - Base Grades) and **Drawing P1** (Phase III Phasing Plan) (**Attachment J**).

2.0 FACILITY SERVICES AND WASTE STREAM

2.1 Facility Services

Currently, the following activities or services are provided at the Harnett County Anderson Creek Landfill facility as shown on **Drawing S1** (**Attachment J**):

- Scales and scale house
- Maintenance building
- MSW transfer station
- Phases I and II C&D landfill
- Yard waste processing area
- White goods, scrap metal, and consumer electronics handling area; and
- Convenience center:
  - Small MSW loads
  - Recyclables
  - Used tires
  - Used vehicle oil filters
  - Automotive batteries
  - Pallets

- Asphalt shingles.

2.2 Types of Waste

The Harnett County Anderson Creek Landfill facility accepts municipal solid waste (MSW) originating from residential, commercial, and industrial sources, construction and demolition debris (C&D) waste, and other wastes (i.e. white goods and tires). These wastes are segregated and directed to on-site facilities for disposal, transfer, or processing/handling area as described in Section 2.5.

2.3 Disposal Rates and Estimated Variances

Based on Solid Waste Management Annual Reports for the facility, the County disposed of an average of 11,622 tons per year (average of approximately 42 tons per day based on 280 days of operation per year) of C&D over the past five reporting years (FY 2009-10 through FY 2013-14). Minimum and maximum disposal quantities were 9,123 tons (FY 2013-14) and 16,204 tons (FY 2010-11), respectively. As documented during the prior local government approval process, the County has set a maximum disposal rate of 35,000 tons per year for the C&D landfill (average of 125 tons/day based on 280 operating days per year). For purposes of facility life expectancy calculations, disposal rates of 10,000 tons per year (Phases I/II remaining) and 15,000 tons per year (Phase III) were assumed.

2.4 Service Area

The landfill facility currently serves Harnett County.

2.5 Procedures for Waste Segregation

A brief description of procedures for waste segregation at the facility is as follows.

Wastes are segregated at the scale house. Operators at the scale house are trained to classify and segregate the waste stream. MSW and C&D wastes will be directed to the transfer station or C&D landfill unit, respectively. Yard wastes will be directed toward the yard waste processing area. Tires, white goods, and asphalt shingles will be directed to the appropriate processing/handling area where they will be temporarily stockpiled for collection by recycling contractors. Small loads and recyclables will be directed toward the citizen's convenience center.

Employees at the facility are trained in the safety procedures for the handling and detection of illegal waste. The screening of unacceptable waste will be done through the random checking of incoming loads by a County employee at the scale house and at the tipping area. When unacceptable waste is detected at the scale house, the load will be rejected and not permitted into the facility. If hazardous waste is found at the tipping area, identification of the truck or persons will be made (if possible) and documented,

then the hazardous waste will be identified and placed in a hazardous waste container by appropriately trained personnel and taken to a designated hazardous waste staging area for proper disposal. If this occurs, the event will be reported to the appropriate authorities.

Refer also to the facility Operations Manual (**Attachment E**) for more information.

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.

3.0 LANDFILL CAPACITY

3.1 Total Operating Capacity and Life Expectancy

Drawing S2 (Site Development Plan - Base Grades) and **Drawing S3** (Site Development Plan - Final Grades), show subgrade and final cover grades, respectively, for the Phase III C&D landfill unit. The final cover side slopes will be at a 3H to 1V (maximum) slope, then transition at flatter slopes (5 to 8%) to the peak elevations.

The estimated gross and net operating capacities, life expectancies, and areas of existing and planned C&D landfill units are shown in **Table 1**. The net capacity for waste and corresponding life expectancy accounts for periodic cover and/or final cover. As noted in **Section 2.3**, life expectancies were calculated based on a disposal rate of 15,000 tons per year.

Note that the gross capacity of Phases III A through D (307,868 CY) is within the gross capacity for Phase III (377,000 CY) approved in the County's most recent local government approval process (2010).

3.2 Periodic Cover Ratio and Airspace Utilization Factor

The capacities shown in **Table 1** were based on a 10 percent periodic cover ratio and an airspace utilization factor (AUF) of 1,000 pounds per cubic yard (pcy) which are typical for C&D landfills.

Note that changes in landfill operations (i.e. changes in compaction equipment/methods) may affect the values assumed above and, thus, alter the life of the landfill.

4.0 AVAILABLE SOIL RESOURCES AND REQUIRED SOIL QUANTITIES

4.1 Earthwork Quantities

The soils required to construct and operate the existing and planned C&D landfill units will be removed from on-site borrow sources. The soils removed during excavation of landfill units may be used for structural fill, periodic cover, final cover, and general fill. These excavation (cut) and structural fill (fill) volumes are shown in **Table 2**.

4.2 Periodic Cover

Assuming the previously mentioned periodic cover ratio, the required in-place volume for use as periodic cover during operations of the landfill is shown in **Table 2**.

4.3 Vegetative Soil Layer

On the basis of an average 2.0-foot thick vegetative soil layer required for the landfill final cover, the in-place volume required for each landfill unit is shown in **Table 2**.

4.4 Soil Summary

The above soil quantities are summarized in **Table 2**. On-site borrow sources are anticipated to have an adequate supply of soil to meet the needs of Phases I/II and Phase III and a significant portion of Phase IV. Full development of Phase IV would require off-site borrow or the purchase of additional property.

5.0 FACILITY DESIGN CRITERIA

Existing and proposed C&D landfill units were and will be constructed in accordance with Section .0540 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 minimum of 200 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. The proposed design satisfies all buffer requirements.

5.2 Vertical Separation Requirements

The post-settlement bottom elevation of the landfill subgrade will meet the minimum requirement of four (4) feet above the seasonal high groundwater table and bedrock.

6.0 CONTAINMENT AND ENVIRONMENTAL CONTROL SYSTEMS

The following systems and elements are the basic containment and environmental controls for the C&D landfill unit. Technical specifications and construction quality assurance requirements can be found in **Attachments C and D**, respectively.

6.1 Landfill Subgrade and Perimeter Berms

The landfill 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 landfill subgrade 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 the landfill units or imported borrow soils, except that no CH, OL, or OH soils will be allowed.

Per State rules, the upper 2 feet of the landfill subgrade must consist of SC, SM, ML, CL, MH, or CH soils (per Unified Soil Classification System). Verification of this requirement will be performed during construction.

6.2 Final Cover System

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

Regulatory Final Cover System (.0543 (c) (2)):

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

OR

Alternative Final Cover System (.0543 (c)(3)):

Top Slopes (Typically 5 to 8%):

- a 24-inch thick vegetative soil layer;
- a drainage geocomposite (with drainage breaks);
- a 30-mil textured LLDPE geomembrane or geosynthetic clay liner (GCL); and
- a 12-inch thick intermediate cover layer.

Side Slopes (Typically 3H or 4H:1V):

- a 24-inch thick vegetative soil layer.

The final cover system will be placed on prepared intermediate cover at a maximum slope of 3H:1V. Surface water control devices and landfill gas (LFG) wells/vents will also be incorporated into the final cover system. The final cover surface will be vegetated upon completion of the final cover installation according to the project seeding specifications.

A final cover infiltration analysis was performed to demonstrate that the proposed final cover system allows less infiltration than the regulatory final cover system (see **Appendix A**). Note that this permit application assumes the installation of the proposed alternative final cover system.

An analysis of the final cover drainage layer (drainage geocomposite) is provided in **Appendix A**. This analysis focused on determining the required transmissivity to maintain the peak head within the drainage geocomposite. An analysis is also provided in **Appendix A** which shows that the upper geotextile of the drainage geocomposite will perform acceptably as a filter when covered with typical site soils.

6.3 Erosion and Sedimentation Control

Erosion and sedimentation control devices/measures are/will be designed and maintained to manage the run-off generated by the 25-year 24-hour storm event and conform to the requirements of the North Carolina Sedimentation Pollution Control Law (15A, NCAC, 4).

6.4 Landfill Gas Control

The landfill gas (LFG) control system for the C&D landfill will consist of wells and/or vents placed within the waste to capture the gas and passively vent the gas. Wells and/or vents will be placed in conjunction with the final cover system.

6.5 Access and Roadways

The facility is accessed from Poplar Drive. A scale and a scale house are located near this entrance. **Drawing S1** (Existing Conditions) shows this infrastructure.

All-weather access to active areas as well as areas under intermediate cover will be provided. Access roads into the landfill units will be provided where necessary.

7.0 SLOPE STABILITY AND SETTLEMENT

An evaluation of the veneer stability of the final cover system utilizing geosynthetics (top slopes) as well as the slope stability of the overall waste mass of Phases I-III is addressed in **Appendix A**. Additionally, an evaluation of foundation settlement is addressed in **Appendix A**. These analyses indicate that the proposed landfill configuration will be stable and will satisfy applicable regulatory criteria.

Table 1 Total Operating Capacity and Life Expectancy

Unit	Area (Ac.)	Capacity (See Note 1)		Life Expectancy (Years)
		Gross (CY)	Net (Tons)	
Phases I & II (Filled) (as of June 17, 2014)	7.5	477,217	169,365	-----
Phases I & II - Remaining	-----	47,319	11,560	1.2 (See Note 2)
Phase IIIA	2.1	96,412	44,818	3.0
Phase IIIB	1.9	129,114	61,492	4.1
Phase IIIC	1.9	32,887	13,378	0.9
Phase IIID	1.6	49,455	22,146	1.5
Phase IIIE	-----	344,526	172,263	11.5
Phase IV	52.6	6,633,472	3,231,875	215.5
Totals:	67.6	7,810,402	3,726,897	237.7

Notes:

1. The net capacity is based on an assumed 10% periodic cover soil ratio and waste density of 0.5 tons/CY.
2. Life expectancy values are based on assumed average disposal rates of 10,000 tons/year (Phases I/II Remaining) and 15,000 tons/year (Phases III and IV) and are projected from June 17, 2014.

Table 2 Soil Summary

Material	Quantity (CY)			
	Phases I-II (See Note 1)	Phase III	Phase IV	Total
Excavation	-----	107,584	558,599	666,183
Structural Fill	-----	(17,293)	(193,848)	(211,141)
Periodic Cover	(2,312)	(62,820)	(646,375)	(711,507)
Vegetative Soil Layer	(24,200)	(24,200)	(169,723)	(218,123)

Notes:

1. Quantities estimated from June 17, 2014 and include a footprint of 7.5 acres (Phases I-II), 7.5 acres (Phase III) and 52.6 acres (Phase IV).

Appendix A

Landfill Design Calculations

Facility and Engineering Plan
Harnett County Anderson Creek Landfill Facility
Harnett County, North Carolina

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Facility and Engineering Plan
Appendix A: Landfill Design Calculations

Table of Contents

1.0 Quantity Calculations
- Capacity Evaluation (Density & Life Calcs.) (*Revised: April 2015*)
- Earthwork Quantities (*Revised: April 2015*)

2.0 Final Cover Infiltration Analysis
3.0 Final Cover Drainage Layer Analysis
4.0 Filter Geotextile Analysis - Final Cover System
5.0 Final Cover Veneer Stability Evaluation
6.0 Slope Stability Evaluation
7.0 Settlement Evaluation

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SMITH+GARDNER

ADDRESS
14 N. Boylan Avenue, Raleigh, NC 27603

TEL
919.828.0577

WEB
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PROJECT Harnett County AC C&D Landfill

SHEET 1 OF 16

DATE 4/8/2015

COMPUTED BY PKS

SUBJECT Capacity Evaluation (Density & Life)

JOB # HARNETT-AC-14-1

CHECKED BY

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 evalution 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.

PROJECT	**Harnett County Anderson Creek C&D Landfill**	SHEET	2/16
SUBJECT	**Capacity Evaluation - Filling Rate & Density Calculations**	JOB #	HARNETT-AC-14-1
		DATE	4/8/2015
		COMPUTED BY	PKS
		CHECKED BY	

Density and Filling Rate Calculations:

Period of Interest Start Date	End Date	Total Time (years)	Volume Filled (cy)	Quantity of Waste Disposed (tons)	Airspace Utilization Factor (AUF)* (tons/cy)	Cumulative AUF** (tons/cy)	Periodic Cover Assumed %	Periodic Cover Volume (cy)	Waste Volume (cy)	Waste Density*** (tons/cy)	Cumulative Waste Density**** (tons/cy)
4/1/1997	7/16/2013	16.30	461,978	161,032	**0.349**	**0.349**	15	69,297	392,681	**0.410**	**0.410**
7/17/2013	6/17/2014	0.92	15,239	8,333	**0.547**	**0.355**	10	1,524	13,715	**0.608**	**0.417**
Totals:		**17.22**	**477,217**	**169,365**				**70,821**	**406,396**		

Current Cumulative AUF = 0.355 tons/cy

Current Cumulative Waste Density = 0.417 tons/cy

Notes:

*Airspace Utilization Factor = (Tons of Waste Disposed)/(Volume Filled).

**Cumulative AUF = (Total Tons of Waste Disposed)/(Total Volume Filled).

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

****Cumulative Waste Density = (Total Tons of Waste Disposed)/(Total Volume Filled - Total Volume of Periodic Cover).

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PROJECT	**Harnett County Anderson Creek C&D Landfill**	SHEET	3/16
		JOB #	HARNETT-AC-14-1
SUBJECT	**Capacity Evaluation - Phases I & II Remaining**	DATE	4/8/2015
		COMPUTED BY	PKS
		CHECKED BY	

Waste & Periodic Cover Parameters:

Airspace Utilization Factor (AUF) (tcy) = 0.50 (From Filling Rate and Density Calcs.) (Conservative Based on Recent)
Percentage of Periodic Cover = 10

Volume Calculations:

Volume From AutoCAD (cy) = 23,119 (June 17, 2014 Topo. to Top of Intermediate Cover Plus 916 CY Addition due to As-Built Change - Ph. I/II Extn.)

Gross Capacity Remaining (Expansion Volume Plus Final Cover):

Adjustment For Other Layers:

Area of Waste Footprint (Acres) = 7.5

2 feet — Vegetative Soil Layer (CY) = 24,200

Sum (CY) = 24,200

Gross Capacity Remaining (CY) = 47,319

Net (Waste) Capacity:

Adjustment For Other Layers:

Area of Waste Footprint (Acres) = 7.5

2 feet — Vegetative Soil Layer (CY) = (24,200)

Sum (CY) = (24,200)

Volume of Waste and Periodic Cover (cy) = 23,119

Volume of Periodic Cover (cy) = (2,312)

Net (Waste) Capacity (tons) = 11,560

Life Expectancy Calculations:

Start Time	End Time	Tons Disposed	Total Tons	Remainder	
2014.46	2015	5,400	5,400	6,160	
2015	2015.62	5,702	11,102	458	Based on 10,000 Tons per Year

Landfill Life Expectancy (years) = 1.2 August 2015

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PROJECT	**Harnett County Anderson Creek C&D Landfill**	SHEET	4/16
		JOB #	HARNETT-AC-14-1
SUBJECT	**Capacity Evaluation - Phase IIIA**	DATE	4/8/2015
		COMPUTED BY	PKS
		CHECKED BY	

Waste & Periodic Cover Parameters:

Airspace Utilization Factor (AUF) (tcy) =	0.50	(From Filling Rate and Density Calcs.) (Conservative Based on Recent)
Percentage of Periodic Cover =	10	

Volume Calculations:

Volume From AutoCAD (cy) =	89,636	(Subgrade to Top of Intermediate Cover)

Gross Capacity (Volume Above Plus Final Cover):

Adjustment For Other Layers:

	Area of Waste Footprint (Acres) =	2.1
2 feet	Vegetative Soil Layer (CY) =	6,776
	Sum (CY) =	6,776
	Gross Capacity (CY) =	96,412

Net (Waste) Capacity:

Adjustment For Other Layers:

	Area of Waste Footprint (Acres) =	2.1
2 feet	Vegetative Soil Layer (CY) =	(6,776)
	Sum (CY) =	(6,776)
	Volume of Waste and Periodic Cover (cy) =	89,636
	Volume of Periodic Cover (cy) =	(8,964)
	Net (Waste) Capacity (tons) =	44,818

Life Expectancy:

Annual Tons Disposed =	15,000
Life Expectancy (years) =	3.0

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PROJECT	**Harnett County Anderson Creek C&D Landfill**	SHEET	5/16
		JOB #	HARNETT-AC-14-1
SUBJECT	**Capacity Evaluation - Phase IIIB**	DATE	4/8/2015
		COMPUTED BY	PKS
		CHECKED BY	

Waste & Periodic Cover Parameters:

Airspace Utilization Factor (AUF) (tcy) =	0.50	(From Filling Rate and Density Calcs.) (Conservative Based on Recent)
Percentage of Periodic Cover =	10	

Volume Calculations:

Volume From AutoCAD (cy) =	122,983	(Subgrade to Top of Intermediate Cover)

Gross Capacity (Volume Above Plus Final Cover):

Adjustment For Other Layers:

	Area of Waste Footprint (Acres) =	1.9
2 feet	Vegetative Soil Layer (CY) =	6,131
	Sum (CY) =	6,131
	Gross Capacity (CY) =	129,114

Net (Waste) Capacity:

Adjustment For Other Layers:

	Area of Waste Footprint (Acres) =	1.9
2 feet	Vegetative Soil Layer (CY) =	(6,131)
	Sum (CY) =	(6,131)
	Volume of Waste and Periodic Cover (cy) =	122,983
	Volume of Periodic Cover (cy) =	(12,298)
	Net (Waste) Capacity (tons) =	61,492

Life Expectancy:

Annual Tons Disposed =	15,000
Life Expectancy (years) =	4.1

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PROJECT	**Harnett County Anderson Creek C&D Landfill**	SHEET	6/16
		JOB #	HARNETT-AC-14-1
SUBJECT	**Capacity Evaluation - Phase IIIC**	DATE	4/8/2015
		COMPUTED BY	PKS
		CHECKED BY	

Waste & Periodic Cover Parameters:

Airspace Utilization Factor (AUF) (tcy) =	0.50	(From Filling Rate and Density Calcs.) (Conservative Based on Recent)
Percentage of Periodic Cover =	10	

Volume Calculations:

Volume From AutoCAD (cy) =	26,756	(Subgrade to Top of Intermediate Cover)

Gross Capacity (Volume Above Plus Final Cover):

Adjustment For Other Layers:

	Area of Waste Footprint (Acres) =	1.9
2 feet	Vegetative Soil Layer (CY) =	6,131
	Sum (CY) =	6,131
	Gross Capacity (CY) =	32,887

Net (Waste) Capacity:

Adjustment For Other Layers:

	Area of Waste Footprint (Acres) =	1.9
2 feet	Vegetative Soil Layer (CY) =	(6,131)
	Sum (CY) =	(6,131)
	Volume of Waste and Periodic Cover (cy) =	26,756
	Volume of Periodic Cover (cy) =	(2,676)
	Net (Waste) Capacity (tons) =	13,378

Life Expectancy:

Annual Tons Disposed =	15,000
Life Expectancy (years) =	0.9

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PROJECT	**Harnett County Anderson Creek C&D Landfill**	SHEET	7/16
		JOB #	HARNETT-AC-14-1
SUBJECT	**Capacity Evaluation - Phase IIID**	DATE	4/8/2015
		COMPUTED BY	PKS
		CHECKED BY	

Waste & Periodic Cover Parameters:

Airspace Utilization Factor (AUF) (tcy) =	0.50	(From Filling Rate and Density Calcs.) (Conservative Based on Recent)
Percentage of Periodic Cover =	10	

Volume Calculations:

Volume From AutoCAD (cy) =	44,292	(Subgrade to Top of Intermediate Cover)

Gross Capacity (Volume Above Plus Final Cover):

Adjustment For Other Layers:

	Area of Waste Footprint (Acres) =	1.6
2 feet	Vegetative Soil Layer (CY) =	5,163
	Sum (CY) =	5,163
	Gross Capacity (CY) =	49,455

Net (Waste) Capacity:

Adjustment For Other Layers:

	Area of Waste Footprint (Acres) =	1.6
2 feet	Vegetative Soil Layer (CY) =	(5,163)
	Sum (CY) =	(5,163)
	Volume of Waste and Periodic Cover (cy) =	44,292
	Volume of Periodic Cover (cy) =	(4,429)
	Net (Waste) Capacity (tons) =	22,146

Life Expectancy:

Annual Tons Disposed =	15,000
Life Expectancy (years) =	1.5

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PROJECT	**Harnett County Anderson Creek C&D Landfill**	SHEET	8/16
		JOB #	HARNETT-AC-14-1
SUBJECT	**Capacity Evaluation - Phase IIIE**	DATE	4/8/2015
		COMPUTED BY	PKS
		CHECKED BY	

Waste & Periodic Cover Parameters:

Airspace Utilization Factor (AUF) (tcy) =	0.50	(From Filling Rate and Density Calcs.) (Conservative Based on Recent)
Percentage of Periodic Cover =	10	

Volume Calculations:

Volume From AutoCAD (cy) =	344,526	(Phase IIID to Top of Intermediate Cover)

Gross Capacity (Volume Above Plus Final Cover):

Adjustment For Other Layers:

	Area of Waste Footprint (Acres) =	0	Gross Capacity of Phases IIIA - IIID Accounts for all of Phase III
2 feet	Vegetative Soil Layer (CY) =	0	
	Sum (CY) =	0	
	Gross Capacity (CY) =	344,526	

Net (Waste) Capacity:

Adjustment For Other Layers:

	Area of Waste Footprint (Acres) =	0	See Above
2 feet	Vegetative Soil Layer (CY) =	0	
	Sum (CY) =	0	
	Volume of Waste and Periodic Cover (cy) =	344,526	
	Volume of Periodic Cover (cy) =	(34,453)	
	Net (Waste) Capacity (tons) =	172,263	

Life Expectancy:

Annual Tons Disposed =	15,000
Life Expectancy (years) =	11.5

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PROJECT	**Harnett County Anderson Creek C&D Landfill**	SHEET	9/16
		JOB #	HARNETT-AC-14-1
SUBJECT	**Capacity Evaluation - Phase IV**	DATE	4/8/2015
		COMPUTED BY	PKS
		CHECKED BY	

Waste & Periodic Cover Parameters:

Airspace Utilization Factor (AUF) (tcy) =	0.50	(From Filling Rate and Density Calcs.) (Conservative Based on Recent)
Percentage of Periodic Cover =	10	

Volume Calculations:

Volume From AutoCAD (cy) =	6,463,749	(Subgrade to Top of Intermediate Cover Minus Gross Capacity of Phases I/II and III)

Gross Capacity (Volume Above Plus Final Cover):

Adjustment For Other Layers:

	Area of Waste Footprint (Acres) =	52.6
2 feet	Vegetative Soil Layer (CY) =	169,723
	Sum (CY) =	169,723
	Gross Capacity (CY) =	6,633,472

Net (Waste) Capacity:

Adjustment For Other Layers:

	Area of Waste Footprint (Acres) =	52.6
2 feet	Vegetative Soil Layer (CY) =	(169,723)
	Sum (CY) =	(169,723)
	Volume of Waste and Periodic Cover (cy) =	6,463,749
	Volume of Periodic Cover (cy) =	(646,375)
	Net (Waste) Capacity (tons) =	3,231,875

Life Expectancy:

Annual Tons Disposed =	15,000
Life Expectancy (years) =	215.5

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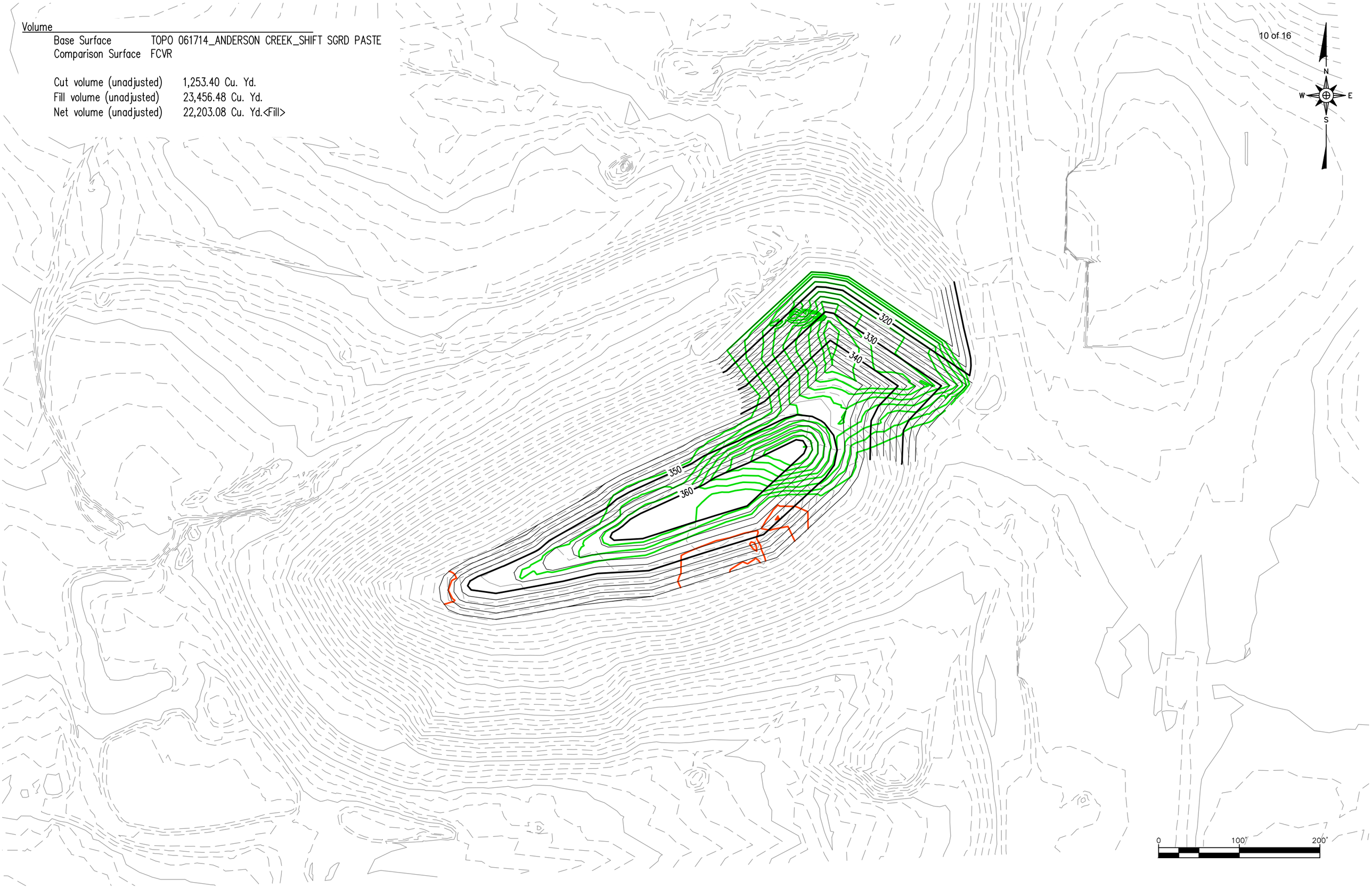
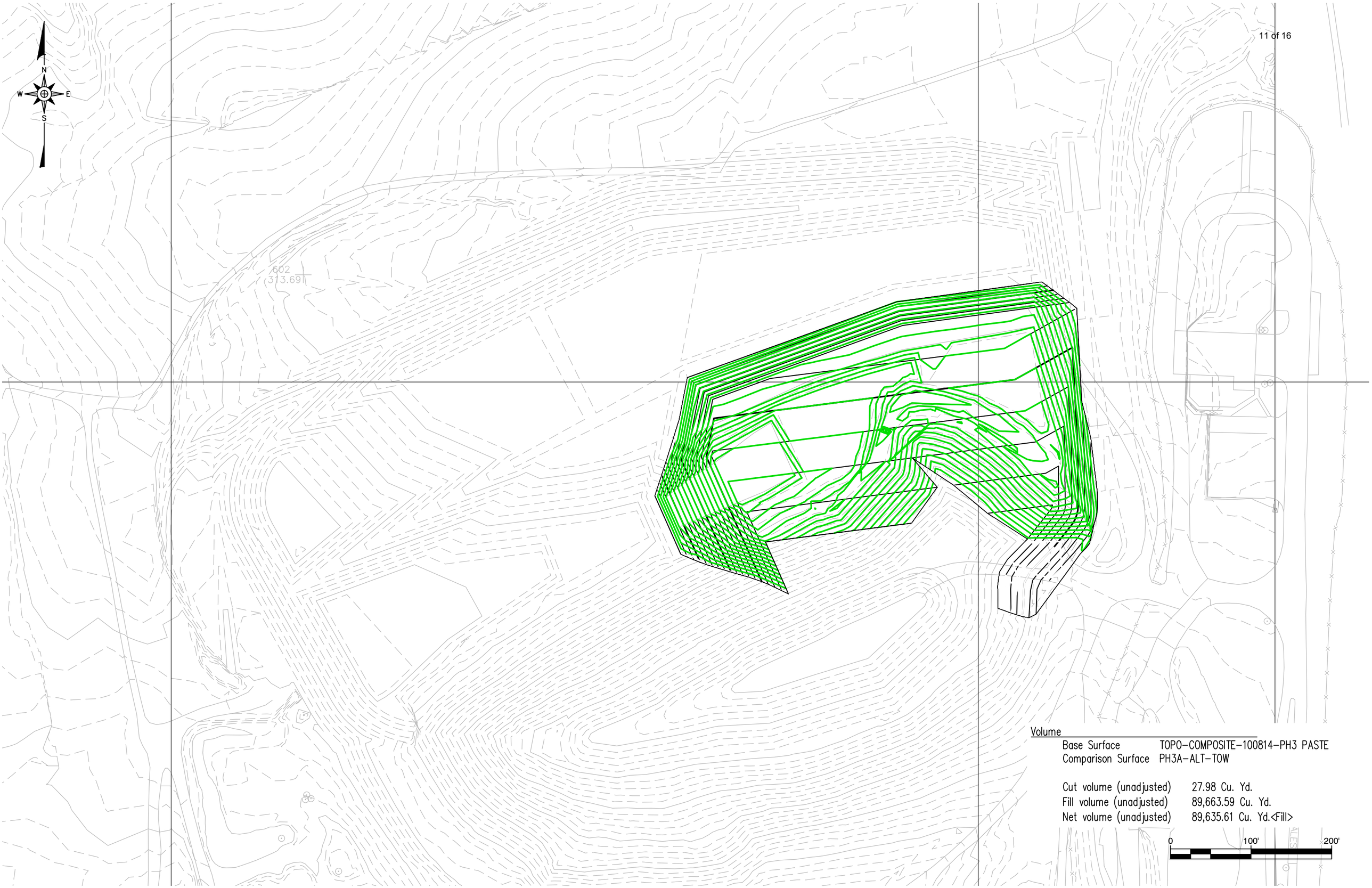
Volume

Base Surface	TOPO 061714_ANDERSON CREEK_SHIFT SGRD PASTE
Comparison Surface	FCVR

Cut volume (unadjusted)	1,253.40 Cu. Yd.
Fill volume (unadjusted)	23,456.48 Cu. Yd.
Net volume (unadjusted)	22,203.08 Cu. Yd.<Fill>

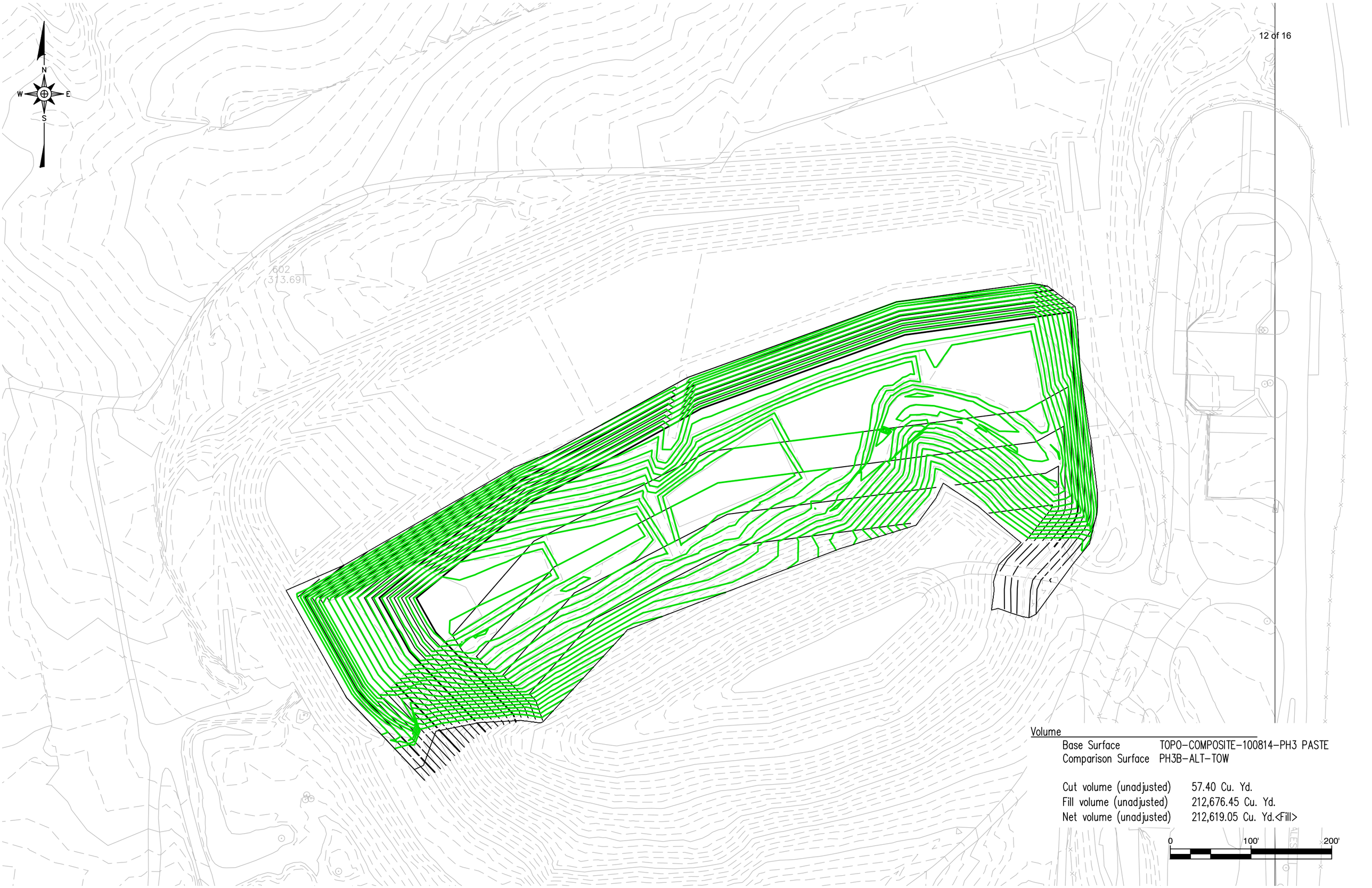




Volume

Base Surface	TOPO-COMPOSITE-100814-PH3 PASTE
Comparison Surface	PH3A-ALT-TOW

Cut volume (unadjusted)	27.98 Cu. Yd.
Fill volume (unadjusted)	89,663.59 Cu. Yd.
Net volume (unadjusted)	89,635.61 Cu. Yd.<Fill>

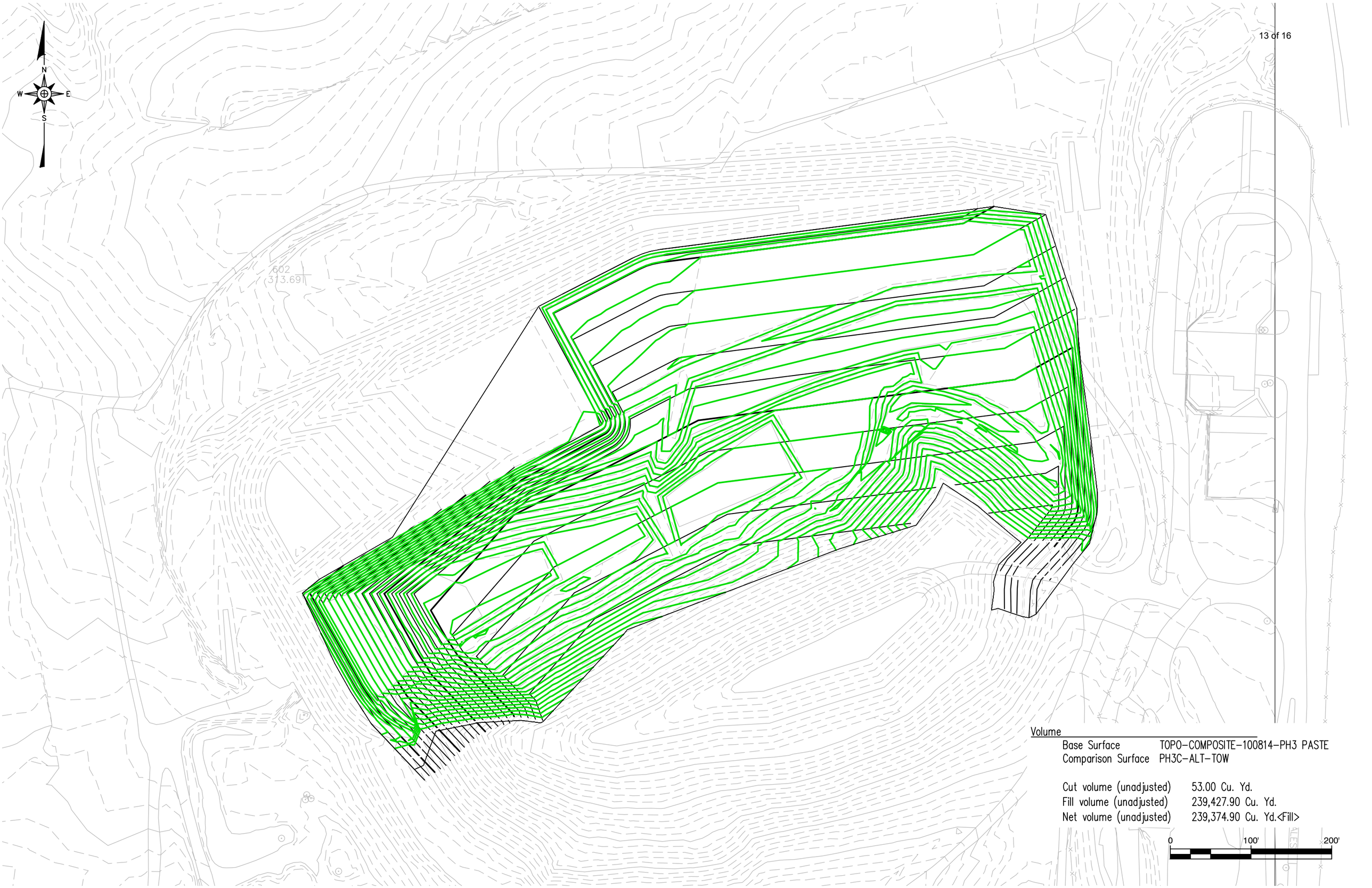


Volume

Base Surface	TOPO-COMPOSITE-100814-PH3 PASTE
Comparison Surface	PH3B-ALT-TOW

Cut volume (unadjusted)	57.40 Cu. Yd.
Fill volume (unadjusted)	212,676.45 Cu. Yd.
Net volume (unadjusted)	212,619.05 Cu. Yd.<Fill>

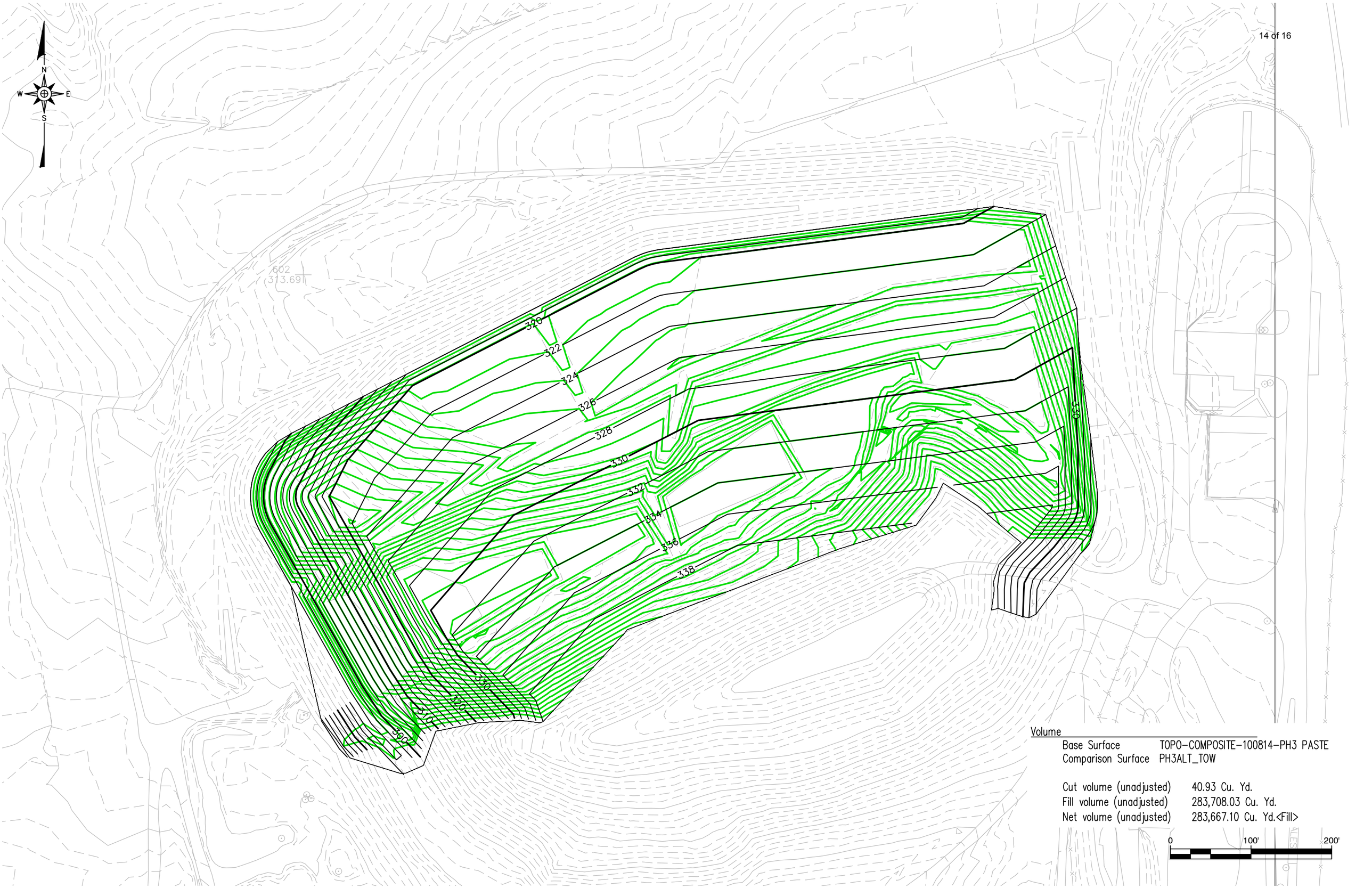
0 100' 200'



Volume

Base Surface	TOPO-COMPOSITE-100814-PH3 PASTE
Comparison Surface	PH3C-ALT-TOW

Cut volume (unadjusted)	53.00 Cu. Yd.
Fill volume (unadjusted)	239,427.90 Cu. Yd.
Net volume (unadjusted)	239,374.90 Cu. Yd.<Fill>



Volume

Base Surface	TOPO-COMPOSITE-100814-PH3 PASTE
Comparison Surface	PH3ALT_TOW

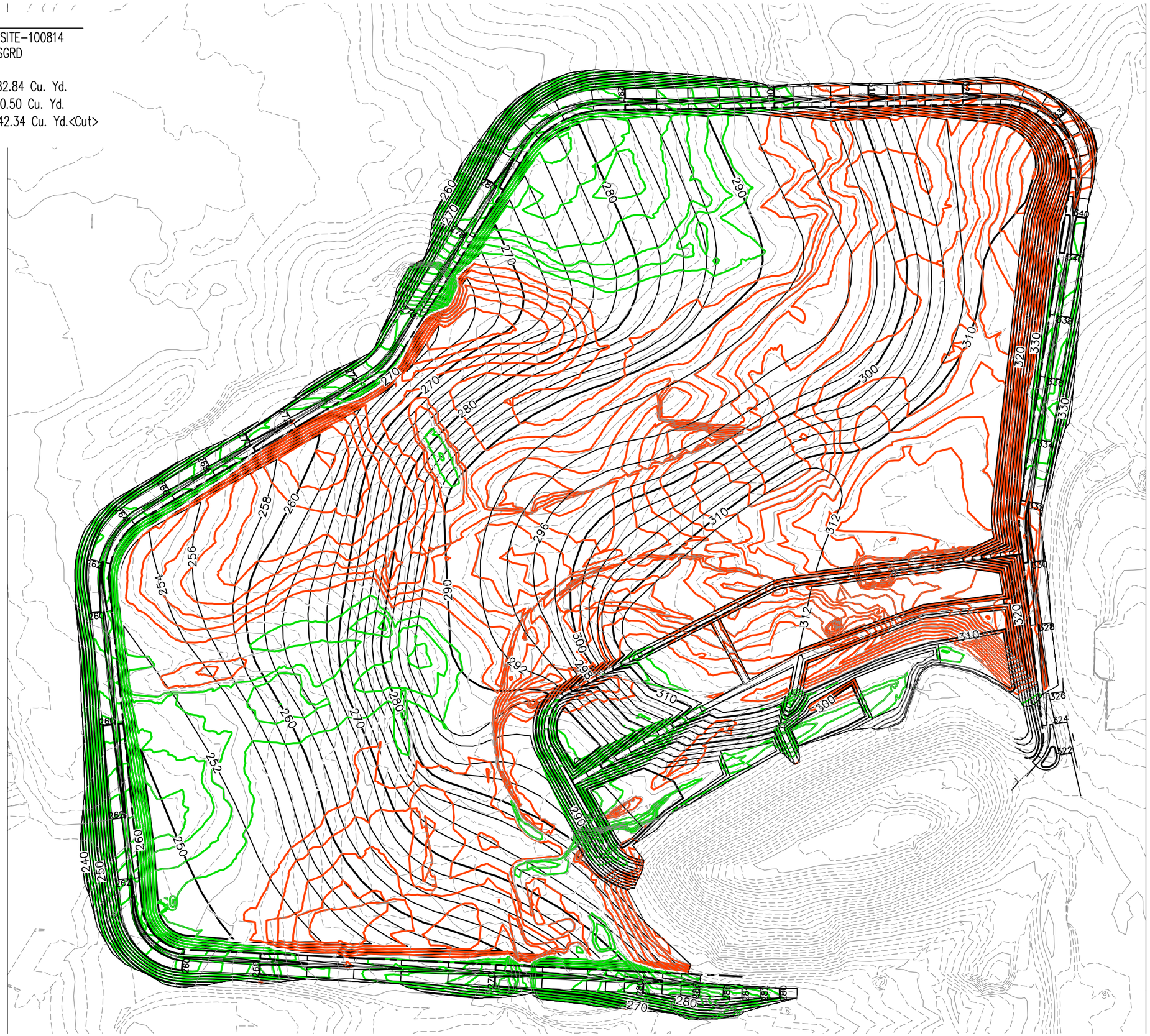
Cut volume (unadjusted)	40.93 Cu. Yd.
Fill volume (unadjusted)	283,708.03 Cu. Yd.
Net volume (unadjusted)	283,667.10 Cu. Yd.<Fill>

0 100' 200'

Volume

Base Surface	TOPO-COMPOSITE-100814
Comparison Surface	PHASE 3-4 SGRD

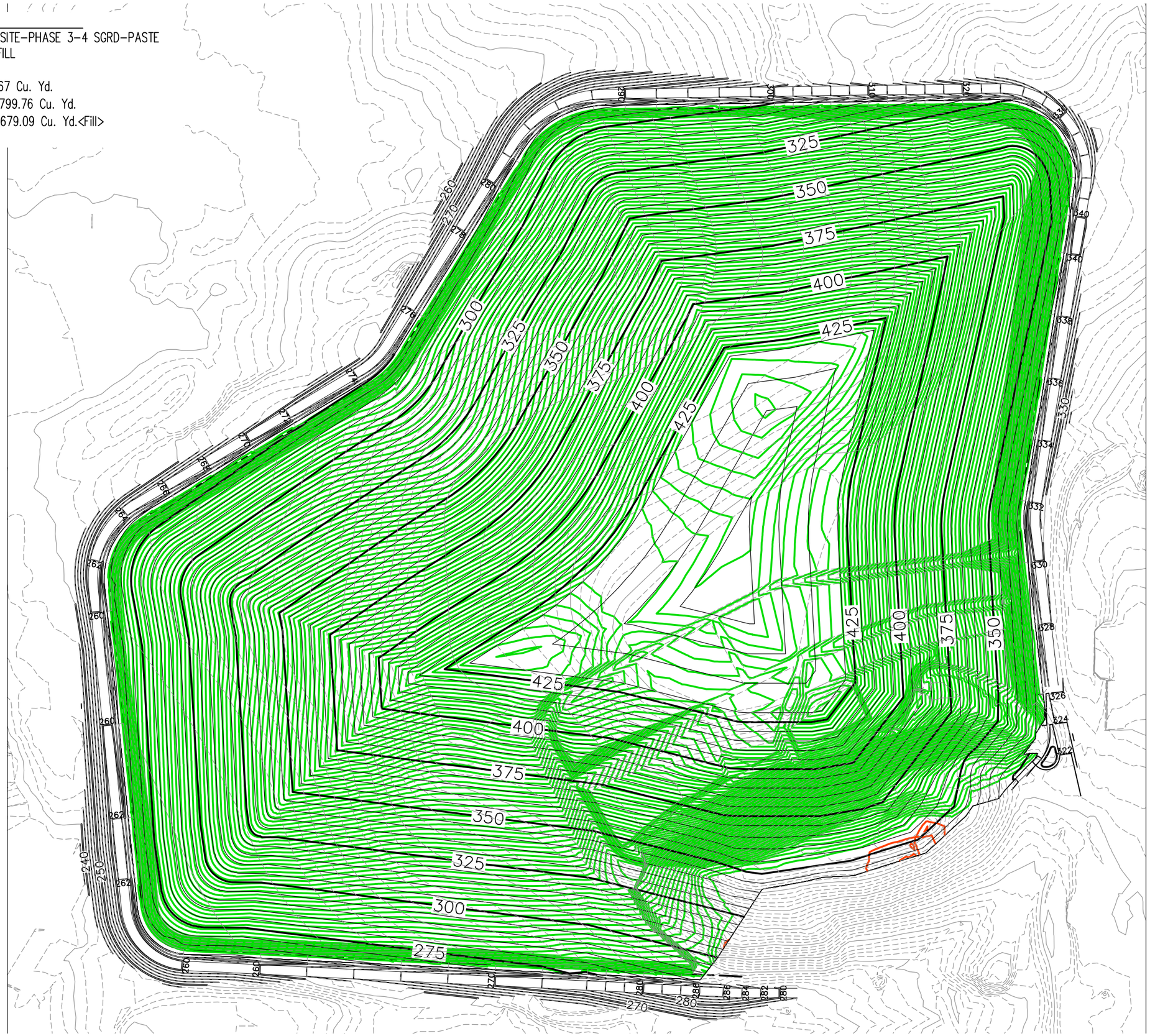
Cut volume (unadjusted)	666,182.84 Cu. Yd.
Fill volume (unadjusted)	211,140.50 Cu. Yd.
Net volume (unadjusted)	455,042.34 Cu. Yd.<Cut>



Volume

Base Surface TOPO-COMPOSITE-PHASE 3-4 SGRD-PASTE
Comparison Surface PHASE 3-4 FILL

Cut volume (unadjusted) 1,120.67 Cu. Yd.
Fill volume (unadjusted) 7,641,799.76 Cu. Yd.
Net volume (unadjusted) 7,640,679.09 Cu. Yd.<Fill>



SMITH+GARDNER

ADDRESS
14 N. Boylan Avenue, Raleigh, NC 27603

TEL
919.828.0577

WEB
www.smithgardnerinc.com

PROJECT Harnett County AC C&DLF

SHEET 1 OF 4

DATE 4/9/2015

COMPUTED BY PKS

SUBJECT Earthwork Quantities

JOB # HARNETT-AC-14-1

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 were calculated by taking design thicknesses and/or cross sections and multiplying by design areas and/or lengths. Areas and lengths were determined using AutoCAD, a planimeter, and/or direct measurement.

PROJECT Harnett County AC C&DLF

SUBJECT Earthwork Quantities - Summary

SHEET	2/4
JOB #	HARNETT-AC-14-1
DATE	4/9/2015
COMPUTED BY	PKS
CHECKED BY	

Landfill Unit	Area (Acres)	General Earthwork			Periodic Cover (CY)		Vegetative Soil Layer (CY)
		Cut (CY)	Fill (CY)				
Phases I & II	7.5	-----	-----		2,312		24,200
Phase III	7.5	107,584	17,293		62,820		24,200
Phase IV	52.6	558,599	193,848		646,375		169,723
Totals (CY) =	**67.6**	**666,183**	**211,141**		**711,507**		**218,123**
Location (On-Site/Off-Site):		On-Site	On-Site		On-Site		On-Site
On-Site Soil Balance Through Phase III (CY) =							**(23,241)**
On-Site Soil Balance Through Phase IV (CY) =							**(474,588)**

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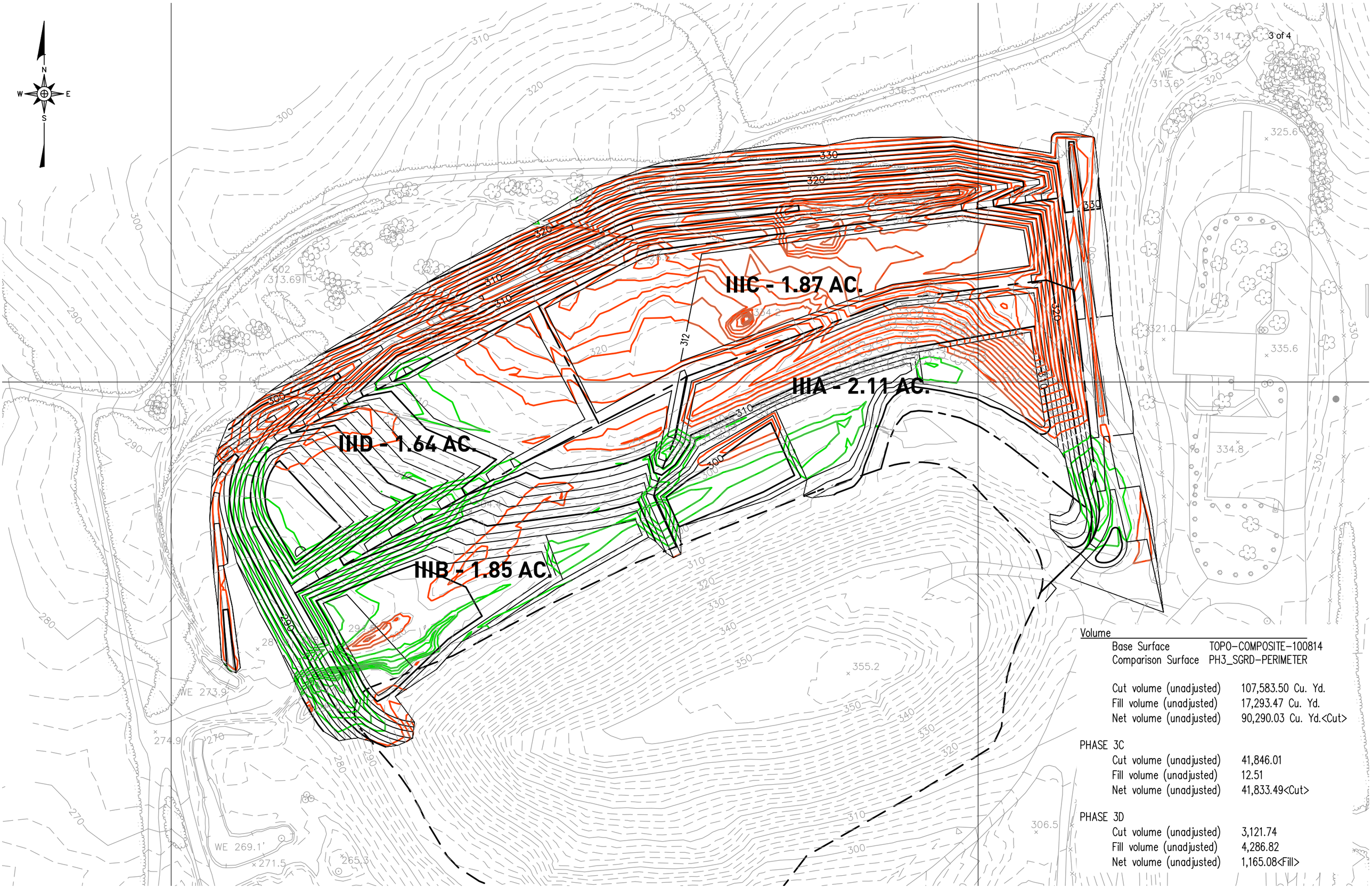


Volume

Base Surface	TOPO-COMPOSITE-100814
Comparison Surface	PH3_SGRD-PERIMETER
Cut volume (unadjusted)	107,583.50 Cu. Yd.
Fill volume (unadjusted)	17,293.47 Cu. Yd.
Net volume (unadjusted)	90,290.03 Cu. Yd.<Cut>

PHASE 3C

Cut volume (unadjusted)	41,846.01
Fill volume (unadjusted)	12.51
Net volume (unadjusted)	41,833.49<Cut>

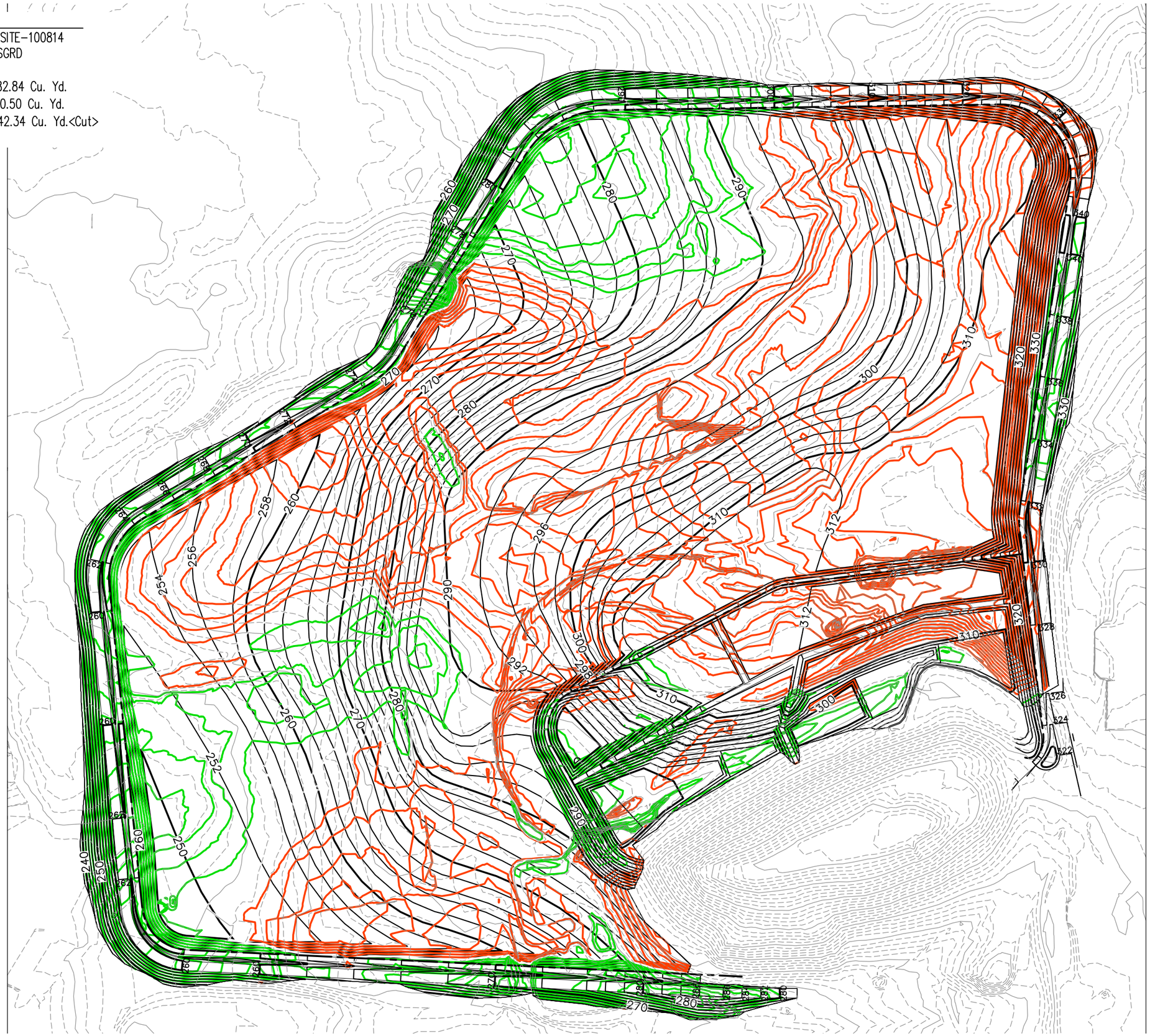
PHASE 3D

Cut volume (unadjusted)	3,121.74
Fill volume (unadjusted)	4,286.82
Net volume (unadjusted)	1,165.08<Fill>

Volume

Base Surface	TOPO-COMPOSITE-100814
Comparison Surface	PHASE 3-4 SGRD

Cut volume (unadjusted)	666,182.84 Cu. Yd.
Fill volume (unadjusted)	211,140.50 Cu. Yd.
Net volume (unadjusted)	455,042.34 Cu. Yd.<Cut>



OBJECTIVE: To determine the expected average annual infiltration into the landfill through the proposed final cover system. In that the proposed final cover system is an alternate system to the regulatory final cover, the infiltration through the proposed system is compared to the infiltration through the regulatory system. Use the EPA HELP Model in the analysis.

REFERENCES:

Berger, Klaus (2011), "Engineering Documentation for HELP 3.90D - Enhancements Compared to HELP 3.07," Institute of Soil Science, University of Hamburg, Hamburg, Germany.

Schroeder, P.R., Lloyd, C.M., et. al, (1994), "The Hydrologic Evaluation of Landfill Performance (HELP) Model - User's Guide for Version 3," EPA/600/9-94/168a, USEPA Risk Reduction Laboratory, Cincinnati, Ohio.

Schroeder, P.R., Lloyd, C.M., et. al, (1994), "The Hydrologic Evaluation of Landfill Performance (HELP) Model - Engineering Documentation for Version 3," EPA/600/9-94/168b, USEPA Risk Reduction Laboratory, Cincinnati, Ohio.

ANALYSIS:

Final Cover Systems Analyzed:

1A. Proposed Final Cover System (Top Slopes - 5 to 10%): (Top Down)

A. 24 inches Vegetative Soil Layer
B. Drainage Geocomposite
C. 30 mil Textured LLDPE Geomembrane or Geosynthetic Clay Liner (GCL)
D. 12 inches Intermediate Cover

1B. Proposed Final Cover System (Side Slopes - 3 or 4H:1V):

A. 24 inches Vegetative Soil Layer

2. Regulatory Final Cover System: (Top Down)

A. 6 inches Vegetative Soil Layer
B. 18 inches Compacted Soil Barrier ($k = 1 \times 10^{-5}$ cm/sec)
C. 12 inches Intermediate Cover

RESULTS:

Case	Slope of Final Cover System (%)	Average Annual Infiltration (inches)
1A-1 (GM)	5	0.004
1A-2 (GCL)	5	0.03
1B (Soil)	25	11.9
2A (RMC)	5	15.6
2B (RMC)	25	15.6

The results show that the proposed final cover system allows less infiltration than the regulatory final cover system. **HELP Model runs are attached.**

```
******************************************************************************
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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                                                                          **
**              HELP Version 3.90 D         (10. August 2011)               **
**                               developed at                               **
**        Institute of Soil Science, University of Hamburg, Germany         **
**                                 based on                                 **
**              US HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)               **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
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TIME: 12.29 DATE: 1.03.2015

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TEMPERATURE DATA FILE: C:\Program Files (x86)\HELPMod\HELP390D\Projects\RaleighNC.d7
SOLAR RADIATION DATA FILE: C:\Program Files (x86)\HELPMod\HELP390D\Projects\RaleighNC.d13
EVAPOTRANSPIRATION DATA F. 1: C:\Program Files (x86)\HELPMod\HELP390D\Projects\RaleighNC.d11
SOIL AND DESIGN DATA FILE 1: C:\Program Files (x86)\HELPMod\HELP390D\Projects\HCACLFC1A1.d10
OUTPUT DATA FILE: C:\Program Files (x86)\HELPMod\HELP390D\Projects\HCACLFC1A1.out

```
******************************************************************************
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TITLE: Harnett County ACLF - Case 1A-1 (GM - Top Slopes)

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WEATHER DATA SOURCES

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

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.55	3.43	3.69	2.91	3.67	3.66
4.38	4.44	3.29	2.73	2.87	3.14

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

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES CELSIUS)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.2	5.3	9.6	15.3	19.6	23.3
25.4	25.0	21.7	15.4	10.0	5.6

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR RALEIGH NORTH CAROLINA AND STATION LATITUDE = 35.87 DEGREES

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******************************************************************************
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LAYER DATA 1

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```

VALID FOR 20 YEARS

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

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 7

THICKNESS	=	24.00	INCHES
POROSITY	=	0.4730	VOL/VOL
FIELD CAPACITY	=	0.2220	VOL/VOL
WILTING POINT	=	0.1040	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2572	VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.	=	0.5200E-03	CM/SEC

NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 3.00 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.25	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0190	VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.	=	10.00	CM/SEC
SLOPE	=	5.00	PERCENT
DRAINAGE LENGTH	=	100.0	FEET

```
                              LAYER  3
                              --------

                 TYPE 4 - FLEXIBLE MEMBRANE LINER
                   MATERIAL TEXTURE NUMBER  36
      THICKNESS                    =      0.03   INCHES
      EFFECTIVE SAT. HYD. CONDUCT.=      0.4000E-12 CM/SEC
      FML PINHOLE DENSITY          =      1.00   HOLES/ACRE
      FML INSTALLATION DEFECTS     =      8.00   HOLES/ACRE
      FML PLACEMENT QUALITY        =  3 - GOOD


                              LAYER  4
                              --------

               TYPE 1 - VERTICAL PERCOLATION LAYER
                   MATERIAL TEXTURE NUMBER   7
      THICKNESS                    =     12.00   INCHES
      POROSITY                     =      0.4730 VOL/VOL
      FIELD CAPACITY               =      0.2220 VOL/VOL
      WILTING POINT                =      0.1040 VOL/VOL
      INITIAL SOIL WATER CONTENT   =      0.2220 VOL/VOL
      EFFECTIVE SAT. HYD. CONDUCT.=      0.5200E-03 CM/SEC


*****************************************************************************
                GENERAL DESIGN AND EVAPORATIVE ZONE DATA   1
-----------------------------------------------------------------------------

                            VALID FOR  20 YEARS


         NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
                  SOIL DATA BASE USING SOIL TEXTURE # 7 WITH A
                  FAIR STAND OF GRASS, A SURFACE SLOPE OF  5.%
                  AND A SLOPE LENGTH OF  100. FEET.

        SCS RUNOFF CURVE NUMBER             =     76.72
        FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
        AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
        EVAPORATIVE ZONE DEPTH              =     20.0    INCHES
        INITIAL WATER IN EVAPORATIVE ZONE   =      5.006  INCHES
        UPPER LIMIT OF EVAPORATIVE STORAGE  =      9.460  INCHES
        FIELD CAPACITY OF EVAPORATIVE ZONE  =      4.440  INCHES
        LOWER LIMIT OF EVAPORATIVE STORAGE  =      2.080  INCHES
        SOIL EVAPORATION ZONE DEPTH         =     17.533  INCHES
        INITIAL SNOW WATER                  =      0.000  INCHES
        INITIAL INTERCEPTION WATER          =      0.000  INCHES
        INITIAL WATER IN LAYER MATERIALS    =      8.843  INCHES
        TOTAL INITIAL WATER                 =      8.843  INCHES
        TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR
```

```
*****************************************************************************
                        EVAPOTRANSPIRATION DATA   1
-----------------------------------------------------------------------------

                            VALID FOR  20 YEARS

         NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                  RALEIGH             NORTH CAROLINA
            STATION LATITUDE                        =  35.87 DEGREES
            MAXIMUM LEAF AREA INDEX                 =   2.00
            START OF GROWING SEASON (JULIAN DATE)   =     86
            END OF GROWING SEASON (JULIAN DATE)     =    310
            EVAPORATIVE ZONE DEPTH                  =  20.0  INCHES
            AVERAGE ANNUAL WIND SPEED               =   7.70 MPH
            AVERAGE 1ST QUARTER RELATIVE HUMIDITY   =  66.0  %
            AVERAGE 2ND QUARTER RELATIVE HUMIDITY   =  70.0  %
            AVERAGE 3RD QUARTER RELATIVE HUMIDITY   =  78.0  %
            AVERAGE 4TH QUARTER RELATIVE HUMIDITY   =  72.0  %
*****************************************************************************


*****************************************************************************
                    FINAL WATER STORAGE AT END OF YEAR   20
-----------------------------------------------------------------------------

                     LAYER        (INCHES)       (VOL/VOL)
                     -----        --------       ---------
                       1           6.4807         0.2700

                       2           0.0067         0.0267

                       3           0.0000         0.0000

                       4           2.6640         0.2220

    TOTAL WATER IN LAYERS          9.151

    SNOW WATER                     0.000

    INTERCEPTION WATER             0.000

    TOTAL FINAL WATER              9.151
*****************************************************************************
```

```
*******************************************************************************
                PEAK DAILY VALUES FOR YEARS    1 THROUGH   20
-------------------------------------------------------------------------------

                                                (INCHES)      (CU. FT.)
                                               ----------   -------------
      PRECIPITATION                              5.22         18948.600

      RUNOFF                                     1.640         5953.2529

      DRAINAGE COLLECTED FROM LAYER  2           1.70283       6181.25830

      PERCOLATION/LEAKAGE THROUGH LAYER  3       0.000288         1.04613

      AVERAGE HEAD ON TOP OF LAYER  3            0.060

      MAXIMUM HEAD ON TOP OF LAYER  3            0.119

      LOCATION OF MAXIMUM HEAD IN LAYER  2
            (DISTANCE FROM DRAIN)                0.8 FEET

      PERCOLATION/LEAKAGE THROUGH LAYER  4       0.000288         1.04613

      SNOW WATER                                 2.50          9076.1426

      MAXIMUM VEG. SOIL WATER (VOL/VOL)                  0.3755

      MINIMUM VEG. SOIL WATER (VOL/VOL)                  0.1040


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

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

*******************************************************************************
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*******************************************************************************
         AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH   20
-------------------------------------------------------------------------------

                        JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                        -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                3.54     2.91     3.75     2.23     4.24     3.77
                          4.33     5.31     2.39     2.98     2.77     2.85

    STD. DEVIATIONS       1.98     1.21     1.50     1.63     2.19     2.07
                          1.94     3.75     1.64     2.03     1.68     0.88

  RUNOFF
  ------
    TOTALS                0.055    0.008    0.009    0.004    0.063    0.015
                          0.014    0.144    0.023    0.033    0.014    0.011

    STD. DEVIATIONS       0.111    0.035    0.028    0.017    0.155    0.036
                          0.047    0.437    0.087    0.079    0.028    0.033

  POTENTIAL EVAPOTRANSPIRATION
  ----------------------------
    TOTALS                1.886    2.137    3.599    4.951    6.322    6.982
                          6.899    6.009    4.614    3.366    2.215    1.584

    STD. DEVIATIONS       0.153    0.203    0.283    0.308    0.266    0.310
                          0.320    0.304    0.314    0.235    0.161    0.117

  ACTUAL EVAPOTRANSPIRATION
  -------------------------
    TOTALS                1.277    1.583    2.405    2.210    4.557    3.670
                          3.879    3.922    2.018    1.222    1.139    1.007

    STD. DEVIATIONS       0.143    0.268    0.394    0.859    0.739    1.680
                          1.368    1.087    0.807    0.382    0.270    0.161

  LATERAL DRAINAGE COLLECTED FROM LAYER  2
  ----------------------------------------
    TOTALS                2.3119   1.4948   1.4432   0.8035   0.7113   0.1405
                          0.1408   0.8049   0.4706   0.6438   1.2724   1.5357

    STD. DEVIATIONS       1.6199   1.0056   1.1709   0.7924   1.1345   0.3246
                          0.3342   2.0219   0.9780   0.9477   1.4077   1.0887

  PERCOLATION/LEAKAGE THROUGH LAYER  3
  -------------------------------------
    TOTALS                0.0008   0.0005   0.0005   0.0003   0.0002   0.0001
                          0.0001   0.0002   0.0002   0.0002   0.0004   0.0005

    STD. DEVIATIONS       0.0004   0.0003   0.0003   0.0002   0.0003   0.0001
                          0.0001   0.0005   0.0003   0.0003   0.0004   0.0003

  PERCOLATION/LEAKAGE THROUGH LAYER  4
  -------------------------------------
    TOTALS                0.0008   0.0005   0.0005   0.0003   0.0002   0.0001
                          0.0001   0.0002   0.0002   0.0002   0.0004   0.0005

    STD. DEVIATIONS       0.0004   0.0003   0.0003   0.0002   0.0003   0.0001
                          0.0001   0.0005   0.0003   0.0003   0.0004   0.0003
```

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	0.0026	0.0019	0.0016	0.0009	0.0008	0.0002
	0.0002	0.0009	0.0006	0.0007	0.0015	0.0018
STD. DEVIATIONS	0.0018	0.0012	0.0013	0.0009	0.0013	0.0004
	0.0004	0.0023	0.0012	0.0011	0.0017	0.0012

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES		CU. FEET	PERCENT
PRECIPITATION	41.08	(8.075)	149102.3	100.00
RUNOFF	0.394	(0.6000)	1429.93	0.959
POTENTIAL EVAPOTRANSPIRATION	50.564	(0.8460)	183547.44	
ACTUAL EVAPOTRANSPIRATION	28.888	(3.2880)	104864.03	70.330
LATERAL DRAINAGE COLLECTED FROM LAYER 2	11.77341	(5.90354)	42737.492	28.66321
PERCOLATION/LEAKAGE THROUGH LAYER 3	**0.00406**	(0.00159)	14.721	0.00987
AVERAGE HEAD ON TOP OF LAYER 3	0.001	(0.001)		
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00406	(0.00159)	14.721	0.00987
CHANGE IN WATER STORAGE	0.015	(0.8124)	56.05	0.038

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                                                                          **
**              HELP Version 3.90 D         (10. August 2011)               **
**                               developed at                               **
**        Institute of Soil Science, University of Hamburg, Germany         **
**                                 based on                                 **
**              US HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)               **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************
```

TIME: 12.30 DATE: 1.03.2015

PRECIPITATION DATA FILE: C:\Program Files (x86)\HELPMod\HELP390D\Projects\RaleighNC.d4
TEMPERATURE DATA FILE: C:\Program Files (x86)\HELPMod\HELP390D\Projects\RaleighNC.d7
SOLAR RADIATION DATA FILE: C:\Program Files (x86)\HELPMod\HELP390D\Projects\RaleighNC.d13
EVAPOTRANSPIRATION DATA F. 1: C:\Program Files (x86)\HELPMod\HELP390D\Projects\RaleighNC.d11
SOIL AND DESIGN DATA FILE 1: C:\Program Files (x86)\HELPMod\HELP390D\Projects\HCACLFC1A2.d10
OUTPUT DATA FILE: C:\Program Files (x86)\HELPMod\HELP390D\Projects\HCACLFC1A2.out

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TITLE: Harnett County ACLF - Case 1A-2 (GCL - Top Slopes)

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WEATHER DATA SOURCES

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

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.55	3.43	3.69	2.91	3.67	3.66
4.38	4.44	3.29	2.73	2.87	3.14

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

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES CELSIUS)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.2	5.3	9.6	15.3	19.6	23.3
25.4	25.0	21.7	15.4	10.0	5.6

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR RALEIGH NORTH CAROLINA AND STATION LATITUDE = 35.87 DEGREES

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LAYER DATA 1

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VALID FOR 20 YEARS

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

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 7

THICKNESS	=	24.00	INCHES
POROSITY	=	0.4730	VOL/VOL
FIELD CAPACITY	=	0.2220	VOL/VOL
WILTING POINT	=	0.1040	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2572	VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.	=	0.5200E-03	CM/SEC

NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 3.00 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.25	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0190	VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.	=	10.00	CM/SEC
SLOPE	=	5.00	PERCENT
DRAINAGE LENGTH	=	100.0	FEET

```
                              LAYER  3
                              --------

                   TYPE 3 - BARRIER SOIL LINER
                   MATERIAL TEXTURE NUMBER  17
      THICKNESS                   =      0.25   INCHES
      POROSITY                    =      0.7500 VOL/VOL
      FIELD CAPACITY              =      0.7470 VOL/VOL
      WILTING POINT               =      0.4000 VOL/VOL
      INITIAL SOIL WATER CONTENT  =      0.7500 VOL/VOL
      EFFECTIVE SAT. HYD. CONDUCT.=      0.5000E-08 CM/SEC


                              LAYER  4
                              --------

                TYPE 1 - VERTICAL PERCOLATION LAYER
                   MATERIAL TEXTURE NUMBER   7
      THICKNESS                   =     12.00   INCHES
      POROSITY                    =      0.4730 VOL/VOL
      FIELD CAPACITY              =      0.2220 VOL/VOL
      WILTING POINT               =      0.1040 VOL/VOL
      INITIAL SOIL WATER CONTENT  =      0.2220 VOL/VOL
      EFFECTIVE SAT. HYD. CONDUCT.=      0.5200E-03 CM/SEC


*****************************************************************************
                 GENERAL DESIGN AND EVAPORATIVE ZONE DATA   1
-----------------------------------------------------------------------------

                            VALID FOR  20 YEARS


         NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
                  SOIL DATA BASE USING SOIL TEXTURE # 7 WITH A
                  FAIR STAND OF GRASS, A SURFACE SLOPE OF  5.%
                  AND A SLOPE LENGTH OF  100. FEET.

        SCS RUNOFF CURVE NUMBER             =     76.72
        FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
        AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
        EVAPORATIVE ZONE DEPTH              =     20.0    INCHES
        INITIAL WATER IN EVAPORATIVE ZONE   =      5.006  INCHES
        UPPER LIMIT OF EVAPORATIVE STORAGE  =      9.460  INCHES
        FIELD CAPACITY OF EVAPORATIVE ZONE  =      4.440  INCHES
        LOWER LIMIT OF EVAPORATIVE STORAGE  =      2.080  INCHES
        SOIL EVAPORATION ZONE DEPTH         =     17.533  INCHES
        INITIAL SNOW WATER                  =      0.000  INCHES
        INITIAL INTERCEPTION WATER          =      0.000  INCHES
        INITIAL WATER IN LAYER MATERIALS    =      9.030  INCHES
        TOTAL INITIAL WATER                 =      9.030  INCHES
        TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR
```

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*****************************************************************************
                        EVAPOTRANSPIRATION DATA   1
-----------------------------------------------------------------------------

                            VALID FOR  20 YEARS


         NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                  RALEIGH             NORTH CAROLINA
             STATION LATITUDE                        =  35.87 DEGREES
             MAXIMUM LEAF AREA INDEX                 =   2.00
             START OF GROWING SEASON (JULIAN DATE)   =     86
             END OF GROWING SEASON (JULIAN DATE)     =    310
             EVAPORATIVE ZONE DEPTH                  =  20.0  INCHES
             AVERAGE ANNUAL WIND SPEED               =   7.70 MPH
             AVERAGE 1ST QUARTER RELATIVE HUMIDITY   =  66.0  %
             AVERAGE 2ND QUARTER RELATIVE HUMIDITY   =  70.0  %
             AVERAGE 3RD QUARTER RELATIVE HUMIDITY   =  78.0  %
             AVERAGE 4TH QUARTER RELATIVE HUMIDITY   =  72.0  %
*****************************************************************************


*****************************************************************************
                     FINAL WATER STORAGE AT END OF YEAR   20
-----------------------------------------------------------------------------

                      LAYER        (INCHES)       (VOL/VOL)
                      -----        --------       ---------
                        1            6.4807         0.2700

                        2            0.0067         0.0267

                        3            0.1875         0.7500

                        4            2.6640         0.2220

    TOTAL WATER IN LAYERS            9.339

    SNOW WATER                       0.000

    INTERCEPTION WATER               0.000

    TOTAL FINAL WATER                9.339
*****************************************************************************
```

```
*******************************************************************************
                PEAK DAILY VALUES FOR YEARS    1 THROUGH   20
-------------------------------------------------------------------------------

                                                (INCHES)      (CU. FT.)
                                               ----------   -------------
      PRECIPITATION                              5.22         18948.600

      RUNOFF                                     1.640         5953.2529

      DRAINAGE COLLECTED FROM LAYER  2           1.70292       6181.58545

      PERCOLATION/LEAKAGE THROUGH LAYER  3       0.000211         0.76610

      AVERAGE HEAD ON TOP OF LAYER  3            0.060

      MAXIMUM HEAD ON TOP OF LAYER  3            0.119

      LOCATION OF MAXIMUM HEAD IN LAYER  2
            (DISTANCE FROM DRAIN)                0.7 FEET

      PERCOLATION/LEAKAGE THROUGH LAYER  4       0.000211         0.76610

      SNOW WATER                                 2.50          9076.1426

      MAXIMUM VEG. SOIL WATER (VOL/VOL)                  0.3755

      MINIMUM VEG. SOIL WATER (VOL/VOL)                  0.1040


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

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

*******************************************************************************


*******************************************************************************
         AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH   20
-------------------------------------------------------------------------------
-

                        JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                        -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                3.54     2.91     3.75     2.23     4.24     3.77
                          4.33     5.31     2.39     2.98     2.77     2.85

    STD. DEVIATIONS       1.98     1.21     1.50     1.63     2.19     2.07
                          1.94     3.75     1.64     2.03     1.68     0.88

  RUNOFF
  ------
    TOTALS                0.055    0.008    0.009    0.004    0.063    0.015
                          0.014    0.144    0.023    0.033    0.014    0.011

    STD. DEVIATIONS       0.111    0.035    0.028    0.017    0.155    0.036
                          0.047    0.437    0.087    0.079    0.028    0.033

  POTENTIAL EVAPOTRANSPIRATION
  ----------------------------
    TOTALS                1.886    2.137    3.599    4.951    6.322    6.982
                          6.899    6.009    4.614    3.366    2.215    1.584

    STD. DEVIATIONS       0.153    0.203    0.283    0.308    0.266    0.310
                          0.320    0.304    0.314    0.235    0.161    0.117

  ACTUAL EVAPOTRANSPIRATION
  -------------------------
    TOTALS                1.277    1.583    2.405    2.210    4.557    3.670
                          3.879    3.922    2.018    1.222    1.139    1.007

    STD. DEVIATIONS       0.143    0.268    0.394    0.859    0.739    1.680
                          1.368    1.087    0.807    0.382    0.270    0.161

  LATERAL DRAINAGE COLLECTED FROM LAYER  2
  ----------------------------------------
    TOTALS                2.3076   1.4912   1.4393   0.7997   0.7094   0.1396
                          0.1401   0.8042   0.4690   0.6424   1.2696   1.5318

    STD. DEVIATIONS       1.6201   1.0055   1.1705   0.7921   1.1337   0.3233
                          0.3330   2.0211   0.9766   0.9468   1.4068   1.0884

  PERCOLATION/LEAKAGE THROUGH LAYER  3
  -------------------------------------
    TOTALS                0.0050   0.0042   0.0045   0.0041   0.0022   0.0010
                          0.0007   0.0009   0.0017   0.0017   0.0032   0.0044

    STD. DEVIATIONS       0.0005   0.0011   0.0013   0.0013   0.0020   0.0016
                          0.0014   0.0017   0.0023   0.0018   0.0021   0.0013

  PERCOLATION/LEAKAGE THROUGH LAYER  4
  -------------------------------------
    TOTALS                0.0050   0.0042   0.0045   0.0041   0.0022   0.0010
                          0.0007   0.0009   0.0017   0.0017   0.0032   0.0044

    STD. DEVIATIONS       0.0005   0.0011   0.0013   0.0013   0.0020   0.0016
                          0.0014   0.0017   0.0023   0.0018   0.0021   0.0013
```

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	0.0026	0.0019	0.0016	0.0009	0.0008	0.0002
	0.0002	0.0009	0.0006	0.0007	0.0015	0.0017
STD. DEVIATIONS	0.0018	0.0012	0.0013	0.0009	0.0013	0.0004
	0.0004	0.0023	0.0012	0.0011	0.0017	0.0012

****

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES		CU. FEET	PERCENT
PRECIPITATION	41.08	(8.075)	149102.3	100.00
RUNOFF	0.394	(0.6000)	1429.93	0.959
POTENTIAL EVAPOTRANSPIRATION	50.564	(0.8460)	183547.44	
ACTUAL EVAPOTRANSPIRATION	28.888	(3.2880)	104864.03	70.330
LATERAL DRAINAGE COLLECTED FROM LAYER 2	11.74389	(5.89945)	42630.320	28.59133
PERCOLATION/LEAKAGE THROUGH LAYER 3	**0.03358**	(0.00730)	121.897	0.08175
AVERAGE HEAD ON TOP OF LAYER 3	0.001	(0.001)		
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.03358	(0.00730)	121.897	0.08175
CHANGE IN WATER STORAGE	0.015	(0.8124)	56.05	0.038

****

****

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                                                                          **
**              HELP Version 3.90 D         (10. August 2011)               **
**                                developed at                              **
**        Institute of Soil Science, University of Hamburg, Germany         **
**                                 based on                                 **
**              US HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)               **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


 TIME:  12.31     DATE:   1.03.2015


 PRECIPITATION DATA FILE:      C:\Program Files
(x86)\HELPMod\HELP390D\Projects\RaleighNC.d4
 TEMPERATURE DATA FILE:        C:\Program Files
(x86)\HELPMod\HELP390D\Projects\RaleighNC.d7
 SOLAR RADIATION DATA FILE:    C:\Program Files
(x86)\HELPMod\HELP390D\Projects\RaleighNC.d13
 EVAPOTRANSPIRATION DATA F. 1: C:\Program Files
(x86)\HELPMod\HELP390D\Projects\RaleighNC.d11
 SOIL AND DESIGN DATA FILE  1: C:\Program Files
(x86)\HELPMod\HELP390D\Projects\HCACLFC1B.d10
 OUTPUT DATA FILE:             C:\Program Files
(x86)\HELPMod\HELP390D\Projects\HCACLFC1AB.out


 ******************************************************************************

     TITLE:  Harnett County ACLF - Case 1B (Soil - Side Slopes)

 ******************************************************************************
                            WEATHER DATA SOURCES
 ------------------------------------------------------------------------------

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

                  NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

     JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
     -------     -------     -------     -------     -------     -------
       3.55        3.43        3.69        2.91        3.67        3.66
       4.38        4.44        3.29        2.73        2.87        3.14
```

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

                  NORMAL MEAN MONTHLY TEMPERATURE (DEGREES CELSIUS)

     JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
     -------     -------     -------     -------     -------     -------
       4.2         5.3         9.6        15.3        19.6        23.3
      25.4        25.0        21.7        15.4        10.0         5.6


         NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR    RALEIGH             NORTH CAROLINA
                    AND STATION LATITUDE  =  35.87 DEGREES


******************************************************************************
                                LAYER DATA   1
------------------------------------------------------------------------------

                              VALID FOR  20 YEARS

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


                                  LAYER  1
                                  --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER   7
           THICKNESS                   =     24.00   INCHES
           POROSITY                    =      0.4730 VOL/VOL
           FIELD CAPACITY              =      0.2220 VOL/VOL
           WILTING POINT               =      0.1040 VOL/VOL
           INITIAL SOIL WATER CONTENT  =      0.2547 VOL/VOL
           EFFECTIVE SAT. HYD. CONDUCT.=      0.5200E-03 CM/SEC
         NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
                  FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


******************************************************************************
                 GENERAL DESIGN AND EVAPORATIVE ZONE DATA   1
------------------------------------------------------------------------------

                              VALID FOR  20 YEARS

         NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
                  SOIL DATA BASE USING SOIL TEXTURE # 7 WITH A
                  FAIR STAND OF GRASS, A SURFACE SLOPE OF 25.%
                  AND A SLOPE LENGTH OF  200. FEET.

        SCS RUNOFF CURVE NUMBER             =     76.87
        FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
        AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
        EVAPORATIVE ZONE DEPTH              =     20.0    INCHES
```

```
        INITIAL WATER IN EVAPORATIVE ZONE   =      4.960  INCHES
        UPPER LIMIT OF EVAPORATIVE STORAGE  =      9.460  INCHES
        FIELD CAPACITY OF EVAPORATIVE ZONE  =      4.440  INCHES
        LOWER LIMIT OF EVAPORATIVE STORAGE  =      2.080  INCHES
        SOIL EVAPORATION ZONE DEPTH         =     17.533  INCHES
        INITIAL SNOW WATER                  =      0.000  INCHES
        INITIAL INTERCEPTION WATER          =      0.000  INCHES
        INITIAL WATER IN LAYER MATERIALS    =      6.113  INCHES
        TOTAL INITIAL WATER                 =      6.113  INCHES
        TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR

*******************************************************************************
                        EVAPOTRANSPIRATION DATA   1
-------------------------------------------------------------------------------

                            VALID FOR  20 YEARS

         NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                  RALEIGH             NORTH CAROLINA
              STATION LATITUDE                      =  35.87 DEGREES
              MAXIMUM LEAF AREA INDEX               =   2.00
              START OF GROWING SEASON (JULIAN DATE) =     86
              END OF GROWING SEASON (JULIAN DATE)   =    310
              EVAPORATIVE ZONE DEPTH                =  20.0  INCHES
              AVERAGE ANNUAL WIND SPEED             =   7.70 MPH
              AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  66.0  %
              AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  70.0  %
              AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  78.0  %
              AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  72.0  %

*******************************************************************************


*******************************************************************************
                    FINAL WATER STORAGE AT END OF YEAR   20
-------------------------------------------------------------------------------

                    LAYER        (INCHES)       (VOL/VOL)
                    -----        --------       ---------
                      1           6.3537         0.2647

    TOTAL WATER IN LAYERS          6.354

    SNOW WATER                     0.000

    INTERCEPTION WATER             0.000

    TOTAL FINAL WATER              6.354

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```

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*******************************************************************************
                 PEAK DAILY VALUES FOR YEARS    1 THROUGH   20
-------------------------------------------------------------------------------

                                                (INCHES)      (CU. FT.)
                                               ----------   -------------
      PRECIPITATION                              5.22         18948.600

      RUNOFF                                     1.610         5843.3662

      PERCOLATION/LEAKAGE THROUGH LAYER  1       2.373388      8615.39941

      SNOW WATER                                 2.50          9076.1426

      MAXIMUM VEG. SOIL WATER (VOL/VOL)                  0.3533

      MINIMUM VEG. SOIL WATER (VOL/VOL)                  0.1040

*******************************************************************************


*******************************************************************************
         AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH   20
-------------------------------------------------------------------------------

                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                  3.54     2.91     3.75     2.23     4.24     3.77
                            4.33     5.31     2.39     2.98     2.77     2.85

    STD. DEVIATIONS         1.98     1.21     1.50     1.63     2.19     2.07
                            1.94     3.75     1.64     2.03     1.68     0.88

  RUNOFF
  ------
    TOTALS                  0.048    0.008    0.005    0.003    0.061    0.015
                            0.014    0.136    0.021    0.029    0.014    0.011

    STD. DEVIATIONS         0.101    0.033    0.015    0.012    0.148    0.036
                            0.047    0.417    0.080    0.072    0.027    0.033

  POTENTIAL EVAPOTRANSPIRATION
  ----------------------------
    TOTALS                  1.886    2.137    3.599    4.951    6.322    6.982
                            6.899    6.009    4.614    3.366    2.215    1.584

    STD. DEVIATIONS         0.153    0.203    0.283    0.308    0.266    0.310
                            0.320    0.304    0.314    0.235    0.161    0.117
```

```
ACTUAL EVAPOTRANSPIRATION
-------------------------
  TOTALS                 1.278    1.586    2.399    2.240    4.468    3.611
                         3.884    3.927    2.019    1.228    1.143    1.009

  STD. DEVIATIONS        0.144    0.268    0.401    0.849    0.766    1.682
                         1.372    1.101    0.825    0.382    0.271    0.160

PERCOLATION/LEAKAGE THROUGH LAYER  1
-------------------------------------
  TOTALS                 2.3424   1.4659   1.4507   0.7938   0.7587   0.1432
                         0.1431   0.8540   0.4376   0.7184   1.3201   1.4793

  STD. DEVIATIONS        1.7460   1.0017   1.1760   0.8465   1.2158   0.3355
                         0.3239   2.0738   0.9181   1.0142   1.5018   1.0006

*******************************************************************************


*******************************************************************************
      AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH   20
 ------------------------------------------------------------------------------

                                      INCHES            CU. FEET       PERCENT
                                  -------------------   -------------   ---------
  PRECIPITATION                    41.08    (   8.075)     149102.3     100.00

  RUNOFF                            0.364   (  0.5552)       1322.86      0.887

  POTENTIAL EVAPOTRANSPIRATION     50.564   (  0.8460)     183547.44

  ACTUAL EVAPOTRANSPIRATION        28.791   (  3.2716)     104512.73     70.095

  PERCOLATION/LEAKAGE THROUGH      11.90714 (  5.91780)     43222.926    28.98878
    LAYER  1

  CHANGE IN WATER STORAGE           0.012   (  0.8130)         43.72      0.029

*******************************************************************************

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                                                                          **
**              HELP Version 3.90 D         (10. August 2011)               **
**                                developed at                              **
**        Institute of Soil Science, University of Hamburg, Germany         **
**                                 based on                                 **
**              US HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)               **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************
```

TIME: 18.46 DATE: 1.03.2015

PRECIPITATION DATA FILE: C:\Program Files (x86)\HELPMod\HELP390D\Projects\RaleighNC.d4
TEMPERATURE DATA FILE: C:\Program Files (x86)\HELPMod\HELP390D\Projects\RaleighNC.d7
SOLAR RADIATION DATA FILE: C:\Program Files (x86)\HELPMod\HELP390D\Projects\RaleighNC.d13
EVAPOTRANSPIRATION DATA F. 1: C:\Program Files (x86)\HELPMod\HELP390D\Projects\RaleighNC.d11
SOIL AND DESIGN DATA FILE 1: C:\Program Files (x86)\HELPMod\HELP390D\Projects\HCACLFC2A.d10
OUTPUT DATA FILE: C:\Program Files (x86)\HELPMod\HELP390D\Projects\HCACLFC2A.out

```
******************************************************************************
```

TITLE: Harnett County ACLF - Case 2A (RMC - Top Slopes)

```
******************************************************************************
```

WEATHER DATA SOURCES

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

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.55	3.43	3.69	2.91	3.67	3.66
4.38	4.44	3.29	2.73	2.87	3.14

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

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES CELSIUS)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.2	5.3	9.6	15.3	19.6	23.3
25.4	25.0	21.7	15.4	10.0	5.6

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR RALEIGH NORTH CAROLINA AND STATION LATITUDE = 35.87 DEGREES

```
******************************************************************************
```

LAYER DATA 1

VALID FOR 20 YEARS

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

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 7

THICKNESS	=	6.00	INCHES
POROSITY	=	0.4730	VOL/VOL
FIELD CAPACITY	=	0.2220	VOL/VOL
WILTING POINT	=	0.1040	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2091	VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.	=	0.5200E-03	CM/SEC

NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 3.00 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 15

THICKNESS	=	18.00	INCHES
POROSITY	=	0.4750	VOL/VOL
FIELD CAPACITY	=	0.3780	VOL/VOL
WILTING POINT	=	0.2650	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4750	VOL/VOL
EFFECTIVE SAT. HYD. CONDUCT.	=	0.1000E-04	CM/SEC

```
                                LAYER  3
                                --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   7
           THICKNESS                    =     12.00   INCHES
           POROSITY                     =      0.4730 VOL/VOL
           FIELD CAPACITY               =      0.2220 VOL/VOL
           WILTING POINT                =      0.1040 VOL/VOL
           INITIAL SOIL WATER CONTENT   =      0.2733 VOL/VOL
           EFFECTIVE SAT. HYD. CONDUCT.=      0.5200E-03 CM/SEC


******************************************************************************
                 GENERAL DESIGN AND EVAPORATIVE ZONE DATA   1
------------------------------------------------------------------------------

                            VALID FOR  20 YEARS

         NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
                  SOIL DATA BASE USING SOIL TEXTURE # 7 WITH A
                  FAIR STAND OF GRASS, A SURFACE SLOPE OF  5.%
                  AND A SLOPE LENGTH OF  100. FEET.

        SCS RUNOFF CURVE NUMBER             =     76.72
        FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
        AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
        EVAPORATIVE ZONE DEPTH              =      6.0    INCHES
        INITIAL WATER IN EVAPORATIVE ZONE   =      1.255  INCHES
        UPPER LIMIT OF EVAPORATIVE STORAGE  =      2.838  INCHES
        FIELD CAPACITY OF EVAPORATIVE ZONE  =      1.332  INCHES
        LOWER LIMIT OF EVAPORATIVE STORAGE  =      0.624  INCHES
        SOIL EVAPORATION ZONE DEPTH         =      6.000  INCHES
        INITIAL SNOW WATER                  =      0.000  INCHES
        INITIAL INTERCEPTION WATER          =      0.000  INCHES
        INITIAL WATER IN LAYER MATERIALS    =     13.084  INCHES
        TOTAL INITIAL WATER                 =     13.084  INCHES
        TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR


******************************************************************************
                        EVAPOTRANSPIRATION DATA   1
------------------------------------------------------------------------------

                           VALID FOR  20 YEARS

         NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                  RALEIGH             NORTH CAROLINA
            STATION LATITUDE                      =  35.87 DEGREES
            MAXIMUM LEAF AREA INDEX               =   2.00
            START OF GROWING SEASON (JULIAN DATE) =     86
            END OF GROWING SEASON (JULIAN DATE)   =    310
            EVAPORATIVE ZONE DEPTH                =   6.0  INCHES
            AVERAGE ANNUAL WIND SPEED             =   7.70 MPH
            AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  66.0  %
            AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  70.0  %
            AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  78.0  %
            AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  72.0  %

******************************************************************************


******************************************************************************
                    FINAL WATER STORAGE AT END OF YEAR   20
------------------------------------------------------------------------------

                      LAYER        (INCHES)       (VOL/VOL)
                      -----        --------       ---------
                        1           1.2108         0.2018

                        2           8.5500         0.4750

                        3           3.4496         0.2875

    TOTAL WATER IN LAYERS         13.210

    SNOW WATER                     0.000

    INTERCEPTION WATER             0.000

    TOTAL FINAL WATER             13.210

******************************************************************************


******************************************************************************
                  PEAK DAILY VALUES FOR YEARS    1 THROUGH   20
------------------------------------------------------------------------------

                                                (INCHES)      (CU. FT.)
                                               ----------   -------------
      PRECIPITATION                              5.22         18948.600

      RUNOFF                                     3.233        11735.6846

      PERCOLATION/LEAKAGE THROUGH LAYER  2       0.453537      1646.34021

      AVERAGE HEAD ON TOP OF LAYER  2            6.000

      PERCOLATION/LEAKAGE THROUGH LAYER  3       0.443759      1610.84521

      SNOW WATER                                 2.50          9076.1426

      MAXIMUM VEG. SOIL WATER (VOL/VOL)                  0.4730

      MINIMUM VEG. SOIL WATER (VOL/VOL)                  0.1040

******************************************************************************
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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.54	2.91	3.75	2.23	4.24	3.77
	4.33	5.31	2.39	2.98	2.77	2.85
STD. DEVIATIONS	1.98	1.21	1.50	1.63	2.19	2.07
	1.94	3.75	1.64	2.03	1.68	0.88
RUNOFF						
TOTALS	0.189	0.022	0.065	0.015	0.185	0.045
	0.058	0.398	0.097	0.125	0.053	0.051
STD. DEVIATIONS	0.376	0.096	0.190	0.065	0.460	0.096
	0.232	1.090	0.419	0.308	0.112	0.174
POTENTIAL EVAPOTRANSPIRATION						
TOTALS	1.886	2.137	3.599	4.951	6.322	6.982
	6.899	6.009	4.614	3.366	2.215	1.584
STD. DEVIATIONS	0.153	0.203	0.283	0.308	0.266	0.310
	0.320	0.304	0.314	0.235	0.161	0.117
ACTUAL EVAPOTRANSPIRATION						
TOTALS	1.282	1.590	2.298	1.783	2.745	2.902
	3.251	3.152	1.640	1.268	1.203	1.033
STD. DEVIATIONS	0.189	0.284	0.490	1.018	1.055	1.263
	1.112	0.961	0.824	0.509	0.355	0.134
PERCOLATION/LEAKAGE THROUGH LAYER 2						
TOTALS	2.0322	1.5486	1.3799	0.5923	1.2470	0.9188
	1.0245	1.6568	0.7721	1.1952	1.5509	1.7091
STD. DEVIATIONS	1.5533	1.1493	1.0698	0.8621	1.2434	1.0991
	0.9154	1.7247	0.7297	1.3205	1.4150	0.9856
PERCOLATION/LEAKAGE THROUGH LAYER 3						
TOTALS	2.0811	1.5559	1.4173	0.8398	1.1196	0.9388
	0.9115	1.5989	1.0629	0.9867	1.4961	1.6101
STD. DEVIATIONS	1.3565	1.0456	1.0202	0.7925	1.0796	0.9209
	0.9032	1.4205	0.6747	1.0851	1.2162	1.0367

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	0.3482	0.1916	0.1831	0.0602	0.2137	0.1374
	0.1245	0.2850	0.1052	0.1712	0.2388	0.2053
STD. DEVIATIONS	0.3989	0.1917	0.2258	0.1317	0.2993	0.1973
	0.1525	0.4543	0.1282	0.2732	0.2965	0.1712

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES		CU. FEET	PERCENT
PRECIPITATION	41.08	(8.075)	149102.3	100.00
RUNOFF	1.302	(1.8292)	4726.33	3.170
POTENTIAL EVAPOTRANSPIRATION	50.564	(0.8460)	183547.44	
ACTUAL EVAPOTRANSPIRATION	24.148	(2.9682)	87656.52	58.790
PERCOLATION/LEAKAGE THROUGH LAYER 2	15.62738	(4.49761)	56727.375	38.04595
AVERAGE HEAD ON TOP OF LAYER 2	0.189	(0.092)		
PERCOLATION/LEAKAGE THROUGH LAYER 3	**15.61885**	(4.58741)	56696.410	38.02518
CHANGE IN WATER STORAGE	0.006	(0.8170)	22.98	0.015

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                                                                          **
**              HELP Version 3.90 D         (10. August 2011)               **
**                               developed at                               **
**        Institute of Soil Science, University of Hamburg, Germany         **
**                                 based on                                 **
**              US HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)               **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


 TIME:  18.47     DATE:   1.03.2015


 PRECIPITATION DATA FILE:      C:\Program Files
(x86)\HELPMod\HELP390D\Projects\RaleighNC.d4
 TEMPERATURE DATA FILE:        C:\Program Files
(x86)\HELPMod\HELP390D\Projects\RaleighNC.d7
 SOLAR RADIATION DATA FILE:    C:\Program Files
(x86)\HELPMod\HELP390D\Projects\RaleighNC.d13
 EVAPOTRANSPIRATION DATA F. 1: C:\Program Files
(x86)\HELPMod\HELP390D\Projects\RaleighNC.d11
 SOIL AND DESIGN DATA FILE  1: C:\Program Files
(x86)\HELPMod\HELP390D\Projects\HCACLFC2B.d10
 OUTPUT DATA FILE:             C:\Program Files
(x86)\HELPMod\HELP390D\Projects\HCACLFC2B.out

******************************************************************************

      TITLE:  Harnett County ACLF - Case 2B (RMC - Side Slopes)

******************************************************************************

                            WEATHER DATA SOURCES
------------------------------------------------------------------------------

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

                   NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

      JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
      -------     -------     -------     -------     -------     -------
        3.55        3.43        3.69        2.91        3.67        3.66
        4.38        4.44        3.29        2.73        2.87        3.14

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

                   NORMAL MEAN MONTHLY TEMPERATURE (DEGREES CELSIUS)

      JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
      -------     -------     -------     -------     -------     -------
         4.2         5.3         9.6        15.3        19.6        23.3
        25.4        25.0        21.7        15.4        10.0         5.6


          NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    RALEIGH             NORTH CAROLINA
                     AND STATION LATITUDE  =  35.87 DEGREES


******************************************************************************
                                 LAYER DATA   1
------------------------------------------------------------------------------

                              VALID FOR  20 YEARS

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


                                   LAYER  1
                                   --------

                       TYPE 1 - VERTICAL PERCOLATION LAYER
                           MATERIAL TEXTURE NUMBER   7
          THICKNESS                   =      6.00   INCHES
          POROSITY                    =      0.4730 VOL/VOL
          FIELD CAPACITY              =      0.2220 VOL/VOL
          WILTING POINT               =      0.1040 VOL/VOL
          INITIAL SOIL WATER CONTENT  =      0.2091 VOL/VOL
          EFFECTIVE SAT. HYD. CONDUCT.=      0.5200E-03 CM/SEC
      NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
               FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                   LAYER  2
                                   --------

                           TYPE 3 - BARRIER SOIL LINER
                           MATERIAL TEXTURE NUMBER  15
          THICKNESS                   =     18.00   INCHES
          POROSITY                    =      0.4750 VOL/VOL
          FIELD CAPACITY              =      0.3780 VOL/VOL
          WILTING POINT               =      0.2650 VOL/VOL
          INITIAL SOIL WATER CONTENT  =      0.4750 VOL/VOL
          EFFECTIVE SAT. HYD. CONDUCT.=      0.1000E-04 CM/SEC
```

```
                                LAYER  3
                                --------

                   TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER   7
          THICKNESS                    =     12.00   INCHES
          POROSITY                     =      0.4730 VOL/VOL
          FIELD CAPACITY               =      0.2220 VOL/VOL
          WILTING POINT                =      0.1040 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.2733 VOL/VOL
          EFFECTIVE SAT. HYD. CONDUCT.=      0.5200E-03 CM/SEC


*****************************************************************************
                 GENERAL DESIGN AND EVAPORATIVE ZONE DATA   1
-----------------------------------------------------------------------------

                            VALID FOR  20 YEARS

         NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
                  SOIL DATA BASE USING SOIL TEXTURE # 7 WITH A
                  FAIR STAND OF GRASS, A SURFACE SLOPE OF 25.%
                  AND A SLOPE LENGTH OF  200. FEET.

        SCS RUNOFF CURVE NUMBER             =     76.87
        FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
        AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
        EVAPORATIVE ZONE DEPTH              =      6.0    INCHES
        INITIAL WATER IN EVAPORATIVE ZONE   =      1.255  INCHES
        UPPER LIMIT OF EVAPORATIVE STORAGE  =      2.838  INCHES
        FIELD CAPACITY OF EVAPORATIVE ZONE  =      1.332  INCHES
        LOWER LIMIT OF EVAPORATIVE STORAGE  =      0.624  INCHES
        SOIL EVAPORATION ZONE DEPTH         =      6.000  INCHES
        INITIAL SNOW WATER                  =      0.000  INCHES
        INITIAL INTERCEPTION WATER          =      0.000  INCHES
        INITIAL WATER IN LAYER MATERIALS    =     13.084  INCHES
        TOTAL INITIAL WATER                 =     13.084  INCHES
        TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR


*****************************************************************************
                       EVAPOTRANSPIRATION DATA   1
-----------------------------------------------------------------------------

                           VALID FOR  20 YEARS

         NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                  RALEIGH             NORTH CAROLINA
            STATION LATITUDE                      =  35.87 DEGREES
            MAXIMUM LEAF AREA INDEX               =   2.00
            START OF GROWING SEASON (JULIAN DATE) =     86
            END OF GROWING SEASON (JULIAN DATE)   =    310
            EVAPORATIVE ZONE DEPTH                =   6.0  INCHES
            AVERAGE ANNUAL WIND SPEED             =   7.70 MPH
            AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  66.0  %
            AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  70.0  %
            AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  78.0  %
            AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  72.0  %
*****************************************************************************


*****************************************************************************
                   FINAL WATER STORAGE AT END OF YEAR   20
-----------------------------------------------------------------------------

                     LAYER        (INCHES)       (VOL/VOL)
                     -----        --------       ---------
                       1           1.2108         0.2018

                       2           8.5500         0.4750

                       3           3.4496         0.2875

    TOTAL WATER IN LAYERS         13.210

    SNOW WATER                     0.000

    INTERCEPTION WATER             0.000

    TOTAL FINAL WATER             13.210
*****************************************************************************


*****************************************************************************
                PEAK DAILY VALUES FOR YEARS    1 THROUGH   20
-----------------------------------------------------------------------------

                                                (INCHES)      (CU. FT.)
                                               ----------   -------------
      PRECIPITATION                              5.22         18948.600

      RUNOFF                                     3.233        11735.6719

      PERCOLATION/LEAKAGE THROUGH LAYER  2       0.453537      1646.34021

      AVERAGE HEAD ON TOP OF LAYER  2            6.000

      PERCOLATION/LEAKAGE THROUGH LAYER  3       0.443864      1611.22644

      SNOW WATER                                 2.50          9076.1426

      MAXIMUM VEG. SOIL WATER (VOL/VOL)                  0.4730

      MINIMUM VEG. SOIL WATER (VOL/VOL)                  0.1040
*****************************************************************************
```

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.54	2.91	3.75	2.23	4.24	3.77
	4.33	5.31	2.39	2.98	2.77	2.85
STD. DEVIATIONS	1.98	1.21	1.50	1.63	2.19	2.07
	1.94	3.75	1.64	2.03	1.68	0.88
RUNOFF						
TOTALS	0.189	0.022	0.065	0.015	0.185	0.045
	0.059	0.399	0.097	0.128	0.051	0.050
STD. DEVIATIONS	0.376	0.096	0.190	0.065	0.460	0.096
	0.232	1.090	0.419	0.314	0.110	0.172
POTENTIAL EVAPOTRANSPIRATION						
TOTALS	1.886	2.137	3.599	4.951	6.322	6.982
	6.899	6.009	4.614	3.366	2.215	1.584
STD. DEVIATIONS	0.153	0.203	0.283	0.308	0.266	0.310
	0.320	0.304	0.314	0.235	0.161	0.117
ACTUAL EVAPOTRANSPIRATION						
TOTALS	1.282	1.590	2.298	1.783	2.745	2.902
	3.251	3.153	1.640	1.268	1.203	1.033
STD. DEVIATIONS	0.189	0.284	0.490	1.018	1.056	1.262
	1.112	0.962	0.824	0.509	0.355	0.134
PERCOLATION/LEAKAGE THROUGH LAYER 2						
TOTALS	2.0323	1.5491	1.3796	0.5923	1.2466	0.9181
	1.0239	1.6560	0.7717	1.1923	1.5528	1.7091
STD. DEVIATIONS	1.5532	1.1494	1.0700	0.8622	1.2427	1.0986
	0.9150	1.7243	0.7294	1.3107	1.4217	0.9858
PERCOLATION/LEAKAGE THROUGH LAYER 3						
TOTALS	2.0808	1.5564	1.4168	0.8401	1.1193	0.9383
	0.9111	1.5990	1.0615	0.9837	1.4976	1.6105
STD. DEVIATIONS	1.3565	1.0454	1.0204	0.7929	1.0791	0.9202
	0.9027	1.4240	0.6721	1.0744	1.2235	1.0369

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	0.3476	0.1920	0.1829	0.0604	0.2135	0.1382
	0.1236	0.2841	0.1051	0.1731	0.2389	0.2063
STD. DEVIATIONS	0.3996	0.1934	0.2257	0.1320	0.2992	0.1968
	0.1519	0.4479	0.1280	0.2803	0.2969	0.1713

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES		CU. FEET	PERCENT
PRECIPITATION	41.08	(8.075)	149102.3	100.00
RUNOFF	1.306	(1.8244)	4739.49	3.179
POTENTIAL EVAPOTRANSPIRATION	50.564	(0.8460)	183547.44	
ACTUAL EVAPOTRANSPIRATION	24.148	(2.9698)	87656.48	58.789
PERCOLATION/LEAKAGE THROUGH LAYER 2	15.62377	(4.49865)	56714.270	38.03716
AVERAGE HEAD ON TOP OF LAYER 2	0.189	(0.092)		
PERCOLATION/LEAKAGE THROUGH LAYER 3	**15.61524**	(4.58872)	56683.316	38.01640
CHANGE IN WATER STORAGE	0.006	(0.8171)	22.97	0.015

OBJECTIVE: To evaluate the required transmissivity for the drainage geocomposite placed in the final cover system.

REFERENCE: Richardson, G.N., Giroud, J-P., and Zhao, A. (2000), Design of Lateral Drainage Systems for Landfills, Tenax Corp., Baltimore.

ANALYSIS:

Step 1:

Determine the required transmissivity (θ_{reqd}) of the drainage geocomposite based on the following equation:

$$\theta_{reqd} = \frac{RF_{dc} q_n Li}{\sin\beta} = \frac{RF_{dc} q_n L \cos\beta}{\sin\beta} = \frac{RF_{dc} q_n L}{\tan\beta}$$ (Richardson et. al. Eq. 4-6 Mod.)

where:

θ_{reqd}	=	required transmissivity (m^3/m/sec)
RF_{dc}	=	drainage geocomposite reduction factor (See Note 1)
q_n	=	fluid input rate (or impingement rate) (m/s) (See Note 2)
L	=	flow length (or drain spacing) (horizontally projected) (m)
β	=	slope angle of final cover (degrees)

Notes:

1. Based on the recommendations of Richardson, Giroud, & Zhao, use RF_{dc} = 6. This accounts for an overall factor of safety of 2, plus a combined reduction factor of 3 for long-term intrusion, creep, and clogging concerns. A lower reduction factor may be used where veneer stability is not a significant concern.
2. Typically the impingement into the drainage geocomposite is determined by the **lessor** of:
   a. Permeability of the overlying vegetative soil layer (k_{veg}) or
   b. Design rainfall.

   Per Richardson, Giroud, & Zhao, use $q_n = k_{veg}$ except in arid/semi-arid areas.

Step 2:

Determine the required transmissivity test parameters:

- Normal Stress (cover thickness x unit weight of cover soil) and
- Hydraulic Gradient (approximately equal to slope of cover system for most slopes).

Step 3:

Calculate the required total flow capactiy (Q) of the drain basin on the following equation:

$$Q = q_n A$$

where:

Q	=	flow capacity (cfs)
q_n	=	impingement (ft/s)
A	=	total area served by the drain (= L x DL) (ft^2)
DL	=	length of drain between outlet locations (ft).

Step 4:

After finding Q for each drain, the designer shall select the appropriate type and size of drain.

PROJECT	**Harnett County - ACLF - Phases I-III**	SHEET	2/2
		JOB #	HARNETT-AC-14-1
SUBJECT	**Final Cover Drainage Layer Analysis**	DATE	3/1/2015
		COMPUTED BY	PKS
		CHECKED BY	

Input Parameters:

Side Slope Angle (β):	4.8	degrees	(12.0H:1V Slope)	***8% Slope***
Impingement (q_n):	0.0001	cm/sec	(= Permeability of Vegetative Soil Layer)	
Drain Spacing (L):	150	ft	(= Horizontally Projected Distance Up & Down Slope) (Max.)	

Reduction Factors for Drainage Geocomposite: (Per Richardson, Giroud, & Zhao Recommendations)

$RF_{intrusion}$:	1.1
RF_{creep}:	1.1
$RF_{chemical\ clogging}$:	1.1
$RF_{biological\ clogging}$:	1.1
Overall Factor of Safety (FS):	1.3
Reduction Factor for Drainage Geocomposite in Final Cover (RF_{dc}):	1.9
Drain Length (DL):	300 ft (= Distance Across Slope at Toe) (> Max.)

Final Cover:	Thickness:	2.0	ft
	Unit Weight:	110	pcf

Note: Spreadsheet Converts Units as Required.

Transmissivity Requirements:

Determine Minimum Transmissivity:

θ_{min} = 1.0E-03 m^3/m/sec = 5.1 gpm/ft

Determine Transmissivity Test Parameters:

Min. Normal Stress = 220.0 psf

Hydraulic Gradient = 0.08

Determine Required Drain Capacity:

Calculate Required Total Flow Capacity:

Q = 0.15 cfs *Based on 300 foot spacing between outlets.

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OBJECTIVE: To determine the maximum geotextile apparent opening size (AOS) to provide proper retention to protect drainage media from piping and clogging from adjacent soil. Additionally, to determine the minimum required geotextile permittivity to provide proper drainage from the adjacent soil. Geotextile filtration properties must be selected based on the up-gradient soil gradation and plasticity and site specific hydraulic conditions.

REFERENCES:

Bhatia, S.K. and Huang, Q. (1995), "Geotextile Filters for Internally Stable/Unstable Soils", Geosynthetics International, Vol. 2, No. 3, pp. 537-565.

Koerner, Robert M. (1999), Designing with Geosynthetics, 4th Ed., Prentice-Hall Inc., Englewood Cliffs, NJ, pp. 84-91.

Mirafi - Geotextile Filter Design, Application, and Product Selection Guide, Ten Cate Nicolon Corp. (www.mirafi.com).

Richardson, G.N., Giroud, J-P., and Zhao, A. (2000), Design of Lateral Drainage Systems for Landfills, Tenax Corp., Baltimore.

ASSUMPTIONS: The design criteria given assume that the soil is "set" in intimate contact with the geotextile.

BACKGROUND: From Richardson et. al.:

For the purposes of filtration design, soils can be characterized as stable or unstable. Stable soils perform an internal filtration process that limits migration of fines within the soil. Typically, these soil types include well-graded soils. Unstable soils are those which cannot perform self-filtration (i.e. they have the potential to pipe internally). They may include gap-graded, broad-graded, and other highly erodible soils. In gap-graded soils, there exists a coarse and fine fraction, but very little medium fraction. If there is an insufficient quantity of soil particles in the medium fraction, fine soil particles pipe through the coarse fraction. In broad-graded soils, the gradation is distributed over a very wide range of particle sizes such that fine soil tends to pipe through coarser particles.

ANALYSIS:

1. Define Application and Function of Geotextile:

Define the application and function of the geotextile (i.e. where the geotextile is to be used and whether retention or permeability is the key function of the material) and also the confining stress (i.e. high - leachate collection system; low - final cover system) and flow conditions (i.e. steady-state - landfill drains; dynamic - shoreline protection).

2. Evaluate Soils Information

For representative soils, evaluate grain size and plasticity information. From the grain size curves determine the coefficients of uniformity and curvature as follows:

$$C_u = \frac{d_{60}}{d_{10}} \qquad C_c = \frac{d_{30}^{\ 2}}{(d_{10} \times d_{60})}$$

where:

C_u	=	coefficient of uniformity (quantifies the distribution of particle sizes)
C_c	=	coefficient of curvature (identifies internal soil stability)
d_x	=	the diameter at which x percent of the soil is finer

For $C_u \leq 4$, the soil is uniformly-graded; for $4 < C_u \leq 20$, the soil is well-graded; and for $C_u > 20$, the soil is broad-graded. Uniformly-graded and broad-graded soils require careful analysis. Gap-graded soils which have a coarse and fine fraction, but limited medium fraction are of particular concern and should be avoided. Gap-graded soils are readily identified by the appearance of the grain size curve. For $1 \leq C_c \leq 3$, the soil should be internally stable (Bhatia and Huang state that soils having $C_c \leq 7$ are internally stable.).

Additionally, in general, particles do not move within soils having a plasticity index (PI) greater than 15% so there is no clogging potential (Richardson et. al.).

3. Selection of Soil Retention Requirements (Maximum AOS):

To determine the maximum AOS, use the method given in Koerner/Mirafi (after Luettich) and the method given in Bhatia and Huang. For the AOS determined by either method, the following shows the relationship between opening size and the corresponding U.S. sieve number (with typical non-woven geotextile information as shown).

Opening Size (mm)	U.S. Sieve	
0.150	100	(most 10 to 16 oz/SY non-woven geotextiles)
0.180	80	(most 8 oz/SY non-woven geotextiles)
0.212	70	(most 4 to 6 oz/SY non-woven geotextiles)
0.250	60	
0.300	50	
0.425	40	
0.600	30	

- Luettich Method:

For steady-state conditions, use the chart below.

- Bhatia and Huang Method:

Bhatia and Huang developed the following retention criteria:

For $n \geq 60\%$ $O_{95} < d_{85}(2.71 - 0.36C_c)$ $C_c \leq 7$

For $n < 60\%$ $O_{95} < d_{85}(0.65 - 0.05C_c)$ $C_c > 7$

where: O_{95} = apparent opening size
n = geotextile porosity (%) (for non-woven geotextiles this value is typically 70 to 90%)

4. Determine Geotextile Permittivity Requirements:

Determine the geotextile permittivity requirements:

$$\Psi = \frac{k_g}{t_g} \qquad (\text{sec}^{-1})$$

where: ψ = mimimum required geotextile permittivity (sec^{-1})
k_g = mimimum allowable geotextile permeability (cm/sec)
k_g $\geq$ $i_s k_s$
t_g = geotextile thickness under design load (cm)
i_S = hydraulic gradient (use 1.5 for landfills)
k_S = permeability of retained soil (cm/sec)

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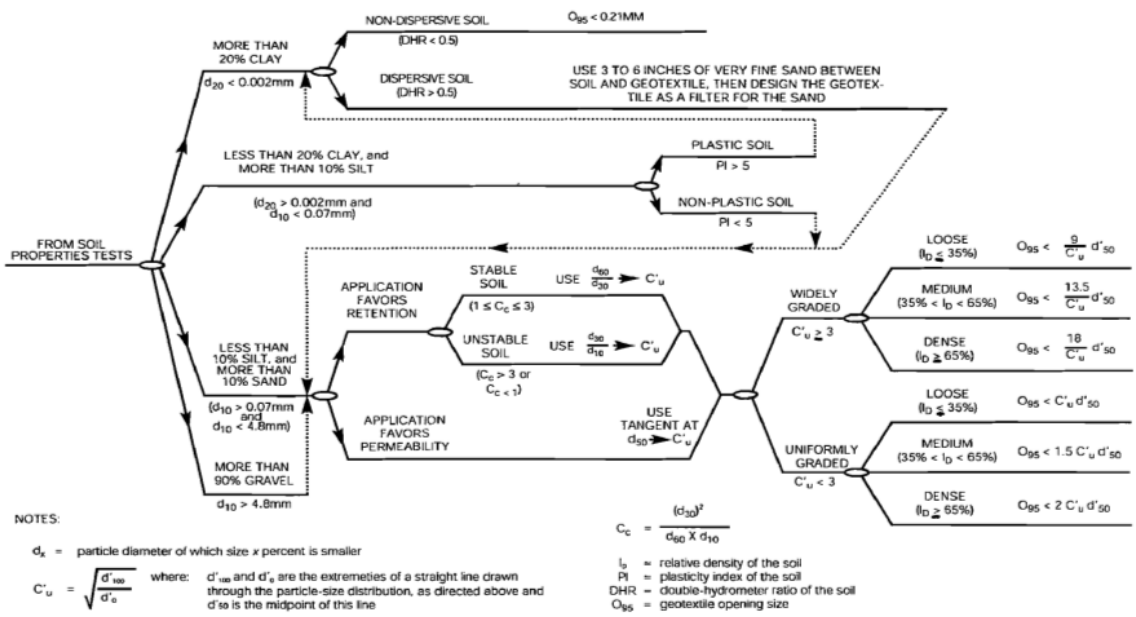
5. Other Considerations

Other things to consider in the design of a filter geotextile include anti-clogging requirements and survivability/durability requirements. For anti-clogging, it is generally best to use the largest AOS that satisfies the retention criteria. For non-woven geotextiles used in landfill applications, an AOS of 0.21 mm (No. 70 sieve) is typically the largest AOS that is available. For survivability/durability concerns, generally an adequately UV stabilized geotextile made from polypropylene or polyester with an AASHTO M288 Strength Class of 2 is suitable for use in subsurface drainage applications.

Chart 1. Soil Retention Criteria of Steady-State Flow Conditions



Ref: Mirafi (After Luettich)

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PROJECT	**Harnett County - ACLF Phases I-III**	SHEET	4/7
SUBJECT	**Filter Geotextile Analysis (Final Cover System)**	JOB #	HARNETT-AC-14-1
		DATE	3/2/2015
		COMPUTED BY	PKS
		CHECKED BY	

Application:	Final Cover System Drainage Geocomposite
Primary Function:	Retention/Permeability
Relative Confining Stress:	Low
Flow Conditions:	Steady-State

	Soil Evaluated		
	Typ. SC (PZ-14, 4-6')	Typ. SM (PZ-15, 20-22')	Typ. SP-SM (PZ-17, 8-10')
Soil Description:	Gray Clayey Sand	Light Brown Silty Sand	D. Brown Sand with Silt
Soil Type:	SC	SM	SP-SM
Particle Size (mm) d_{85}:	1.100	1.800	1.400
d_{60}:	0.400	0.510	0.900
d_{50}:	0.280	0.410	0.710
d_{30}:	0.150	0.210	0.470
d_{20}:	0.060	0.170	0.300
d_{10}:	0.026	0.030	0.170
PI:	10	0	0
C_u :	15.38	17.00	5.29
	Soil is Well Graded.	Soil is Well Graded.	Soil is Well Graded.
C_c :	2.16	2.88	1.44
Luettich Method:*	-----	-----	-----
Soil Dispersion (When Applicable):	Is Soil Dispersive? (Y/N)	NA	NA
	N		
Recommended Maximum AOS (mm) (When Applicable):	**0.210**		
	No. 70 Sieve		
Internal Soil Stability (When Applicable):	NA	Soil is Stable	Soil is Stable
		Draw straight line through d60 and d30 to obtain C'u.	Draw straight line through d60 and d30 to obtain C'u.
Particle Size (mm) for Determining C'_u d'_{100}:		1.800	2.100
d'_{50}:		0.400	0.710
d'_0:		0.090	0.210
C'_u (When Applicable):		4.47	3.16
		Soil is Widely Graded.	Soil is Widely Graded.
Soil Relative Density (I_D) (Loose (L), Medium (M), Dense (D) (When Applicable):		M	M
Recommended Maximum AOS (mm) (When Applicable):		**1.207**	**3.031**
		No. 30 Sieve	**No. 30 Sieve**
Bhatia & Huang Method:	-----	-----	-----
Internal Soil Stability:	Soil is Stable.	Soil is Stable.	Soil is Stable.
Geotextile Porosity (%):	80	80	80
Recommended Max. AOS (mm):	**2.124**	**3.010**	**3.066**
	No. 30 Sieve	**No. 30 Sieve**	**No. 30 Sieve**
Required Geotextile Properties:	-----	-----	-----
Hydraulic Gradient (i_s):	1.5	1.5	1.5
Estimated Soil Permeability (k_s) (cm/sec):	1.0E-04	1.0E-04	1.0E-04
Min. Allowable Geotextile Permeability (k_g) (cm/sec):	1.5E-04	1.5E-04	1.5E-04
Geotextile Thickness (t_g) (cm):	0.25	0.25	0.25
Min. Required Geotextile Permittivity (Y) (sec^{-1}):	**0.0006**	**0.0006**	**0.0006**

***Note: Spreadsheet assumes retention application in using the Luettich Method.**

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7/1/2009

Grain Size Distribution Calculations

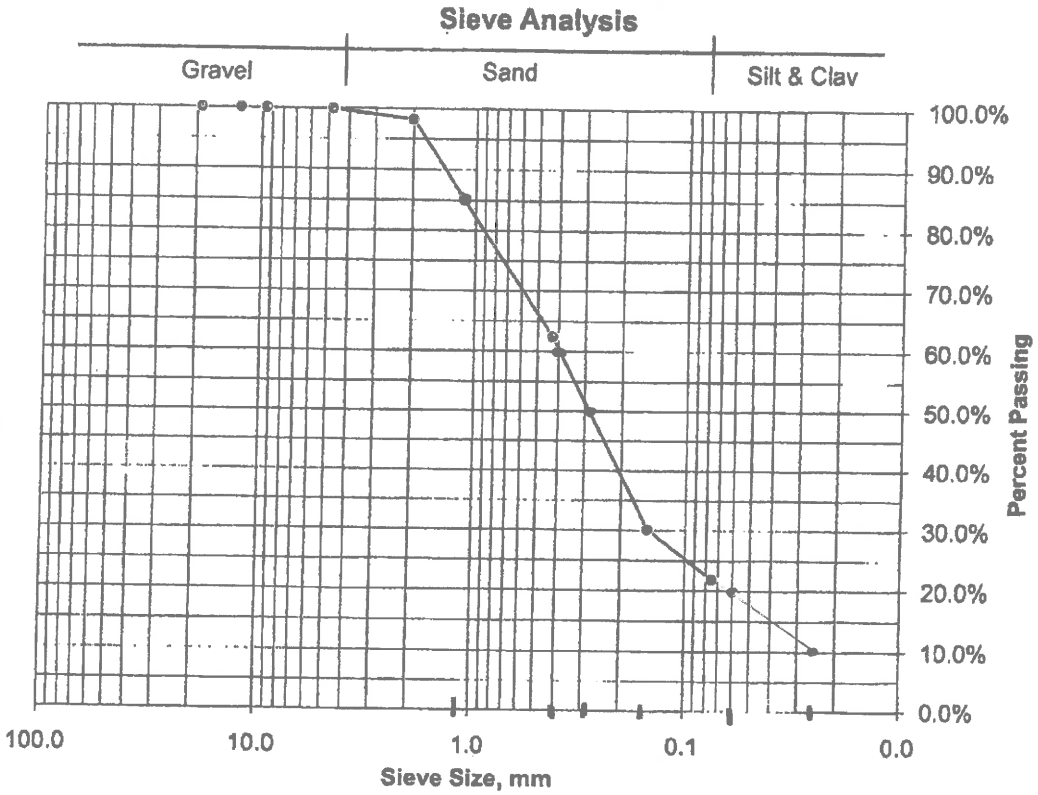
ACLF C&D Phase III - Lab
DAA # R09358R-01
Prepared By: ADC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID PZ-14
Sample Depth 4'-6'

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.16	0.1%	4.75	99.9%
No. 10	3.35	1.7%	2.0	98.3%
No. 40	71.94	35.8%	0.425	62.5%
No. 100	64.88	32.3%	0.15	30.2%
No. 200	16.61	8.3%	0.075	21.9%
Pan	0.84	0.4%		
Total	157.78	78.1%		



7/1/2009

Grain Size Distribution Calculations

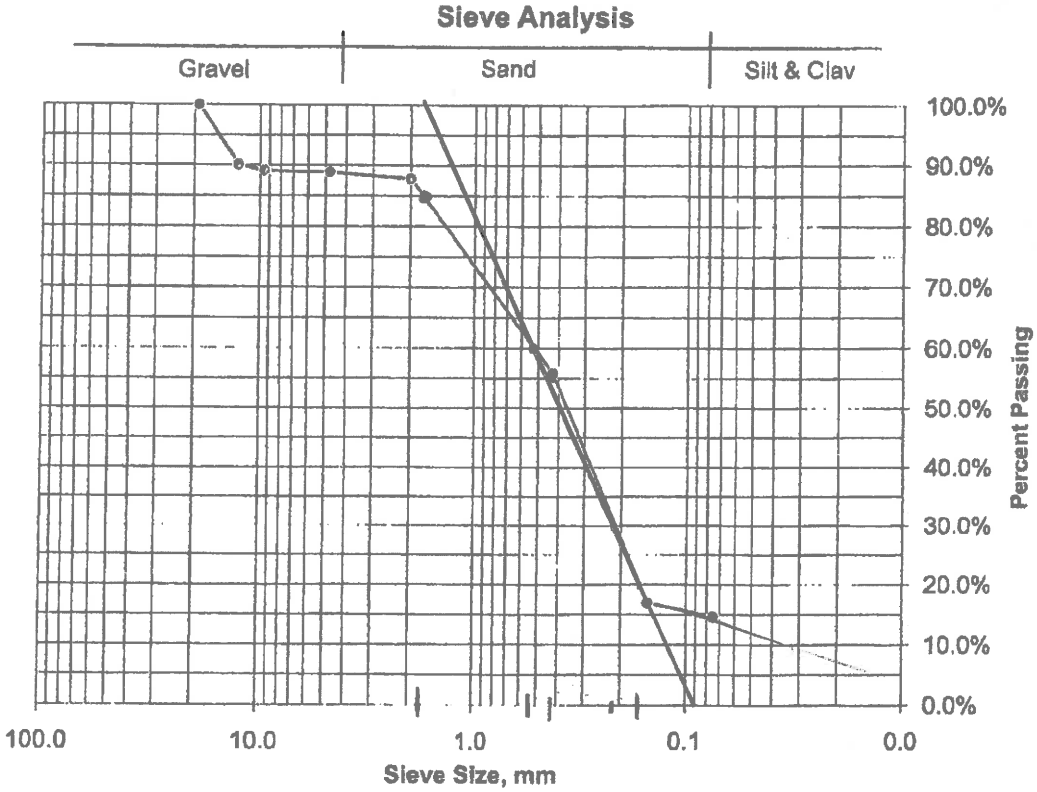
ACLF C&D Phase III - Lab
DAA # R09358R-01
Prepared By: ADC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID PZ-15
Sample Depth 20'-22'

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
3/4"	0.00	0.0%	19.0	100.0%
1/2"	15.89	9.9%	12.5	90.1%
3/8"	1.63	1.0%	9.5	89.1%
No. 4	0.42	0.3%	4.75	88.8%
No. 10	1.68	1.0%	2.0	87.8%
No. 40	51.37	31.9%	0.425	55.9%
No. 100	62.58	38.9%	0.15	17.0%
No. 200	3.71	2.3%	0.075	14.7%
Pan	0.28	0.2%		
Total	137.56	85.3%		



7/1/2009

Grain Size Distribution Calculations

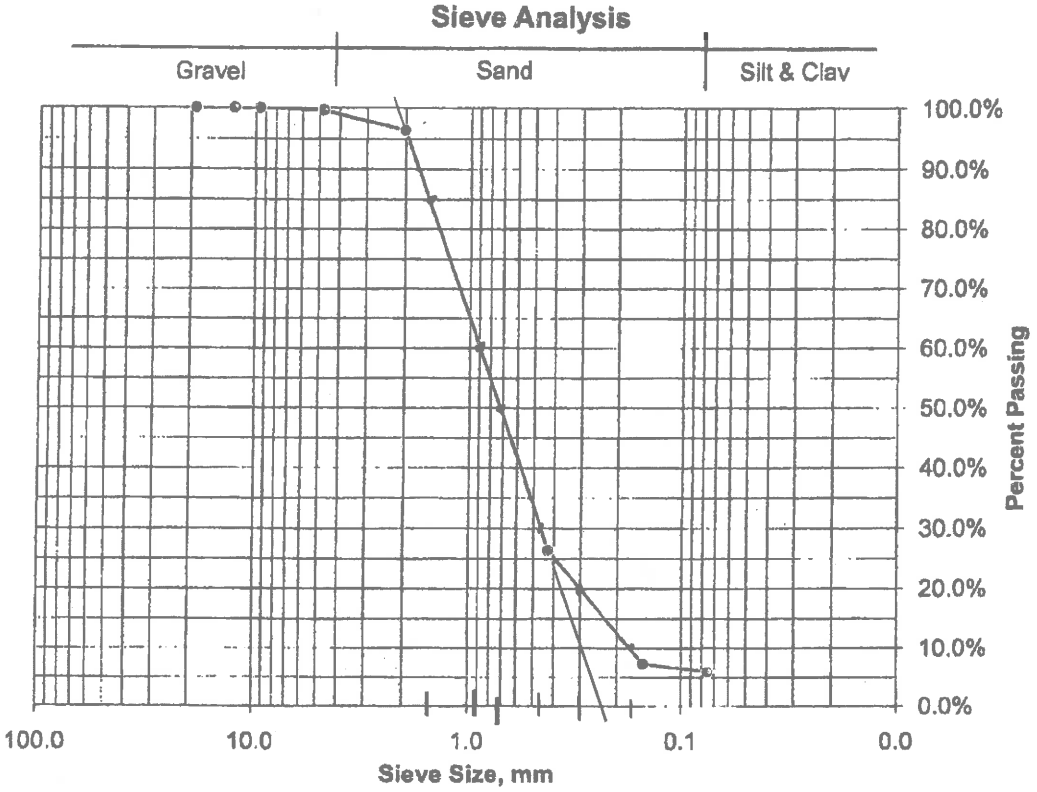
ACLF C&D Phase III - Lab
DAA # R09358R-01
Prepared By: ADC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID PZ-17
Sample Depth 8'-10'

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.62	0.3%	4.75	99.7%
No. 10	5.83	3.3%	2.0	96.4%
No. 40	125.01	70.0%	0.425	26.4%
No. 100	34.03	19.1%	0.15	7.3%
No. 200	2.45	1.4%	0.075	6.0%
Pan	0.18	0.1%		
Total	168.12	94.0%		



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OBJECTIVE: To determine the interface shear strength requirements for the final cover system veneer to satisfy the required factor(s) of safety against sliding.

REFERENCE: Matasovic, N. (1991), "Selection of Method for Seismic Slope Stability Analysis," Proc. 2nd International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics, St. Louis, Vol. 2, pp.1057-1062.

REQUIREMENTS: FS_{min}(Static) = 1.5
FS_{min}(Seismic) = 1.0 (If Applicable)

ANALYSIS:

1. Treat the final cover as an infinite slope and use the following equation:

$$FS = \frac{ResistingForce}{DrivingForce} = \frac{\dfrac{c}{\gamma_c z_c \cos^2\beta} + \tan\delta\left[1 - \dfrac{\gamma_w(z_c - d_w)}{\gamma_c z_c}\right] - k_s(\tan\beta)(\tan\delta)}{k_s + \tan\beta}$$

(Matasovic, 1991)

where:

FS	=	factor of safety against shallow veneer failure
k_s	=	seismic coefficient (= 0 for static conditions) (= peak ground acceleration for seismic conditions)
γ_c	=	unit weight of final cover material(s) (pcf)
γ_w	=	unit weight of water (62.4 pcf) (pcf)
c	=	cohesion/adhesion along assumed failure surface (psf)
δ	=	interface friction angle along assumed failure surface (degrees)
z_c	=	depth of final cover (depth to failure surface) (ft)
d_w	=	depth to seepage surface (assumed parallel to slope) (ft)
β	=	slope angle of final cover (degrees)

$$u = \gamma_w(z_c - d_w)$$

*Note: Based on an allowable LFG pressure of 6 inch-w.c. (= 31.2 psf), the use of a depth to seepage of 1.5 feet or less (for evaluation of interfaces above the geomembrane) will satisfy the evaluation for LFG pressure against the bottom of the geomembrane as well.

2. Determine minimum interface shear strength as follows:

$$\tau = \sigma \tan\delta + c$$

where:

τ	=	interface shear strength (lbs)
σ	=	normal load (psf)
δ	=	interface friction angle (min. value from analysis or greater)
c	=	cohesion/adhesion (min. value from analysis or greater)

PROJECT	**Harnett County - ACLF - Phases I-III**	SHEET	2/2
		JOB #	HARNETT-AC-14-1
SUBJECT	**Final Cover Veneer Stability Evaluation**	DATE	5/27/2014
		COMPUTED BY	PKS
		CHECKED BY	

Input Parameters:

Side Slope Angle (β): 9.5 degrees (6.0H:1V Slope) ***Much Steeper than Top Areas***

Final Cover:

Thickness (z_c): 2.0 ft
Unit Weight (γ_c): 110 pcf
Cohesion/Adhesion (c): 0 psf
Depth to Seepage (d_w): 1.5 ft (= z if Slope is Dry) ***Assumes 6" Gas Pressure on Bottom***

Seismic Coefficient (k_s): 0 Static Conditions
0.10 Seismic Conditions (= Peak Ground Acceleration For The Site)

Required Factors of Safety:

Static: 1.5
Dynamic: 1.0

Static Conditions:

Interface Friction Angle (δ) (degrees)	Resisting Force	Driving Force	FS	Comment
15	0.23	0.17	1.37	**NO GOOD**
16	0.25	0.17	1.47	**NO GOOD**
17	0.26	0.17	1.57	**OK**
17.7	0.27	0.17	1.64	**OK**
18	0.28	0.17	1.67	**OK**
19	0.30	0.17	1.77	**OK**

Seismic Conditions:

Interface Friction Angle (δ) (degrees)	Resisting Force	Driving Force	FS	Comment
15	0.23	0.27	0.84	**NO GOOD**
16	0.24	0.27	0.90	**NO GOOD**
17	0.26	0.27	0.96	**NO GOOD**
17.7	0.27	0.27	1.00	**OK**
18	0.27	0.27	1.02	**OK**
19	0.29	0.27	1.08	**OK**

Minimum Interface Shear Strength Requirements:

Cohesion/Adhesion (c) (From Above) = 0 psf
Interface Friction Angle (δ) = 17.7 degrees (Use Min. Value From Above or Greater)

Normal Load (σ) (psf)	Interface Shear Strength (τ) (psf)
100	32
200	64
500	160

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ADDRESS
14 N. Boylan Avenue, Raleigh, NC 27603

TEL
919.828.0577

WEB
www.smithgardnerinc.com

PROJECT Harnett County ACLF - Ph. I-III

SHEET 1 OF 7

DATE 3/3/2015

COMPUTED BY PKS

SUBJECT Slope Stability Evaluation

JOB # HARNETT-AC-14-1

CHECKED BY

OBJECTIVE:

To perform a slope stability evaluation for the C&D landfill. Note that only static conditions were evaluated in that the landfill is not in a seismic impact zone (apeak = 0.098). Based on EPA guidance for MSW landfills (EPA/600/R-95/051), landfills are required to have a minimum long-term static factor of safety of 1.5.

ANALYSIS:

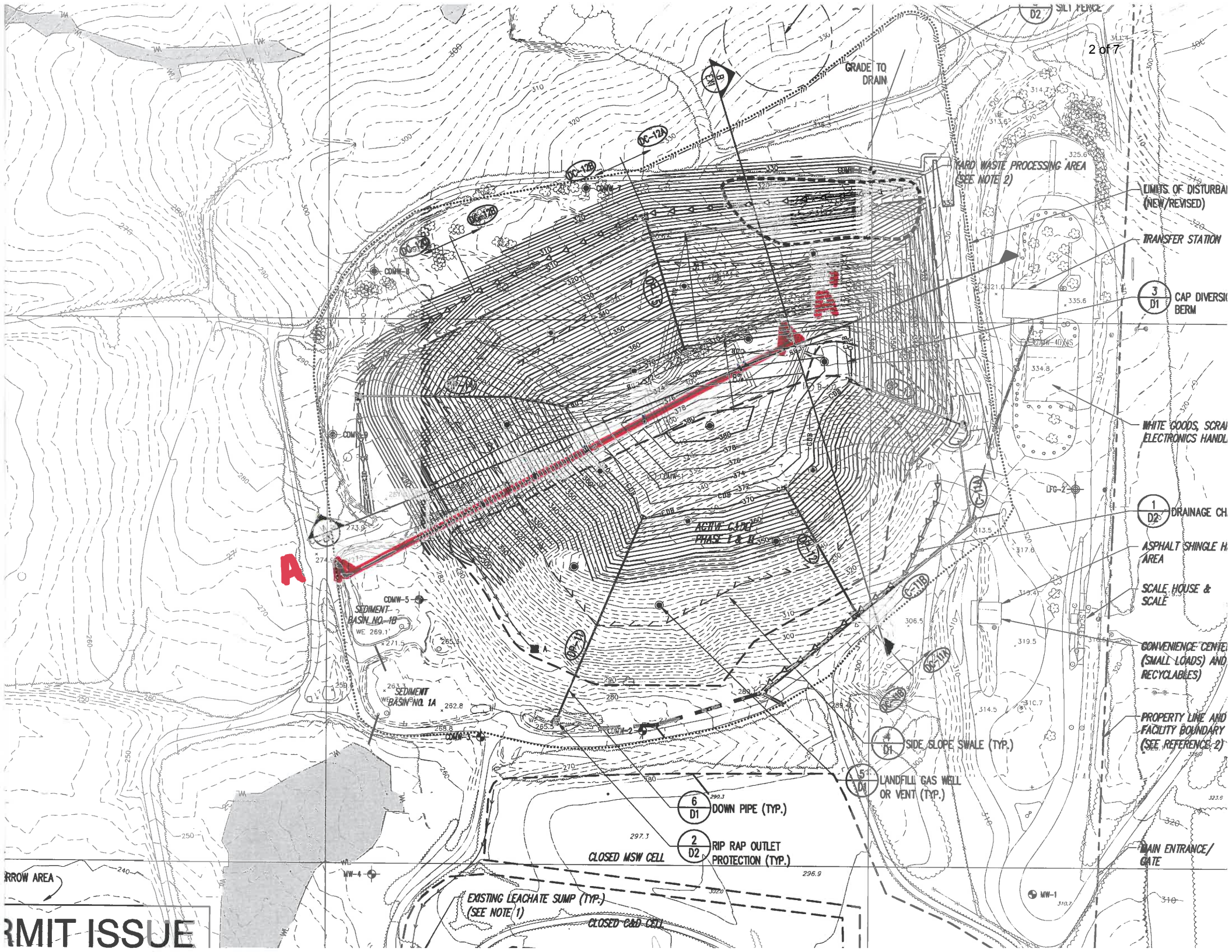
The slope stability evaluations for the overall C&D landfill area were performed using the computer program STABL5M, a computer program developed by Purdue University.

The slope stability evaluation was performed on Cross Section A (reference Permit Drawings) which represents a worst case. The shear strength envelope assumed for the waste in this evaluation was cohesion = 500 psf and phi = 25 degrees; which is believed to be conservative for C&D wastes. Also, the shear strength envelope assumed for the subgrade/berms in this evaluation was cohesion = 0 psf and phi = 20 degrees; which is conservative as well. The result is as follows:

Circular Failure (Static): 2.42

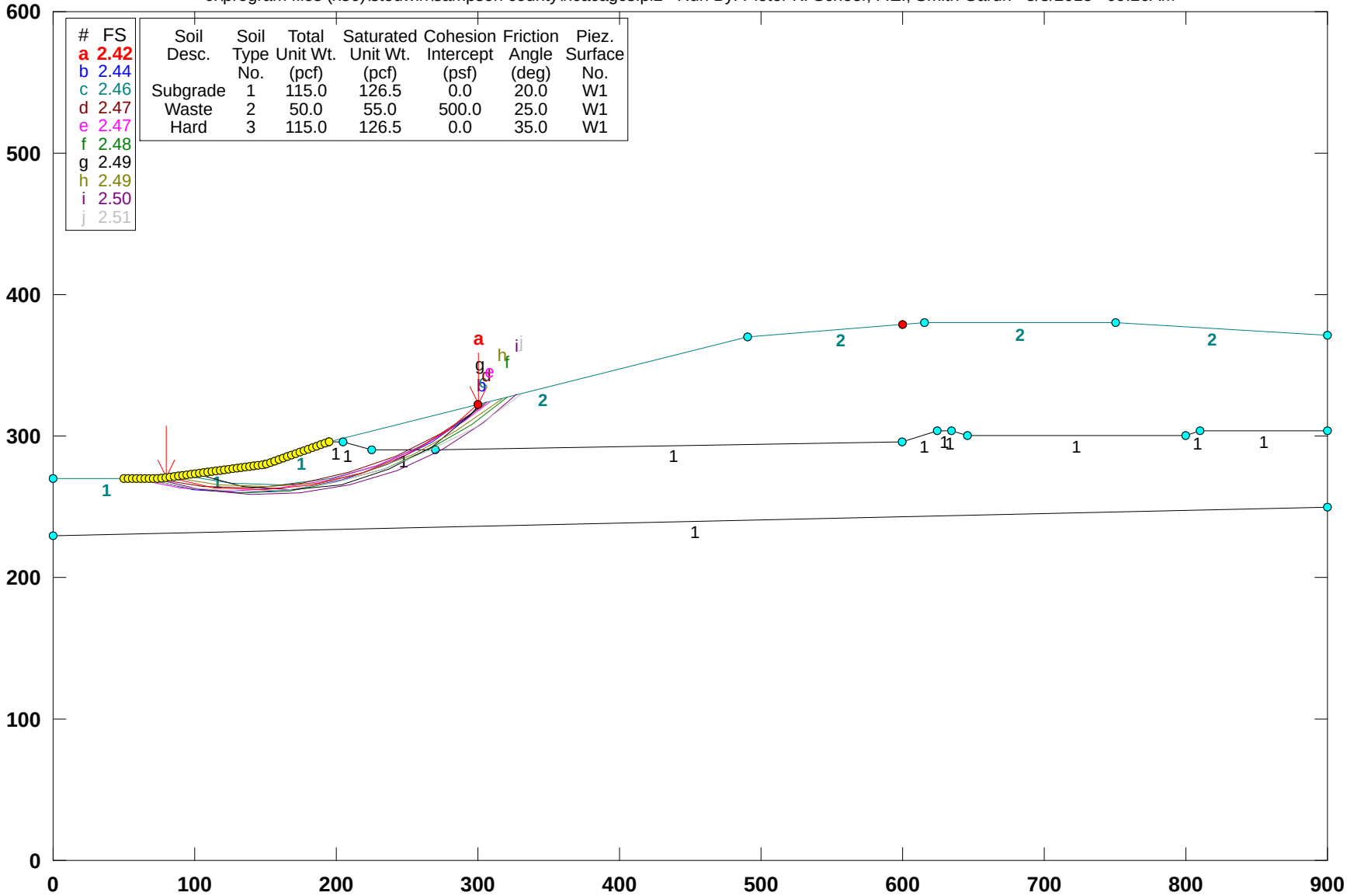
RESULTS:

Based on the results of the evaluation (see attached), the minimum factor of safety satisfies EPA guidelines.


D2 SILT FENCE
GRADE TO DRAIN
YARD WASTE PROCESSING AREA (SEE NOTE 2)
LIMITS OF DISTURBA (NEW/REVISED)
TRANSFER STATION
3 D1 CAP DIVERSI BERM
WHITE GOODS, SCRA ELECTRONICS HANDL
1 D2 DRAINAGE CH
ASPHALT SHINGLE H AREA
SCALE HOUSE & SCALE
CONVENIENCE CENTE (SMALL LOADS) AND RECYCLABLES)
PROPERTY LINE AND FACILITY BOUNDARY (SEE REFERENCE 2)
4 D1 SIDE SLOPE SWALE (TYP.)
5 D1 LANDFILL GAS WELL OR VENT (TYP.)
6 D1 DOWN PIPE (TYP.)
2 D2 RIP RAP OUTLET PROTECTION (TYP.)
MAIN ENTRANCE/ GATE
ACTIVE C&D PHASE I & II
CLOSED MSW CELL
CLOSED C&D CELL
EXISTING LEACHATE SUMP (TYP.) (SEE NOTE 1)
SEDIMENT BASIN NO. 1B
SEDIMENT BASIN NO. 1A
CDMW-1
CDMW-2
CDMW-3
CDMW-5
CDMW-8
CDMW-9
MW-1
MW-4
LFG-2
A
A'
RMIT ISSUE

Harnett County AC C&DLF - Section A Global Circular Static

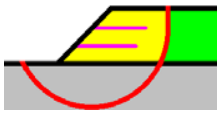
c:\program files (x86)\stedwin\sampson county\hcacagcs.pl2 Run By: Pieter K. Scheer, P.E., Smith Gardn 3/3/2015 09:26AM



PCSTABL5M/si FSmin=2.42

Safety Factors Are Calculated By The Modified Bishop Method

STED



**** PCSTABL5M ****
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 3/3/2015
Time of Run: 09:26AM
Run By: Pieter K. Scheer, P.E., Smith Gardn
Input Data Filename: C:HCACAGCS.
Output Filename: C:HCACAGCS.OUT
Unit: ENGLISH
Plotted Output Filename: C:HCACAGCS.PLT
PROBLEM DESCRIPTION Harnett County AC C&DLF - Section A
Global Circular Static

BOUNDARY COORDINATES
7 Top Boundaries
18 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	270.00	75.00	270.00	1
2	75.00	270.00	150.00	280.00	1
3	150.00	280.00	195.00	296.00	1
4	195.00	296.00	490.00	370.00	2
5	490.00	370.00	615.00	380.00	2
6	615.00	380.00	750.00	380.00	2
7	750.00	380.00	900.00	371.00	2

8	195.00	296.00	205.00	296.00	1
9	205.00	296.00	225.00	290.00	1
10	225.00	290.00	270.00	290.00	1
11	270.00	290.00	600.00	296.00	1
12	600.00	296.00	624.00	304.00	1
13	624.00	304.00	634.00	304.00	1
14	634.00	304.00	646.00	300.00	1
15	646.00	300.00	800.00	300.00	1
16	800.00	300.00	810.00	304.00	1
17	810.00	304.00	900.00	304.00	1
18	0.00	230.00	900.00	250.00	1

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	115.0	126.5	0.0	20.0	0.00	0.0	1
2	50.0	55.0	500.0	25.0	0.00	0.0	1
3	115.0	126.5	0.0	35.0	0.00	0.0	1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
2500 Trial Surfaces Have Been Generated.
50 Surfaces Initiate From Each Of 50 Points Equally Spaced
Along The Ground Surface Between X = 50.00 ft.
and X = 195.00 ft.
Each Surface Terminates Between X = 300.00 ft.
and X = 600.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00 ft.
35.00 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 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	79.59	270.61
2	113.86	263.51
3	148.81	261.62
4	183.65	265.00
5	217.59	273.55
6	249.86	287.09
7	279.74	305.32
8	300.05	322.35

Circle Center At X = 143.8 ; Y = 492.7 and Radius, 231.2
*** 2.424 ***
Individual data on the 12 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	34.3	23000.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	34.9	60065.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	1.2	2489.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	33.7	87517.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	11.3	35966.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	10.0	31544.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	12.6	35829.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	7.4	17897.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	24.9	43924.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	4.8	5654.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	25.1	20654.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	20.3	6061.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	64.80	270.00
2	98.98	262.48
3	133.87	259.75

```
    4        168.81      261.84
    5        203.13      268.73
    6        236.17      280.28
    7        267.30      296.27
    8        295.94      316.39
    9        303.16      323.13
Circle Center At X =  136.2 ; Y =  513.3  and Radius,  253.5
      ***     2.437   ***
Failure Surface Specified By  8 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1         91.43      272.19
    2        125.91      266.21
    3        160.90      265.36
    4        195.64      269.66
    5        229.37      279.01
    6        261.36      293.21
    7        290.91      311.95
    8        304.14      323.38
Circle Center At X =  149.1 ; Y =  500.1  and Radius,  235.1
      ***     2.460   ***
Failure Surface Specified By  9 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1         70.71      270.00
    2        105.31      264.70
    3        140.30      263.69
    4        175.14      266.97
    5        209.32      274.51
    6        242.32      286.17
    7        273.64      301.80
    8        302.81      321.14
    9        305.94      323.83
Circle Center At X =  131.0 ; Y =  548.4  and Radius,  284.9
      ***     2.472   ***
Failure Surface Specified By  9 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1         55.92      270.00
    2         90.31      263.50
    3        125.23      261.15
    4        160.18      262.98
    5        194.67      268.97
    6        228.19      279.03
    7        260.27      293.01
    8        290.46      310.73
    9        308.54      324.48
Circle Center At X =  127.4 ; Y =  554.0  and Radius,  292.9
      ***     2.474   ***
Failure Surface Specified By  9 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1         61.84      270.00
    2         96.11      262.91
    3        131.00      260.06
    4        165.97      261.50
    5        200.50      267.21
    6        234.07      277.10
    7        266.18      291.03
    8        296.35      308.77
    9        320.85      327.57
Circle Center At X =  136.7 ; Y =  545.6  and Radius,  285.6
      ***     2.483   ***
Failure Surface Specified By  8 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        100.31      273.37
    2        134.10      264.28
    3        169.01      261.72
    4        203.77      265.78
```

```
    5        237.15      276.32
    6        267.94      292.95
    7        295.05      315.10
    8        301.40      322.69
Circle Center At X =  164.9 ; Y =  444.7  and Radius,  183.1
      ***     2.486   ***
Failure Surface Specified By  9 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1         82.55      271.01
    2        117.06      265.19
    3        152.04      263.89
    4        186.89      267.15
    5        221.02      274.90
    6        253.86      287.01
    7        284.84      303.28
    8        313.46      323.44
    9        316.85      326.57
Circle Center At X =  144.5 ; Y =  532.9  and Radius,  269.1
      ***     2.490   ***
Failure Surface Specified By  9 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1         70.71      270.00
    2        104.80      262.05
    3        139.63      258.66
    4        174.61      259.89
    5        209.12      265.73
    6        242.56      276.08
    7        274.34      290.74
    8        303.91      309.47
    9        327.54      329.25
Circle Center At X =  147.8 ; Y =  523.3  and Radius,  264.7
      ***     2.496   ***
Failure Surface Specified By 10 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1         61.84      270.00
    2         96.23      263.49
    3        131.13      260.92
    4        166.10      262.32
    5        200.69      267.67
    6        234.45      276.91
    7        266.94      289.92
    8        297.75      306.52
    9        326.48      326.51
   10        330.42      329.97
Circle Center At X =  136.3 ; Y =  568.0  and Radius,  307.2
      ***     2.507   ***
```

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OBJECTIVE: To estimate the total foundation settlement due to the weight of the planned waste loads. A worst-case point (maximum waste load) was assumed.

REFERENCES:

Holtz, R.D., & Kovacs, W.D. (1981), An Introduction To Geotechnical Engineering, Prentice-Hall, Englewood Cliffs, NJ, Chapters 8 and 9.

Ohio EPA - Geotechnical Resource Group (2004), "Geotechnical and Stability Analyses for Ohio Waste Containment Facilities", Ohio EPA, Columbus, Ohio, Chapter 6.

Quian, X., Koerner, R.M., & Gray, D.H. (2001), Geotechnical Aspects of Landfill Design and Construction, Prentice Hall, Upper Saddle River, N.J., pp. 310, 469-473.

ASSUMPTIONS:

1. Vertical stresses acting on the liner are assumed to be one-dimensional (1-D).
2. Assumptions for soil properties are listed in the attached spreadsheet.

ANALYSIS: The following approach is used to perform the evaluation:

1. Identify the critical cross section(s) to be evaluated (maximum waste fill, minimum liner slopes, etc.).
2. Select points along each cross section to perform calculations (points of grade breaks in final cover and/or liner system).
3. For each calculation point, determine the subsurface profile beneath the liner system and separate into distinct layers (thickness and material properties) (Include structural fill where applicable).
4. For each calculation point, determine the stresses acting on the midpoint of each layer both before and after liner construction.
5. For each calculation point, determine the stress change at the liner. Take into account the stress decrease due to excavation (where applicable) and the stress increase due to waste loads.
6. Calculate elastic settlements for each granular soil layer using the equations below.
7. Calculate consolidation (primary and secondary) settlements for each clay/silt soil layer using the equations below.
8. Calculate total settlements at each calculation point and resulting post-settlement slopes and liner strain between each point. Verify that slopes meet or exceed the minimum allowable slope. Verify that tensile strains do not exceed allowable values.

CALCULATIONS:

- Elastic Settlement Equation:

$$S_e = \frac{\Delta p}{M_S} H$$

where:

S_e = elastic settlement (ft)
Δp = net stress change acting on middle of soil layer (psf)
M_s = constrained modulus of soil (psf)

$$M_S = \frac{E_S(1-\upsilon_S)}{(1+\upsilon_S)(1-2\upsilon_S)}$$

E_s = elastic modulus of soil (psf)
v_s = Poisson's ratio of soil
H = initial thickness of soil layer (ft)

- Primary Consolidation Settlement Equations:

for $p'_O + \Delta p \geq p'_{mp}$

$$S_C = H\left(C_{r\varepsilon} \log \frac{p'_{mp}}{p'_o} + C_{c\varepsilon} \log \frac{p'_o + \Delta p}{p'_{mp}} \right)$$

for $p'_O + \Delta p < p'_{mp}$

$$S_C = H\left(C_{r\varepsilon} \log \frac{p'_o + \Delta p}{p'_o} \right)$$

where:

S_c	=	primary consolidation settlement (ft)
H	=	initial thickness of soil layer (ft)
p'_{mm}	=	maximum past consolidation pressure (psf)
p'_o	=	effective vertical stress in middle of soil layer afer excavation, but before loading (psf)
Δp	=	net stress change acting on middle of soil layer (psf).
$C_{r\varepsilon}$	=	modified recompression index

$$C_{r\varepsilon} = \frac{C_r}{1 + e_o}$$

$C_{c\varepsilon}$	=	modified primary compression index

$$C_{c\varepsilon} = \frac{C_c}{1 + e_o}$$

C_r	=	recompression index
C_c	=	primary compression index
e_0	=	initial void ratio

- Secondary Consolidation Settlement Equation:

$$S_s = C_{s\varepsilon} H \log \frac{t_s}{t_{pf}}$$

where:

S_s	=	secondary consolidation settlement (ft)
$S_{s\varepsilon}$	=	modified secondary compression index
H	=	initial thickness of soil layer (ft)
t_s	=	time over which secondary settlement is to be calculated (typ. this is a max. of 100 years plus the max. time to complete primary consolidation) (years)
t_{pf}	=	time to complete primary consolidation (years)

$$t_{pf} = \frac{T_V * H_t^2}{C_V}$$

T_V	=	dimensionless time factor associated with the time it takes for primary consolidation settlement to be completed

$$For U < 60\%: \; T_V = \frac{\pi}{4}\left(\frac{U\%}{100}\right)^2$$

$$For U \geq 60\%: \; T_V = 1.781 - 0.933 \log(100 - U\%)$$

H_t	=	maximum length of drainage in the consolidating layer (= H for single-drained; = 0.5H for double-drained)
C_V	=	coefficient of consolidation (ft^2/year)
U	=	percent of primary consolidation (%) (typ. max. is 99.999; results in TV = 4.58)

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- Total Settlement Equation:

$$S_{Total} = S_e + S_c + S_s$$

where:
S_{Total} = total settlement (ft)
S_e = elastic settlement (ft)
S_c = primary consolidation settlement (ft)
S_s = secondary consolidation settlement (ft)

- Liner Strain Equation:

$$E_T = \frac{L_f - L_o}{L_o} \text{x} 100$$

where:
E_T = total strain (%) ("+" = tension; "-" = compression)
L_o = original distance separating two adjacent calculation points (ft)
L_f = final distance separating two adjacent calculation points after settlement is complete (ft)

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PROJECT	**Harnett County ACLF - Phases I-III**	SHEET	4/8
SUBJECT	**Settlement Analysis - Worst Case Point**	JOB #	HARNETT-AC-14-1
		DATE	3/1/2015
		COMPUTED BY	PKS
		CHECKED BY	

Soils Information: (Note: When elastic or consolidation settlement is not applicable to a particular layer, enter "NA" for requested parameters.)

Soil Layer	Description	Dry Unit Wt. (pcf)	Natural Moisture Content (%)	Wet Unit Wt. (pcf)	Elastic Settlement Parameters E_s (psf)	n_s	M_s (psf)	Consolidation Settlement Parameters OCR	C_{ce}	C_{re}	C_{se}
1	Clayey Sand w/ Interbedded Clay	110.0	15.0	126.5	200,000	0.00	200,000	NA	NA	NA	NA
2	V. Stiff Clay (V. Low Compressibility)										

Waste Information:

Average Unit Weight, γ_{Waste} (pcf) = 50 Waste and Soil Cover

Assumptions:

Es (Silty Sand): Es (kPa) = 320 (N_{55} + 15) (Bowles Table 5-5)* where N_{70} = 12 bpf and N_{55} = 70/55 x N_{70} = 15; 1 kPa = 20.89 psf

Poisson's Ratio (Silty Sand): 0.3

* Bowles, J.E. (1988), Foundation Analysis and Design, McGraw-Hill, Inc., page 266.

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PROJECT	**Harnett County ACLF - Phases I-III**	SHEET	5/8
SUBJECT	**Settlement Analysis - Worst Case Point**	JOB #	HARNETT-AC-14-1
		DATE	3/1/2015
		COMPUTED BY	PKS
		CHECKED BY	

Settlement Points - Location Information:

Parameter	Point 1	2	3	4	5	6	7	8	9	10	11	12
Original Ground Surface Elevation (ft) =	320.0											
Avg. Unit Wt. of Soil Excavated (pcf) =	110.0											
Top of Landfill Elevation (ft) =	430.0	Future Ph. IV										
Top of Subgrade Elevation (ft) =	300.0											
Top of Groundwater Elevation (ft) =	290.0											
Layer 1: Thickness (ft) =	35.0											
Elevation of Mid Point (ft) =	282.5											
(Before Liner Construct.) p'_o at Mid Point (psf) =	3,946											
p'_{mp} at Mid Point (psf) =	NA											
(After Liner Construct.) p'_o at Mid Point (psf) =	1,746											

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PROJECT	**Harnett County ACLF - Phases I-III**	SHEET	6/8
SUBJECT	**Settlement Analysis - Worst Case Point**	JOB #	HARNETT-AC-14-1
		DATE	3/1/2015
		COMPUTED BY	PKS
		CHECKED BY	

Stress Change, *Dp*, at Liner:

Parameter	Point 1	2	3	4	5	6	7	8	9	10	11	12
Stress Decrease From Excavation (psf) =	2,200											
Stress Increase From Waste Load (psf) =	6,500											
Net Stress Increase/Decrease, Δ_p (psf) =	4,300											

Elastic Settlement:

Parameter	Point 1	2	3	4	5	6	7	8	9	10	11	12
Elastic Settlement (ft):												
Layer 1: S_e =	**0.75**											
Total Elastic Settlement (ft) =	**0.75**											

Elastic Settlement Equation:

$$Se = \frac{\Delta p}{M_S} H$$

Primary Consolidation Settlement:

Parameter	Point 1	2	3	4	5	6	7	8	9	10	11	12
Primary Consolidation Settlement (ft):												
Layer 1: S_c =	**NA**											

Total Primary Consol. Settlement (ft) =	**0.00**											

Primary Consolidation Settlement Equations:

For primary recompression and compression (designated C):

$$S_C = H\left(C_{r\varepsilon}\log\frac{p'_{mp}}{p'_o} + C_{c\varepsilon}\log\frac{p'_o+\Delta p}{p'_{mp}}\right)$$

For primary recompression only (designated R):

$$S_C = H\left(C_{r\varepsilon}\log\frac{p'_o+\Delta p}{p'_o}\right)$$

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PROJECT	**Harnett County ACLF - Phases I-III**	SHEET	7/8
SUBJECT	**Settlement Analysis - Worst Case Point**	JOB #	HARNETT-AC-14-1
		DATE	3/1/2015
		COMPUTED BY	PKS
		CHECKED BY	

Secondary Consolidation Settlement:

Assumed % Primary Consolidation (U) = 99.999 **(Max. = 99.999)**

T_v (dimensionless) = 4.58

Addl. # Time for Determination of Seconary Settlement (X) (Years) = 100 ($t_s = t_{pf} + X$)

Parameter	Point 1	2	3	4	5	6	7	8	9	10	11	12
Secondary Consolidation Settlement (ft):												
Layer 1: Drainage* =	1											
H_t (ft) =	35.0											
C_v (in^2/min) =	0.000											
t_{pf} (years) =	0.0											
S_s =	**NA**											
Total Sec. Consol. Settlement (ft) =	**0.00**											

* Single-Drained = 1; Double-Drained = 2

Secondary Consolidation Settlement Equation:

$$S_s = C_{se} H \log \frac{t_s}{t_{pf}}$$

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PROJECT	**Harnett County ACLF - Phases I-III**	SHEET	8/8
SUBJECT	**Settlement Analysis - Worst Case Point**	JOB #	HARNETT-AC-14-1
		DATE	3/1/2015
		COMPUTED BY	PKS
		CHECKED BY	

Total Settlement:

Parameter	Point 1	2	3	4	5	6	7	8	9	10	11	12
Total Settlement (ft):												
Layer 1: S_{Total} =	**0.75**											
Total Settlement (ft) =	**0.75**											

Total Settlement Equation:

$$S_{Total} = S_e + S_c + S_s$$

Liner Slopes & Liner Strain:

Parameter	Point 1	2	3	4	5	6	7	8	9	10	11	12
Before Settlement:												
Top of Subgrade Elevation (ft) =	300.0											
After Settlement:												
Top of Subgrade Elevation (ft) =	299.2											
Comments:												

Liner Strain Equation:

$$E_T = \frac{L_f - L_o}{L_o} \times 100$$

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Closure and Post-Closure Plan

Harnett County Anderson Creek Landfill Facility
Harnett County, North Carolina

Prepared for:

Harnett County Solid Waste Department
Lillington, North Carolina

February 2015
Revised: April 2015

NC LIC. NO. C-0828 (ENGINEERING)

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14 N. Boylan Avenue, Raleigh NC 27603 | 919.828.0577

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Harnett County Anderson Creek Landfill Facility
Harnett County, North Carolina

Closure and Post-Closure Plan

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Appendix A Closure, Post-Closure, and Assessment/Corrective Action Cost Estimates

1.0 CLOSURE PLAN

This Closure Plan has been prepared to provide information related to closure of the active landfill units at Harnett County's Anderson Creek Landfill facility. This information includes the following:

- An estimate of the maximum closure area and waste capacity;
- A description of the final cover system and related features;
- A schedule for completion of closure activities;
- Procedures necessary for verifying closure activities; and
- A cost estimate for closure activities (see **Section 3.0**).

Note that construction plans for closure of each landfill unit (or incremental portion thereof) will be submitted to the North Carolina Department of Environment and Natural Resources Division of Waste Management (DWM) for approval prior to beginning closure construction.

1.1 Maximum Closure Area and Waste Capacity

The following are the estimated areas and capacity for each landfill unit to be closed under this plan.

Table 1.1 Closure Areas and Capacity Summary

Landfill Unit	Closure Area (Acres)	Gross Capacity (CY)[1]	Net (Waste) Capacity (Tons)[1]
C&D Units			
Phases I, II, & IIIA	9.6	620,948	225,743

Notes:

1. The volume and tonnage figures assumed are based on the site's Facility Plan. Refer to Section 2.0 (Facility Report) of the Facility and Engineering Plan (**Attachment B**).

1.2 Final Cover System

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

C&DLF Units - Alternative Final Cover System (.0543 (c)(3)):

Top Slopes (Typically 5 to 8%):

- a 24-inch thick vegetative soil layer;
- a drainage geocomposite (with drainage breaks);
- a 30-mil textured LLDPE geomembrane or geosynthetic clay liner (GCL); and
- a 12-inch thick intermediate cover layer.

Side Slopes (Typically 3H or 4H:1V):

- a 24-inch thick vegetative soil layer.

The final cover system will be placed on prepared intermediate cover at a maximum slope of 3H:1V. Surface water control devices and passive landfill gas (LFG) vents 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.

Refer to the Facility and Engineering Plan (**Attachment B**) and the Permit Drawings (**Attachment J**) for a detailed discussion and details related to the design of the final cover system for each active landfill unit.

1.3 Landfill Gas System

For the C&D landfill units, a landfill gas system is provided in the final cover design. This system includes collection wells/vents placed within the waste (at a spacing of approximately one well/vent per acre) to capture and passively vent the gas. Refer to the Permit Drawings (**Attachment J**) for a detail showing/describing LFG wells/vents.

1.4 Surface Water Systems

Precipitation falling on the cover will infiltrate into the cover or run off of 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 (diversion berms). Water captured by 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 Erosion and Sedimentation Control Plan (**Attachment G**) and the Permit Drawings (**Attachment J**) for a detailed discussion and details related to the design of surface water systems for each active landfill unit.

1.4.1 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 berms must be installed if required to accomplish this run-off routing.

1.4.2 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.

1.5 Closure Schedule

In general, closure activities will occur on the following schedule:

C&D Landfill Units (15A NCAC 13B.0543(c)(5)):

- No later than 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.

Prior to beginning closure of any landfill unit, the County will notify the DWM that a notice of the intent to close the unit has been placed in the operating record.

All closure activities shall be completed within 180 days. Exemptions and extensions may be approved by the DWM.

1.6 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 and placed in the operating record.

- 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 (through the County Register of Deed's Office) 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 and notification will be provided to the DWM.

2.0 POST-CLOSURE PLAN

This Post-Closure Plan has been prepared to provide information related to post-closure care of the landfill units at Harnett County's Anderson Creek Landfill facility. This information includes the following:

- Contact information for the person or office responsible for the facility during the post-closure period;
- A description of the planned use(s) of the property during the post-closure period;
- A description of the monitoring and maintenance activities required for each landfill unit and the frequency at which these activities are to occur; and
- A cost estimate for post-closure activities (see **Section 3.0**).

The post-closure care period will last 30 years after final closure (unless increased or decreased by the DWM).

2.1 Post-Closure Contact

All correspondence and questions concerning the post-closure care of the landfill should be directed to:

Ms. Amanda Bader, P.E.
Harnett County Solid Waste Department
200 Alexander Drive
Lillington, NC 27546
Phone: (910) 814-6156
Fax: (910) 814-8263

2.2 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. Harnett 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. Additionally, the County will maintain access to all site monitoring locations through the post-closure period.

2.3 Maintenance

2.3.1 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.

2.3.2 Erosion Damage Repair and Vegetation

If erosion of the final cover occurs during post-closure, the affected area will be repaired and revegetated as necessary. If necessary, rolled erosion control products (RECPs) will be used to expedite rapid revegetation of slopes and to secure topsoil in place. Revegetation (including fertilization and seeding) will be performed in accordance with the most recently approved erosion and sedimentation control plan and the North Carolina Erosion and Sediment Control Planning and Design Manual.

Mowing of the final cover surfaces will occur approximately once per year in order to help maintain a healthy stand of grasses and to cut down saplings and woody-stemmed plants.

2.3.3 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.

2.3.4 Leachate Collection System

The County currently plans to modify the existing leachate collection system which consists of four (4) sumps (A-D), connecting French drains, and load out areas (for pump and haul operations). The County anticipates that Sumps B, C, and D and the associated French drains will be removed prior to closure of the C&D landfill at the site. Thus, only Sump A (located at the southwest end of Phase I) will remain in service. After closure, the flow in Sump A is expected to curtail. A flow of 5,000 gallons per week (one tanker load per week) is assumed during the post-closure period.

2.3.5 Leachate Seeps

If evidence of leachate seeps is observed, the County will take the following actions. Depending on the circumstances, various combinations of actions may be appropriate.

1. If leachate is observed outside of the limits of waste disposal areas, notify the DWM.
2. Contain the flow of leachate using soil berms and/or excavation.
3. Excavate the area of seepage to attempt to allow flow into the underlying waste (i.e. break-up soil layers that may be causing the seep.).
4. The use of soil (particularly clay) to plug the seepage may also be successful in the case where flows are minor.
5. For contained leachate that will not flow into underlying waste, a pump may be required to a tanker truck (only in the event that other options are not effective).
6. Remove and dispose of impacted cover soils accordingly.
7. Repair landfill cover as necessary.

2.3.6 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. Sediment basins/ponds will be cleaned out when sediment has reached design cleanout levels.

2.3.7 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, and/or water), binding or corrosion, additional and/or replacement wells/vents can be installed if necessary in accordance with the current Landfill Gas Management Plan.

2.3.8 Groundwater Monitoring Wells

Procedures outlined in the current Water Quality Monitoring (WQM) 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 WQM Plan and a new well installed at a location that is approved by the DWM.

2.4 Monitoring Plan

The closed unit will be monitored throughout the post-closure period. Inspections of the closed landfill 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.

2.4.1 Inspection Frequencies

Inspections to be conducted by the County during the post-closure care period will occur regularly as shown in **Table 2.1**.

2.4.2 Inspection Activities

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. Additionally, the condition of the groundwater and gas monitoring systems and permanent benchmarks will be checked.

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.

2.4.3 Record Keeping

Records of inspections and repairs will be kept on file by the County throughout the post-closure period.

2.5 Engineering Certification

Following completion of the post-closure care period for each landfill unit, the County will notify the DWM that a certification, signed by a registered professional engineer, verifying that post-closure care has been completed in accordance with the post-closure plan, has been placed in the operating record.

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 Collection System	Quarterly	Semi-Annually
Landfill Gas System	Quarterly[2]	Semi-Annually[2]
Water Quality Monitoring	Semi-Annually[3]	Semi-Annually[3]
LFG Monitoring System	Quarterly[4]	Quarterly[4]
Benchmark Integrity	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 the current Landfill Gas Management Plan or air quality permit(s).
3. Or in accordance with groundwater monitoring schedule described in the current Water Quality Monitoring Plan.
4. Or in accordance with the current LFG Monitoring Plan.

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3.0 FINANCIAL ASSURANCE

This section of the Closure and Post-Closure Plan has been prepared to provide cost estimates for closure, post-closure, and assessment and corrective action activities at Harnett County's Anderson Creek Landfill facility and to identify the mechanism to be used by the County in demonstrating financial assurance.

3.1 Estimated Closure Costs

A cost estimate for complete closure of the Phases I, II, and IIIA C&D landfill units (the maximum area to be closed) is provided in **Appendix A** and is summarized in **Table 3.1**. The cost estimate 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.

3.2 Estimated Post-Closure Costs

A cost estimate for the post-closure care activities for the C&D landfill is provided in **Appendix A** and summarized in **Table 3.1**. The cost estimate 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.

3.3 Estimated Assessment and Corrective Action Costs

A cost estimate for current potential assessment and corrective (remedial) action at the landfill facility is provided in **Appendix A**. The total cost as shown in **Table 3.1** is equal to the required minimum amount ($2,000,000) per NCGS 130A 295.2(h).

3.4 Financial Assurance Mechanism

Harnett County intends to continue to use the Local Government Financial Test (15A NCAC 13B.1628(e)(1)(f)) to demonstrate financial assurance for this facility.

Table 3.1 Summary of Cost Estimates

Activity	Total
C&D Phases I, II, & IIIA – Closure	$506,467
C&DLF - Post-Closure (30 Year)	$1,389,300
Assessment and Corrective Action	$2,000,000
Total:	**$3,895,767**

Appendix A

Closure, Post-Closure, and Assessment/Corrective Action Cost Estimates

Closure and Post-Closure Plan
Harnett County Anderson Creek Landfill Facility
Harnett County, North Carolina

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SHEET:	1/3
JOB #:	HARNETT-AC-14-1
DATE:	3/3/15
BY:	PKS

Harnett County Anderson Creek C&D Landfill - Financial Assurance
Table 1: Summary

Item No.	Description	Total
1.0	C&D Landfill - Phases I, II, & IIIA - Estimated Closure Cost (See Table 2)	$506,467
2.0	C&D Landfill - Phases I, II, & IIIA - Estimated Post-Closure Cost (30-Year) (See Table 3)	$1,389,300
3.0	Assessment & Corrective Action Cost	$2,000,000
	TOTAL =	$3,895,767

Notes:

1. All cost projections are presented in 2015 dollars. Appropriate annual escalators should be applied.

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SHEET: 2/3
JOB #: HARNETT-AC-14-1
DATE: 3/3/15
BY: PKS

Harnett County Anderson Creek Landfill - Financial Assurance
Table 2: C&D Landfill - Phases I, II, & IIIA - Estimated Closure Cost

Item No.	Description	Estimated Quantity	Units	Unit Cost	Item Cost
1.0	Site Preparation	9.6	AC	$2,000	$19,200
2.0	Landfill Gas Wells/Vents	10.0	EA	$2,500	$25,000
3.0	Compacted Soil Barrier (18")	23,300	CY	$6.00	$139,800
4.0	Vegetative Soil Layer (18")	23,300	CY	$4.00	$93,200
5.0	Erosion Control (Diversion Berms, Down Pipes, Etc.)	9.6	AC	$5,000	$48,000
6.0	Revegetation	9.6	AC	$1,500	$14,400
7.0	Surveying	9.6	AC	$2,000	$19,200
				Subtotal (Items 1 - 7) =	$358,800
8.0	Bonds, Mobilization, & Insurance			4% of Subtotal (Items 1 - 7) =	$14,352
				Subtotal (Items 1 - 8) =	$373,152
				Contingency (10%) =	*$37,315*
				Construction Subtotal =	**$410,467**
9.0	Engineering	9.6	AC	$3,000.00	$28,800
10.0	CQA	9.6	AC	$7,000.00	$67,200
				TOTAL =	**$506,467**

Notes:

1. All cost projections are presented in 2015 dollars. Appropriate annual escalators should be applied.
2. Unit costs include materials and anticipated labor/installation costs.
3. Estimate assumes installation of regulatory final cover system.

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SHEET:	3/3
JOB #:	HARNETT-AC-14-1
DATE:	3/3/15
BY:	PKS

Harnett County Anderson Creek Landfill - Financial Assurance
Table 3: C&D Landfill - Phases I, II, & IIIA - Estimated Post-Closure Cost (30-Year)

Item No.	Description	Estimated Quantity	Units	Unit Cost	Item Cost
1.0	Site Inspection & Record Keeping	80	HR	$75	$6,000
2.0	Revegetation	1	AC	$1,500	$1,500
3.0	Mowing (once per year)	10	AC	$100	$1,000
4.0	Erosion Control	1	LS	$3,000	$3,000
5.0	Gates/Fences/Access	1	LS	$2,000	$2,000
6.0	Water Quality Monitoring & Reporting (See Note 4)	1	LS	$10,200	$10,200
7.0	LFG Monitoring & Reporting (See Note 5)	1	LS	$2,800	$2,800
8.0	Leachate Pump & Haul & Disposal (See Note 6)	52	Trips	$300	$15,600
				Subtotal (Items 1 - 8) =	$42,100
				Contingency (10%) =	*$4,210*
				Annual Total =	**$46,310**
				30-YEAR TOTAL =	**$1,389,300**

Notes:

1. All cost projections are presented in 2015 dollars. Appropriate annual escalators should be applied.
2. Unit costs include materials and anticipated labor/installation costs.
3. Assumes total of 9.6 acres (Phases I, II, & IIIA).
4. The water quality monitoring and reporting cost assumes 13 long-term wells & 2 surface water locations sampled semi-annually @ $5,100 per event (annual cost = $10,200).
5. The LFG monitoring and reporting cost assumes quarterly monitoring @ $700 per event (annual cost = $2,800).
6. One trip per week and 5,000 gallons per load are assumed.

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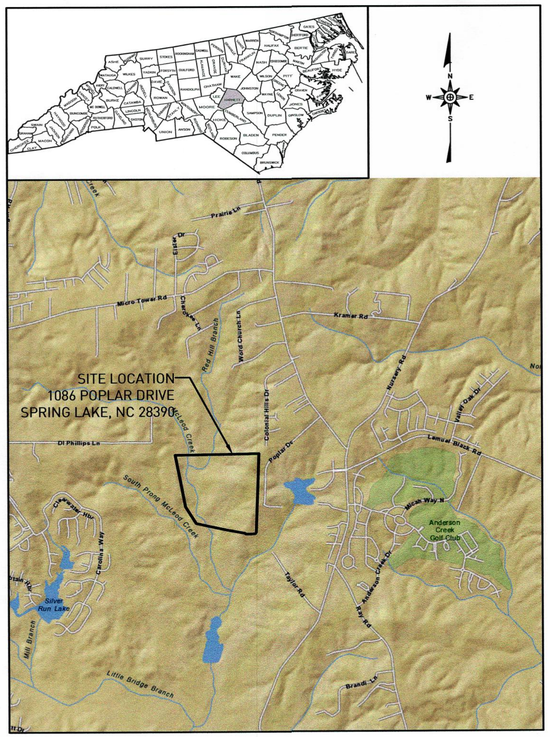
HARNETT COUNTY SOLID WASTE DEPARTMENT
LILLINGTON, NORTH CAROLINA

ANDERSON CREEK C&D LANDFILL
PHASE III

PERMIT DRAWINGS
FEBRUARY 2015
REVISED: APRIL 2015

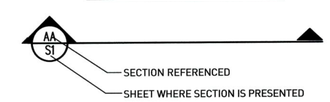


SITE LOCATION MAP
NOT TO SCALE

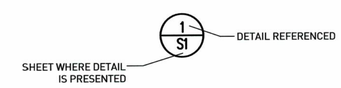
RIVER BASIN: CAPE FEAR

SHEET NO.	DRAWING NO.	DRAWING TITLE	REVISION
1	-	TITLE - COVER SHEET	1
2	S1	EXISTING CONDITIONS	
3	S2	SITE DEVELOPMENT PLAN - BASE GRADES	
4	S3	SITE DEVELOPMENT PLAN - FINAL COVER GRADES	
5	S4	PHASE III SUBGRADE GRADING AND DRAINAGE PLAN	
6A	S5A	PHASE III (A - D) INTERMEDIATE COVER GRADING AND DRAINAGE PLAN	1
6B	S5B	PHASE III (A - E) FINAL COVER GRADING AND DRAINAGE PLAN	1
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	EX1	ENGINEERING CROSS SECTIONS	1
12	P1	PHASE III PHASING PLAN (SHEET 1 OF 2)	1
13	P2	PHASE III PHASING PLAN (SHEET 2 OF 2)	1

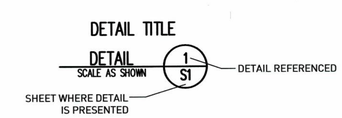
STANDARD SECTION LOCATION CALLOUT (SHEET AND DETAIL)



STANDARD DETAIL CALLOUT



STANDARD DETAIL LABEL AND CALLOUT



STANDARD REVISION CALLOUT (SHEET AND DETAIL)

SEAL

NORTH CAROLINA PROFESSIONAL SEAL 021666 ENGINEER PETER K. SCHEER 4/24/15

SEAL

REV.	DATE	DESCRIPTION
1	4/15	REVISED PHASING

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NC LIC. NO. C-0828 (ENGINEERING)

SMITH+GARDNER

14 N. Boylan Avenue, Raleigh NC 27603 | 919.828.0577

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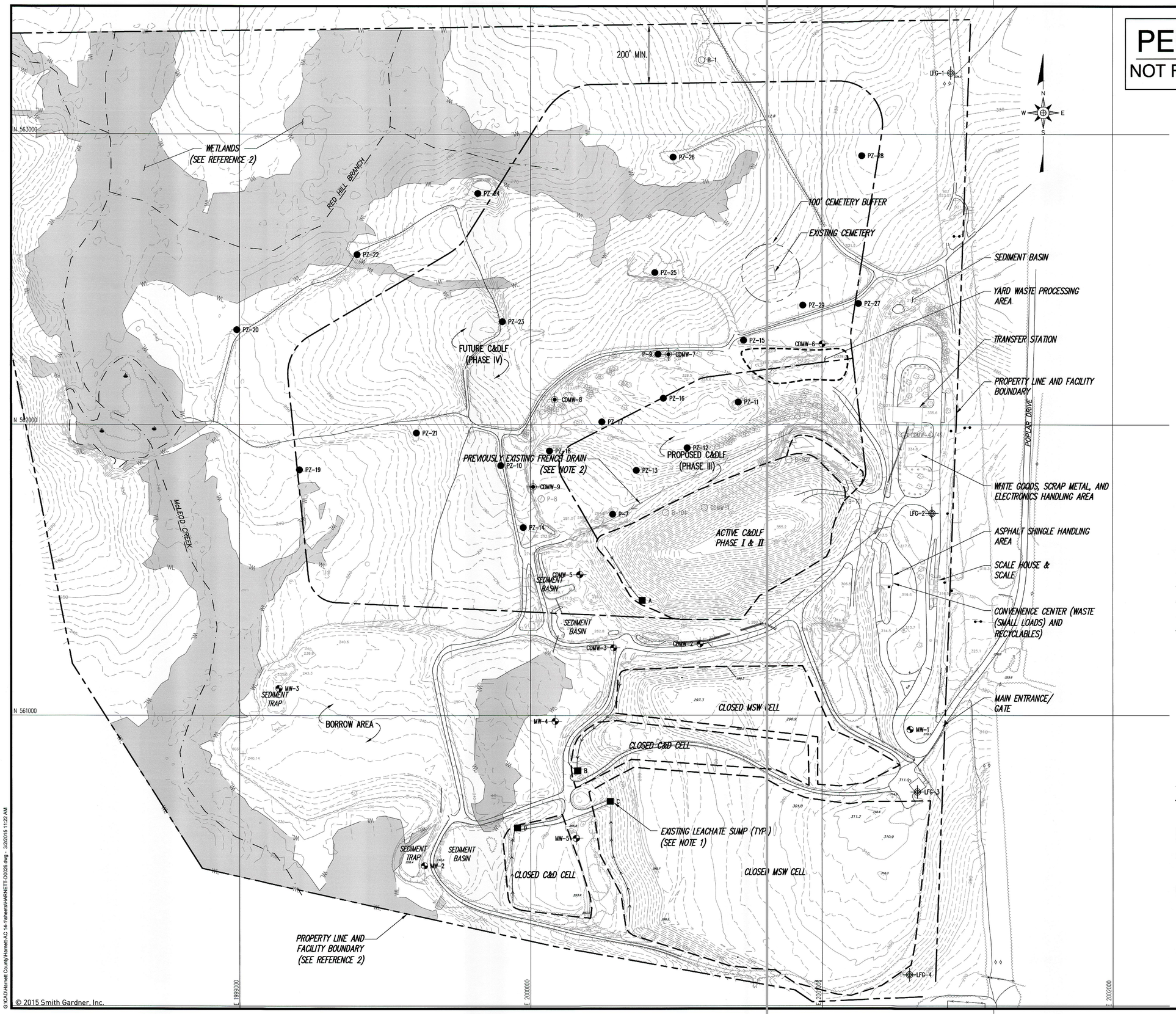

LEGEND

310	EXISTING 10' CONTOUR (SEE REFERENCE 1)
	EXISTING 2' CONTOUR
	PROPERTY LINE (APPROXIMATE)
	WASTE LIMITS (APPROXIMATE)
WL	WETLAND BOUNDARY (SEE REFERENCE 2)
	STREAM (APPROXIMATE)
PZ-14	PIEZOMETER (SEE REFERENCE 3)
CDMW-2	C&D MONITORING WELL
CDMW-7	PROPOSED C&D MONITORING WELL
MW-4	MONITORING WELL
LFG-1	LANDFILL GAS MONITORING WELL
B-104	WELL/PIEZOMETER (REMOVED)
A	LEACHATE SUMP (APPROXIMATE)
	FRENCH DRAIN (APPROXIMATE)
	PROPOSED WASTE LIMITS

NOTES
1. EXISTING SUMPS B, C, AND D AND ASSOCIATED FRENCH DRAINS ARE SLATED TO BE REMOVED BY THE COUNTY.
2. THE PREVIOUSLY EXISTING FRENCH DRAIN (STONE & PIPE) WAS REMOVED AND BACKFILLED IN THE FIRST HALF OF 2014.

REFERENCES
1. OVERALL SITE BASE TOPOGRAPHY BASED ON AERIAL SURVEY BY MAPPING RESOURCE GROUP, DATED 7/16/13. TOPOGRAPHY IN ACTIVE AREAS PERFORMED BY GEODATA CORPORATION, ZEBULON, NC, DATED 6/17/14.
2. OVERALL EXISTING SITE CONDITIONS PROVIDED BY C.T. CLAYTON, SR., P.E., INC., IN DRAWING TITLED "03001C ACLF Exp MAS-1", DATED 5/31/13.
3. WELL DATA AND LOCATIONS FROM C.T. CLAYTON, SR., P.E., INC., IN DRAWING TITLED "03001C ACLF Exp MAS-1", DATED 5/31/13.

0 150' 300' 450'

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PREPARED FOR:

HARNETT COUNTY
SOLID WASTE DEPARTMENT
LILLINGTON
NORTH CAROLINA

PREPARED BY:

NC LIC. NO. C-0828 (ENGINEERING)
SMITH+ GARDNER
ENGINEERS
14 N. Boylan Avenue, Raleigh NC 27603 | 919.828.0577

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NORTH CAROLINA PROFESSIONAL SEAL 021666 ENGINEER PIETER K. SCHEER 3/13/15

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REV.	DATE	DESCRIPTION

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PROJECT TITLE:

ANDERSON CREEK
C&D LANDFILL PHASE III
PERMIT DRAWINGS

DRAWING TITLE:

EXISTING CONDITIONS

DESIGNED: P.K.S.	PROJECT NO: HARNETT-AC-14-1
DRAWN: K.C.B.	SCALE: AS SHOWN
APPROVED: PKS	DATE: FEB. 2015
FILENAME: HARNETT-D0026	
SHEET NUMBER: 2	DRAWING NUMBER: S1

PERMIT ISSUE
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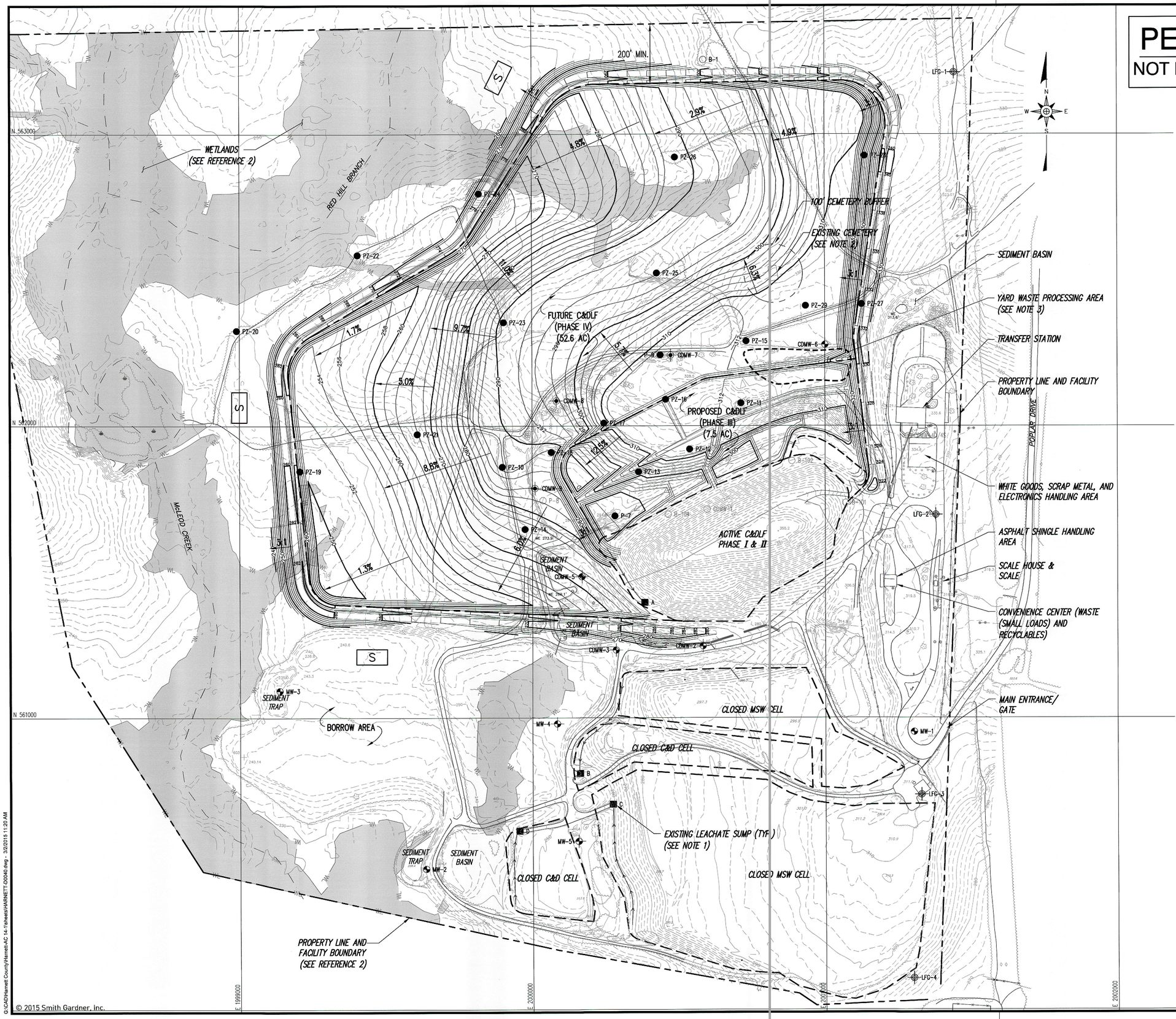

LEGEND

310	EXISTING 10' CONTOUR (SEE REFERENCE 1)
	EXISTING 2' CONTOUR
	PROPERTY LINE (APPROXIMATE)
	WASTE LIMITS (APPROXIMATE)
WL	WETLAND BOUNDARY (SEE REFERENCE 2)
	STREAM (APPROXIMATE)
PZ-14	PIEZOMETER (SEE REFERENCE 3)
CDMW-2	C&D MONITORING WELL
CDMW-7	PROPOSED C&D MONITORING WELL
MW-4	MONITORING WELL
LFG-1	LANDFILL GAS MONITORING WELL
B-104	WELL/PIEZOMETER (REMOVED)
A	LEACHATE SUMP (APPROXIMATE)
	FRENCH DRAIN (APPROXIMATE)
	PROPOSED WASTE LIMITS
S	FUTURE SEDIMENT BASIN

NOTES
1. EXISTING SUMPS B, C, AND D AND ASSOCIATED FRENCH DRAINS ARE SLATED TO BE REMOVED BY THE COUNTY.
2. PRIOR TO DEVELOPMENT IN THE VICINITY OF THE EXISTING CEMETERY, THE COUNTY INTENDS TO RELOCATE THE CEMETERY FOLLOWING STATE REQUIREMENTS.
3. THE YARD WASTE PROCESSING AREA WILL BE RELOCATED AS NEEDED DURING DEVELOPMENT OF PHASE III.

REFERENCES
1. OVERALL SITE BASE TOPOGRAPHY BASED ON AERIAL SURVEY BY MAPPING RESOURCE GROUP, DATED 7/16/13. TOPOGRAPHY IN ACTIVE AREAS PERFORMED BY GEODATA CORPORATION, ZEBULON, NC, DATED 6/17/14.
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3. WELL DATA AND LOCATIONS FROM C.T. CLAYTON, SR., P.E., INC., IN DRAWING TITLED "03001C ACLF Exp MAS-1", DATED 5/31/13.

0 150' 300' 450'

PREPARED FOR:

HARNETT COUNTY
SOLID WASTE DEPARTMENT
LILLINGTON
NORTH CAROLINA

PREPARED BY:

NC LIC. NO. C-0828 (ENGINEERING)

SMITH+ GARDNER
ENGINEERS
14 N. Boylan Avenue, Raleigh NC 27603 | 919.828.0577

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NORTH CAROLINA PROFESSIONAL SEAL 021666 ENGINEER PIETER K. SCHEER 3/13/15

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PROJECT TITLE:

ANDERSON CREEK
C&D LANDFILL PHASE III
PERMIT DRAWINGS

DRAWING TITLE:

SITE DEVELOPMENT PLAN
BASE GRADES

DESIGNED: P.K.S.	PROJECT NO: HARNETT-AC-14-1
DRAWN: K.C.B.	SCALE: AS SHOWN
APPROVED: PKS	DATE: FEB. 2015
FILENAME: HARNETT-D0040	
SHEET NUMBER: 3	DRAWING NUMBER: S2

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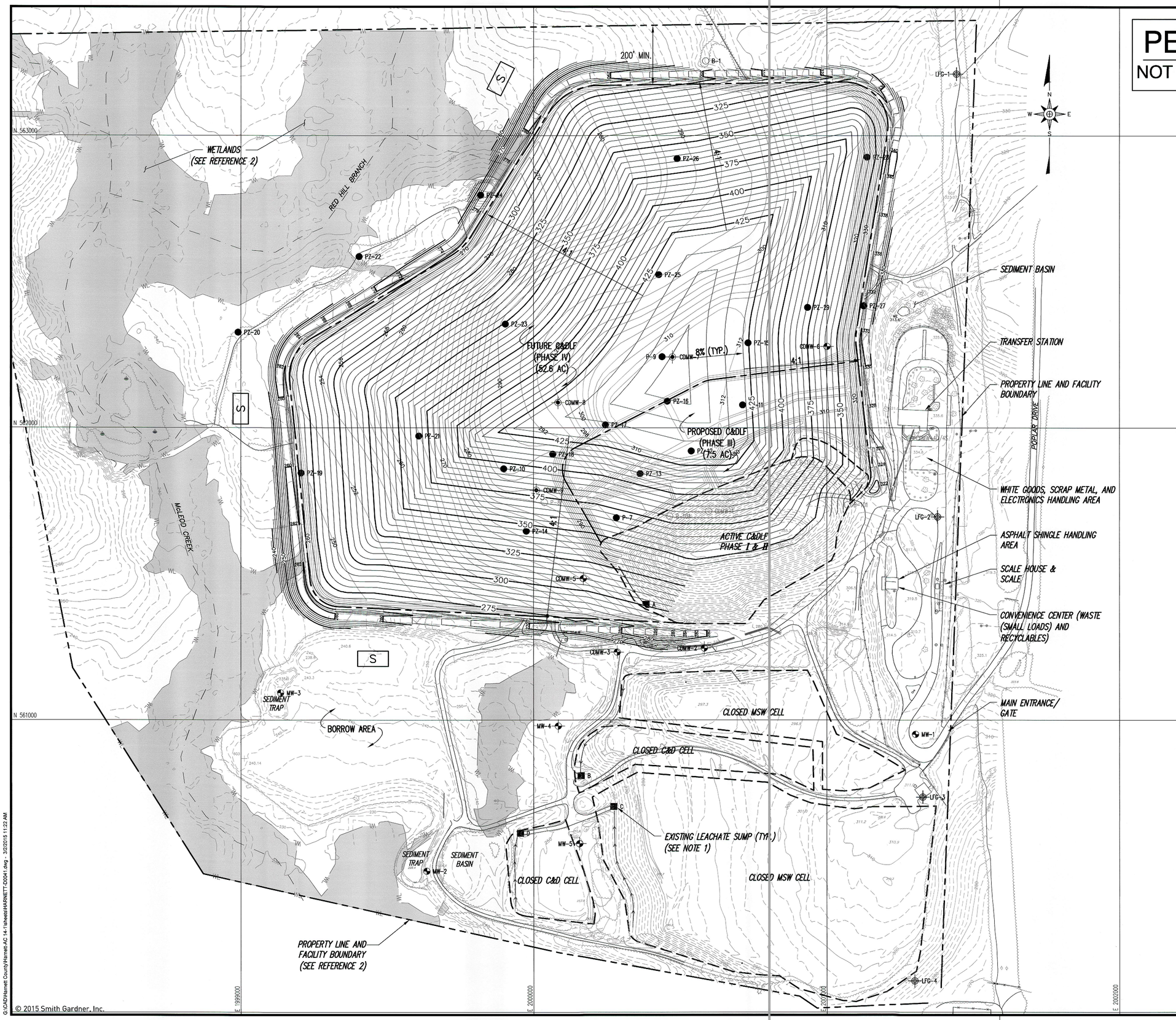

LEGEND

310	EXISTING 10' CONTOUR (SEE REFERENCE 1)
	EXISTING 2' CONTOUR
	PROPERTY LINE (APPROXIMATE)
	WASTE LIMITS (APPROXIMATE)
WL	WETLAND BOUNDARY (SEE REFERENCE 2)
	STREAM (APPROXIMATE)
PZ-14	PIEZOMETER (SEE REFERENCE 3)
CDMW-2	C&D MONITORING WELL
CDMW-7	PROPOSED C&D MONITORING WELL
MW-4	MONITORING WELL
LFG-1	LANDFILL GAS MONITORING WELL
B-104	WELL/PIEZOMETER (REMOVED)
A	LEACHATE SUMP (APPROXIMATE)
	FRENCH DRAIN (APPROXIMATE)
	PROPOSED WASTE LIMITS
S	FUTURE SEDIMENT BASIN

NOTES
1. EXISTING SUMPS B, C, AND D AND ASSOCIATED FRENCH DRAINS ARE SLATED TO BE REMOVED BY THE COUNTY.

REFERENCES
1. OVERALL SITE BASE TOPOGRAPHY BASED ON AERIAL SURVEY BY MAPPING RESOURCE GROUP, DATED 7/16/13. TOPOGRAPHY IN ACTIVE AREAS PERFORMED BY GEODATA CORPORATION, ZEBULON, NC, DATED 6/17/14.
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3. WELL DATA AND LOCATIONS FROM C.T. CLAYTON, SR., P.E., INC., IN DRAWING TITLED "03001C ACLF Exp MAS-1", DATED 5/31/13.

0 150' 300' 450'

PREPARED FOR:

HARNETT COUNTY
SOLID WASTE DEPARTMENT
LILLINGTON
NORTH CAROLINA

PREPARED BY:

NC LIC. NO. C-0828 (ENGINEERING)
SMITH+ GARDNER
ENGINEERS
14 N. Boylan Avenue, Raleigh NC 27603 | 919.828.0577

SEAL

NORTH CAROLINA PROFESSIONAL SEAL 021666 ENGINEER PIETER K. SCHEER 3/13/15

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PROJECT TITLE:

ANDERSON CREEK
C&D LANDFILL PHASE III
PERMIT DRAWINGS

DRAWING TITLE:

SITE DEVELOPMENT PLAN
FINAL COVER GRADES

DESIGNED: P.K.S.	PROJECT NO: HARNETT-AC-14-1
DRAWN: K.C.B.	SCALE: AS SHOWN
APPROVED: PKS	DATE: FEB. 2015
FILENAME: HARNETT-D0041	
SHEET NUMBER: 4	DRAWING NUMBER: S3

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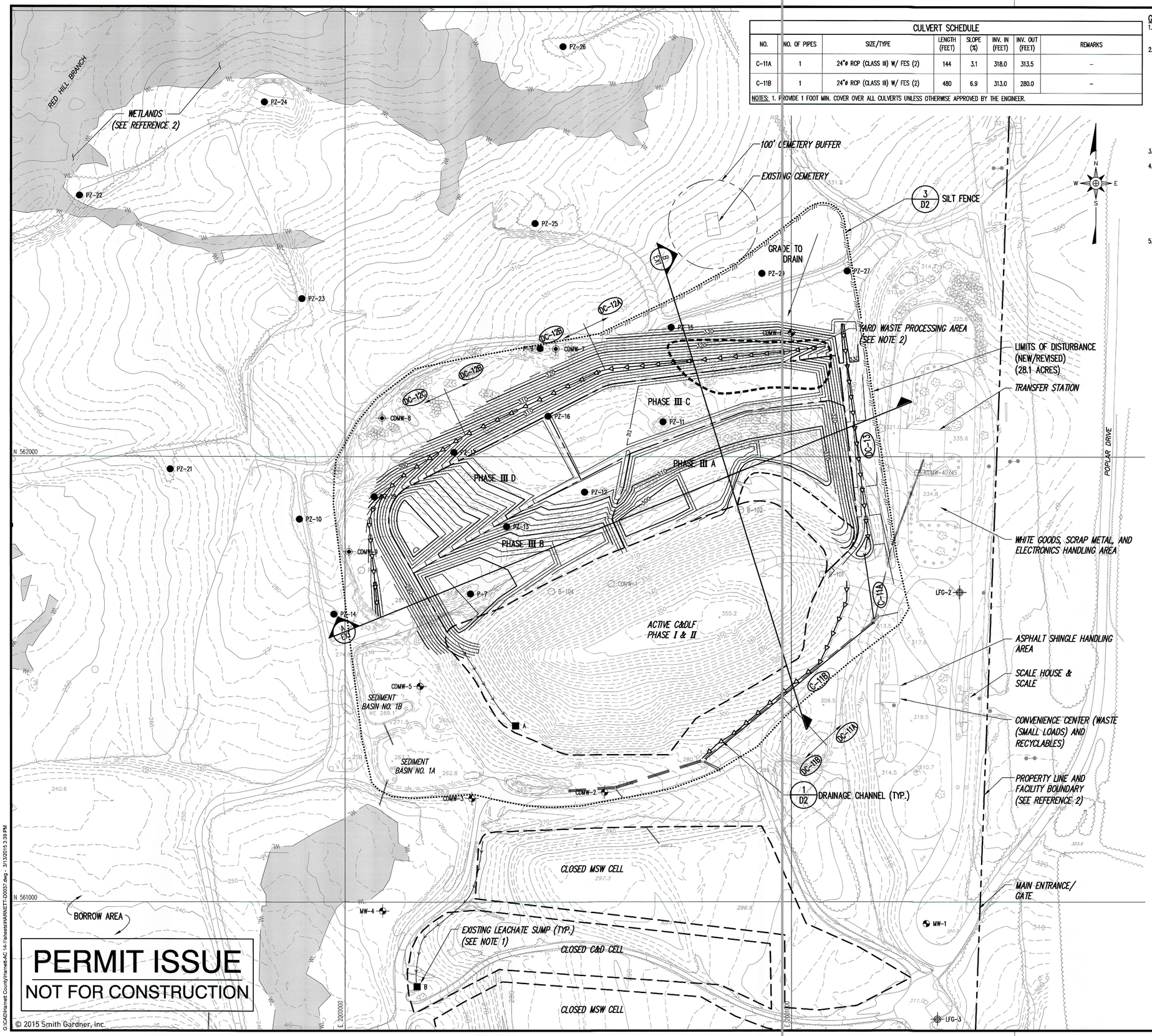

CULVERT SCHEDULE

NO.	NO. OF PIPES	SIZE/TYPE	LENGTH (FEET)	SLOPE (%)	INV. IN (FEET)	INV. OUT (FEET)	REMARKS
C-11A	1	24"ø RCP (CLASS III) W/ FES (2)	144	3.1	318.0	313.5	–
C-11B	1	24"ø RCP (CLASS III) W/ FES (2)	480	6.9	313.0	280.0	–

NOTES: 1. PROVIDE 1 FOOT MIN. COVER OVER ALL CULVERTS UNLESS OTHERWISE APPROVED BY THE ENGINEER.

GENERAL EROSION AND SEDIMENTATION CONTROL NOTES

1. 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. EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE ESTABLISHED PRIOR TO, OR AS SOON AS PRACTICAL THEREAFTER, ANY LAND CLEARING OR CONSTRUCTION ACTIVITIES MAY BEGIN. THE CONTRACTOR SHALL FOLLOW THE FOLLOWING SCHEDULE FOR CONSTRUCTION OF FIRING RANGE:
   - A. CONTACT THE NCDENR DIVISION OF ENERGY, MINERAL, AND LAND RESOURCES, LAND QUALITY SECTION, (FAYETTEVILLE REGIONAL OFFICE: (910) 433-3300).
   - B. FLAG THE CLEARING LIMITS.
   - C. INSTALL TEMPORARY GRAVEL CONSTRUCTION ENTRANCE/EXIT.
   - D. CLEAR THE VEGETATED PORTION OF THE SITE AND INSTALL SILT AND STONE FILTER FENCING (WHERE REQUIRED) PRIOR TO STRIPPING/GRUBBING.
   - E. REMOVE/STOCKPILE SOIL AS REQUIRED FOR CONSTRUCTION.
   - F. PERFORM FINE GRADING AND ESTABLISH PERMANENT VEGETATION ON COMPLETED AREAS.
   - G. AFTER STABILIZATION, REMOVE SILT FENCING AND OTHER TEMPORARY MEASURES AS DIRECTED BY THE OWNER AND INSTALL PERMANENT VEGETATION ON THE DISTURBED AREAS.
3. ALL EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE CONSTRUCTED ACCORDING TO THE CONTRACT DRAWINGS AND SPECIFICATIONS.
4. 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. MAINTENANCE SHALL INCLUDE, BUT NOT BE LIMITED TO:
   - A. THE REMOVAL AND SATISFACTORY DISPOSAL OF TRAPPED OR DEPOSITED SEDIMENTS FROM BASINS, TRAPS, BARRIERS, FILTERS, AND/OR DRAINAGE FEATURES/DEVICES;
   - B. REPLACEMENT OF FILTER FABRICS USED FOR SILT FENCES UPON LOSS OF EFFICIENCY; AND
   - C. REPLACEMENT OF ANY OTHER COMPONENTS WHICH ARE DAMAGED OR CANNOT SERVE THE INTENDED USE.
5. SOIL STABILIZATION SHALL BE ACHIEVED ON ANY AREA OF THE SITE WHERE LAND-DISTURBING ACTIVITIES HAVE TEMPORARILY OR PERMANENTLY CEASED ACCORDING TO THE FOLLOWING SCHEDULE:

GROUND STABILIZATION

SITE AREA DESCRIPTION	STABILIZATION TIME FRAME	STABILIZATION TIME FRAME EXCEPTIONS
PERIMETER DIKES, SWALES, DITCHES, AND SLOPES	7 DAYS	NONE
HIGH QUALITY WATER (HQW) ZONES	7 DAYS	NONE
SLOPES STEEPER THAN 3:1	7 DAYS	IF SLOPES ARE 10' OR LESS IN LENGTH AND ARE NOT STEEPER THAN 2:1, 14 DAYS ARE ALLOWED.
SLOPES 3:1 OR FLATTER	14 DAYS	7 DAYS FOR SLOPES GREATER THAN 50 FEET IN LENGTH
ALL OTHER AREAS WITH SLOPES FLATTER THAN 4:1	14 DAYS	NONE (EXCEPT FOR PERIMETERS AND HQW ZONES)

*EXTENSIONS OF TIME MAY BE APPROVED BY THE PERMITTING AUTHORITY BASED ON WEATHER OR OTHER SITE-SPECIFIC CONDITIONS THAT MAKE COMPLIANCE IMPRACTICABLE." (SECTION II.B(2)(b))

LEGEND

- 310 — EXISTING 10' CONTOUR (SEE REFERENCE 1)
- EXISTING 2' CONTOUR
- 370 — PROPOSED 10' CONTOUR
- PROPOSED 2' CONTOUR
- PROPERTY LINE (APPROXIMATE)
- WASTE LIMITS (APPROXIMATE)
- WL — WETLAND BOUNDARY (SEE REFERENCE 2)
- STREAM (APPROXIMATE)
- PZ-14 — PIEZOMETER (SEE REFERENCE 3)
- CDMW-2 — C&D MONITORING WELL
- CDMW-7 — PROPOSED C&D MONITORING WELL
- MW-4 — MONITORING WELL
- LFG-1 — LANDFILL GAS MONITORING WELL
- B-104 — WELL/PIEZOMETER (REMOVED)
- A — LEACHATE SUMP (APPROXIMATE)
- /// — SILT FENCE
- LIMITS OF DISTURBANCE (NEW/REVISED)
- FRENCH DRAIN (APPROXIMATE)
- PROPOSED WASTE LIMITS
- C-1 — CULVERT (FLARED END)
- DC-11 — DRAINAGE CHANNEL

NOTES

1. EXISTING SUMPS B, C, AND D AND ASSOCIATED FRENCH DRAINS ARE SLATED TO BE REMOVED BY THE COUNTY.
2. THE YARD WASTE PROCESSING AREA WILL BE RELOCATED TO THE NORTH (WITHIN LIMITS OF DISTURBANCE) AS NEEDED DURING DEVELOPMENT OF PHASE III.

REFERENCES

1. OVERALL SITE BASE TOPOGRAPHY BASED ON AERIAL SURVEY BY MAPPING RESOURCE GROUP, DATED 7/16/13.TOPOGRAPHY IN ACTIVE AREAS PERFORMED BY GEODATA CORPORATION, ZEBULON, NC, DATED 6/17/14.
2. OVERALL EXISTING SITE CONDITIONS PROVIDED BY C.T. CLAYTON, SR., P.E., INC., IN DRAWING TITLED "03001C ACLF Exp MAS-1", DATED 5/31/13.
3. WELL DATA AND LOCATIONS FROM C.T. CLAYTON, SR., P.E., INC., IN DRAWING TITLED "03001C ACLF Exp MAS-1", DATED 5/31/13.

0 100' 200' 300'

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PREPARED FOR:

HARNETT COUNTY
SOLID WASTE DEPARTMENT
LILLINGTON
NORTH CAROLINA

PREPARED BY:

NC LIC. NO. C-0828 (ENGINEERING)
SMITH+ GARDNER
ENGINEERS
14 N. Boylan Avenue, Raleigh NC 27603 | 919.828.0577

SEAL

NORTH CAROLINA PROFESSIONAL SEAL 021666 ENGINEER PETER K. SCHEER 3/13/15

SEAL

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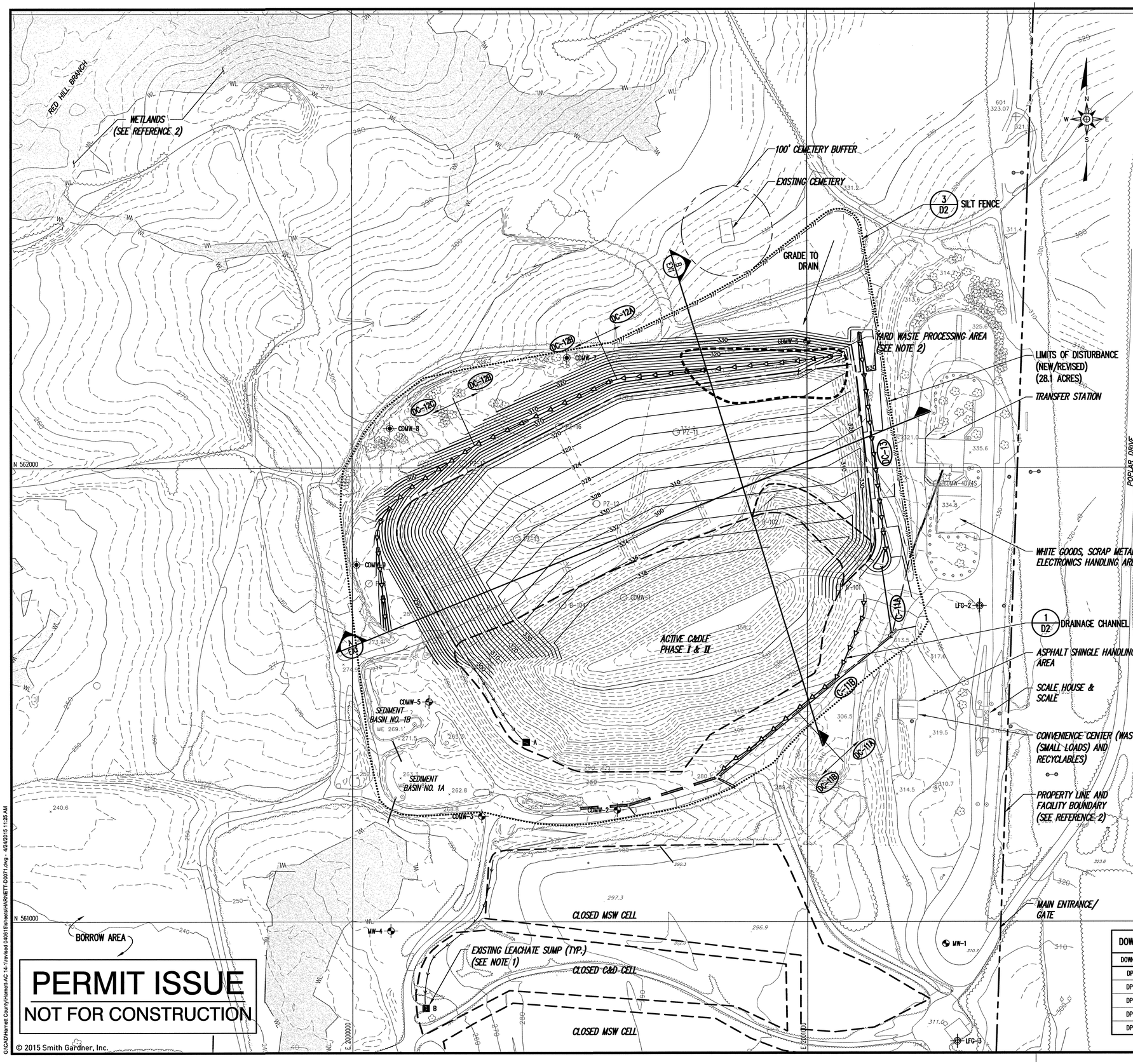
PROJECT TITLE:

ANDERSON CREEK
C&D LANDFILL PHASE III
PERMIT DRAWINGS

DRAWING TITLE:

PHASE III
SUBGRADE GRADING
AND DRAINAGE PLAN

DESIGNED: P.K.S.	PROJECT NO: HARNETT-AC-14-1
DRAWN: K.C.B.	SCALE: AS SHOWN
APPROVED: PKS	DATE: FEB. 2015
FILENAME: HARNETT-D0037	
SHEET NUMBER: 5	DRAWING NUMBER: S4



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GENERAL EROSION AND SEDIMENTATION CONTROL NOTES

1. 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. EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE ESTABLISHED PRIOR TO, OR AS SOON AS PRACTICAL THEREAFTER, ANY LAND CLEARING OR CONSTRUCTION ACTIVITIES MAY BEGIN. THE CONTRACTOR SHALL FOLLOW THE FOLLOWING SCHEDULE FOR CONSTRUCTION OF FIRING RANGE:
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   - B. FLAG THE CLEARING LIMITS.
   - C. INSTALL TEMPORARY GRAVEL CONSTRUCTION ENTRANCE/EXIT.
   - D. CLEAR THE VEGETATED PORTION OF THE SITE AND INSTALL SILT AND STONE FILTER FENCING (WHERE REQUIRED) PRIOR TO STRIPPING/GRUBBING.
   - E. REMOVE/STOCKPILE SOIL AS REQUIRED FOR CONSTRUCTION.
   - F. PERFORM FINE GRADING AND ESTABLISH PERMANENT VEGETATION ON COMPLETED AREAS.
   - G. AFTER STABILIZATION, REMOVE SILT FENCING AND OTHER TEMPORARY MEASURES AS DIRECTED BY THE OWNER AND INSTALL PERMANENT VEGETATION ON THE DISTURBED AREAS.
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   - B. REPLACEMENT OF FILTER FABRICS USED FOR SILT FENCES UPON LOSS OF EFFICIENCY; AND
   - C. REPLACEMENT OF ANY OTHER COMPONENTS WHICH ARE DAMAGED OR CANNOT SERVE THE INTENDED USE.
5. SOIL STABILIZATION SHALL BE ACHIEVED ON ANY AREA OF THE SITE WHERE LAND-DISTURBING ACTIVITIES HAVE TEMPORARILY OR PERMANENTLY CEASED ACCORDING TO THE FOLLOWING SCHEDULE:

GROUND STABILIZATION

SITE AREA DESCRIPTION	STABILIZATION TIME FRAME	STABILIZATION TIME FRAME EXCEPTIONS
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*EXTENSIONS OF TIME MAY BE APPROVED BY THE PERMITTING AUTHORITY BASED ON WEATHER OR OTHER SITE-SPECIFIC CONDITIONS THAT MAKE COMPLIANCE IMPRACTICABLE." (SECTION II.B(2)(b))

LEGEND

- 310 — EXISTING 10' CONTOUR (SEE REFERENCE 1)
- EXISTING 2' CONTOUR
- 370 — PROPOSED 10' CONTOUR (SEE NOTE 3)
- PROPOSED 2' CONTOUR
- PROPERTY LINE (APPROXIMATE)
- WASTE LIMITS (APPROXIMATE)
- WL — WETLAND BOUNDARY (SEE REFERENCE 2)
- STREAM (APPROXIMATE)
- CDMW-2 — C&D MONITORING WELL
- CDMW-7 — PROPOSED C&D MONITORING WELL
- MW-4 — MONITORING WELL
- LFG-1 — LANDFILL GAS MONITORING WELL
- B-104 — WELL/PIEZOMETER (REMOVED)
- A — LEACHATE SUMP (APPROXIMATE)
- FRENCH DRAIN (APPROXIMATE)
- PROPOSED WASTE LIMITS
- /// — SILT FENCE
- LIMITS OF DISTURBANCE (NEW/REVISED)
- DC-11 — DRAINAGE CHANNEL

NOTES

1. EXISTING SUMPS B, C, AND D AND ASSOCIATED FRENCH DRAINS ARE SLATED TO BE REMOVED BY THE COUNTY.
2. THE YARD WASTE PROCESSING AREA WILL BE RELOCATED TO THE NORTH (WITHIN LIMITS OF DISTURBANCE) AS NEEDED DURING DEVELOPMENT OF PHASE III.
3. GRADES SHOWN FOR PHASE III REPRESENT TOP OF INTERMEDIATE COVER.

REFERENCES

1. OVERALL SITE BASE TOPOGRAPHY BASED ON AERIAL SURVEY BY MAPPING RESOURCE GROUP, DATED 7/16/13.TOPOGRAPHY IN ACTIVE AREAS PERFORMED BY GEODATA CORPORATION, ZEBULON, NC, DATED 6/17/14.
2. OVERALL EXISTING SITE CONDITIONS PROVIDED BY C.T. CLAYTON, SR., P.E., INC., IN DRAWING TITLED "03001C ACLF Exp MAS-1", DATED 5/31/13.
3. WELL DATA AND LOCATIONS FROM C.T. CLAYTON, SR., P.E., INC., IN DRAWING TITLED "03001C ACLF Exp MAS-1", DATED 5/31/13.

DOWN PIPE SCHEDULE

DOWN PIPE	DIAMETER (IN.)
DP-11	24
DP-12	18
DP-13	18
DP-14	18
DP-15	24

0 100' 200' 300'

PREPARED FOR:

HARNETT COUNTY SOLID WASTE DEPARTMENT LILLINGTON NORTH CAROLINA

PREPARED BY:

NC LIC. NO. C-0828 (ENGINEERING)
SMITH+ GARDNER
ENGINEERS
14 N. Boylan Avenue, Raleigh NC 27603 | 919.828.0577

SEAL

NORTH CAROLINA PROFESSIONAL SEAL 021666 ENGINEER PETER K. SCHEER 4/24/15

SEAL

REV.	DATE	DESCRIPTION
1	4/15	REVISED PHASING

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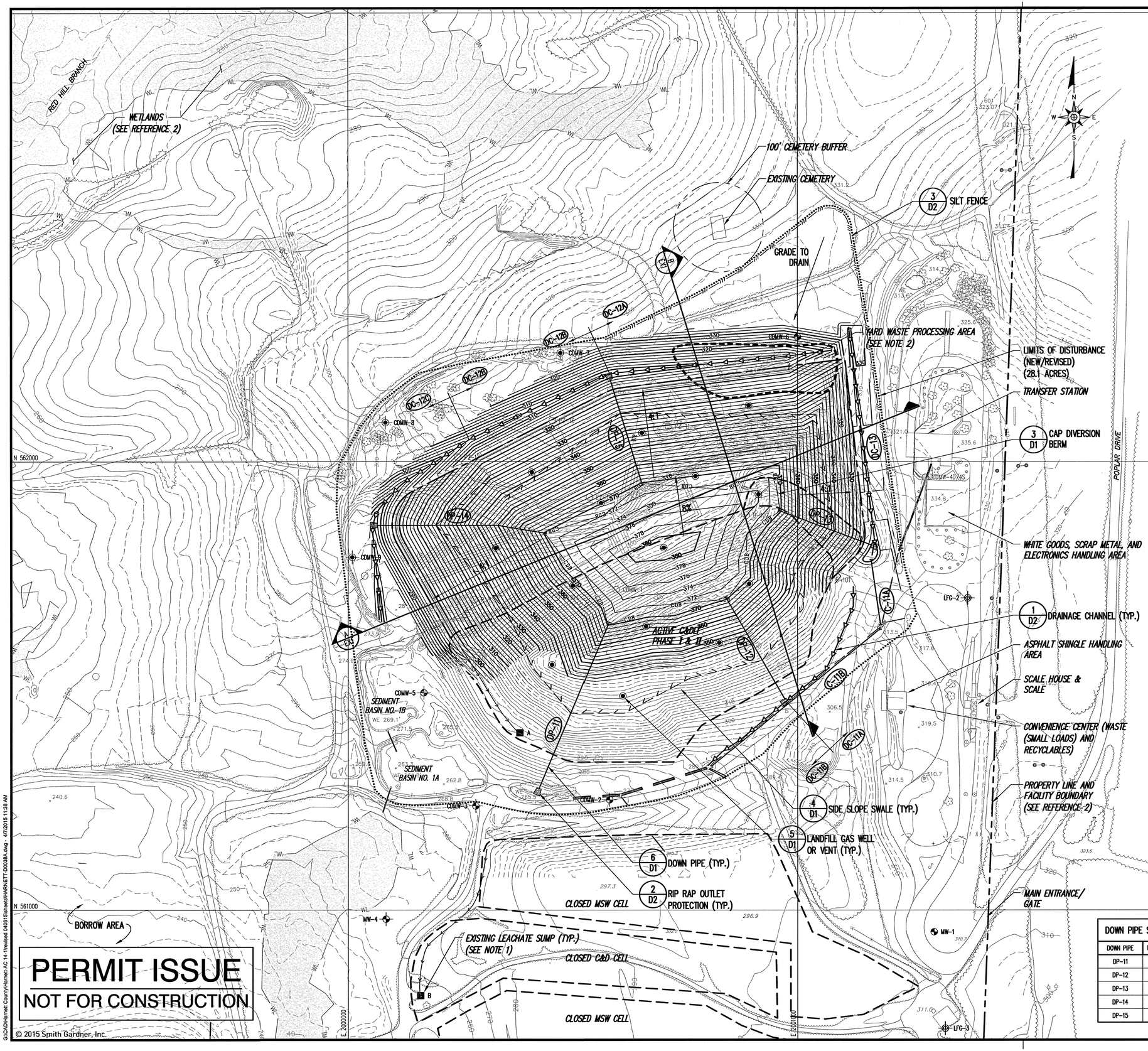
PROJECT TITLE:

ANDERSON CREEK C&D LANDFILL PHASE III PERMIT DRAWINGS

DRAWING TITLE:

PHASE III (A - D) INTERMEDIATE COVER GRADING AND DRAINAGE PLAN

DESIGNED: P.K.S.	PROJECT NO: HARNETT-AC-14-1
DRAWN: K.C.B.	SCALE: AS SHOWN
APPROVED: PKS	DATE: APRIL 2015
FILENAME: HARNETT-D0071	
SHEET NUMBER: 6A	DRAWING NUMBER: S5A



PERMIT ISSUE
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GENERAL EROSION AND SEDIMENTATION CONTROL NOTES

1. 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. EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE ESTABLISHED PRIOR TO, OR AS SOON AS PRACTICAL THEREAFTER, ANY LAND CLEARING OR CONSTRUCTION ACTIVITIES MAY BEGIN. THE CONTRACTOR SHALL FOLLOW THE FOLLOWING SCHEDULE FOR CONSTRUCTION OF FIRING RANGE:
   - A. CONTACT THE NCDENR DIVISION OF ENERGY, MINERAL, AND LAND RESOURCES, LAND QUALITY SECTION, (FAYETTEVILLE REGIONAL OFFICE: (910) 433-3300).
   - B. FLAG THE CLEARING LIMITS.
   - C. INSTALL TEMPORARY GRAVEL CONSTRUCTION ENTRANCE/EXIT.
   - D. CLEAR THE VEGETATED PORTION OF THE SITE AND INSTALL SILT AND STONE FILTER FENCING (WHERE REQUIRED) PRIOR TO STRIPPING/GRUBBING.
   - E. REMOVE/STOCKPILE SOIL AS REQUIRED FOR CONSTRUCTION.
   - F. PERFORM FINE GRADING AND ESTABLISH PERMANENT VEGETATION ON COMPLETED AREAS.
   - G. AFTER STABILIZATION, REMOVE SILT FENCING AND OTHER TEMPORARY MEASURES AS DIRECTED BY THE OWNER AND INSTALL PERMANENT VEGETATION ON THE DISTURBED AREAS.
3. ALL EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE CONSTRUCTED ACCORDING TO THE CONTRACT DRAWINGS AND SPECIFICATIONS.
4. 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. MAINTENANCE SHALL INCLUDE, BUT NOT BE LIMITED TO:
   - A. THE REMOVAL AND SATISFACTORY DISPOSAL OF TRAPPED OR DEPOSITED SEDIMENTS FROM BASINS, TRAPS, BARRIERS, FILTERS, AND/OR DRAINAGE FEATURES/DEVICES;
   - B. REPLACEMENT OF FILTER FABRICS USED FOR SILT FENCES UPON LOSS OF EFFICIENCY; AND
   - C. REPLACEMENT OF ANY OTHER COMPONENTS WHICH ARE DAMAGED OR CANNOT SERVE THE INTENDED USE.
5. SOIL STABILIZATION SHALL BE ACHIEVED ON ANY AREA OF THE SITE WHERE LAND-DISTURBING ACTIVITIES HAVE TEMPORARILY OR PERMANENTLY CEASED ACCORDING TO THE FOLLOWING SCHEDULE:

GROUND STABILIZATION

SITE AREA DESCRIPTION	STABILIZATION TIME FRAME	STABILIZATION TIME FRAME EXCEPTIONS
PERIMETER DIKES, SWALES, DITCHES, AND SLOPES	7 DAYS	NONE
HIGH QUALITY WATER (HQW) ZONES	7 DAYS	NONE
SLOPES STEEPER THAN 3:1	7 DAYS	IF SLOPES ARE 10' OR LESS IN LENGTH AND ARE NOT STEEPER THAN 2:1, 14 DAYS ARE ALLOWED.
SLOPES 3:1 OR FLATTER	14 DAYS	7 DAYS FOR SLOPES GREATER THAN 50 FEET IN LENGTH
ALL OTHER AREAS WITH SLOPES FLATTER THAN 4:1	14 DAYS	NONE (EXCEPT FOR PERIMETERS AND HQW ZONES)

*EXTENSIONS OF TIME MAY BE APPROVED BY THE PERMITTING AUTHORITY BASED ON WEATHER OR OTHER SITE-SPECIFIC CONDITIONS THAT MAKE COMPLIANCE IMPRACTICABLE." (SECTION II.8(2)(b))

LEGEND

- 310 — EXISTING 10' CONTOUR (SEE REFERENCE 1)
- EXISTING 2' CONTOUR
- 370 — PROPOSED 10' CONTOUR (SEE NOTE 3)
- PROPOSED 2' CONTOUR
- PROPERTY LINE (APPROXIMATE)
- WASTE LIMITS (APPROXIMATE)
- WL — WETLAND BOUNDARY (SEE REFERENCE 2)
- STREAM (APPROXIMATE)
- CDMW-2 — C&D MONITORING WELL
- CDMW-7 — PROPOSED C&D MONITORING WELL
- MW-4 — MONITORING WELL
- LFG-1 — LANDFILL GAS MONITORING WELL
- B-104 — WELL/PIEZOMETER (REMOVED)
- LANDFILL GAS WELL OR VENT
- A — LEACHATE SUMP (APPROXIMATE)
- FRENCH DRAIN (APPROXIMATE)
- PROPOSED WASTE LIMITS
- /// — SILT FENCE
- LIMITS OF DISTURBANCE (NEW/REVISED)
- CDB — CAP DIVERSION BERM
- SIDE SLOPE SWALE
- DOWN PIPE
- DP-11 — DRAINAGE CHANNEL
- DC-11

NOTES

1. EXISTING SUMPS B, C, AND D AND ASSOCIATED FRENCH DRAINS ARE SLATED TO BE REMOVED BY THE COUNTY.
2. THE YARD WASTE PROCESSING AREA WILL BE RELOCATED TO THE NORTH (WITHIN LIMITS OF DISTURBANCE) AS NEEDED DURING DEVELOPMENT OF PHASE III.
3. GRADES SHOWN FOR PHASE III REPRESENT TOP OF INTERMEDIATE COVER.

REFERENCES

1. OVERALL SITE BASE TOPOGRAPHY BASED ON AERIAL SURVEY BY MAPPING RESOURCE GROUP, DATED 7/16/13.TOPOGRAPHY IN ACTIVE AREAS PERFORMED BY GEODATA CORPORATION, ZEBULON, NC, DATED 6/17/14.
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3. WELL DATA AND LOCATIONS FROM C.T. CLAYTON, SR., P.E., INC., IN DRAWING TITLED "03001C ACLF Exp MAS-1", DATED 5/31/13.

DOWN PIPE SCHEDULE

DOWN PIPE	DIAMETER (IN.)
DP-11	24
DP-12	18
DP-13	18
DP-14	18
DP-15	24

0 100' 200' 300'

PREPARED FOR:

HARNETT COUNTY SOLID WASTE DEPARTMENT LILLINGTON NORTH CAROLINA

PREPARED BY:

NC LIC. NO. C-0828 (ENGINEERING)

SMITH+ GARDNER ENGINEERS

14 N. Boylan Avenue, Raleigh NC 27603 | 919.828.0577

SEAL

NORTH CAROLINA PROFESSIONAL SEAL 021666 ENGINEER PIETER K. SCHEER 4/24/15

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REV.	DATE	DESCRIPTION
1	4/15	REVISED PHASING

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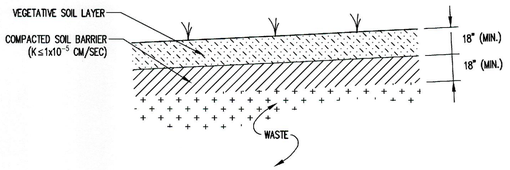
PROJECT TITLE:

ANDERSON CREEK C&D LANDFILL PHASE III PERMIT DRAWINGS

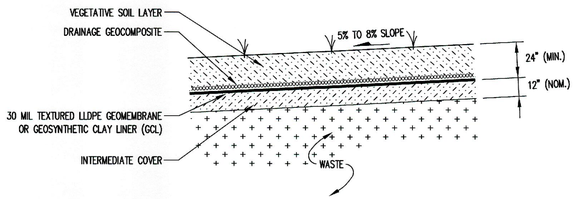
DRAWING TITLE:

PHASE III (A - E) FINAL COVER GRADING AND DRAINAGE PLAN

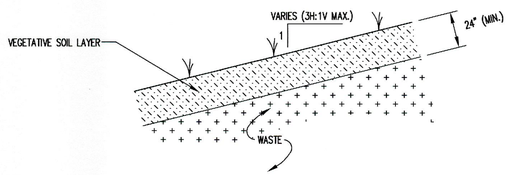
DESIGNED: P.K.S.	PROJECT NO: HARNETT-AC-14-1
DRAWN: K.C.B.	SCALE: AS SHOWN
APPROVED: PKS	DATE: APRIL 2015
FILENAME: HARNETT-D0038A	
SHEET NUMBER: 6B	DRAWING NUMBER: S5B



REGULATORY FINAL COVER SYSTEM



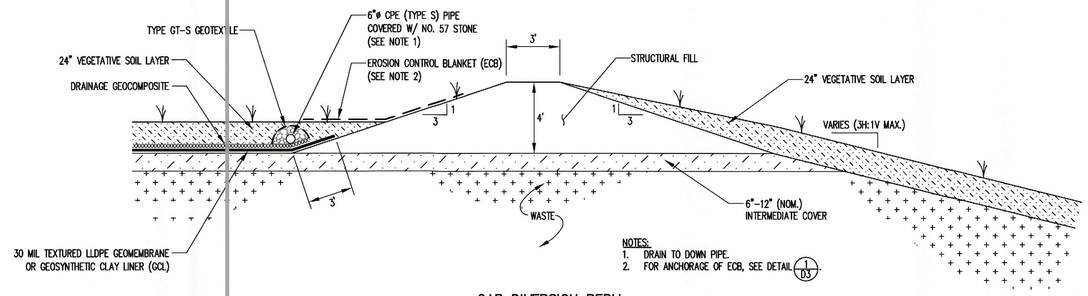
ALTERNATIVE FINAL COVER SYSTEM – TOP SLOPES



ALTERNATIVE FINAL COVER SYSTEM – SIDE SLOPES

FINAL COVER SYSTEM CROSS SECTIONS

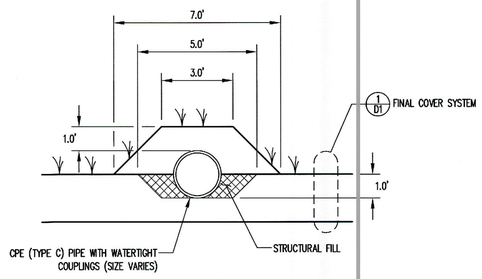
DETAIL 1/D1
NOT TO SCALE



NOTES:
1. DRAIN TO DOWN PIPE.
2. FOR ANCHORAGE OF ECB, SEE DETAIL 1/D3.

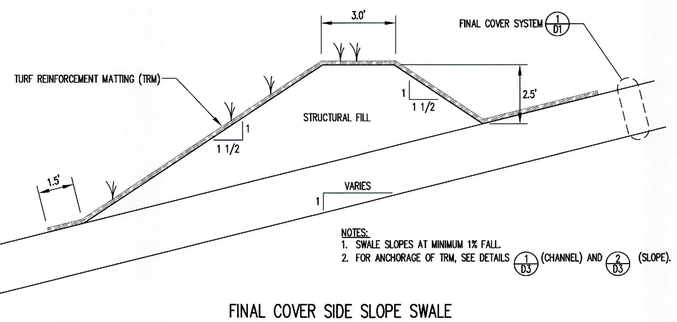
CAP DIVERSION BERM

DETAIL 3/D1
NOT TO SCALE



DOWN PIPE ON SLOPE

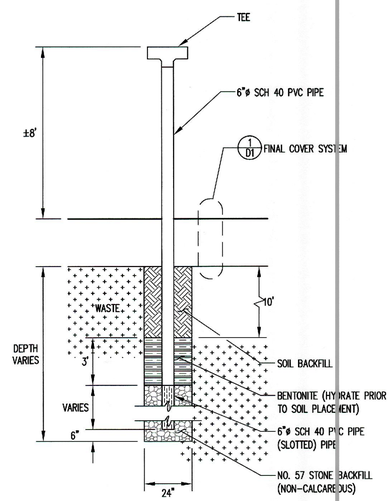
DETAIL 2/D1
NOT TO SCALE



NOTES:
1. SWALE SLOPES AT MINIMUM 1% FALL.
2. FOR ANCHORAGE OF TRM, SEE DETAILS 1/D3 (CHANNEL) AND 2/D3 (SLOPE).

FINAL COVER SIDE SLOPE SWALE

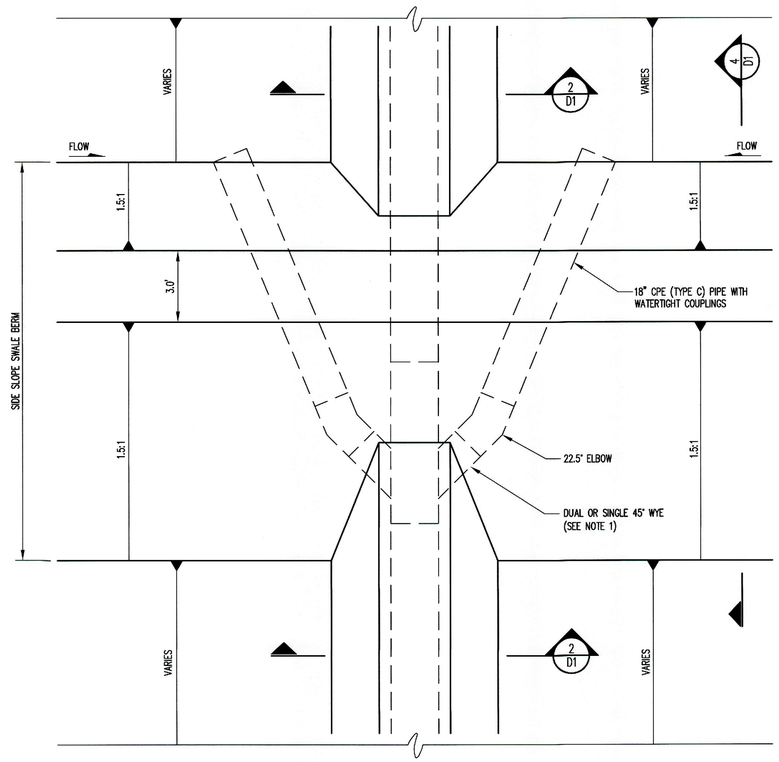
DETAIL 4/D1
NOT TO SCALE



NOTES:
1. AS AN ALTERNATIVE TO WELLS, GAS COLLECTION TRENCHES MAY BE INSTALLED JUST BELOW THE FINAL COVER. TRENCHES SHALL CONSIST OF PERFORATED PIPE BEDDED IN NO. 57 STONE (NON-CALCAREOUS) AND WRAPPED IN A TYPE GT-S GEOTEXTILE. TRENCHES SHALL HAVE NOMINAL SIZE OF 6' WIDE x 20' LONG x 2' DEEP.

TYPICAL LANDFILL GAS WELL

DETAIL 5/D1
NOT TO SCALE



NOTES:
1. DEPENDING ON LOCATION AND SIZE OF DOWN PIPE, WYE FITTING MAY BE SINGLE OR DUAL AND MAY BE A REDUCING WYE. OPTIONALLY, TERMINATE WITH TEE AT LOW POINT ABOVE BERM WHEN DOWN PIPE IS NOT TO BE EXTENDED VERTICALLY.

DOWN PIPE

DETAIL 6/D1
NOT TO SCALE

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PREPARED FOR:

HARNETT COUNTY
SOLID WASTE DEPARTMENT
LILLINGTON
NORTH CAROLINA

PREPARED BY:

NC LIC. NO. C-0828 (ENGINEERING)
SMITH+ GARDNER
ENGINEERS
14 N. Boylan Avenue, Raleigh NC 27603 | 919.828.0577

SEAL

NORTH CAROLINA PROFESSIONAL SEAL 021666 ENGINEER PIETER K. SCHEER
3/13/15

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PROJECT TITLE:

ANDERSON CREEK
C&D LANDFILL PHASE III
PERMIT DRAWINGS

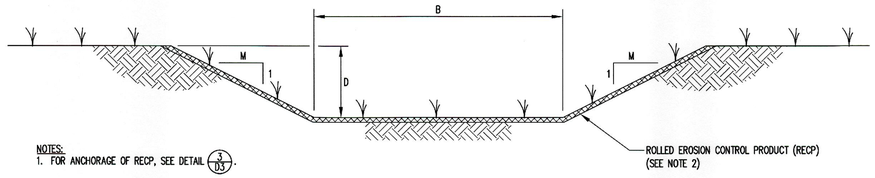
DRAWING TITLE:

DETAILS
(SHEET 1 OF 4)

DESIGNED: P.K.S.	PROJECT NO: HARNETT-AC-14-1
DRAWN: C.T.J.	SCALE: AS SHOWN
APPROVED: PKS	DATE: FEB. 2015
FILENAME: HARNETT-D0028	
SHEET NUMBER: 7	DRAWING NUMBER: D1

DRAINAGE CHANNEL SCHEDULE				
DRAINAGE CHANNEL	LINING	B	D	M
DC-11A	TRM*	2.0	1.5	3
DC-11B	TRM	4.0	2.0	3
DC-12A	ECB**	6.0	VARIES (2.0 MIN.)	3
DC-12B	TRM	6.0	VARIES (2.0 MIN.)	3
DC-12C	TRM	6.0	VARIES (2.0 MIN.)	3
DC-13	TRM	6.0	2.0	3

*TRM = TURF REINFORCEMENT MATTING
**ECB = EROSION CONTROL BLANKET



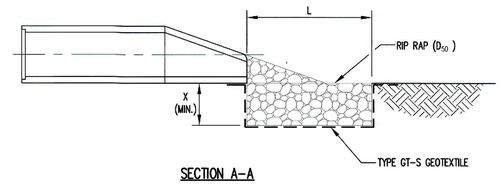
NOTES:
1. FOR ANCHORAGE OF RECP, SEE DETAIL 3/D3.

RECP LINED CHANNELS

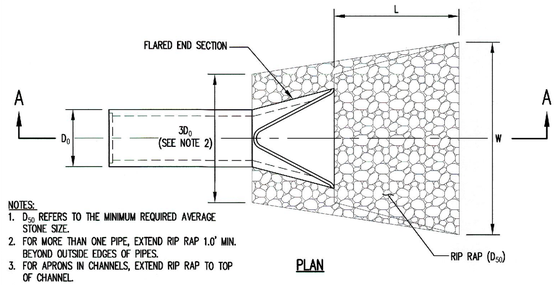
DRAINAGE CHANNEL
DETAIL 1/D2
NOT TO SCALE

RIP RAP OUTLET PROTECTION SCHEDULE				
DOWN PIPES	L (FEET)	W (FEET)	D_{50} (INCHES)	X (FEET)
DP-11, 12, 13, 14, & 15	12	14	6	1.0

NOTES:
1. PLACE RIP RAP FULL WIDTH OF CHANNEL.



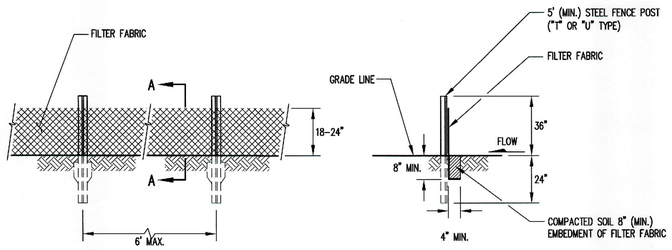
SECTION A-A



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.
3. FOR APRONS IN CHANNELS, EXTEND RIP RAP TO TOP OF CHANNEL.

PLAN

RIP RAP OUTLET PROTECTION (OUTLET TO FLAT AREA)
DETAIL 2/D2
NOT TO SCALE

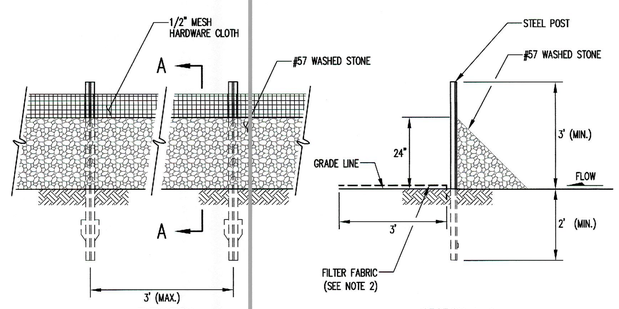


ELEVATION

SECTION A-A

NOTE:
1. SEDIMENT SHALL BE REMOVED WHEN IT REACHES HALF THE HEIGHT OF THE FENCE.

SILT FENCE
DETAIL 3/D2
NOT TO SCALE



ELEVATION

SECTION A-A

NOTE:
1. PLACE 10' SECTION OF STONE FILTER FENCE AT LOW POINTS ALONG SILT FENCE.
2. BURY FILTER FABRIC IN TRENCH.

STONE FILTER FENCE
DETAIL 4/D2
NOT TO SCALE

PERMIT ISSUE
NOT FOR CONSTRUCTION

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PREPARED FOR:

HARNETT COUNTY
SOLID WASTE DEPARTMENT
LILLINGTON
NORTH CAROLINA

PREPARED BY:

NC LIC. NO. C-0828 (ENGINEERING)
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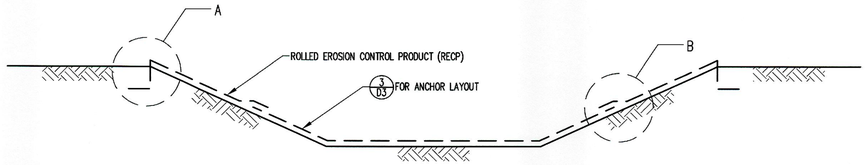
PROJECT TITLE:

ANDERSON CREEK
C&D LANDFILL PHASE III
PERMIT DRAWINGS

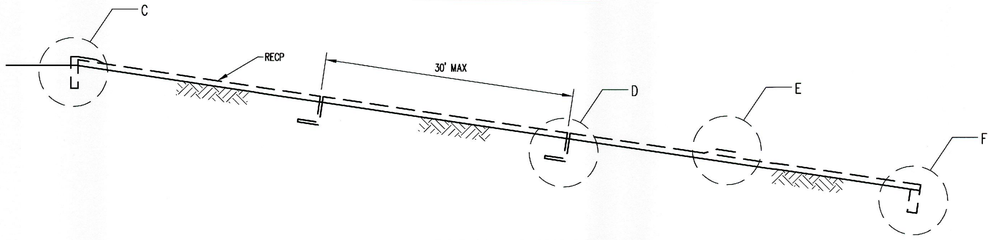
DRAWING TITLE:

DETAILS
(SHEET 2 OF 4)

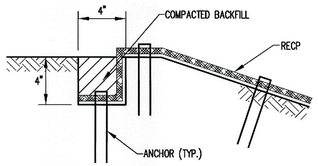
DESIGNED: P.K.S.	PROJECT NO.: HARNETT-AC-14-1
DRAWN: C.T.J.	SCALE: AS SHOWN
APPROVED: PKS	DATE: FEB. 2015
FILENAME: HARNETT-D0028	
SHEET NUMBER: 8	DRAWING NUMBER: D2



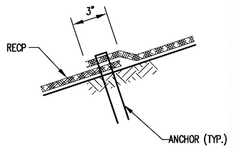
TYPICAL CHANNEL CROSS SECTION



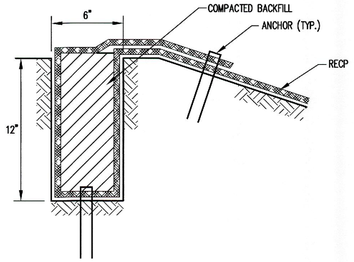
TYPICAL CHANNEL PROFILE



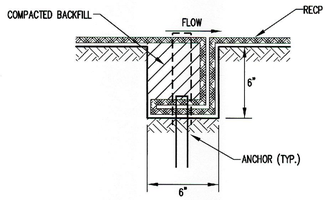
A. LONGITUDINAL ANCHOR TRENCH



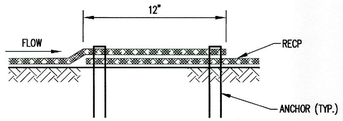
B. OVERLAP AT ADJACENT EDGES



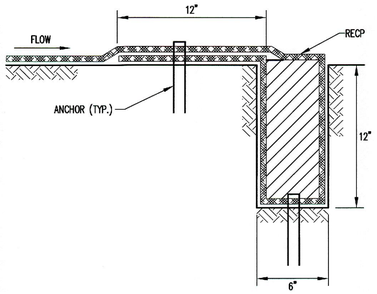
C. UPSTREAM TERMINAL ANCHOR TRENCH



D. INTERMITTENT CHECK SLOT



E. OVERLAP AT ROLL ENDS

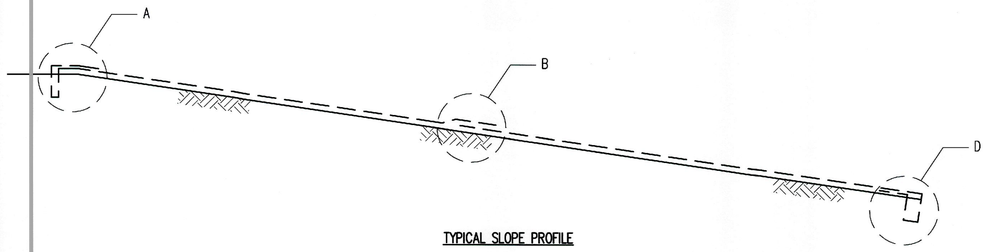


F. DOWNSTREAM TERMINAL ANCHOR TRENCH

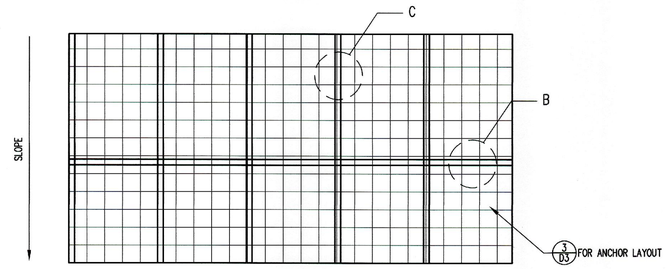
NOTES:
1. PLACE ANCHORS AT ANCHOR TRENCHES, OVERLAPS, AND CHECK SLOTS ON 1 FOOT CENTERS. IF APPLICABLE, STAGGER ANCHOR SPACING BETWEEN MULTIPLE ROWS OF ANCHORS.

INSTALLATION OF ROLLED EROSION CONTROL PRODUCTS (CHANNELS)

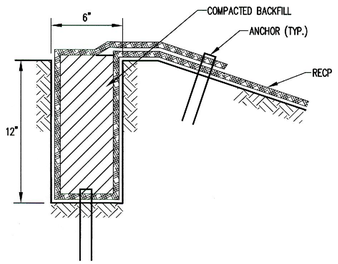
DETAIL 1/D3
NOT TO SCALE



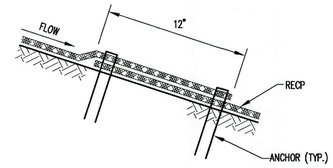
TYPICAL SLOPE PROFILE



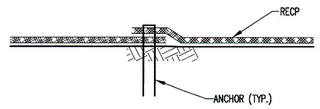
TYPICAL SLOPE PLAN VIEW



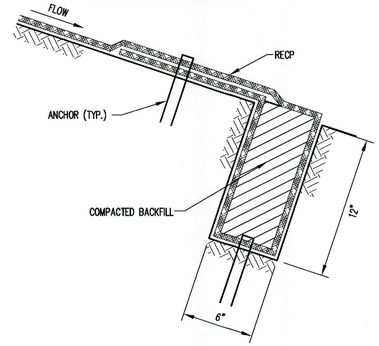
A. UPSLOPE TERMINAL ANCHOR TRENCH



B. OVERLAP AT ROLL ENDS



C. OVERLAP AT ADJACENT EDGES

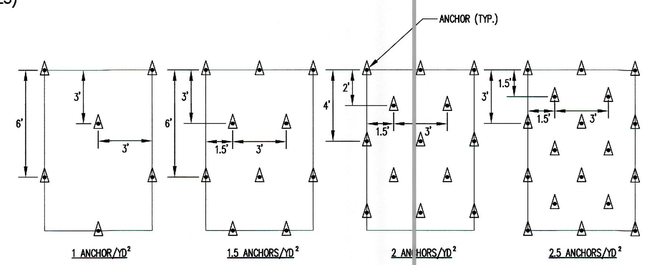


D. DOWNSLOPE TERMINAL ANCHOR TRENCH

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/D3
NOT TO SCALE



1 ANCHOR/YD^2 | 1.5 ANCHORS/YD^2 | 2 ANCHORS/YD^2 | 2.5 ANCHORS/YD^2

ANCHOR LAYOUT

DETAIL 3/D3
NOT TO SCALE

PERMIT ISSUE
NOT FOR CONSTRUCTION

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PREPARED FOR:

HARNETT COUNTY
SOLID WASTE DEPARTMENT
LILLINGTON
NORTH CAROLINA

PREPARED BY:

NC LIC. NO. C-0828 (ENGINEERING)
SMITH+ GARDNER
ENGINEERS
14 N. Boylan Avenue, Raleigh NC 27603 | 919.828.0577

SEAL

NORTH CAROLINA PROFESSIONAL SEAL 021666 ENGINEER PIETER K. SCHEER
3/13/15

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REV.	DATE	DESCRIPTION

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PROJECT TITLE:

ANDERSON CREEK
C&D LANDFILL PHASE III
PERMIT DRAWINGS

DRAWING TITLE:

DETAILS
(SHEET 3 OF 4)

DESIGNED: P.K.S.	PROJECT NO: HARNETT-AC-14-1
DRAWN: C.T.J.	SCALE: AS SHOWN
APPROVED: PKS	DATE: FEB. 2015
FILENAME: HARNETT-D0028	
SHEET NUMBER: 9	DRAWING NUMBER: D3

SPECIFICATIONS:

1. GENERAL:

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 THE SEEDING SCHEDULE.
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 THE SEEDING SCHEDULE.
G. USE SUITABLE DISTRIBUTOR.
H. INCORPORATE FERTILIZER INTO SOIL TO DEPTH OF A LEAST TWO (2) INCHES.
I. REMOVE STONES OR OTHER SUBSTANCES WHICH WILL INTERFERE WITH TURF DEVELOPMENT OR SUBSEQUENT MOWING. GRADE SEEDED AREAS TO SMOOTH, EVEN SURFACE WITH LOOSE, UNIFORMLY FINE TEXTURE.
J. ROLL AND RAKE, REMOVE RIDGES AND FILL DEPRESSIONS, AS REQUIRED TO MEET FINISH GRADES.
K. 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 THE SEEDING SCHEDULE.
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, WHERE APPLICABLE.
G. SPREAD MULCH IN A CONTINUOUS BLANKET AT THE RATE SPECIFIED IN THE SEEDING SCHEDULE.
H. IMMEDIATELY FOLLOWING SPREADING MULCH, SECURE WITH EVENLY DISTRIBUTED BINDER AT THE RATE SPECIFIED IN THE SEEDING SCHEDULE.
I. FOR SLOPES NOT STEEPER THAN 3H:1V AND AS AN OPTION TO USING BINDER TO SECURE MULCH, USE A MULCH ANCHORING TOOL OPERATED ALONG THE CONTOUR OF THE SLOPE.

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.

SEEDING SCHEDULE

MATERIAL	SEED TYPE	APPLICATION RATE (SEE NOTE 1)
LIME	–	4,000 LBS/ACRE
FERTILIZER (10-20-10)	–	1,000 LBS/ACRE
SEED		
PERMANENT	COMMON BERMUDA PENSACOLA BAHIAGRASS KOBE LESPEDEZA SEASONAL NURSE CROP	30 LBS/ACRE (SEE NOTE 3) 50 LBS/ACRE 80 LBS/ACRE (SEE NOTE 4) SEE NOTE 2
TEMPORARY	SEASONAL NURSE CROP	SEE NOTE 2
MULCH	–	4,000–5,000 LBS/ACRE
BINDER	–	400 GALLONS/ACRE

NOTES:
1. APPLICATION RATES AND/OR CHEMICAL ANALYSIS SHALL BE CONFIRMED OR ESTABLISHED BY A SOIL TEST.
2. USE SEASONAL NURSE CROP IN ACCORDANCE WITH SEEDING DATES AS STATED BELOW:
   APRIL 15 – AUGUST 15 — 10 LBS/ACRE GERMAN MILLET OR 15 LBS/ACRE SUDANGRASS
   AUGUST 16 – APRIL 14 — 40 LBS/ACRE RYE (GRAIN)
3. HALF HULLED AND HALF UN-HULLED.
4. PLACE KOBE LESPEDEZA ON SLOPES STEEPER THAN OR EQUAL TO 4H:1V.

VEGETATIVE STABILIZATION

DETAIL 1/D4
NOT TO SCALE

MAINTENANCE OF EROSION AND SEDIMENTATION FEATURES

ROLLED EROSION CONTROL PRODUCT

1. INSPECT ROLLED EROSION CONTROL PRODUCTS AT LEAST WEEKLY AND AFTER EACH SIGNIFICANT (1/2 INCH OR GREATER) RAIN FALL EVENT REPAIR IMMEDIATELY.
2. GOOD CONTACT WITH THE GROUND MUST BE MAINTAINED, AND EROSION MUST NOT OCCUR BENEATH THE RECP.
3. ANY AREAS OF THE RECP THAT ARE DAMAGED OR NOT IN CLOSE CONTACT WITH THE GROUND SHALL BE REPAIRED AND STAPLED.
4. IF EROSION OCCURS DUE TO POORLY CONTROLLED DRAINAGE, THE PROBLEM SHALL BE FIXED AND THE ERODED AREA PROTECTED.
5. MONITOR AND REPAIR THE RECP AS NECESSARY UNTIL GROUND COVER IS ESTABLISHED.

SILT FENCE

1. INSPECT SEDIMENT FENCES AT LEAST ONCE A WEEK AND AFTER EACH RAINFALL. MAKE ANY REQUIRED REPAIRS IMMEDIATELY.
2. SHOULD THE FABRIC OF A SEDIMENT FENCE COLLAPSE, TEAR, DECOMPOSE, OR BECOME INEFFECTIVE, REPLACE IT PROMPTLY.
3. REMOVE SEDIMENT DEPOSITS AS NECESSARY TO PROVIDE ADEQUATE STORAGE VOLUME FOR THE NEXT RAIN AND TO REDUCE PRESSURE ON THE FENCE. TAKE CARE TO AVOID UNDERMINING THE FENCE DURING CLEANOUT.
4. REMOVE ALL FENCING MATERIALS AND UNSTABLE SEDIMENT DEPOSITS AND BRING THE AREA TO GRADE AND STABILIZE IT AFTER THE CONTRIBUTING DRAINAGE AREA HAS BEEN PROPERLY STABILIZED.

FILTER BERM (ROCK PIPE INLET PROTECTION)

1. INSPECT ROCK PIPE INLET PROTECTION AT LEAST WEEKLY AND AFTER EACH SIGNIFICANT (½ INCH OR GREATER) RAINFALL EVENT AND REPAIR IMMEDIATELY. REMOVE SEDIMENT AND RESTORE THE SEDIMENT STORAGE AREA TO ITS ORIGINAL DIMENSIONS WHEN THE SEDIMENT HAS ACCUMULATED TO ONE-HALF THE DESIGN DEPTH OF THE TRAP. PLACE THE SEDIMENT THAT IS REMOVED IN THE DESIGNATED DISPOSAL AREA AND REPLACE THE CONTAMINATED PART OF THE GRAVEL FACING. CHECK THE STRUCTURE FOR DAMAGE. ANY RIPRAP DISPLACED FROM THE STONE HORSESHOE MUST BE REPLACED IMMEDIATELY.
2. AFTER ALL THE SEDIMENT-PRODUCING AREAS HAVE BEEN PERMANENTLY STABILIZED, REMOVE THE STRUCTURE AND ALL THE UNSTABLE SEDIMENT. SMOOTH THE AREA TO BLEND WITH THE ADJOINING AREAS AND PROVIDE PERMANENT GROUND COVER (SURFACE STABILIZATION).

RIP RAP OUTLET PROTECTION

1. IN GENERAL, ONCE A RIPRAP INSTALLATION HAS BEEN PROPERLY DESIGNED AND INSTALLED IT REQUIRES VERY LITTLE MAINTENANCE. RIPRAP SHOULD BE INSPECTED PERIODICALLY FOR SCOUR OR DISLODGED STONES. CONTROL OF WEED AND BRUSH GROWTH MAY BE NEEDED IN SOME LOCATIONS.

TEMPORARY CONSTRUCTION ENTRANCE/EXIT

1. MAINTAIN THE GRAVEL PAD IN A CONDITION TO PREVENT MUD OR SEDIMENT FROM LEAVING THE CONSTRUCTION SITE. THIS MAY REQUIRE PERIODIC TOPDRESSING WITH 2-INCH STONE. AFTER EACH RAINFALL, INSPECT ANY STRUCTURE USED TO TRAP SEDIMENT AND CLEAN IT OUT AS NECESSARY. IMMEDIATELY REMOVE ALL OBJECTIONABLE MATERIALS SPILLED, WASHED, OR TRACKED ONTO PUBLIC ROADWAYS.

STONE FILTER FENCE

1. INSPECT STONE FILTER FENCE AT LEAST ONCE A WEEK AND AFTER EACH RAINFALL. MAKE ANY REQUIRED REPAIRS IMMEDIATELY.
2. SHOULD THE MESH HARDWARE CLOTH, POST, OR STONE OF A STONE FILTER FENCE COLLAPSE, TEAR, MOVE, REPLACE IT PROMPTLY.
3. REMOVE SEDIMENT DEPOSITS WHEN HALF OF THE STONE OUTLET IS COVERED TO ENSURE DEWATERING DURING THE NEXT RAIN EVENT. TAKE CARE TO AVOID UNDERMINING THE STONE FILTER FENCE DURING CLEANOUT.
4. REPLACE STONE AS NEEDED TO ENSURE DEWATERING. THE STONE HEIGHT MUST BE AT LEAST 12 INCHES HIGH AND THERE MUST BE AT LEAST 12 INCHES OF SEPARATION BETWEEN THE TOP OF THE MESH HARDWARE CLOTH AND THE TOP OF THE STONE.
5. REMOVE ALL STONE FILTER FENCING MATERIALS AND UNSTABLE SEDIMENT DEPOSITS AND BRING THE AREA TO GRADE AND STABILIZE IT AFTER THE CONTRIBUTING DRAINAGE AREA HAS BEEN PROPERLY STABILIZED.

MAINTENANCE OF E&S FEATURES

DETAIL 2/D4
NOT TO SCALE

PERMIT ISSUE
NOT FOR CONSTRUCTION

PREPARED FOR:

HARNETT COUNTY
SOLID WASTE DEPARTMENT
LILLINGTON
NORTH CAROLINA

PREPARED BY:

NC LIC. NO. C-0828 (ENGINEERING)
SMITH+ GARDNER
ENGINEERS
14 N. Boylan Avenue, Raleigh NC 27603 | 919.828.0577

SEAL

NORTH CAROLINA PROFESSIONAL SEAL 021666 ENGINEER PIETER K. SCHEER 3/13/15

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PROJECT TITLE:

ANDERSON CREEK
C&D LANDFILL PHASE III
PERMIT DRAWINGS

DRAWING TITLE:

DETAILS
(SHEET 4 OF 4)

DESIGNED: P.K.S.	PROJECT NO.: HARNETT-AC-14-1
DRAWN: C.T.J.	SCALE: AS SHOWN
APPROVED: PKS	DATE: FEB. 2015
FILENAME: HARNETT-D0028	
SHEET NUMBER: 10	DRAWING NUMBER: D4

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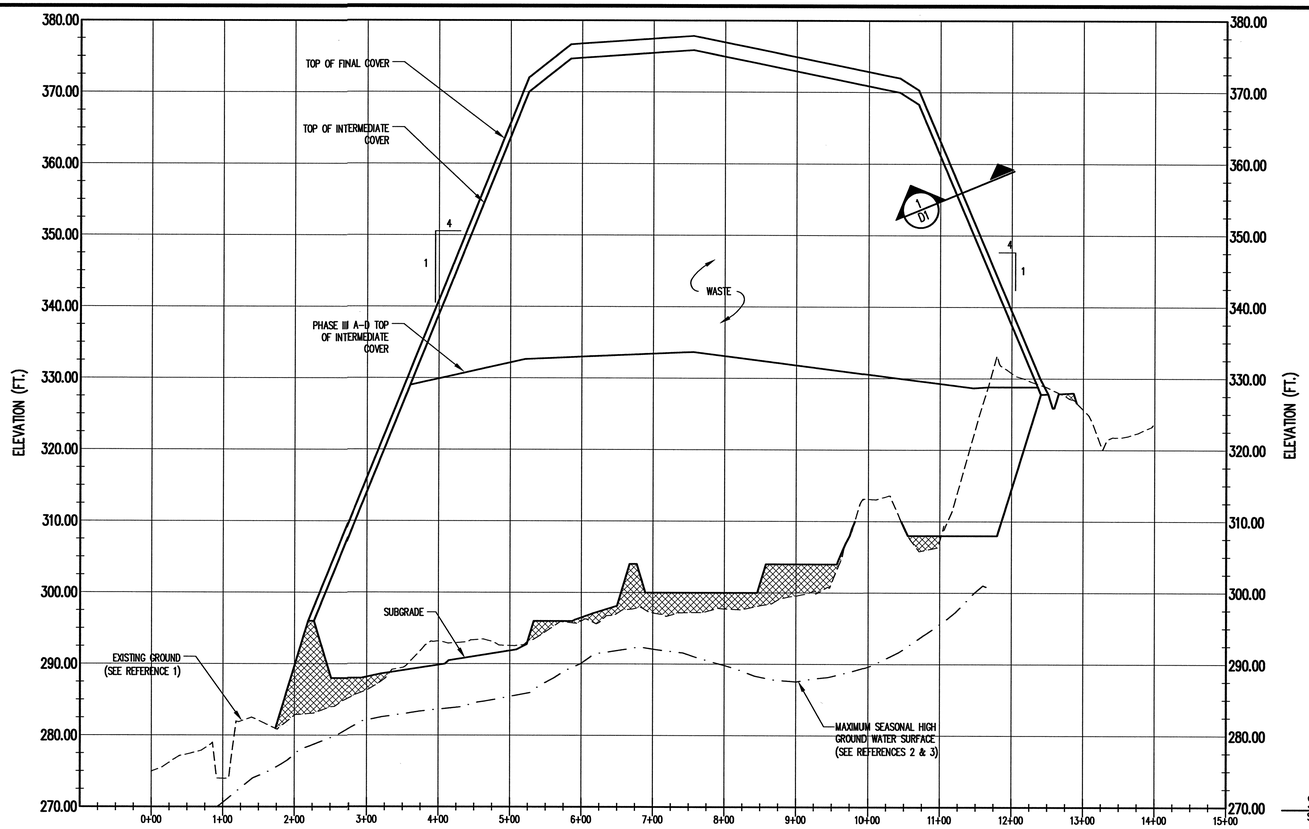
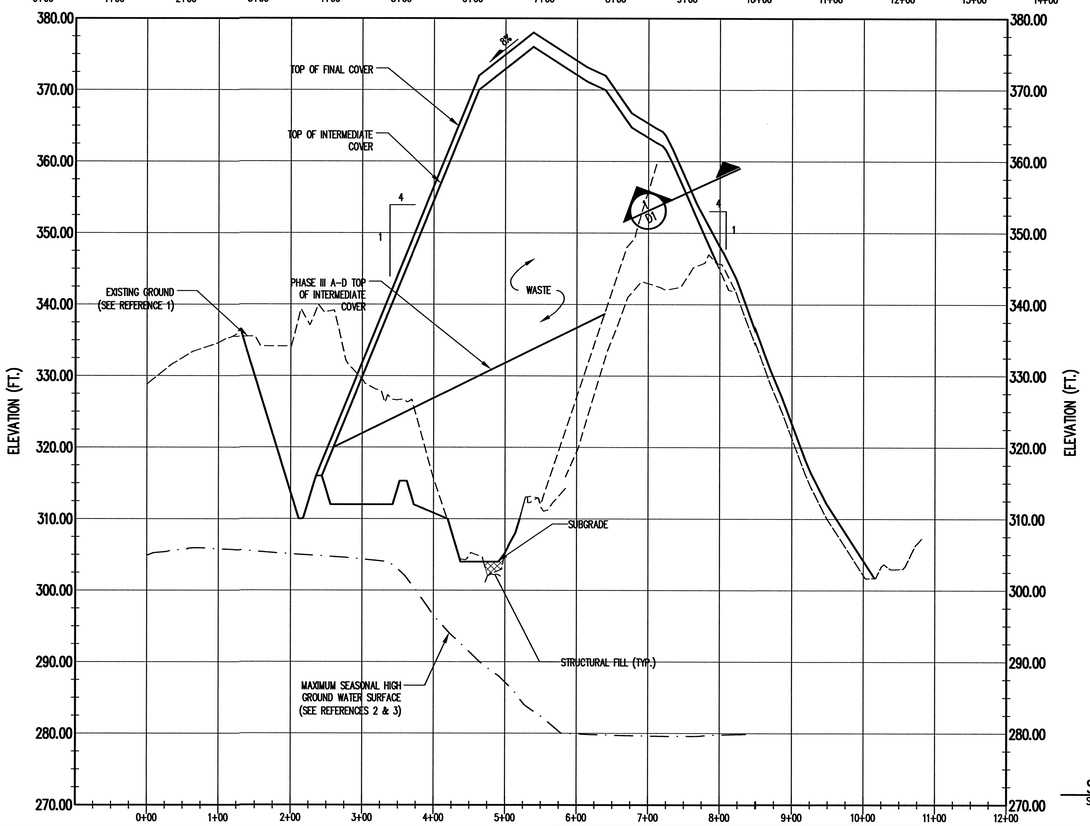


SECTION AA

SECTION A / EX1
SCALE: AS SHOWN



SECTION BB

SECTION B / EX1
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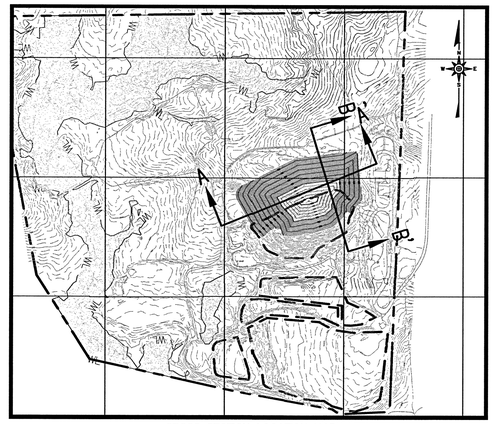

CROSS SECTION LOCATION MAP

PERMIT ISSUE
NOT FOR CONSTRUCTION

LEGEND

- EXISTING GROUND (SEE REFERENCE 1 & 2)
- PROPOSED GRADES
- MAXIMUM SEASONAL HIGH GROUND WATER SURFACE
- STRUCTURAL FILL

30' 20' 10' 0

0 100' 200' 300'

NOTES

1. EXISTING SUMPS B, C, AND D AND ASSOCIATED FRENCH DRAINS ARE SLATED TO BE REMOVED BY THE COUNTY.
2. THE PREVIOUSLY EXISTING FRENCH DRAIN (STONE & PIPE) WAS REMOVED AND BACKFILLED IN THE FIRST HALF OF 2014.

REFERENCES

1. OVERALL SITE BASE TOPOGRAPHY BASED ON AERIAL SURVEY BY MAPPING RESOURCE GROUP, DATED 7/16/13. TOPOGRAPHY IN ACTIVE AREAS PERFORMED BY GEODATA CORPORATION, ZEBULON, NC, DATED 6/17/14.
2. OVERALL EXISTING SITE CONDITIONS PROVIDED BY C.T. CLAYTON, SR., P.E., INC., IN DRAWING TITLED "03001C ACLF Exp MAS-1", DATED 5/31/13.
3. WELL DATA AND LOCATIONS FROM C.T. CLAYTON, SR., P.E., INC., IN DRAWING TITLED "03001C ACLF Exp MAS-1", DATED 5/31/13.

PREPARED FOR:

HARNETT COUNTY
SOLID WASTE DEPARTMENT
LILLINGTON
NORTH CAROLINA

PREPARED BY:

NC LIC. NO. C-0828 (ENGINEERING)

SMITH+ GARDNER
ENGINEERS
14 N. Boylan Avenue, Raleigh NC 27603 | 919.828.0577

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NORTH CAROLINA PROFESSIONAL SEAL 021666 ENGINEER PIETER K. SCHEER
4/24/15

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1	4/15	REVISED PHASING

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PROJECT TITLE:

ANDERSON CREEK
C&D LANDFILL PHASE III
PERMIT DRAWINGS

DRAWING TITLE:

ENGINEERING
CROSS SECTIONS

DESIGNED: P.K.S.	PROJECT NO: HARNETT-AC-14-1
DRAWN: K.C.B.	SCALE: AS SHOWN
APPROVED: PKS	DATE: APRIL 2015
FILENAME: HARNETT-D0061A	
SHEET NUMBER: 11	DRAWING NUMBER: EX1

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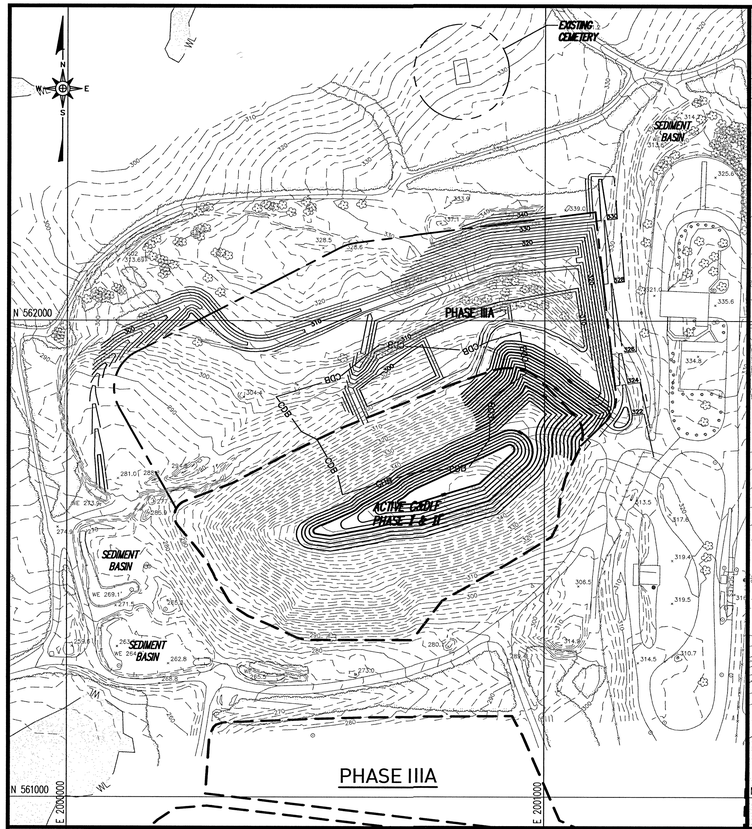
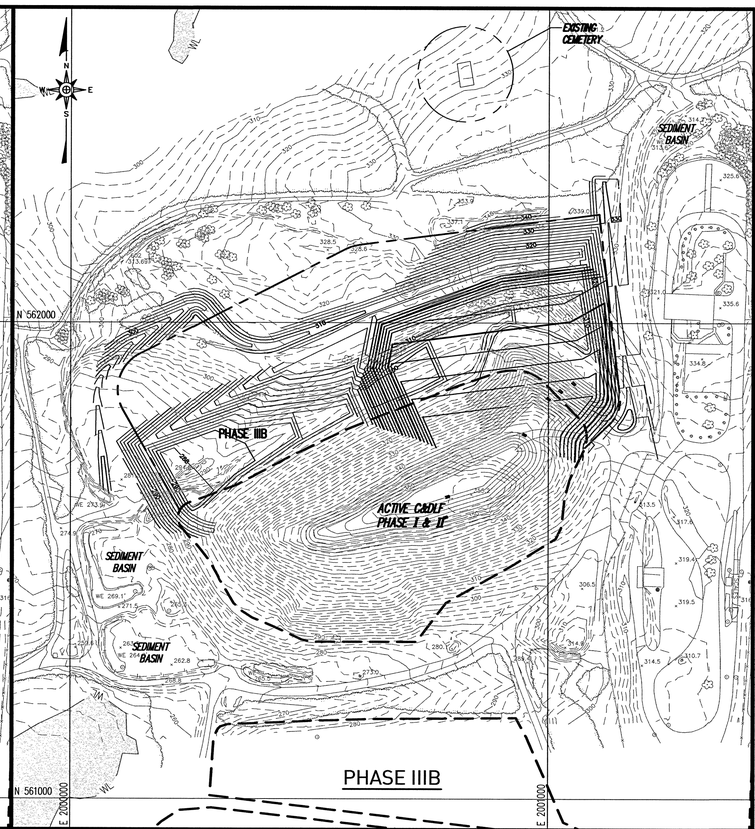
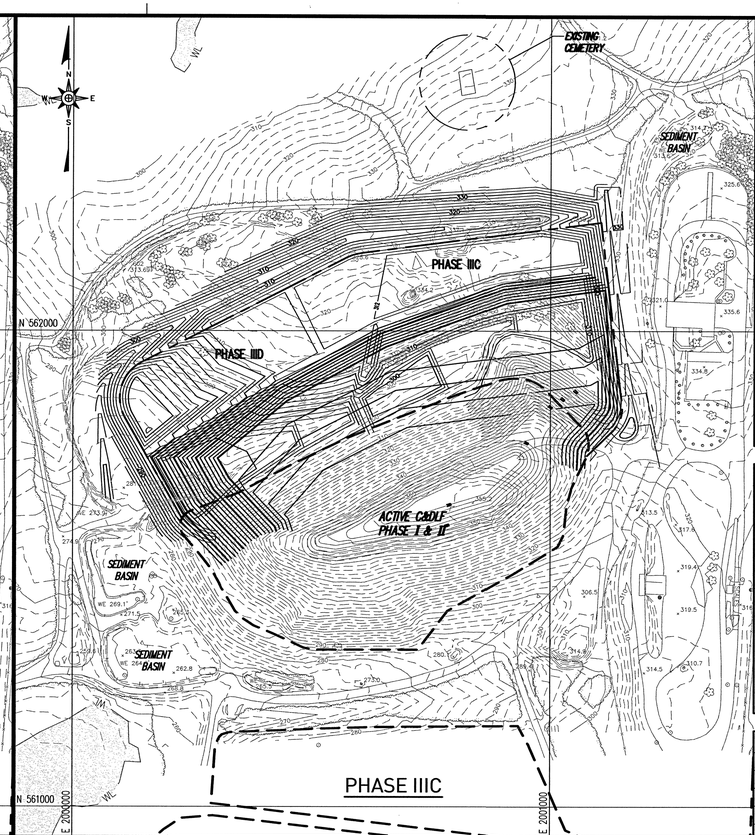


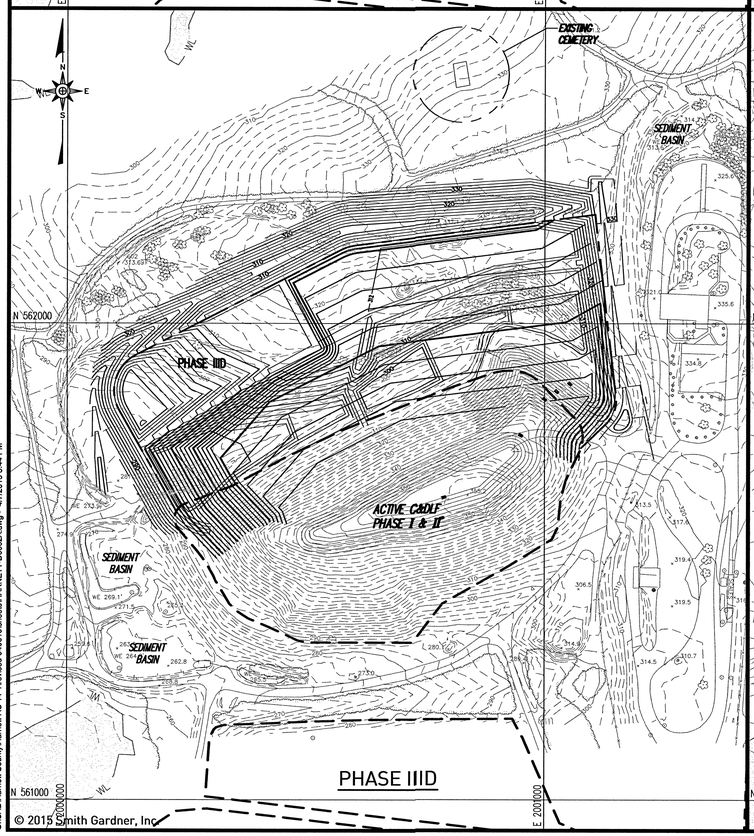
PHASE IIIA



PHASE IIIB



PHASE IIIC



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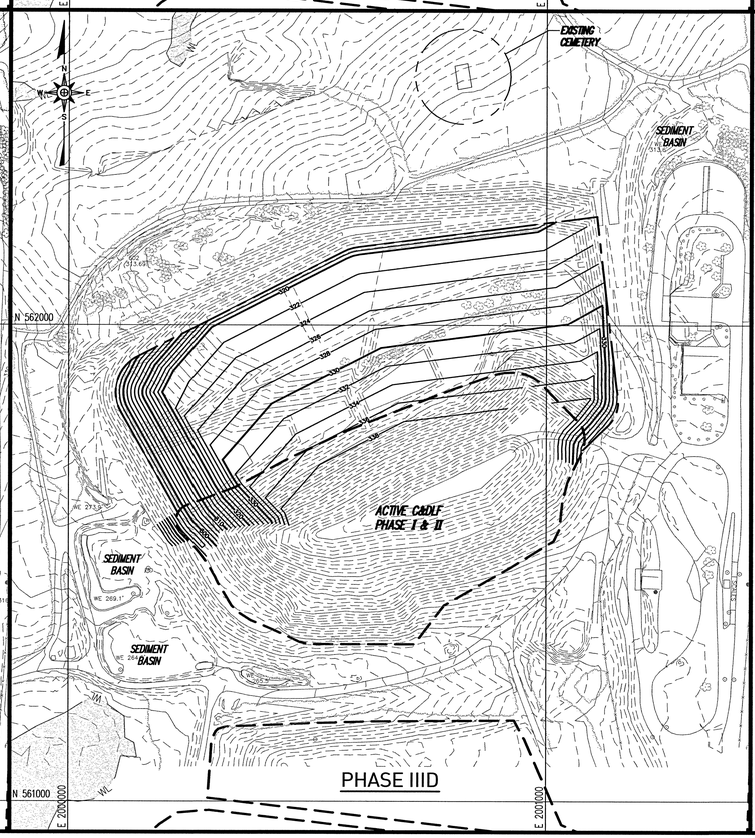

PHASE IIID

PERMIT ISSUE
NOT FOR CONSTRUCTION

LEGEND

- EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- PROPERTY LINE
- STREAM (PERENNIAL AND INTERMITTENT)
- LIMITS OF DISPOSAL AREA (LINED)

NOTES

1. GRADES SHOWN FOR AREA 2 REPRESENT TOP OF FINAL COVER OR TOP OF INTERMEDIATE COVER (AS INDICATED).

REFERENCES

1. OVERALL SITE BASE TOPOGRAPHY BASED ON AERIAL SURVEY BY MAPPING RESOURCE GROUP, DATED 7/16/13. TOPOGRAPHY IN ACTIVE AREAS PERFORMED BY GEODATA CORPORATION, ZEBULON, NC, DATED 6/17/14.
2. OVERALL EXISTING SITE CONDITIONS PROVIDED BY C.T. CLAYTON, SR., P.E., INC., IN DRAWING TITLED "03001C ACLF Exp MAS-1", DATED 5/31/13.
3. WELL DATA AND LOCATIONS FROM C.T. CLAYTON, SR., P.E., INC., IN DRAWING TITLED "03001C ACLF Exp MAS-1", DATED 5/31/13.

0 150' 300' 450'

PREPARED FOR:

HARNETT COUNTY
SOLID WASTE DEPARTMENT
LILLINGTON
NORTH CAROLINA

PREPARED BY:

NC LIC. NO. C-0828 [ENGINEERING]

SMITH+ GARDNER
ENGINEERS
14 N. Boylan Avenue, Raleigh NC 27603 | 919.828.0577

SEAL

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4/24/15

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1	4/15	REVISED PHASING

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PROJECT TITLE:

ANDERSON CREEK
C&D LANDFILL PHASE III
PERMIT DRAWINGS

DRAWING TITLE:

PHASE III
PHASING PLAN
(SHEET 1 OF 2)

DESIGNED: P.K.S.	PROJECT NO: HARNETT-AC-14-1
DRAWN: K.C.B.	SCALE: AS SHOWN
APPROVED: PKS	DATE: APRIL 2015
FILENAME: HARNETT-D0062A	
SHEET NUMBER: 12	DRAWING NUMBER: P1

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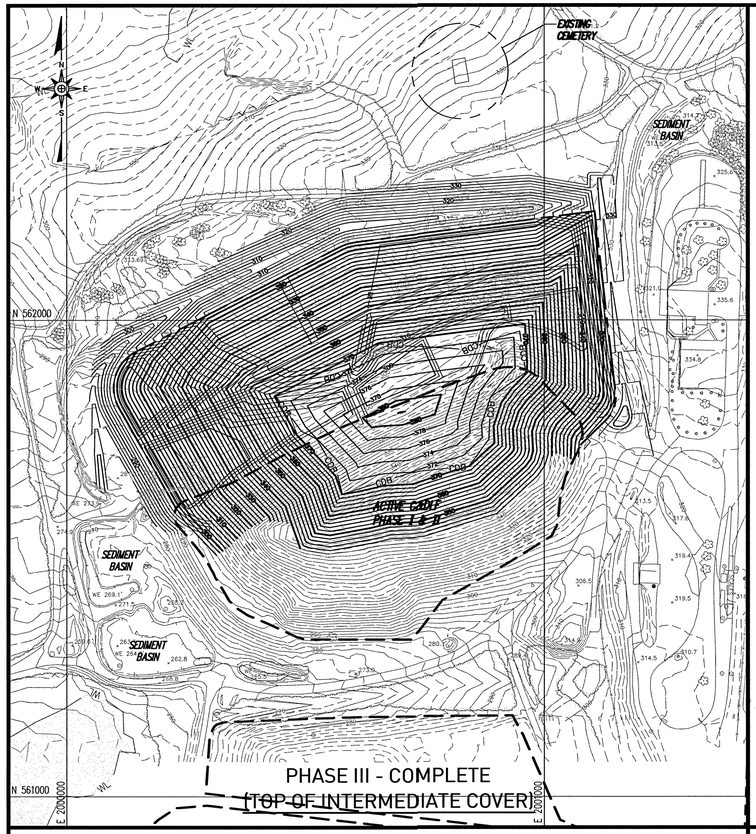

PERMIT ISSUE
NOT FOR CONSTRUCTION

LEGEND

- EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- PROPERTY LINE
- STREAM (PERENNIAL AND INTERMITTENT)
- LIMITS OF DISPOSAL AREA (LINED)

NOTES

1. GRADES SHOWN FOR AREA 2 REPRESENT TOP OF FINAL COVER OR TOP OF INTERMEDIATE COVER (AS INDICATED).

REFERENCES

1. OVERALL SITE BASE TOPOGRAPHY BASED ON AERIAL SURVEY BY MAPPING RESOURCE GROUP, DATED 7/16/13. TOPOGRAPHY IN ACTIVE AREAS PERFORMED BY GEODATA CORPORATION, ZEBULON, NC, DATED 6/17/14.
2. OVERALL EXISTING SITE CONDITIONS PROVIDED BY C.T. CLAYTON, SR., P.E., INC., IN DRAWING TITLED "03001C ACLF Exp MAS-1", DATED 5/31/13.
3. WELL DATA AND LOCATIONS FROM C.T. CLAYTON, SR., P.E., INC., IN DRAWING TITLED "03001C ACLF Exp MAS-1", DATED 5/31/13.

0 150' 300' 450'

PREPARED FOR:

HARNETT COUNTY
SOLID WASTE DEPARTMENT
LILLINGTON
NORTH CAROLINA

PREPARED BY:

NC LIC. NO. C-0828 (ENGINEERING)

SMITH+ GARDNER
ENGINEERS
14 N. Boylan Avenue, Raleigh NC 27603 | 919.828.0577

SEAL

NORTH CAROLINA PROFESSIONAL SEAL 021666 ENGINEER PIETER K. SCHEER
4/24/15

SEAL

REV.	DATE	DESCRIPTION
1	4/15	REVISED PHASING

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PROJECT TITLE:

ANDERSON CREEK
C&D LANDFILL PHASE III
PERMIT DRAWINGS

DRAWING TITLE:

PHASE III
PHASING PLAN
(SHEET 2 OF 2)

DESIGNED: P.K.S.	PROJECT NO: HARNETT-AC-14-1
DRAWN: K.C.B.	SCALE: AS SHOWN
APPROVED: PKS	DATE: APRIL 2015
FILENAME: HARNETT-D0062A	
SHEET NUMBER: 13	DRAWING NUMBER: P2

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