| Permit No. | Date | Document ID No. |
|---|---|---|
| 55-04 | November 4, 2008 | 6149 |

309 East Morehead Street, Suite 160
Charlotte, North Carolina 28202

Tel: (704) 358-7204
Fax: (704) 358-7205

RECEIVED
**October 15, 2008**
Solid Waste Section
Asheville Regional Office

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OCT 15 2008
SOLID WASTE SECTION

October 8, 2008

BROWN AND CALDWELL

Mr. Ming Chao, P.E.
NCDENR - Division of Waste Management
Solid Waste Section - Permitting Branch
1646 Mail Service Center
Raleigh, North Carolina 27699-1646 135836

Subject: Revised Closure and Post-Closure Plan and updated Operations Plan for the BFI - Lake Norman Construction and Demolition Landfill Facility (Facility Permit No. 55-04)

Dear Mr. Chao:

On behalf of BFI - Lake Norman Landfill, Inc. an Allied Waste Industries, Inc. subsidiary, we are submitting a revised Closure and Post-Closure Plan for the Lake Norman Construction and Demolition (C&D) Landfill Facility (Facility Permit No. 55-04). This revised plan is a replacement of the Closure and Post-Closure Plan submitted on July 17, 2008. In addition, we are submitting an updated Operations Plan for the Lake Norman C&D Landfill Facility for review by the Solid Waste Section. This updated Operations Plan was requested during a recent inspection of the landfill facility by Mooresville regional office field operations branch inspector. A duplicate of the updated Operations Plan is also being forwarded to Mr. Larry Frost in the Asheville Regional Office of the Solid Waste Section Permitting Branch.

If you have any questions, or need additional information, please don't hesitate to contact Mike Gurley with Allied Waste at (704) 782-2004 ext. 391 or myself at (704) 373-7127.

Sincerely,

BROWN AND CALDWELL

Albert Glenn

Albert Glenn, P.E.
Senior Engineer

Cc: Mr. Larry Frost, Asheville Regional Office of the Solid Waste Section.
Mr. Mike Gurley, Allied Waste Industries, Inc.

Enclosures: Revised Closure and Post-Closure Plan dated August 8, 2008.
Updated Operations Plan dated October 2008.

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# CLOSURE AND POST-CLOSURE PLAN

Prepared for

BFI – Lake Norman Landfill, Inc.

Stanley, North Carolina

August 8, 2008

# CLOSURE AND POST-CLOSURE PLAN
# FOR THE
# LAKE NORMAN CONSTRUCTION AND DEMOLITION LANDFILL FACILITY

Prepared for

BFI – Lake Norman Landfill, Inc.

Stanley, North Carolina

August 8, 2008

NORTH CAROLINA
PROFESSIONAL
SEAL
031802
ENGINEER
ALBERT D. GLENN

8/8/2008


BROWN AND CALDWELL

309 East Morehead Street, Suite 160

Charlotte, North Carolina 28202

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## LIST OF TABLES

# 1. CLOSURE PLAN

The requirements are contained in the North Carolina Solid Waste Management Regulations (15A NCAC 13B .0543) and in the Financial Assurance Rule of Solid Waste Management Facilities (15A NCAC 13B .0546) require that a closure and post-closure plan be submitted to the North Carolina Department of Environment and Natural Resources (NCDENR) Division of Waste Management that details the activities that will be performed to satisfy the requirements of these regulations.

## 1.1 Closure Plan – 15 NCAC 13B .0543

All construction and demolition landfill facility (C&DLF) owners/operators shall prepare a closure plan that describes the steps necessary to close a C&DLF at any point during its active life as well as the steps necessary to facilitate final closure. In providing this information, the closure plan will assist the Lake Norman C&D Landfill Facility in achieving the goals of closure implementation, which are: prevent exposure of the disposed waste, minimize precipitation infiltration, and control the emission of landfill gas in order to protect human health and the environment. Specifically, this closure plan establishes: design criteria for the final cover system, a description of the landfill gas collection system, a closure sequence and construction schedule, construction costs, and other information relating to closure.

In accordance with 15 NCAC 13B .0542(n) the NCDENR Division of Waste Management approved closure plan shall be placed in the Lake Norman C&D Landfill Facility's operating record. The closure plan shall be reviewed and updated if any changes occur which require a deviation from the approved closure plan and submitted to the Division of Waste Management for approval.

## 1.2 Closure Schedule – 15 NCAC 13B .0543(d)(4)

The proposed closure schedule and estimated maximum area and inventory of waste is included as Table1-1. In accordance with 15 NCAC 13B .0543(c)(5) the landfill facility may conduct partial closure of a portion of the C&DLF upon reaching final waste grades.

**Table 1-1. Closure Schedule and Inventory of Waste**

| Maximum Landfill Area | Current Waste Inventory(1) | Remaining Disposal Airspace(2) | Permitted Annual Waste Disposal Tonnage | Average Annual Waste Disposal Tonnage(3) | Estimated Waste Density | Anticipated Landfill Closure Year(4) (Permitted Annual Tonnage) | Anticipated Landfill Closure Year(4) (Average Annual Tonnage) |
|---|---|---|---|---|---|---|---|
| 31.77 acres | 1,457,991 $yd^3$ | 1,137,572 $yd^3$ | 200,000 tons | 110,520 tons | 1,200 $lbs/yd^3$ | 2010 | 2013 |

*Notes:*

*(1) Waste inventory as of February 2008 based on aerial survey.*

*(2) Volumes were calculated with a digital terrain model generated using Autodesk Civil 3D 2008 software.*

*(3) Waste disposal rate is based on waste tonnage received for years 2007 & 2008.*

*(4) Anticipated year of closure is an estimate only. Actual closure time frames will be determined as filling of the landfill progresses.*

## 1.3 Closure Performance Standard – 15A NCAC 13B .0543(c)(1)

The landfill final cover system is designed to minimize infiltration of precipitation and erosion and the need for post-closure maintenance.

## 1.4 Landfill Closure – 15A NCAC 13B .0543

### 1.4.1 Plan Sheets

Closure Plan Engineering Drawings are provided in Appendix A showing cover layers and thickness, final slope topography, stormwater management, erosion and sediment controls, and associated details.

### 1.4.2 Closure Cap Description

The following provides a description of each layer of the landfill closure cap system. Details for the cap system are provided in the Engineering Drawings included in Appendix A. Technical specifications for the system are included in Appendix C.

- The cap system will consist of the following layers (listed from top to bottom):
  - An 18-inch Erosion Soil Layer consisting of soil capable of supporting native plant growth and designed to maintain vegetative growth over the landfill; and
  - An 18-inch Low-Permeability Soil Barrier Layer to minimize infiltration of precipitation through the closed landfill.

### 1.4.3 Intermediate/Operational Soil Cover

A 12-inch intermediate/operational soil cover layer will be placed over the in-place waste prior to placement of the cap system. The intermediate/operational soil cover layer will be placed in such a manner as to protect the integrity of the in-place waste and landfill closure cap system.

### 1.4.4 Soil Cap Construction

The closure cap system for the Lake Norman C&D Landfill shall be constructed in accordance with the requirements within this plan and the Engineering Drawings and Technical Specifications included in Appendix A and Appendix C respectively.

### 1.4.5 Low-Permeability Soil Barrier Layer

The closure cap system low permeability soil barrier layer shall have a maximum permeability less than or equal to soils underlying the landfill or $1.0 * 10^{-5}$ cm/sec, whichever is less. According to soils testing information provided in the Construction Plan Application prepared by S&ME, Inc. dated February 20, 1998, the lowest permeability soils underlying the landfill had a hydraulic conductivity of $6.36 * 10^{-5}$ cm/sec. Therefore, the closure cap system for the Lake Norman C&D Landfill shall have a maximum permeability of $1.0 * 10^{-5}$ cm/sec.

### 1.4.6 Final Closure Slopes

The closure cover system will accommodate the differential settlement anticipated to occur during the post-closure period. The closure cover system will be placed on a slope of no less than 5 percent to promote positive drainage and at a maximum slope of 33 percent. A closure system slope stability evaluation including calculations was completed for determining the static and seismic stability of the landfill final cover system and waste mass and is included in Appendix D. The stability evaluation concluded that the final cover system and waste mass met Federal EPA's guidance document 600/R-95/051 minimum factors of safety against slope failures of 1.5 for static loading and 1.0 for earthquake loading.

### 1.4.7 Stormwater Management and Erosion and Sediment Control

Proposed stormwater management and erosion and sediment control for the final closure conditions includes side-slope terrace benches, downchute inlets and piping, perimeter channels, sediment basins and sediment basin inlet and outlet structures, silt fencing and rip-rap aprons.

Applicable regulations and guidance used in the design of the erosion and sediment control system include the North Carolina Erosion and Sediment Control Planning and Design Manual dated June 1, 2006. Plan and detail drawings for the stormwater management and erosion and sediment control systems are provided in Appendix A. Specific stormwater management and erosion and sedimentation control design information and calculations are provided in Appendix D.

### 1.4.8 Landfill Gas Management

In accordance with 15 NCAC 13B .0543(c)(2)(B) a passive gas venting system will be installed as part of the final closure cap system to minimize pressures exerted on the low-permeability soil barrier layer of the cap system. The approximate locations and details of the venting system are provided in the Engineering Drawings included in Appendix A.

### 1.4.9 Construction Quality Assurance

Procedures, observations, and tests required during construction of the landfill closure cap system are included in the Construction Quality Assurance Plan located in Appendix B.

## 1.5 Schedule for Landfill Closure – 15 NCAC 13B .0543(c)(5)

The Lake Norman C&D Landfill will be developed in a single phase divided into multiple cells. Each cell has the waste disposal capacity for approximately one year of life. Final landfill closure procedures will begin when the filling operations have reached the proposed final waste grades. An estimate of landfill area that has reached final waste grade will be determined annually by a surveyor during the active life of the facility.

Upon reaching final waste grades, all areas will be covered with a minimum of 12 inches of intermediate/ operational soil and then seeded. These areas will be inspected quarterly and after every major storm event for excessive erosion, and will be repaired accordingly. These areas will be maintained until the construction of the closure cap system.

The landfill facility is anticipated to be closed with a cap system as shown on the proposed closure schedule provided in Table 1-1. The cap system construction will be initiated when waste placement reaches final grades. The facility will perform an aerial survey each year and will determine areas that have reached final waste grade elevation.

Table 1-1 presents a schedule for completing all activities necessary to satisfy the closure criteria. The schedule presented in Table 1-1 is based upon the final waste grades presented in the Drawings included in the Lake Norman C&D Landfill's Operations Plan. This schedule does not reflect any variations to the filling rate or filling sequence which are likely to occur during the life of the facility.

When the landfill has reached final waste grades the Lake Norman C&D Landfill Facility shall initiate the closure process no later than 30 days after the final receipt of waste. However, if the area has not reached permitted final grades and there is reasonable likelihood that additional waste will be received, then closure activities must begin no later than one year after the most recent receipt of wastes. The Division of Waste Management may grant extensions beyond the one year deadline for beginning closure if Lake Norman C&D Landfill Facility demonstrates the area has additional capacity and the facility has implemented measures to protect human health and the environment.

According to 15 NCAC 13B .0543(c)(6), Lake Norman C&D Landfill Facility shall complete all closure activities of each C&DLF unit in accordance with the closure plan within 180 days following the beginning of closure activities. Extensions of the closure period may be granted by the Division of Waste Management if the Lake Norman C&D Landfill Facility demonstrates that closure will, of necessity, take longer than 180 days and the facility has taken and will continue to take all steps to prevent threats to human health and the environment from the unclosed C&DLF unit.

## 1.6 Security and Posting

The site security fencing around the perimeter of the landfill facility property will be maintained. All gates will remain locked to prevent unauthorized entry to the site. The site will be properly posted with signage to clearly delineate the limits of the landfill.

## 1.7 Closure Certification – 15 NCAC 13B .0543(c)(7)

Upon closure of the C&DLF, Lake Norman C&D Landfill Facility will provide a certification from a North Carolina registered professional engineer verifying that the closure activities have been completed in accordance with the regulatory approved closure plan. The certification will be submitted with the results of the construction quality assurance program.

## 1.8 Notification – 15 NCAC 13B .0543(c)(8)

In accordance with 15 NCAC 13B .0543(c)(8), following closure of all C&DLF units, Lake Norman C&D Landfill Facility shall record a notation on the deed to the landfill facility property, or some other instrument that is normally examined during title search, and notify the Division of Waste Management that the notation has been recorded and a copy has been placed in the facility's operating record. The notation on the deed shall, in perpetuity, notify any potential purchaser of the property that the land has been used as a landfill facility and that its future use is restricted to the planned post-closure property uses presented in the post-closure plan. Lake Norman C&D Landfill Facility will also notify Lincoln County's Register of Deeds office as the local land recording authority.

## 1.9 Financial Assurance – 15 NCAC 13B .0543(d)(5)

A cost estimate for hiring a third party to close the entire 31.77 acre Lake Norman C&D Landfill Facility has been prepared and included in Appendix E. Each year, the estimate will be adjusted according to the areas of the landfill that are operational and closed, for inflation and to reflect any changes to the closure plan.

The latest closure financial assurance cost estimate prepared on May 30, 2008 for the Lake Norman C&D Landfill Facility is included in Appendix E. The May 30, 2008 closure financial assurance cost estimate was prepared for the area of the landfill that is operational which is approximately 18.4 acres.

# 2. POST-CLOSURE PLAN

15 NCAC 13B .0543 of the State of North Carolina Administrative Code and North Carolina Department of Natural Resources (NCDENR) Solid Waste Management (SWM) Regulations requires all construction and demolition landfill (C&DLF) owners/operators to prepare a post-closure plan detailing activities to be performed to satisfy the requirements of the code. The purpose of the plan is to provide the necessary information for preserving the integrity of the landfill facility during the post-closure period. This post-closure plan specifically addresses monitoring and maintenance activities for the final cover system, landfill gas venting and monitoring systems, groundwater and surface water monitoring locations and stormwater management system to be installed at the Lake Norman C&D Landfill Facility. This plan also addresses certification and financial assurance requirements.

Post-closure care will begin immediately following final or partial closure of the landfill and continue for a period of 30 years. The post-closure care period may be decreased from the minimum time period of 30 years specified in the regulations if the Lake Norman C&D Landfill Facility can demonstrate that the facility poses no threat to human health or the environment.

## 2.1 Maintenance & Monitoring Activities – 15 NCAC 13B .0543(e)

Following final closure of each C&DLF unit, Lake Norman C&D Landfill Facility shall conduct post-closure care for a minimum of 30 years, except as provided 15 NCAC 13B .0543(e)(2). At a minimum, post-closure care shall consist of the activities as detailed below.

## 2.2 Final Cover System – 15 NCAC 13B .0543(e)(1)(A)

Inspection of the final cover system will take place quarterly. The inspection will consist of a field survey of the entire final cover system. Items of concern to be noted by the inspector include, but are not limited to: settlement, subsidence and signs of erosion. Following each inspection, a summary report of the condition of the final cover and the items requiring repair or maintenance shall be recorded on an inspection form and filed in the post-closure log book for the facility. Areas that require further attention should be photographed and delineated on a map of the facility and attached to the inspection report. Since post-closure inspection personnel will most likely change during the post-closure period, the post-closure log book should be kept in a standardized format as part of the operating record of the facility so that new inspection personnel may easily review the results of past post-closure inspections of the site.

Action should be taken immediately to address any items of concern identified during the inspection. Obvious repair items should be performed under the supervision of the post-closure maintenance manager.

Maintenance required for the final cover is anticipated to be minimal. The vegetative cover shall be mowed as required.

## 2.3 Groundwater and Surface Water Monitoring – 15 NCAC 13B .0543(e)(1)(B)

A site-specific groundwater monitoring program will be maintained for the landfill throughout the post-closure care period in accordance with Lake Norman C&D Landfill Facility's Groundwater and Surface Water Monitoring Plan, as amended and 15 NCAC 13B .0544 and .0545. The program will monitor the groundwater and surface water at the landfill on a semi-annual basis and verify that the landfill is functioning as intended, as well as provide an early warning system in the unlikely event of a release. If contamination is found in the groundwater or surface water, the action required will be determined at that time, based on the extent and concentration of the release. Copies of all required monitoring tests and reports will be provided to the facility's operating record during the landfill's post-closure care period.

A list of groundwater monitoring parameters, sampling frequencies and reporting requirements are provided in the facilities Groundwater Monitoring Plan, as amended. The groundwater monitoring wells identified therein will require sampling during the post-closure care period.

Each time water levels are measured or a groundwater sample is collected, the integrity of the monitoring well will be inspected. A record of each inspection will be made and kept within the landfill facility's operating record. The following will be recorded during each inspection:

- Check well identification and make sure it is clearly marked;
- Check the protective casing for damage or corrosion;
- Check the concrete surface seals for cracks;
- Check the casing lock; and,
- View the well casing and check for damage.

If any damage is detected, the well will be repaired, or if repair is not possible, replaced before the next scheduled sample event.

## 2.4 Landfill Gas Monitoring – 15 NCAC 13B .0543(e)(1)(B)

A site-specific landfill gas monitoring program will be maintained for the landfill throughout the post-closure care period in accordance with Lake Norman C&D Landfill Facility's Landfill Gas Monitoring Plan, as amended and 15 NCAC 13B .0544. The program will monitor the landfill gas at the landfill facility's property boundary to verify that the landfill gas concentrations do not exceed the lower explosive limit (LEL) for methane or other explosive gases. If methane concentrations are detected to exceed the LEL at the facility's property boundary, the facility will immediately take all steps necessary to ensure protection of human health and notify the Division. In addition, within seven days of detection, place in the operating record the methane or explosive gas levels detected and a description of the steps taken to protect human health; and within 60 days of detection, implement a remediation plan for the methane or explosive gas releases, place a copy of the plan in the operating record, and notify the Division of Waste Management that the plan has been implemented. The plan must describe the nature and extent of the problem and the proposed remedy.

## 2.5 Name of Individual Responsible for Post-Closure Care – 15 NCAC 13B .0543(f)(2)

Mr. Mike Gurley, Environmental Manager for the Lake Norman C&D Landfill Facility will be responsible for operations and maintenance of the site during the post-closure period. Mr. Gurley can be reached at the following address and telephone number:

BFI - Lake Norman Landfill, Inc.
5105 Morehead Road
Concord, North Carolina 28027
Phone: 704-782-2004 Ext. 391

This plan will be updated to reflect changes in the responsible party.

## 2.6 Post-Closure Security

During the post-closure period the site security fencing will be maintained. All gates will remain locked to prevent unauthorized entry to the site.

## 2.7 Planned Use of Landfill after Closure – 15 NCAC 13B. 0543(f)(3)

Post-closure use of the property shall not disturb the integrity of the final cover system or any other components of the containment system, or the function of the monitoring systems. The Division of Waste Management may approve any disturbance of these systems if the owner or operator demonstrates that disturbance of the final cover system or other component of the containment system, including any removal of waste, will not increase the potential threat to human health or the environment.

There are no planned uses for the landfill site after closure. The property will continue to be owned and maintained by BFI – Lake Norman Landfill, Inc., with public access prohibited. If at some later date, BFI - Lake Norman Landfill, Inc. wishes to propose alternative end uses for the facility, this plan will be revised accordingly.

## 2.8 Notification – 15 NCAC 13B .0543(e)(3)

Following completion of the post-closure care period, BFI – Lake Norman Landfill, Inc. shall notify the Division of Waste Management that a certification, signed by a North Carolina registered professional engineer, verifying that post-closure care has been completed in accordance with the regulatory approved post-closure plan and has been placed in the landfill facility's operating record.

## 2.9 Financial Assurance – 15 NCAC 13B .0543(f)(4)

A cost estimate for hiring a third party to provide post-closure care and monitoring for the entire 31.77 acre Lake Norman C&D Landfill Facility has been prepared and included in Appendix E. The cost estimate is based on 30 years of post-closure care for the entire facility. Each year, the estimate will be adjusted according to the areas of the landfill that are operational and closed, for inflation and to reflect any changes to the post-closure plan. Each year adjusted post-closure care financial assurance cost estimate will be placed in the landfill facility's operating record.

The latest post-closure care financial assurance cost estimate prepared on May 30, 2008 for the Lake Norman C&D Landfill Facility is included in Appendix E. The May 30, 2008 post-closure financial assurance cost estimate was prepared for the area of the landfill that is operational which is approximately 18.4 acres.

# 3. LIMITATIONS

## 3.1 Report Limitations

This document was prepared solely for BFI - Lake Norman Landfill, Inc. / Allied Waste Services, Inc. in accordance with professional standards at the time the services were performed and in accordance with the contract between BFI - Lake Norman Landfill, Inc. / Allied Waste Services, Inc. and Brown and Caldwell dated July 11, 2008. This document is governed by the specific scope of work authorized by BFI - Lake Norman Landfill, Inc. / Allied Waste Services, Inc.; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by BFI - Lake Norman Landfill, Inc. / Allied Waste Services, Inc. and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

# APPENDIX A: ENGINEERING DRAWINGS

**Drawing No C1** **Aerial Site Photograph**

**Drawing No C2** **Existing Site Conditions**

**Drawing No C3** **Current Waste Grades and Proposed Subgrade**

**Drawing No C4** **Proposed Closure Grades**

**Drawing No C5** **Proposed Closure Stormwater and Erosion & Sediment Control Plan**

**Drawing No C6** **Proposed Closure Profile A-A**

**Drawing No C7** **Proposed Closure Profile B-B**

**Drawing No C8** **Closure Details – Sheet 1**

**Drawing No C9** **Closure Details – Sheet 2**

**Drawing No C10** **Stormwater and Erosion & Sediment Control Details – Sheet 1**

**Drawing No C11** **Stormwater and Erosion & Sediment Control Details – Sheet 2**

**Drawing No C12** **Stormwater and Erosion & Sediment Control Details – Sheet 3**

**Drawing No C13** **Stormwater and Erosion & Sediment Control Details – Sheet 4**


Scale 1" = 100'

REFERENCE NOTES:

1. EXISTING PLANIMETRIC AND TOPOGRAPHIC INFORMATION OBTAINED FROM AERIAL SURVEY DATA DATED FEBRUARY 2008 PROVIDED BY IMG AND SEPARATE TOPOGRAPHICAL INFORMATION PROVIDED BY ESP & ASSOCIATES DATED 2004-2005
2. BUFFER ZONE SETBACK DISTANCES BASED ON REQUIREMENTS SETFORTH IN STATE SOLID WASTE MANAGEMENT RULE 15A NCAC 13B.054D EFFECTIVE JANUARY 1, 2007

## LEGEND

EXISTING

- 2 FOOT ELEVATION CONTOUR
- 280 — 10 FOOT ELEVATION CONTOUR
- APPROXIMATE WASTE LIMITS
- PROPERTY LINE
- RAILROAD RIGHT OF WAY
- WATERCOURSE BUFFER ZONE
- PROPERTY BUFFER ZONE
- 100 YR FLOODPLAIN
- WATERCOURSE
- EDGE OF VEGETATION

BROWN AND CALDWELL

Environmental Engineering and Consulting

309 East Morehead Street, Suite 160, Charlotte, North Carolina 28202 (704) 358-7204

SUBMITTED: PROJECT MANAGER DATE:

APPROVED: BROWN AND CALDWELL DATE:

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: CJM
DRAWN: DCV
CHECKED: ADG
CHECKED:
APPROVED:

EXTERNAL REFERENCES
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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 021662 ALBERTO GLENN

8/8/2008

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BFI - LAKE NORMAN C&D LANDFILL FACILITY
7099 QUARRY LANE, STANLEY, NC

FACILITY PERMIT NUMBER 55-04

CLOSURE AND POST-CLOSURE PLAN
EXISTING SITE CONDITIONS

LAKE NORMAN C&D LANDFILL FACILITY

FILENAME 135836C-XC
BC PROJECT NUMBER 135836
SCALE 1"=100'
DRAWING NUMBER C2
SHEET NUMBER 2 OF 13

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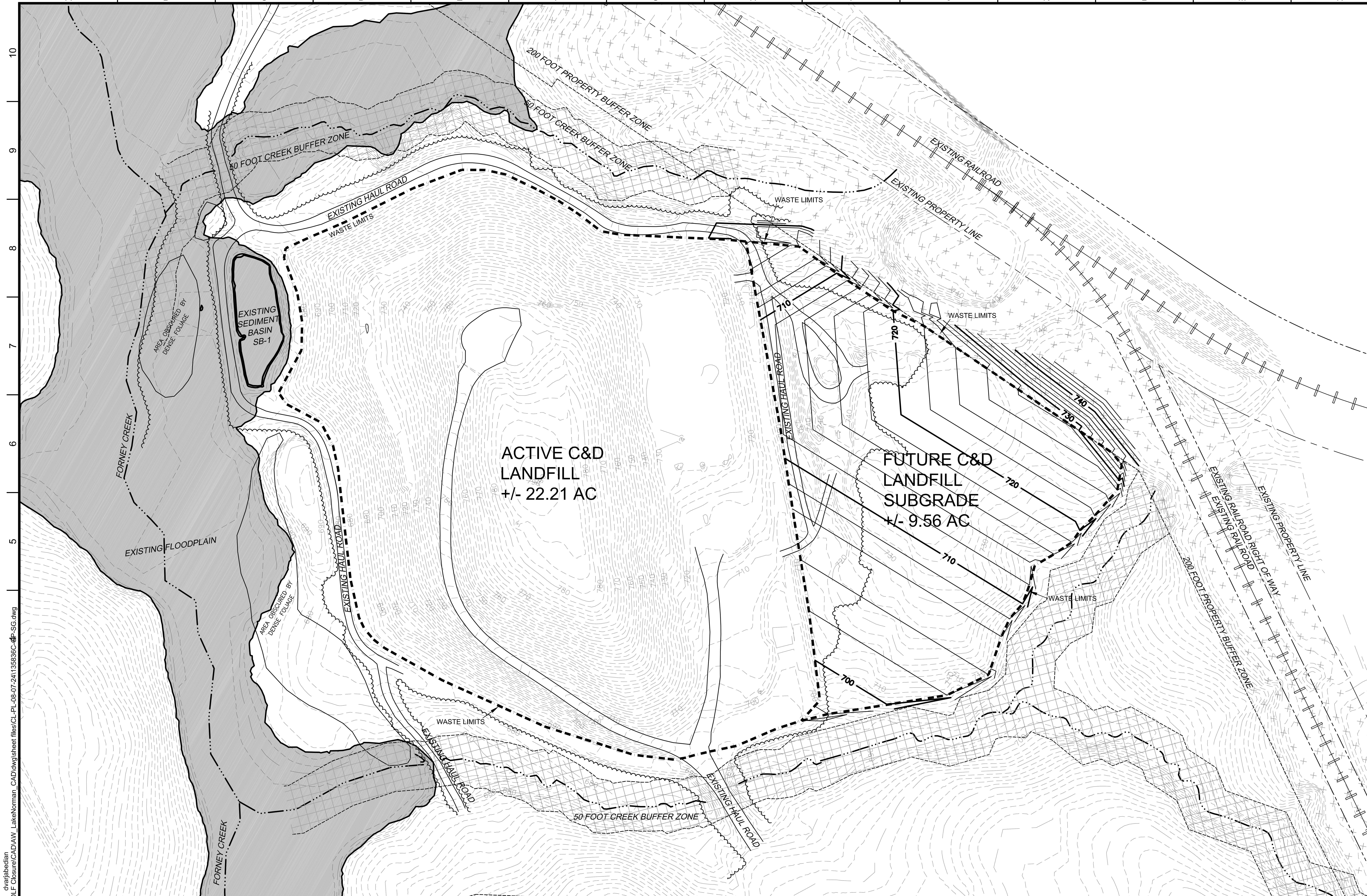


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## LEGEND

PROPOSED

- 2 FOOT ELEVATION CONTOUR
280 - 10 FOOT ELEVATION CONTOUR
WASTE LIMITS

EXISTING

2 FOOT ELEVATION CONTOUR
280 10 FOOT ELEVATION CONTOUR
APPROXIMATE WASTE LIMITS
PROPERTY LINE
RAILROAD RIGHT OF WAY
WATERCOURSE BUFFER ZONE
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100 YR FLOODPLAIN
WATERCOURSE
EDGE OF VEGETATION

**BROWN AND CALDWELL**

*Environmental Engineering and Consulting*
309 East Morehead Street, Suite 160, Charlotte, North Carolina 28202 (704) 358-7204

SUBMITTED: ____________ DATE: ________
PROJECT MANAGER

APPROVED: ____________ DATE: ________
BROWN AND CALDWELL

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EXTERNAL REFERENCES
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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 018182 ALBERT D. GLENN
8/8/2008

REVISIONS

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BFI - LAKE NORMAN C&D LANDFILL FACILITY
7099 QUARRY LANE, STANLEY, NC

FACILITY PERMIT NUMBER 55-04

CLOSURE AND POST-CLOSURE PLAN
CURRENT WASTE GRADES AND PROPOSED FUTURE SUBGRADE
LAKE NORMAN C&D LANDFILL FACILITY

FILENAME 135836C-GP-SG
BC PROJECT NUMBER 135836
SCALE 1"=100'
DRAWING NUMBER C3
SHEET NUMBER 3 OF 13

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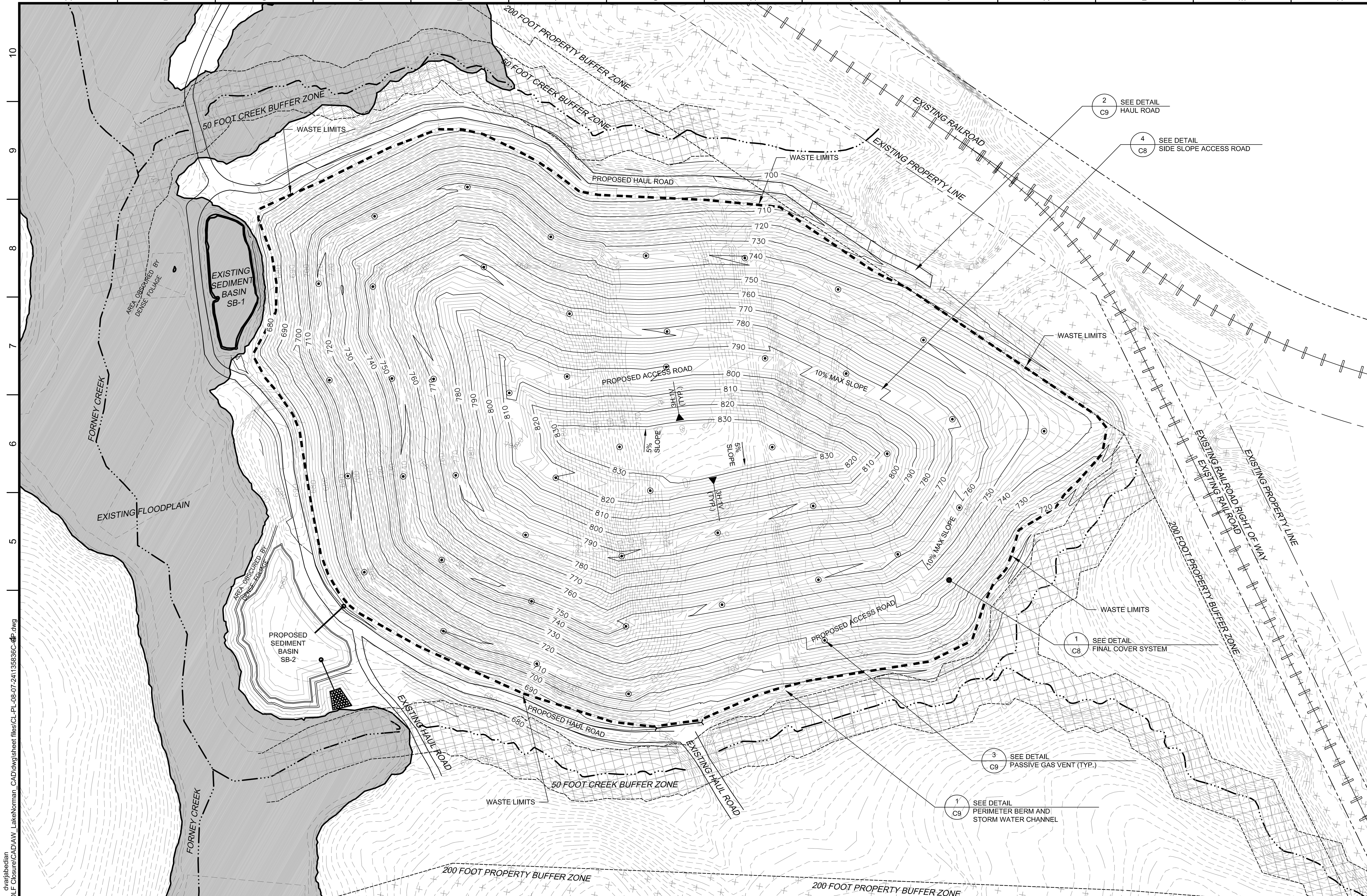


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2. BUFFER ZONE SETBACK DISTANCES BASED ON REQUIREMENTS SETFORTH IN STATE SOLID WASTE MANAGEMENT RULE 15A NCAC 13B.054D EFFECTIVE JANUARY 1, 2007

## LEGEND

PROPOSED

- 2 FOOT ELEVATION CONTOUR
280 - 10 FOOT ELEVATION CONTOUR
WASTE LIMITS
PASSIVE GAS VENT (SEE DETAIL 3 /DRAWING C9)

EXISTING

- 2 FOOT ELEVATION CONTOUR
280 - 10 FOOT ELEVATION CONTOUR
PROPERTY LINE
RAILROAD RIGHT OF WAY
WATERCOURSE BUFFER ZONE
PROPERTY BUFFER ZONE
100 YR FLOODPLAIN
WATERCOURSE

BROWN AND CALDWELL
Environmental Engineering and Consulting
309 East Morehead Street, Suite 160, Charlotte, North Carolina 28202 (704) 358-7204

SUBMITTED: PROJECT MANAGER DATE:
APPROVED: BROWN AND CALDWELL DATE:

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EXTERNAL REFERENCES
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BFI - LAKE NORMAN C&D LANDFILL FACILITY
7099 QUARRY LANE, STANLEY, NC

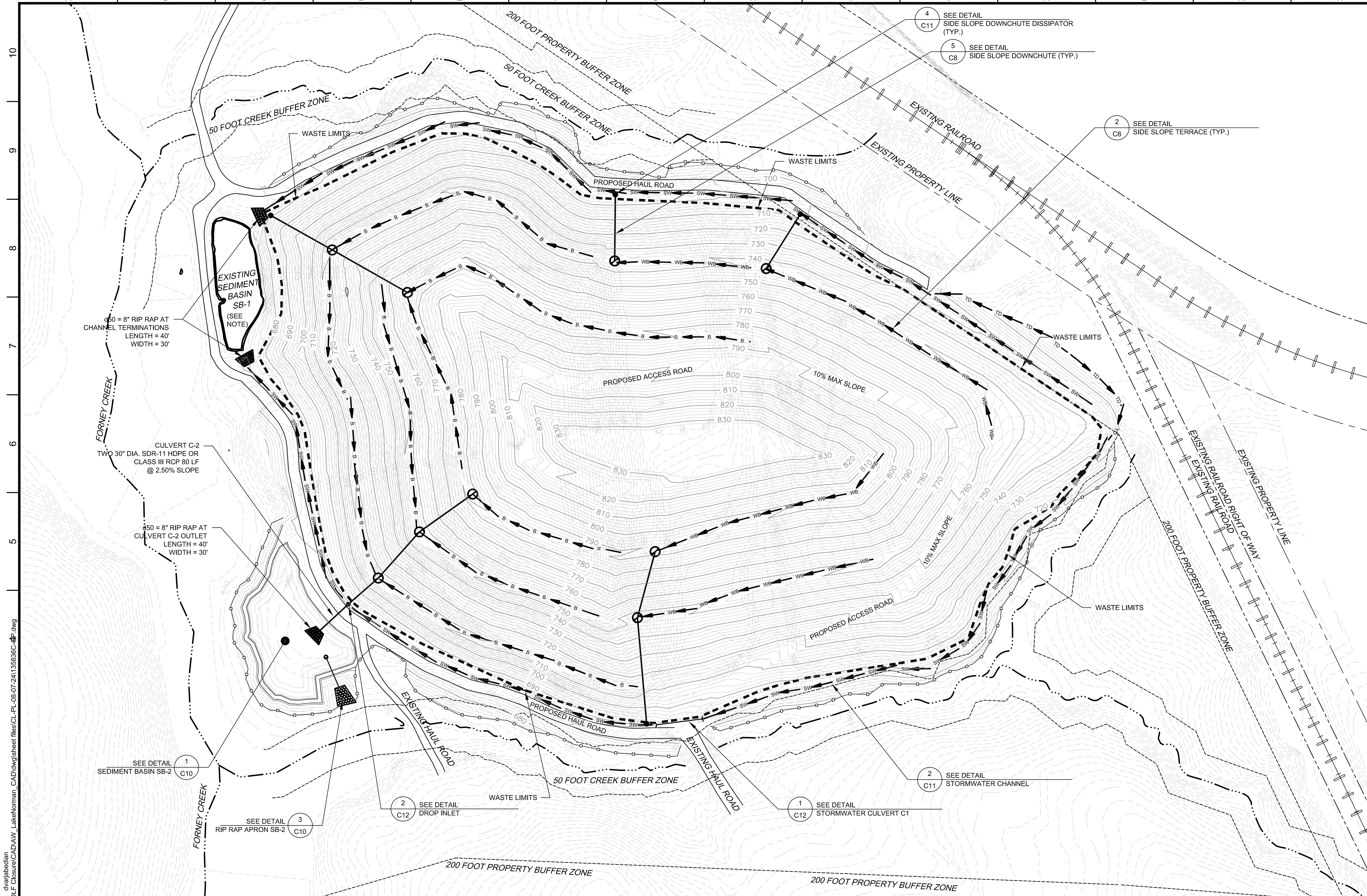
FACILITY PERMIT NUMBER 55-04

CLOSURE AND POST-CLOSURE PLAN
PROPOSED CLOSURE GRADES

LAKE NORMAN C&D LANDFILL FACILITY

FILENAME 135836C-GP
BC PROJECT NUMBER 135836
SCALE 1"=100'
DRAWING NUMBER C4
SHEET NUMBER 4 OF 13

Oct 22, 2008 - 12:30pm
7-17-08




NOTE:

SEDIMENT BASIN SB-1 DESIGNED BY S&ME, INC. FOR SB-1 DESIGN INFORMATION REFER TO "CONSTRUCTION PLAN APPLICATION, CONSTRUCTION AND DEMOLITION LANDFILL, LAKE NORMAN LANDFILL, INC." PREPARED BY S&ME, INC., FEBRUARY 20, 1998.

REFERENCE NOTES:

1. EXISTING PLANIMETRIC AND TOPOGRAPHIC INFORMATION OBTAINED FROM AERIAL SURVEY DATA DATED FEBRUARY 2008 PROVIDED BY IMG AND SEPARATE TOPOGRAPHICAL INFORMATION PROVIDED BY ESP & ASSOCIATES DATED 2004-2005
2. BUFFER ZONE SETBACK DISTANCES BASED ON REQUIREMENTS SETFORTH IN STATE SOLID WASTE MANAGEMENT RULE 15A NCAC 13B.054D EFFECTIVE JANUARY 1, 2007

## LEGEND

PROPOSED

- 2 FOOT ELEVATION CONTOUR
280 - 10 FOOT ELEVATION CONTOUR
WASTE LIMITS
SILT FENCE
TD TEMPORARY DIVERSION DITCH
SW STORMWATER CHANNEL
B TACK-ON BENCH / STORMWATER TERRACE
WB BENCH / STORMWATER TERRACE - GRADED IN WASTE
DOWNCHUTE DISSIPATOR
CULVERT
SIDE SLOPE DOWN CHUTE INLET (SEE DETAIL 5 ON SHEET C8)

EXISTING

- 2 FOOT ELEVATION CONTOUR
280 - 10 FOOT ELEVATION CONTOUR
PROPERTY LINE
RAILROAD RIGHT OF WAY
WATERCOURSE

BROWN AND CALDWELL

Environmental Engineering and Consulting

309 East Morehead Street, Suite 160, Charlotte, North Carolina 28202 (704) 358-7204

SUBMITTED: PROJECT MANAGER DATE:

APPROVED: BROWN AND CALDWELL DATE:

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

| | |
|---|---|
| DESIGNED: | CJM |
| DRAWN: | DCV |
| CHECKED: | ADG |
| CHECKED: | |
| APPROVED: | |

EXTERNAL REFERENCES

135836-BS-D.dwg
135836-V-ET.dwg

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 11582 ALBERT G. GLENN

8/8/2008

REVISIONS

| ZONE | REV. | DESCRIPTION | BY | DATE | APP. |
|---|---|---|---|---|---|
| | | | | | |

BFI - LAKE NORMAN C&D LANDFILL FACILITY
7099 QUARRY LANE, STANLEY, NC

FACILITY PERMIT NUMBER 55-04

CLOSURE AND POST-CLOSURE PLAN
E&S CONTROL AND STORMWATER MANAGEMENT PLAN
LAKE NORMAN C&D LANDFILL FACILITY

FILENAME 135836C-GP
BC PROJECT NUMBER 135836
SCALE 1"=100'
DRAWING NUMBER C5
SHEET NUMBER 5 OF 13

Oct 22, 2008 - 12:29pm dvarjabedian
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7-17-08

albert_Glenn-seal-8-8-08


## PLAN VIEW

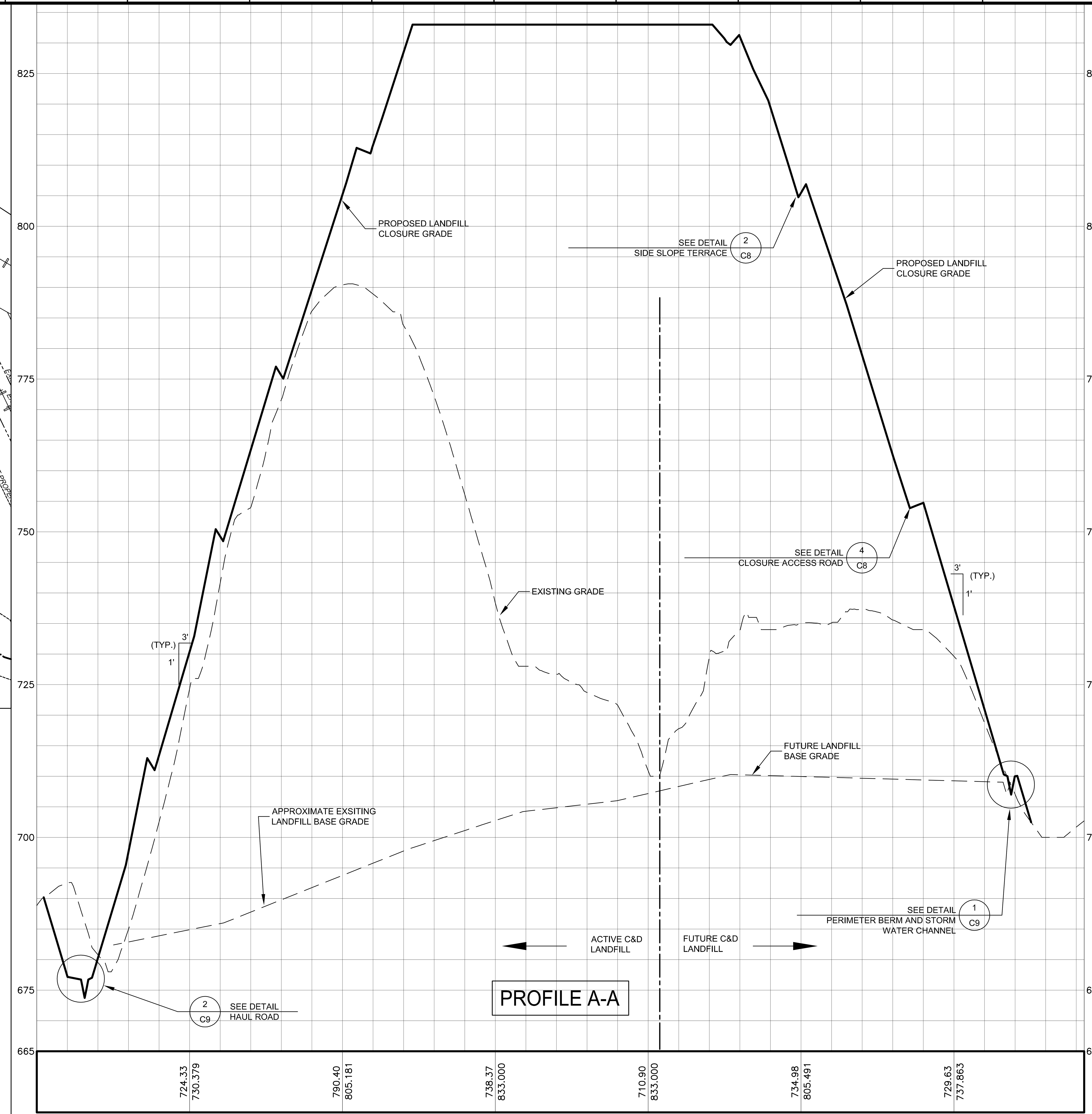
SCALE: 1" = 150'

Profile Vertical
Scale 1" = 10'

Profile Horizontal
Scale 1" = 100'

REFERENCE NOTE:

EXISTING PLANIMETRIC AND TOPOGRAPHIC INFORMATION OBTAINED FROM AERIAL SURVEY DATA DATED FEBRUARY 2008 PROVIDED BY IMG AND SEPARATE TOPOGRAPHICAL INFORMATION PROVIDED BY ESP & ASSOCIATES DATED 2004-2005




## PROFILE A-A

**BROWN AND CALDWELL**

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PROJECT MANAGER

APPROVED: ______ DATE: ______
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| DESIGNED: | CJM |
| DRAWN: | DCV |
| CHECKED: | ADG |
| CHECKED: | |
| APPROVED: | |

EXTERNAL REFERENCES
135836-BS-D.dwg
135836-V-ET.dwg

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 11582 ALBERT D. GLENN
8/8/2008

REVISIONS

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|---|---|---|---|---|---|
| | | | | | |

BFI - LAKE NORMAN C&D LANDFILL FACILITY
7099 QUARRY LANE, STANLEY, NC

FACILITY PERMIT NUMBER 55-04

CLOSURE AND POST-CLOSURE PLAN
CLOSURE PROFILE A-A

LAKE NORMAN C&D LANDFILL FACILITY

FILENAME 135836C-PR
BC PROJECT NUMBER 135836
SCALE AS SHOWN
DRAWING NUMBER **C6**
SHEET NUMBER 6 OF 13

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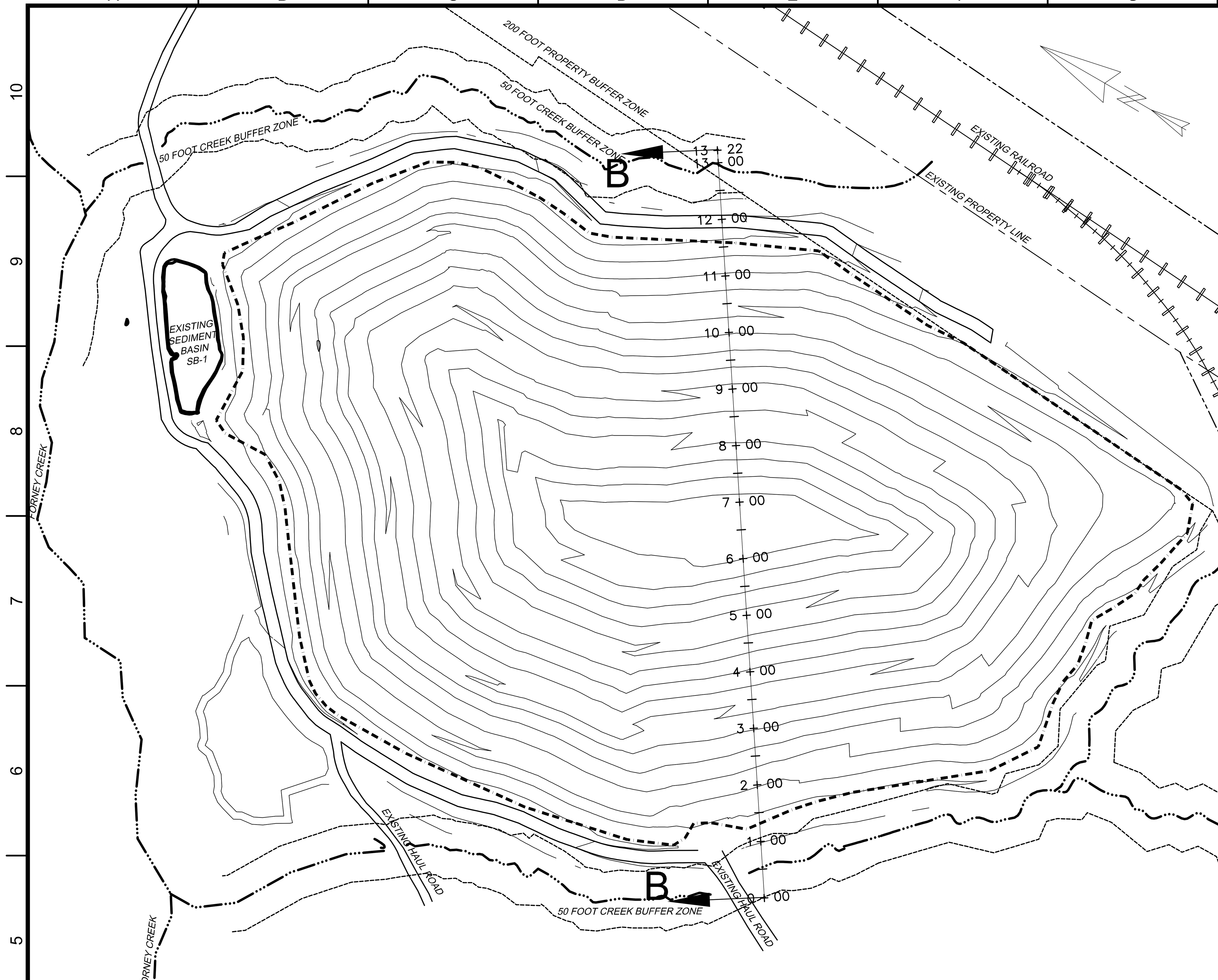
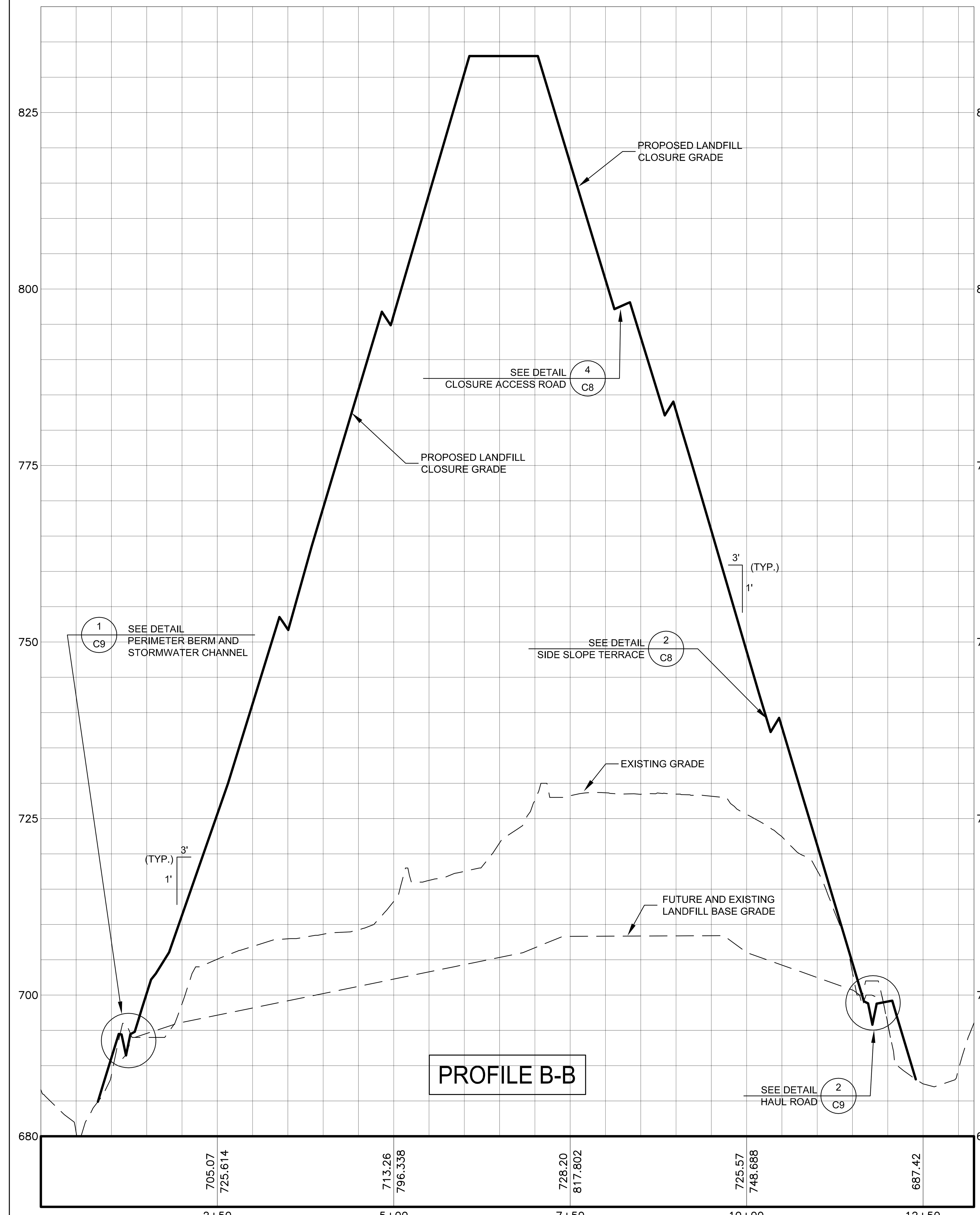
7-17-08
albert_Glenn-seal-8-8-08




PLAN VIEW

SCALE: 1" = 150'




Profile Vertical
Scale 1" = 10'

Profile Horizontal
Scale 1" = 100'

REFERENCE NOTE:

EXISTING PLANIMETRIC AND TOPOGRAPHIC INFORMATION OBTAINED FROM AERIAL SURVEY DATA DATED FEBRUARY 2008 PROVIDED BY IMG AND SEPARATE TOPOGRAPHICAL INFORMATION PROVIDED BY ESP & ASSOCIATES DATED 2004-2005

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APPROVED: BROWN AND CALDWELL DATE:

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DESIGNED: CJM
DRAWN: DCV
CHECKED: ADG
CHECKED:
APPROVED:

EXTERNAL REFERENCES
135836-BS-D.dwg
135836-V-ET.dwg

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| ZONE | REV. | DESCRIPTION | BY | DATE | APP. |

BFI - LAKE NORMAN C&D LANDFILL FACILITY
7099 QUARRY LANE, STANLEY, NC

FACILITY PERMIT NUMBER 55-04

CLOSURE AND POST-CLOSURE PLAN
CLOSURE PROFILE B-B

LAKE NORMAN C&D LANDFILL FACILITY

FILENAME 135836C-PR
BC PROJECT NUMBER 135836
SCALE AS SHOWN
DRAWING NUMBER C7
SHEET NUMBER 7 OF 13

Oct 22, 2008 - 12:34pm
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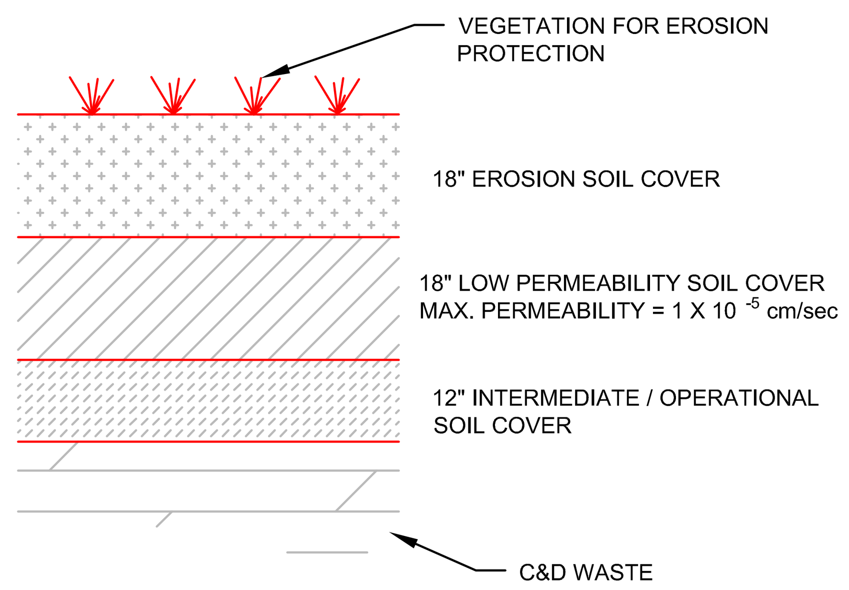
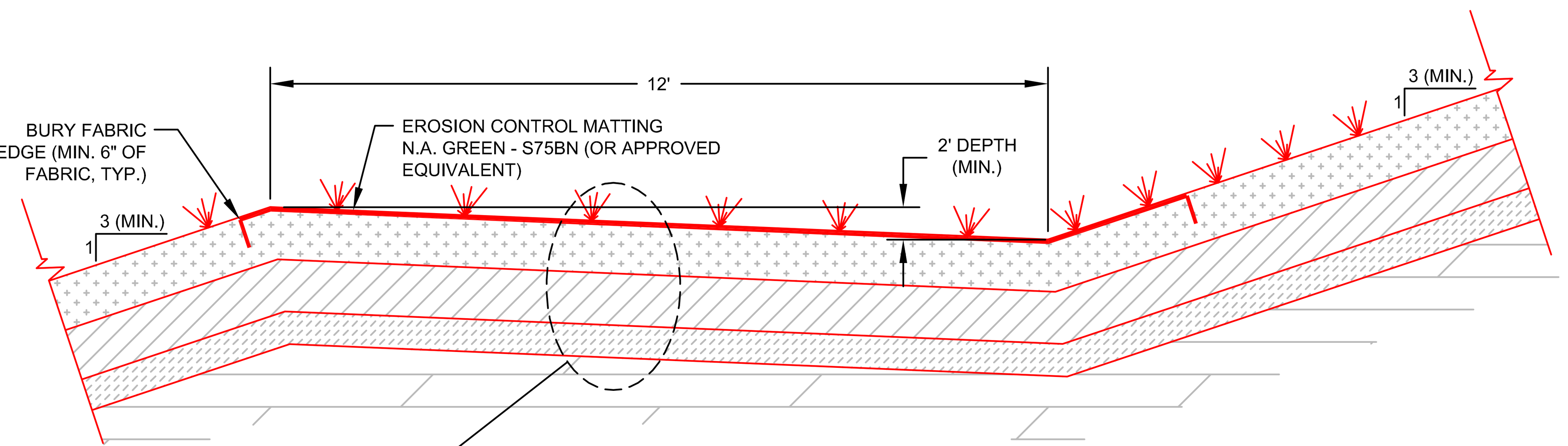
7-17-08




FINAL COVER SYSTEM

DETAIL 1 / C8

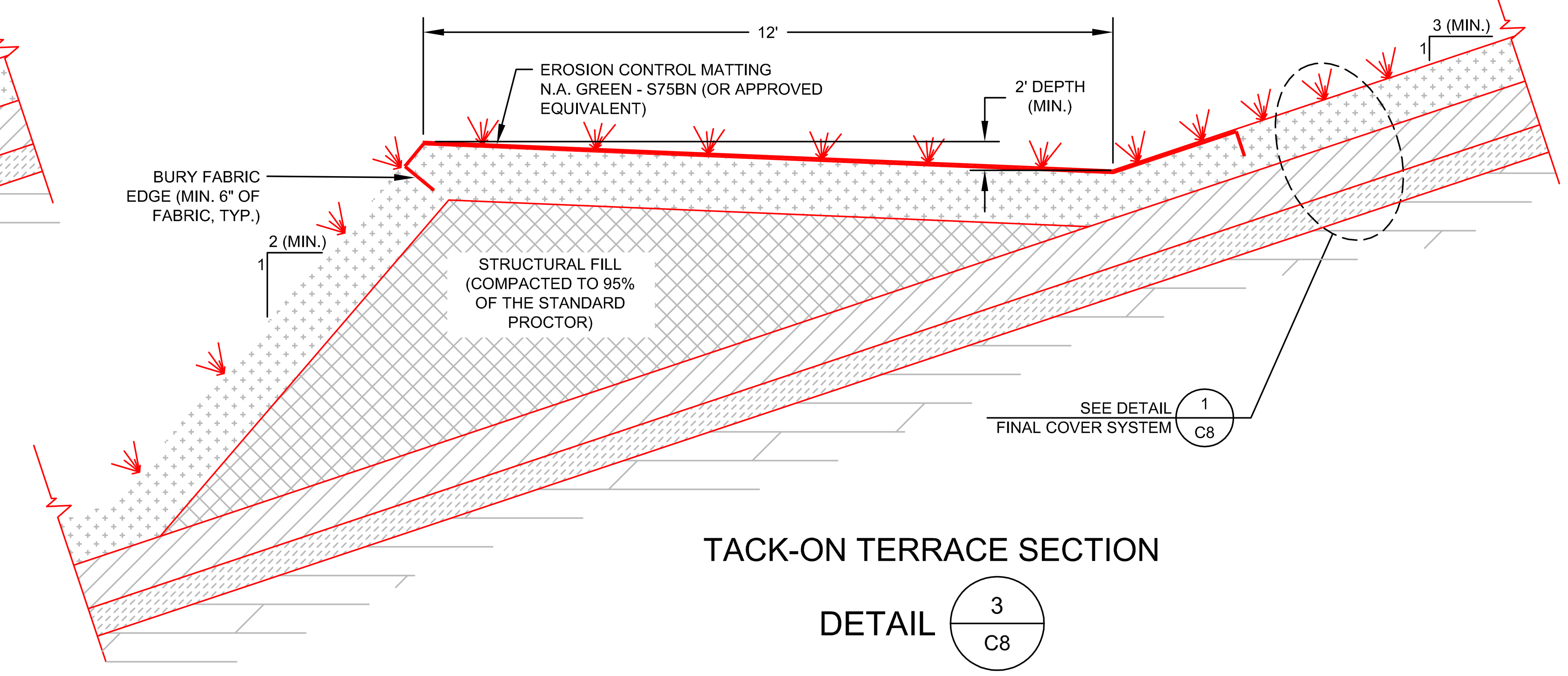
NOT TO SCALE




SIDE SLOPE TERRACE SECTION

DETAIL 2 / C8

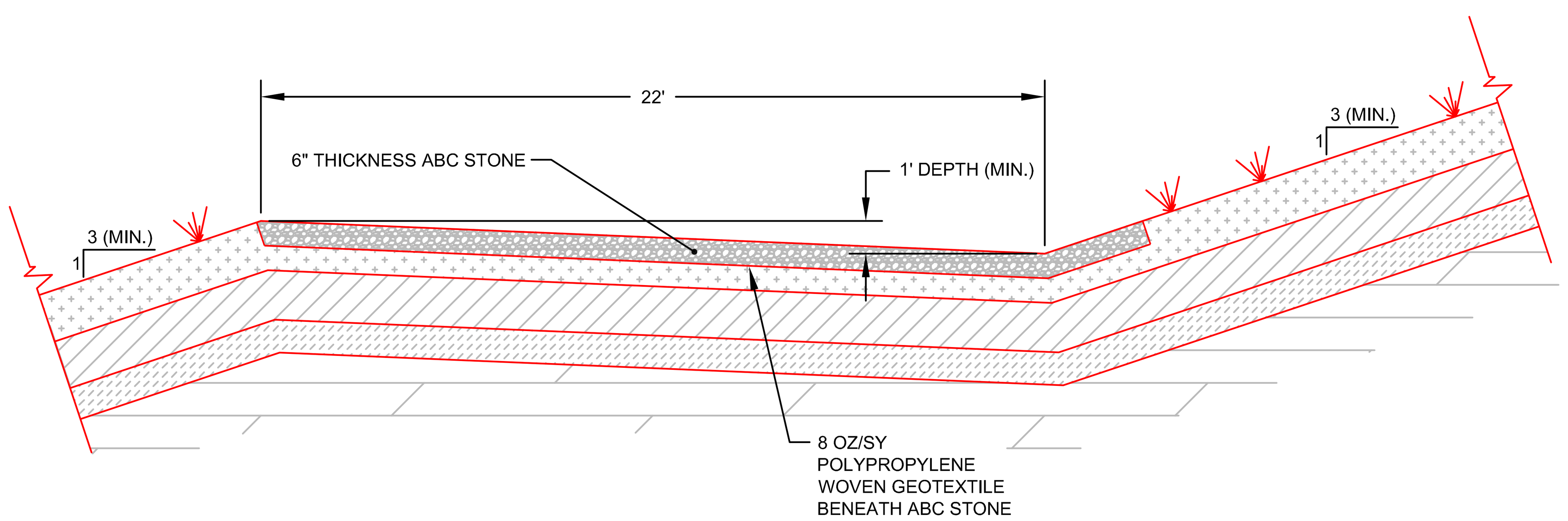
NOT TO SCALE




TACK-ON TERRACE SECTION

DETAIL 3 / C8

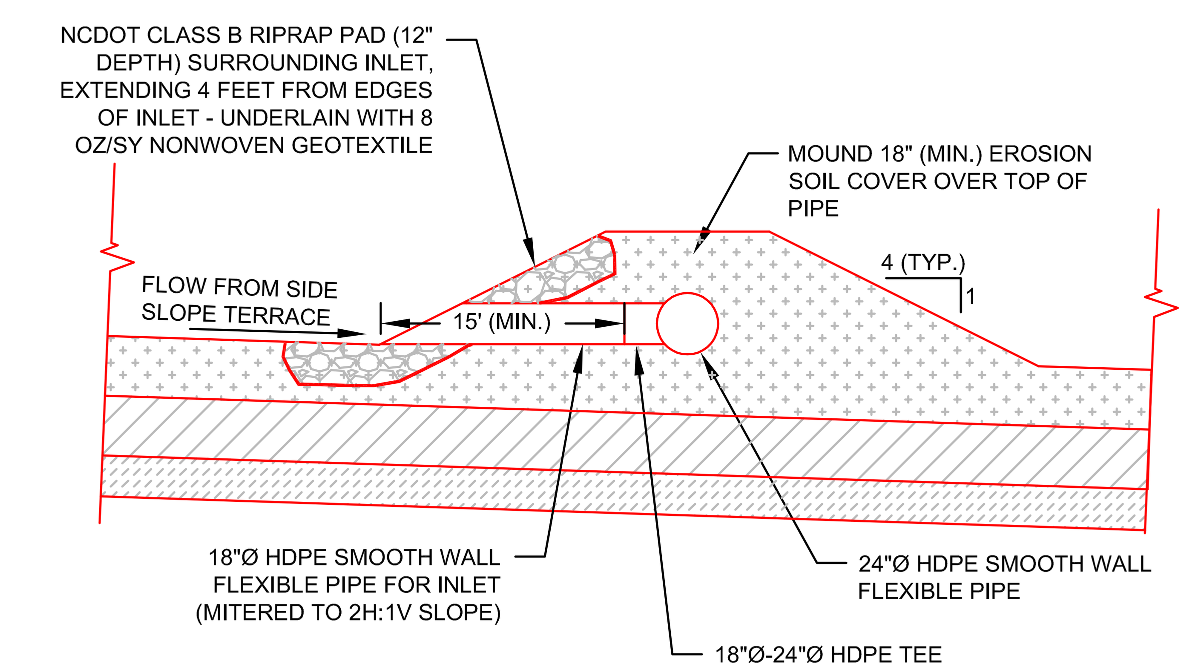
NOT TO SCALE




CLOSURE ACCESS ROAD SECTION

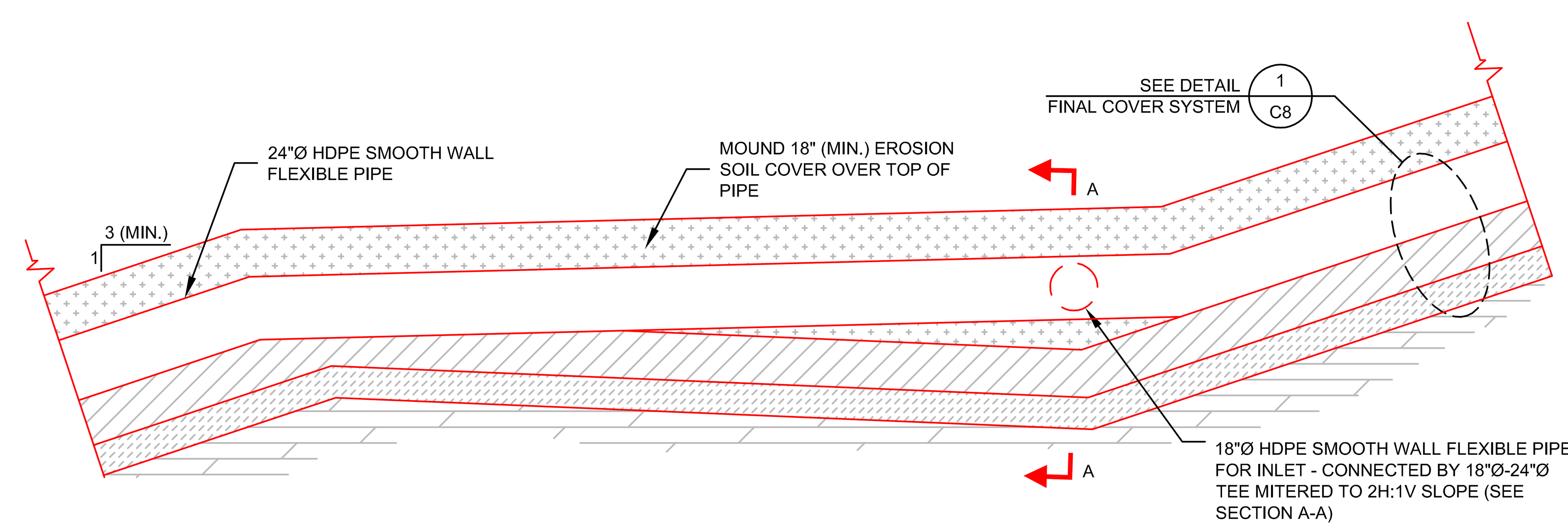
DETAIL 4 / C8

NOT TO SCALE




SECTION A-A SINGLE INLET

N.T.S.

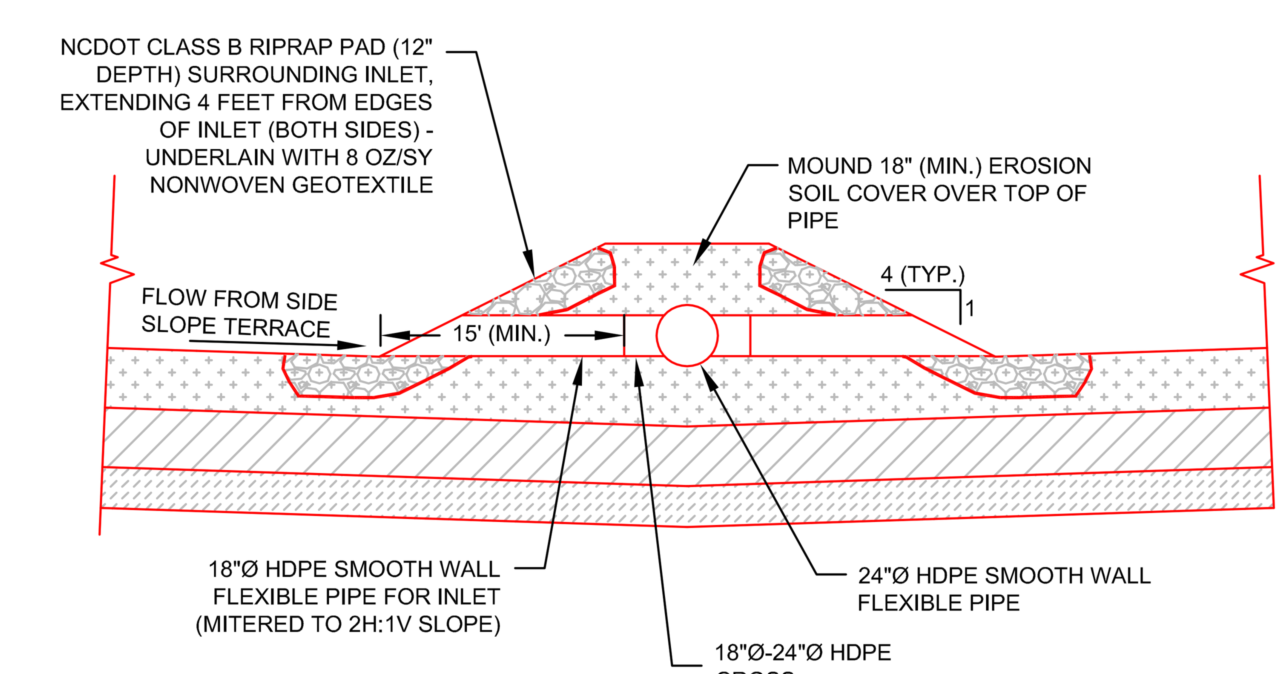



TYPICAL

SIDE SLOPE DOWNCHUTE

DETAIL 5 / C8

NOT TO SCALE




SECTION A-A DOUBLE INLET

N.T.S.

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*Environmental Engineering and Consulting*

309 East Morehead Street, Suite 160, Charlotte, North Carolina 28202 (704) 358-7204

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PROJECT MANAGER

APPROVED: ____________ DATE: ________
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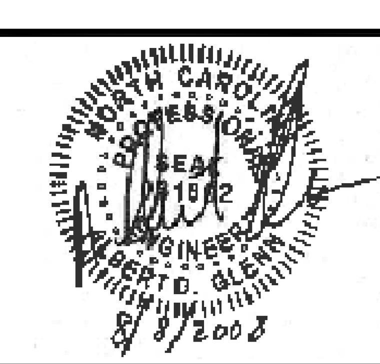
|---|---|
| DESIGNED: | CJM |
| DRAWN: | DCV |
| CHECKED: | |
| CHECKED: | |
| APPROVED: | ADG |

EXTERNAL REFERENCES




REVISIONS

| ZONE | REV. | DESCRIPTION | BY | DATE | APP. |
|---|---|---|---|---|---|
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BFI - LAKE NORMAN C&D LANDFILL FACILITY
7099 QUARRY LANE, STANLEY, NC

FACILITY PERMIT NUMBER 55-04

CLOSURE AND POST-CLOSURE PLAN
CLOSURE DETAILS - SHEET 1

LAKE NORMAN C&D LANDFILL FACILITY

| | |
|---|---|
| FILENAME | 135836C-DT.dwg |
| BC PROJECT NUMBER | 135836 |
| SCALE | AS SHOWN |
| DRAWING NUMBER | C8 |
| SHEET NUMBER | 8 OF 13 |

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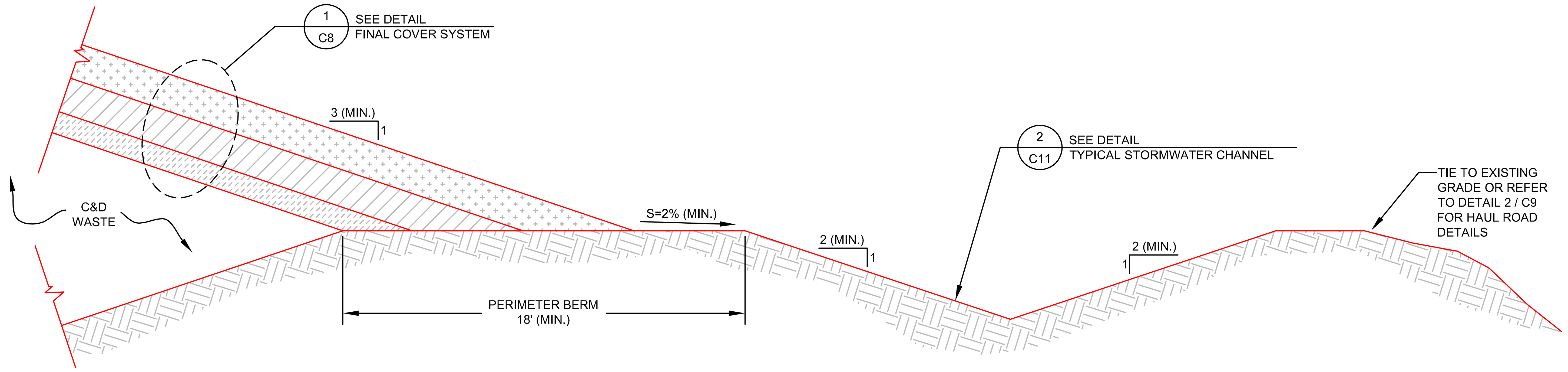
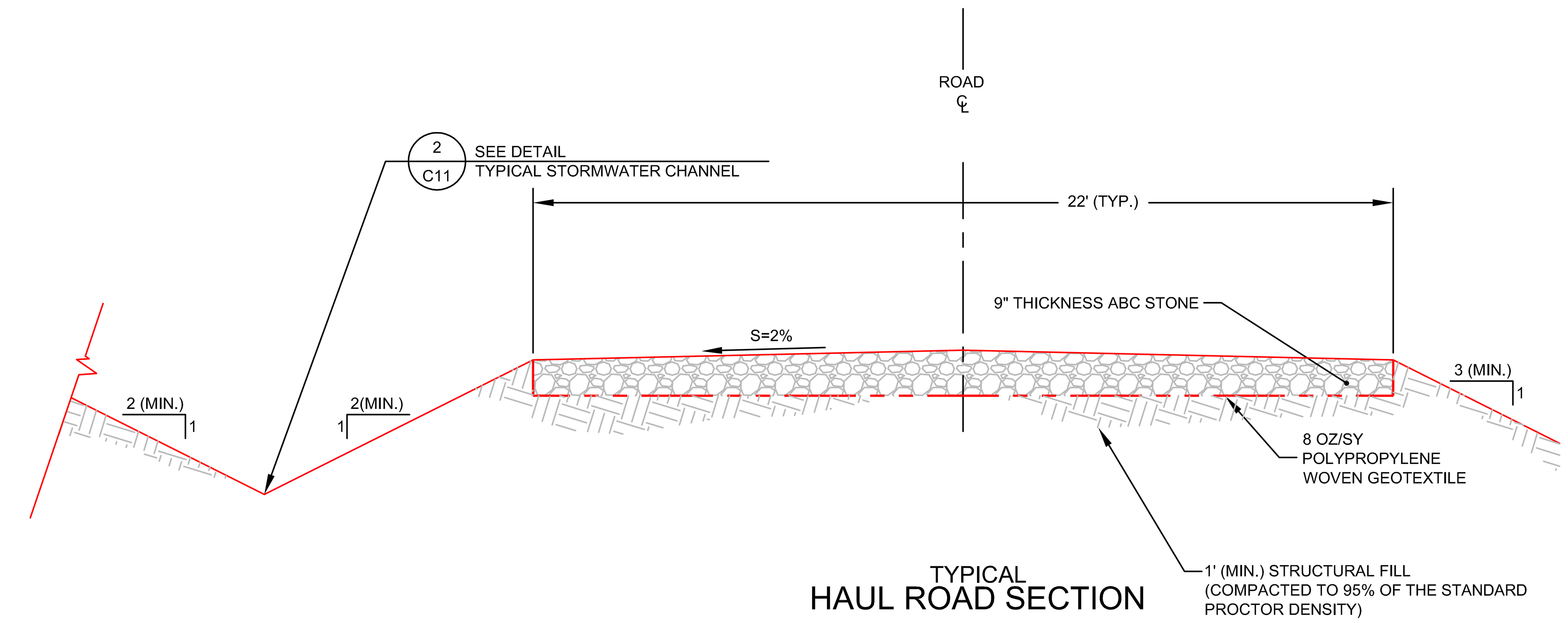
7-17-08




PERIMETER BERM AND STORMWATER CHANNEL

DETAIL 1 / C9

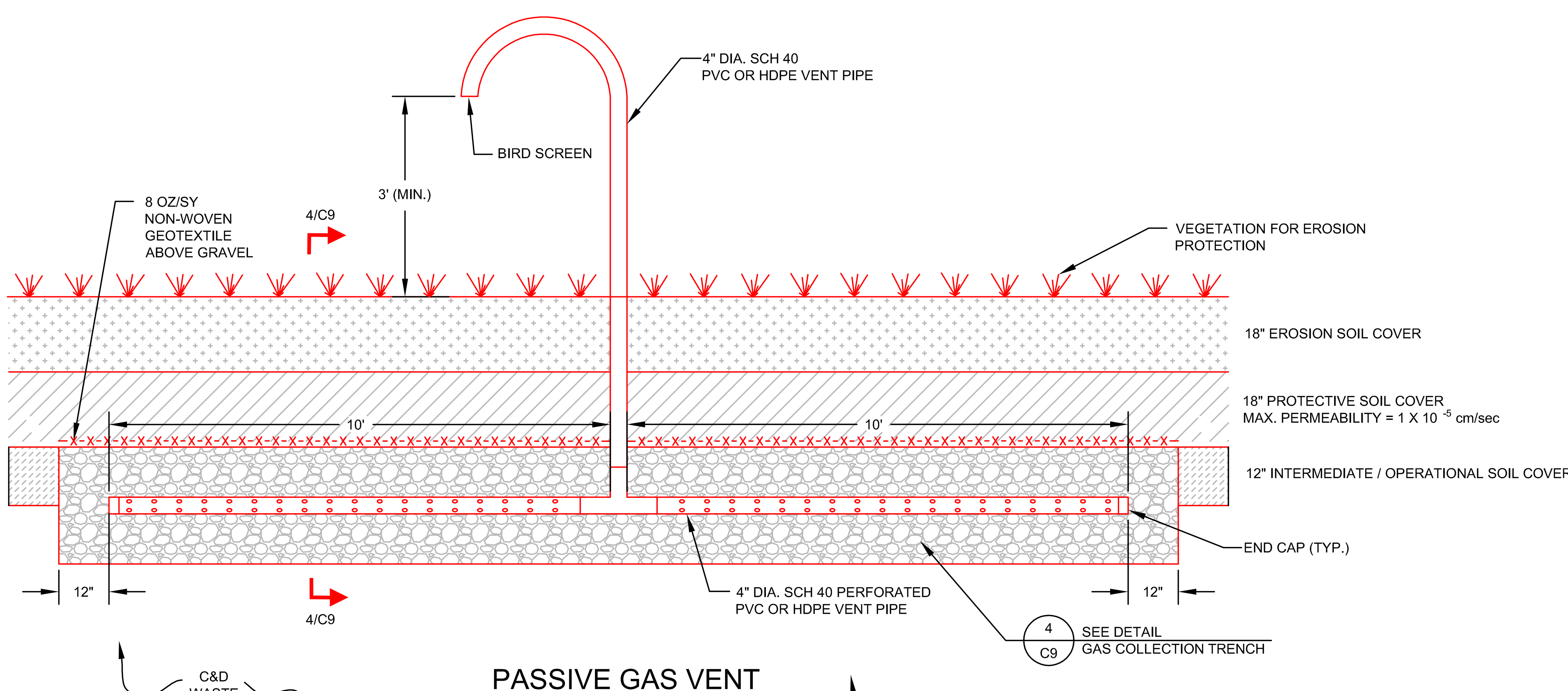
NOT TO SCALE




TYPICAL
HAUL ROAD SECTION

DETAIL 2 / C9

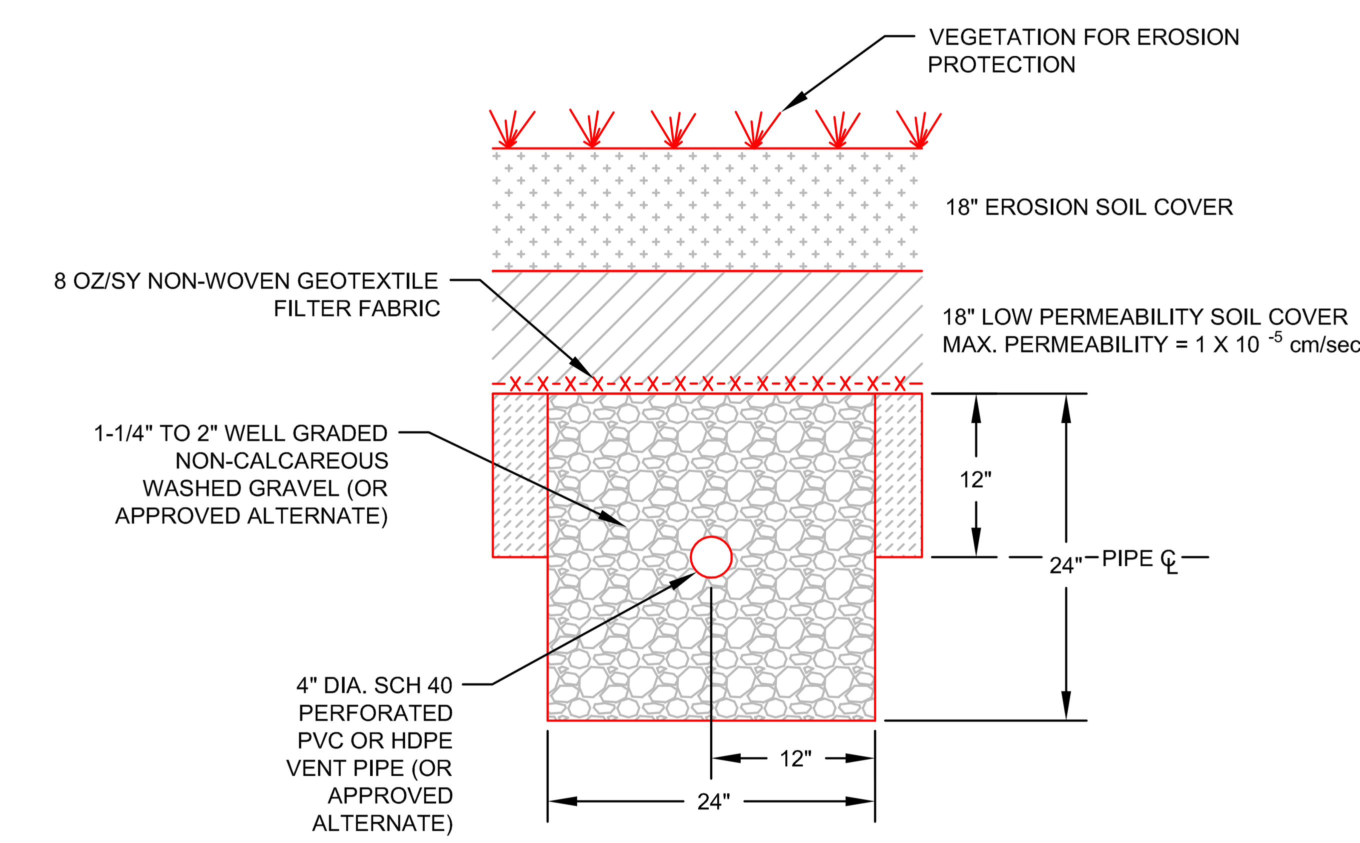
NOT TO SCALE




PASSIVE GAS VENT

DETAIL 3 / C9

NOT TO SCALE




GAS COLLECTION TRENCH

DETAIL 4 / C9

NOT TO SCALE

BROWN AND CALDWELL
Environmental Engineering and Consulting
309 East Morehead Street, Suite 160, Charlotte, North Carolina 28202 (704) 358-7204

SUBMITTED: ______ PROJECT MANAGER DATE: ______
APPROVED: ______ BROWN AND CALDWELL DATE: ______

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" – SCALE ACCORDINGLY)

DESIGNED: CJM
DRAWN: DCV
CHECKED:
CHECKED:
APPROVED: ADG

EXTERNAL REFERENCES

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 16192 ALBERT G. GLENN 7/17/2008

REVISIONS

| ZONE | REV. | DESCRIPTION | BY | DATE | APP. |
|---|---|---|---|---|---|
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BFI - LAKE NORMAN C&D LANDFILL FACILITY
7099 QUARRY LANE, STANLEY, NC

FACILITY PERMIT NUMBER 55-04

CLOSURE AND POST-CLOSURE PLAN
CLOSURE DETAILS - SHEET 2

LAKE NORMAN C&D LANDFILL FACILITY

FILENAME 135836C-DT.dwg
BC PROJECT NUMBER 135836
SCALE AS SHOWN
DRAWING NUMBER C9
SHEET NUMBER 9 OF 13

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JULY 17, 2008
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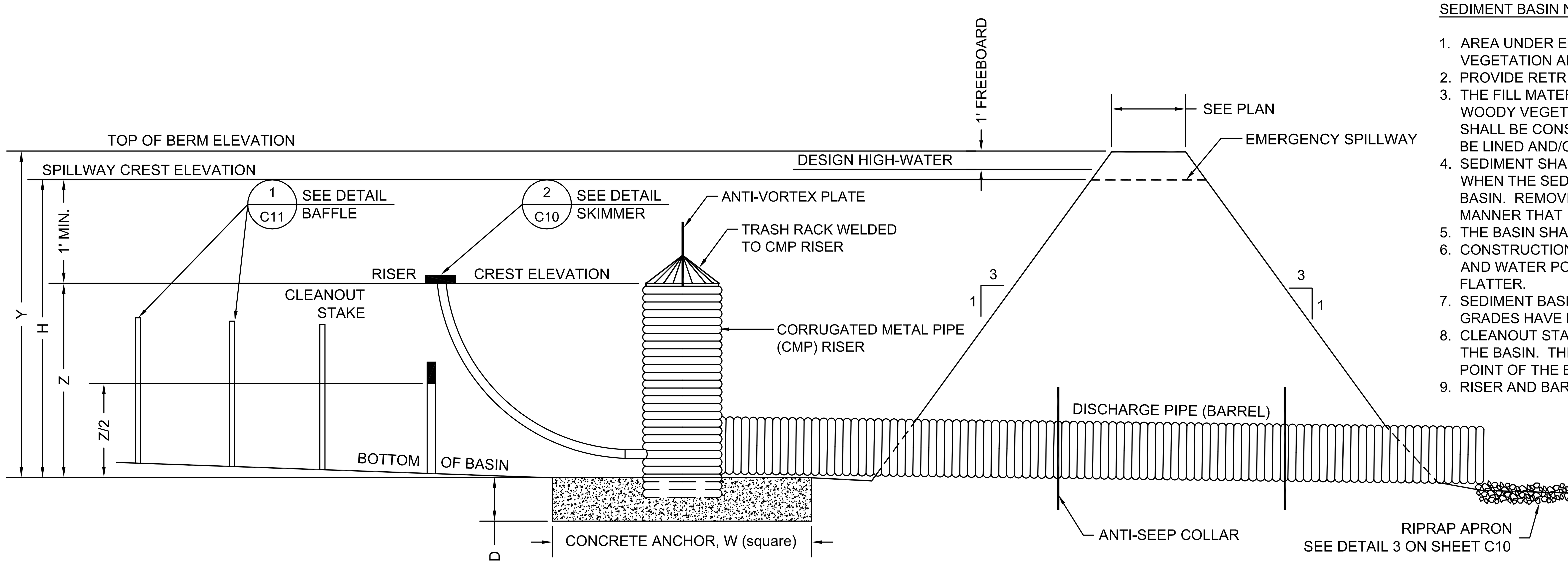
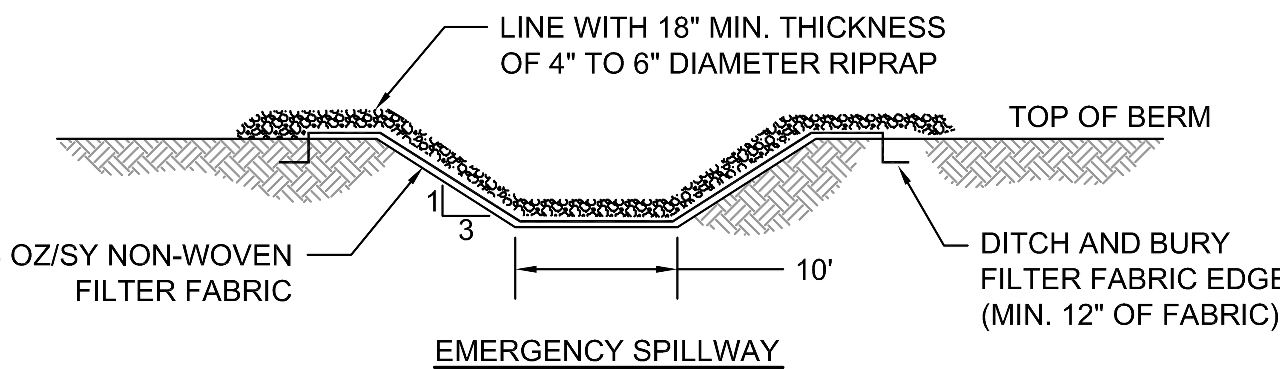
7-17-08




## SEDIMENT BASIN NOTES

1. AREA UNDER EMBANKMENT SHALL BE CLEARED, GRUBBED, AND STRIPPED OF ANY VEGETATION AND ROOT MAT. THE POOL AREA SHALL BE CLEARED ALSO.
2. PROVIDE RETRIEVAL ROPE FOR FLOATING SKIMMER
3. THE FILL MATERIAL FOR THE EMBANKMENT SHALL BE FREE OF ROOTS OR OTHER WOODY VEGETATION AS WELL AS OVERSIZED STONES, AND ROCKS. THE EMBANKMENT SHALL BE CONSTRUCTED IN 8 TO 12-INCH COMPACTED LIFTS. ALL SPILLWAYS SHOULD BE LINED AND/OR RIPRAPPED.
4. SEDIMENT SHALL BE REMOVED AND BASIN RESTORED TO ITS ORIGINAL DIMENSIONS WHEN THE SEDIMENT HAS ACCUMULATED TO ONE-HALF THE DESIGN DEPTH OF THE BASIN. REMOVED SEDIMENT SHALL BE DEPOSITED IN A SUITABLE AREA IN SUCH A MANNER THAT IT WILL NOT ERODE.
5. THE BASIN SHALL BE INSPECTED AFTER EACH RAIN AND REPAIRS MADE AS NECESSARY.
6. CONSTRUCTION OPERATION SHALL BE CARRIED OUT IN SUCH A MANNER THAT EROSION AND WATER POLLUTION IS MINIMIZED. ALL CUT AND FILL SLOPES SHALL BE 2:1 OR FLATTER.
7. SEDIMENT BASIN EMBANKMENTS SHOULD BE SEEDED AND MULCHED ONCE FINAL GRADES HAVE BEEN REACHED.
8. CLEANOUT STAKES SHALL BE PLACED IN ALL SEDIMENT BASINS AT THE LOW POINT IN THE BASIN. THE STAKES SHALL BE MARKED SHOWING THE HALF FULL, CLEANOUT POINT OF THE BASIN.
9. RISER AND BARREL PIPE SHALL BE ASPHALT COATED CORRUGATED METAL PIPE.



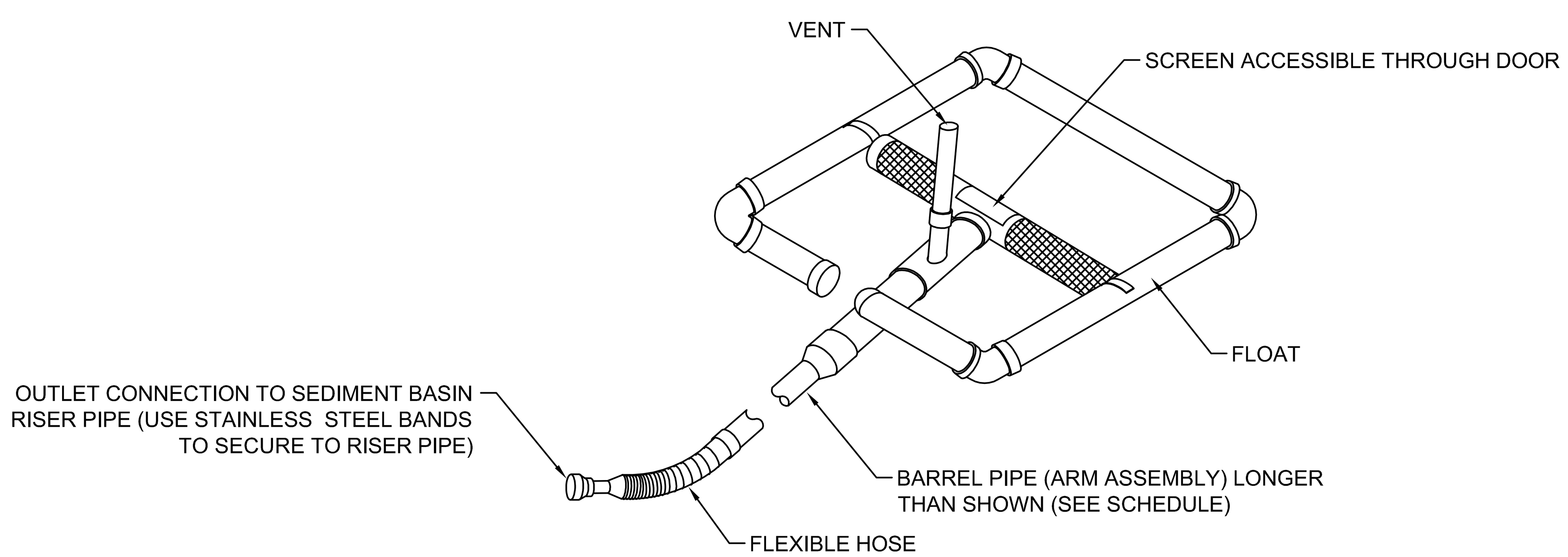

EMERGENCY SPILLWAY

| BASIN IDENTIFICATION | RISER DIAMETER | BARREL DIAMETER | BARREL SLOPE | BARREL LENGTH | BARREL INVERT IN | BARREL INVERT OUT | D (feet) | W (feet) | Y (feet) | H (feet) | Z (feet) | DRAINAGE AREA | DENUDED AREA | STORMWATER FLOW, $Q_{10}$ | SEDIMENT STORAGE VOLUME REQUIRED | ACTUAL SEDIMENT STORAGE VOLUME | SURFACE AREA REQUIRED | ACTUAL SURFACE AREA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SB-2 | 24 inch | 15 inch | 1.6% | 62 feet | 673 feet | 672 feet | 2 | 4 | 8 | 6 | 5 | 21.96 acres | 21.96 acres | 75.8 cfs | 39,528 cu. ft. | 94,215 cu. ft. | 32,951 sq. ft. | 33,467 sq. ft. |

## SEDIMENT BASIN DETAIL

DETAIL 1 / C10

NOT TO SCALE

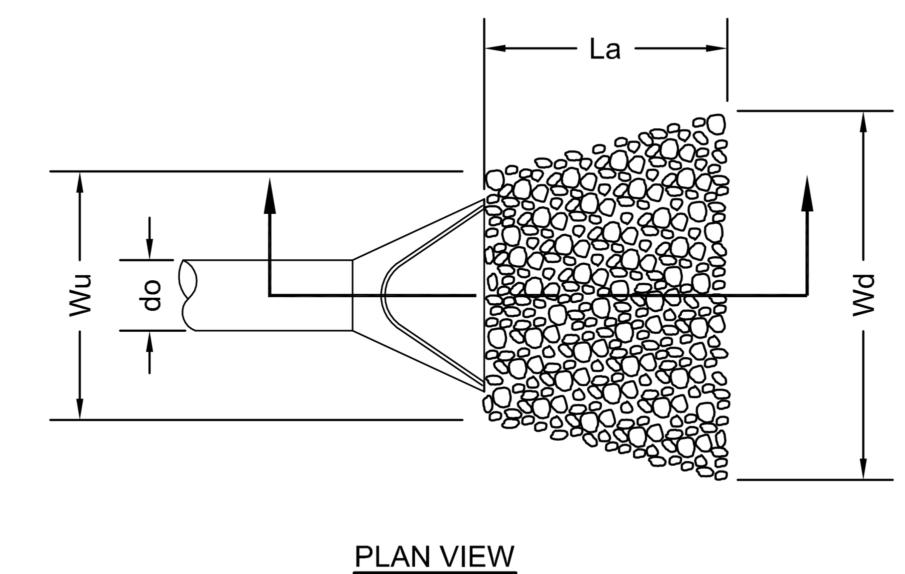



| SKIMMER LOCATION | BARREL PIPE DIAMETER | BARREL PIPE LENGTH | SKIMMER QUANTITY | SKIMMER ORIFICE SIZE | TYPE |
|---|---|---|---|---|---|
| SB -2 | 6 inch | 5 ft | 1 | 2.8 inch | FAIRCLOTH 6-INCH SKIMMER |

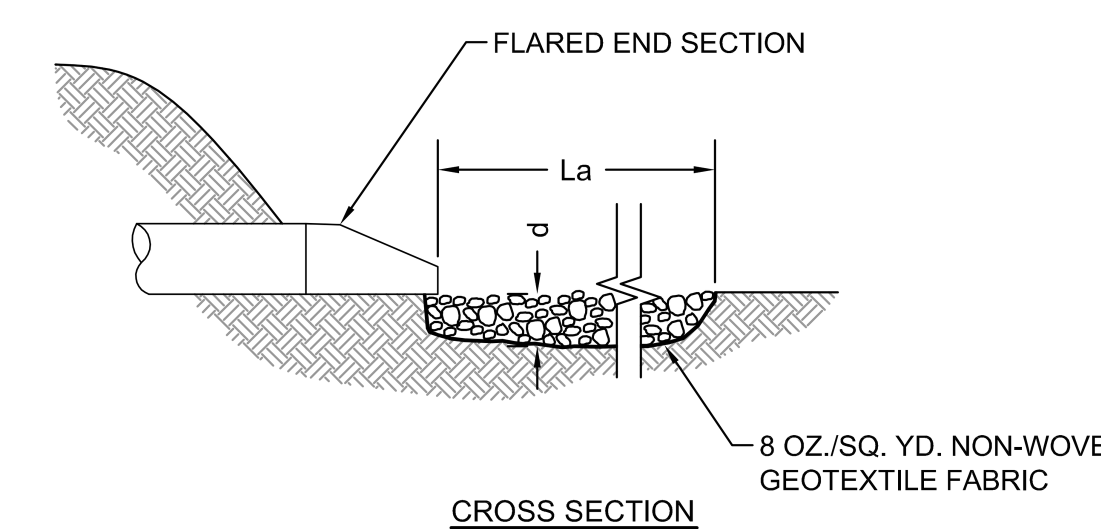
## STANDARD SKIMMER DETAIL

DETAIL 2 / C10

NOT TO SCALE




PLAN VIEW




CROSS SECTION

| APRON IDENTIFICATION | do (inches) | AGGREGATE GRADATION | | | d (inches) | La (feet) | Wu (feet) | Wd (feet) |
|---|---|---|---|---|---|---|---|---|
| | | dMIN (inch) | d50 (inch) | dMAX (inch) | | | | |
| SB-2 | 15 | 2 | 4 | 6 | 9 | 10 | 4 | 11 |

## RIPRAP APRON DETAIL

DETAIL 3 / C10

NOT TO SCALE

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Environmental Engineering and Consulting

309 East Morehead Street, Suite 160, Charlotte, North Carolina 28202 (704) 358-7204

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APPROVED: ______ BROWN AND CALDWELL DATE: ______

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: CJM

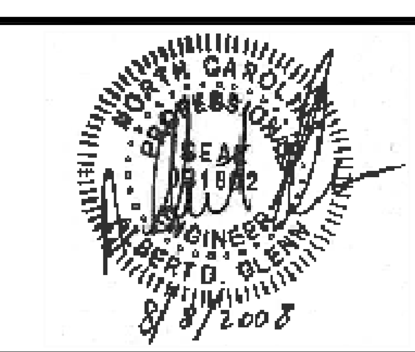
DRAWN: DCV

CHECKED:

CHECKED:

APPROVED: ADG

EXTERNAL REFERENCES



REVISIONS

| ZONE | REV. | DESCRIPTION | BY | DATE | APP. |
|---|---|---|---|---|---|

BFI - LAKE NORMAN C&D LANDFILL FACILITY
7099 QUARRY LANE, STANLEY, NC

FACILITY PERMIT NUMBER 55-04

CLOSURE AND POST-CLOSURE PLAN
STORMWATER AND EROSION & SEDIMENT CONTROL DETAILS - SHEET 1
LAKE NORMAN C&D LANDFILL FACILITY

FILENAME 135836C-DT-ES.dwg

BC PROJECT NUMBER 135836

SCALE 1"=80'

DRAWING NUMBER C10

SHEET NUMBER 10 OF 13

APRIL 12, 2008
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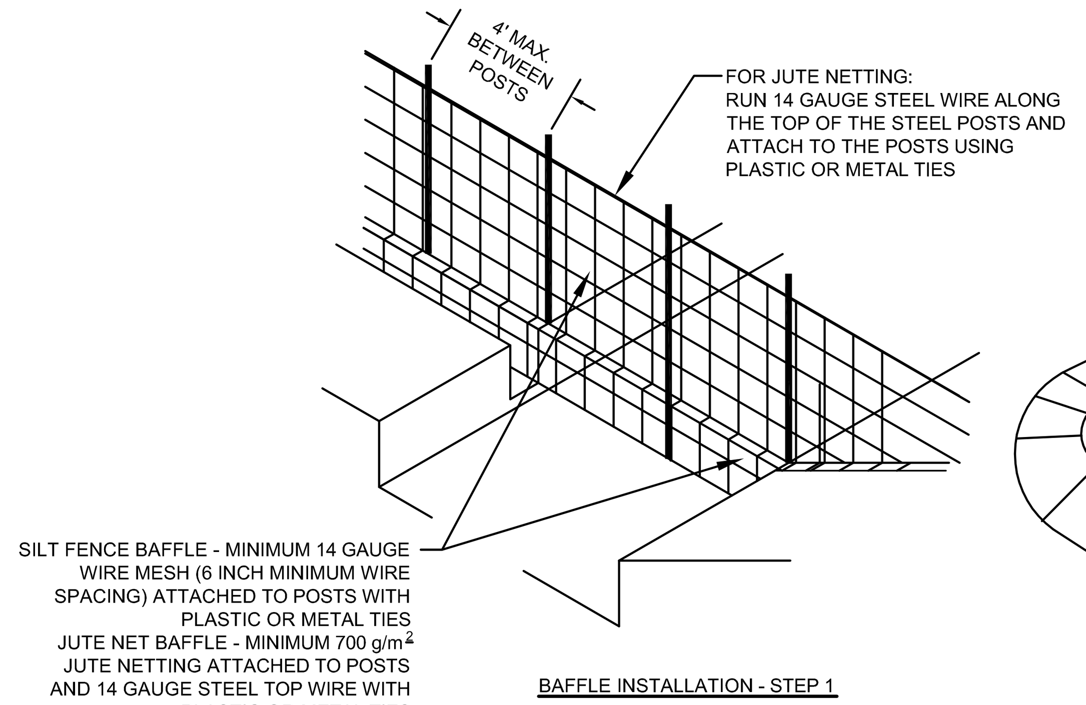
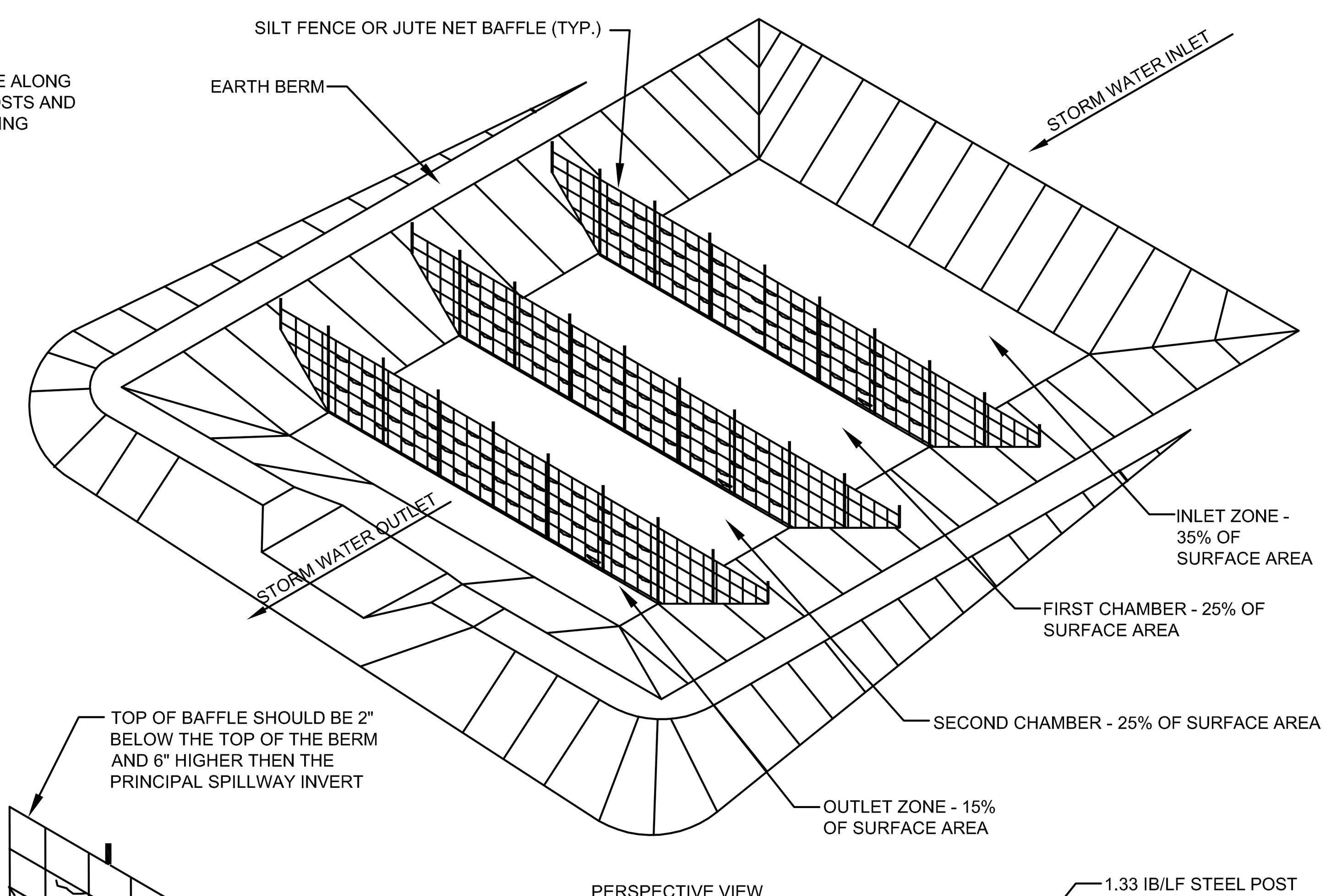


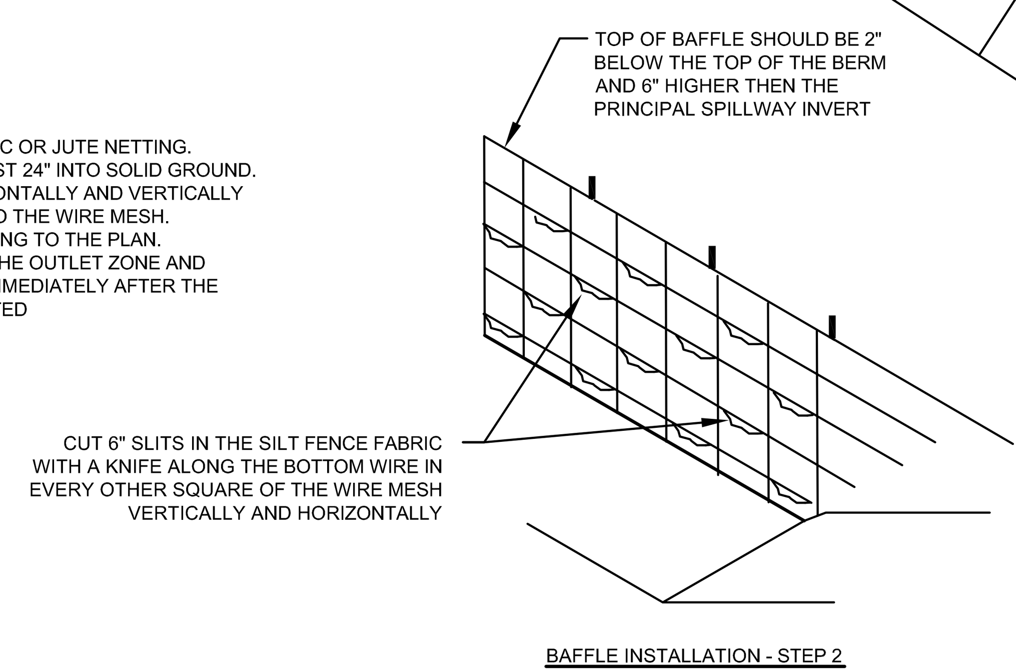

BAFFLE INSTALLATION - STEP 1



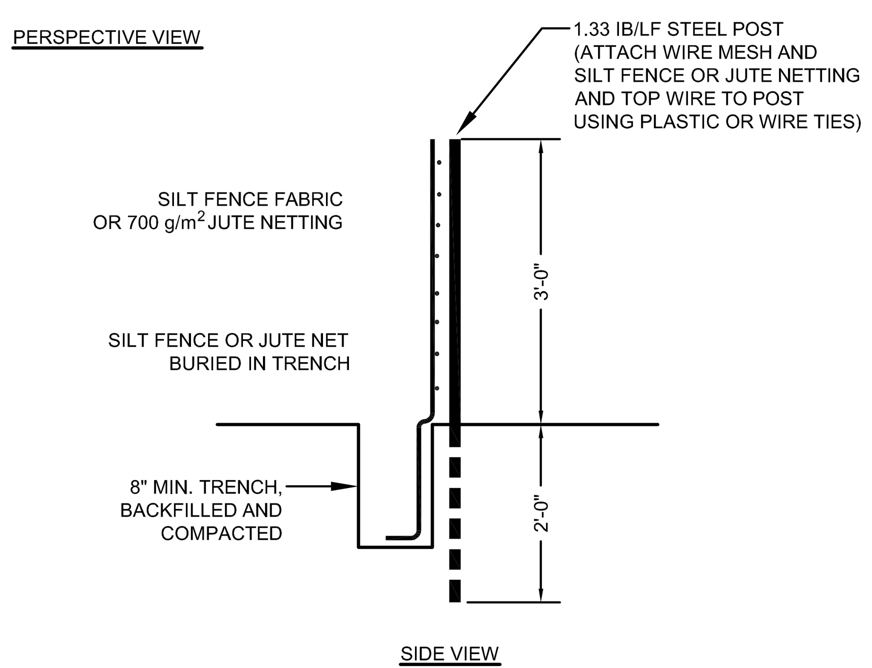

PERSPECTIVE VIEW

NOTES:

1. USE EITHER SILT FENCE FABRIC OR JUTE NETTING.
2. DRIVE 5' STEEL POSTS AT LEAST 24" INTO SOLID GROUND.
3. USE STAPLES 1' APART HORIZONTALLY AND VERTICALLY TO ATTACH THE SILT FENCE TO THE WIRE MESH.
4. SPACE THE BAFFLES ACCORDING TO THE PLAN.
5. THE FLOOR OF THE BASIN IN THE OUTLET ZONE AND BERMS SHOULD BE SEEDED IMMEDIATELY AFTER THE BASIN OR TRAP IS CONSTRUCTED




BAFFLE INSTALLATION - STEP 2




SIDE VIEW

BAFFLE DETAIL

DETAIL 1 / C11

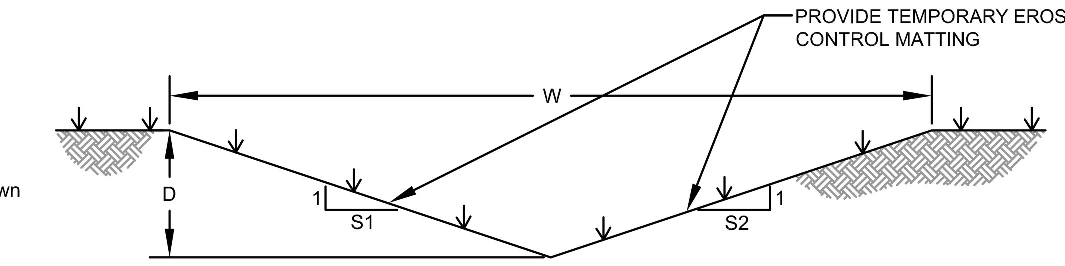
NOT TO SCALE

CHANNEL CONSTRUCTION SEQUENCE

1. Remove all trees, brush, stumps, and other objectionable material from the foundation area and dispose of properly.
2. Place fill to construct the channel and shape it to dimensions shown on the plans plus a 0.2 feet. overcut around the channel perimeter to allow for bulking during seedbed preparations and sod buildup.
3. Remove and properly dispose of all excess soil so that surface water may enter the channel freely.
4. The procedure used to establish grass in the channel will depend upon the severity of the conditions and selection of species. Protect the channel with mulch or a temporary liner sufficient to withstand anticipated velocities during the establishment period
5. Apply lime, fertilizer and seed before laying the net (without mulch) or mat (with mulch or synthetic). If open-weave netting is used, lime may be incorporated before installing the net and the fertilizer and seed can be sprayed on afterward, otherwise apply seed and fertilizer before installation.
6. Start laying the net or mat from the top of the channel or slope and unroll it down the grade. Allow netting to lay loosely on the soil but without wrinkles--do not stretch.
7. To secure the net, bury the upslope end in a slot or trench no less than 6 inches deep, cover with soil, and tamp firmly. Staple the net every 12 inches across the top end and every 3 feet around the edges and bottom. Where 2 strips of net are laid side by side, the one adjacent edges should be overlapped 3 inches and stapled together. Each strip of netting or matting should also be stapled down the center or every 3 feet if the strip is not wider than 8 feet. Do not stretch the net/mat when applying staples.
8. Staples should be the "U"-shaped type and 4 to 6-inches long (depending on soil conditions).
9. To join the ends of two strips of netting, cut a trench to anchor the end of the down gradient net. Overlap the end of the previous roll 18 inches and staple every 12 inches just below the anchor slot.
10. To join ends of two strips of matting, overlap the upgradient strip over the downgradient one at least 4 inches. Staple the overlap at the ends and every 12 inches along the center of the overlap.

CHANNEL MAINTENANCE

1. During the establishment period, check grass-lined channels after every rainfall. After grass is established, periodically check the channel; check it after every heavy rainfall event. Immediately make repairs. It is particularly important to check the channel outlet and all road crossings for bank stability and evidence of piping or scour holes.
2. Remove all significant sediment accumulations to maintain the design carrying capacity. Keep the grass in a healthy, vigorous condition at all times, since it is the primary erosion protection for the channel.
3. Inspect all mulches periodically, and after rainstorms to check for rill erosion, dislocation, or failure. Where erosion is observed, apply additional mulch. If washout occurs, repair the slope grade, reseed, and reinstall mulch. Continue inspections until vegetation is firmly established.




GRASS LINED CHANNEL

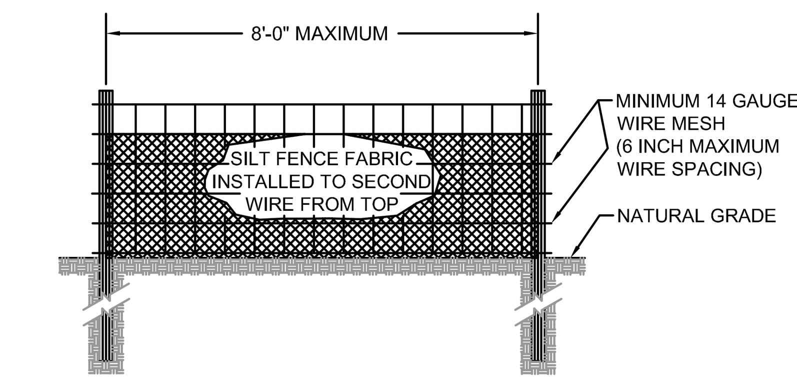
| PERMANENT CHANNEL IDENTIFICATION | TEMPORARY CHANNEL LINING* | PERMANENT CHANNEL LINING | W (feet) | D (feet) | S1 (ft/ft) | S2 (ft/ft) |
|---|---|---|---|---|---|---|
| D1 | S75BN | GRASS | 12 | 3 | 2 | 2 |
| D2 | SC150 | GRASS | 12 | 3 | 2 | 2 |
| D3 | S75BN | GRASS | 12 | 3 | 2 | 2 |
| D4 | S75BN | GRASS | 12 | 3 | 2 | 2 |
| SIDE SLOPE TERRACES | S75BN | GRASS | 12 | 2 | 6 | 3 |

* NORTH AMERICAN GREEN PRODUCT OR APPROVED EQUIVALENT

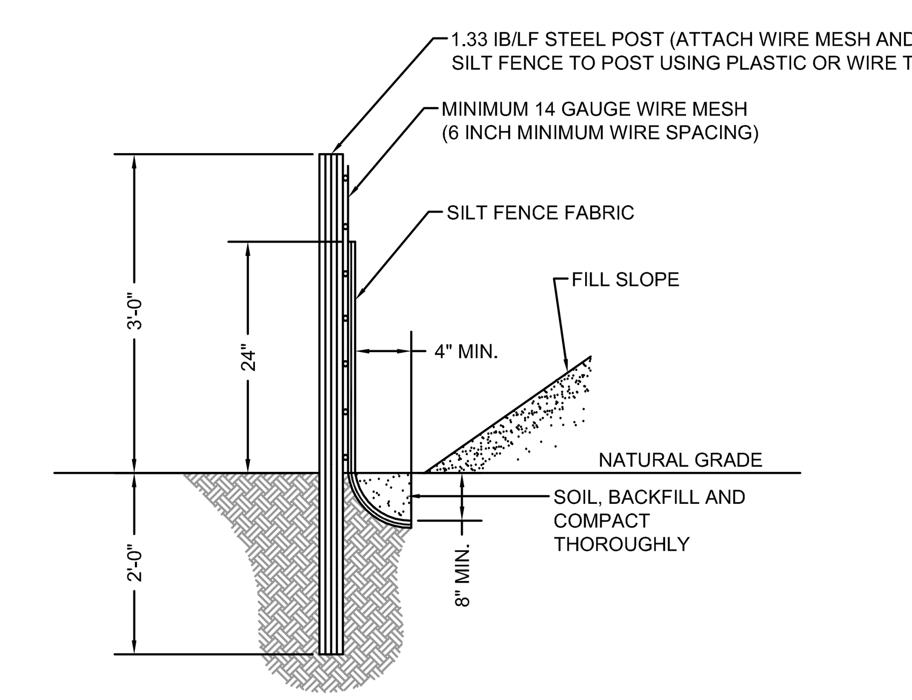
STORMWATER CHANNEL DETAIL

DETAIL 2 / C11

NOT TO SCALE




FRONT VIEW

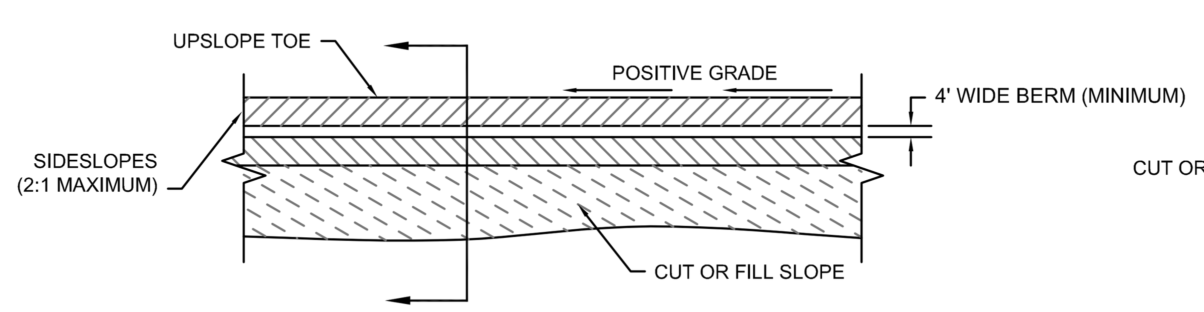



SIDE VIEW

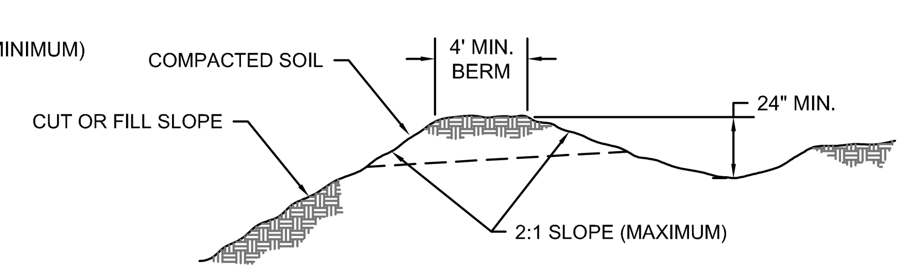
SILT FENCE DETAIL

DETAIL 5 / C11

NOT TO SCALE




PLAN VIEW



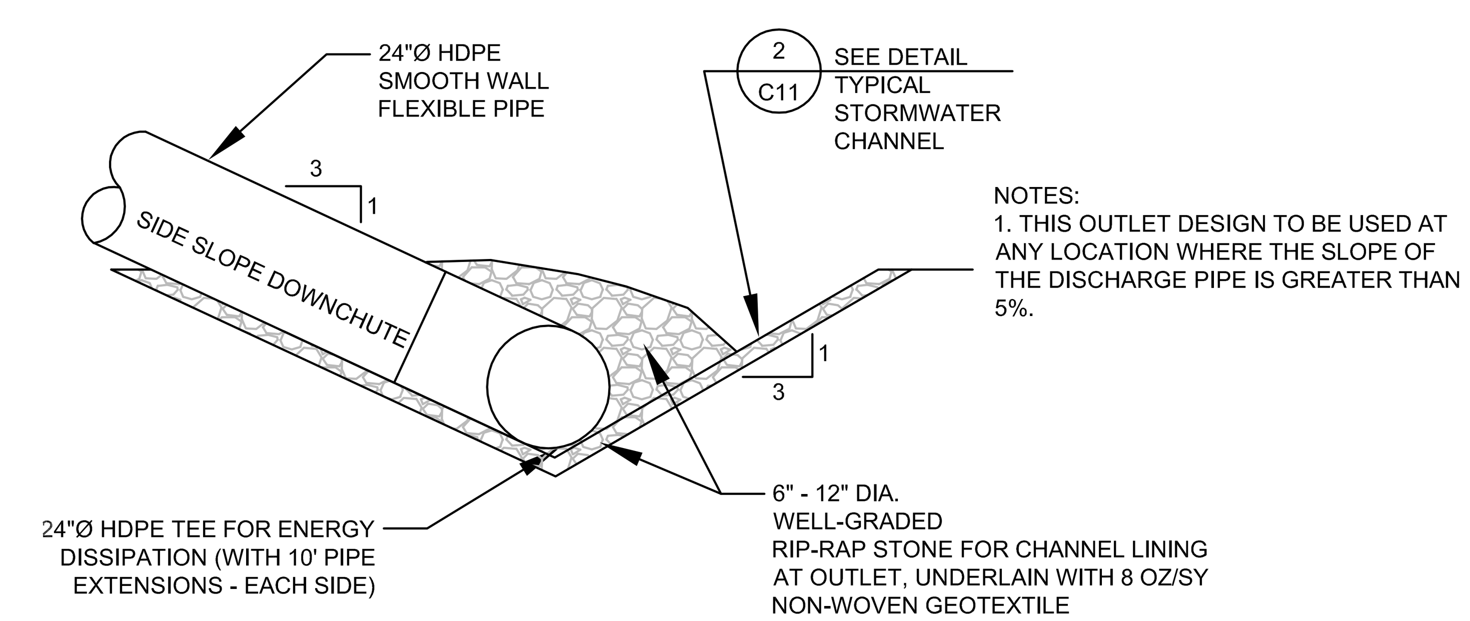

CROSS SECTION

TEMPORARY DIVERSION DITCH DETAIL

DETAIL 3 / C11

NOT TO SCALE

STABILIZE THE TEMPORARY DIVERSION DITCH WITH TEMPORARY OR PERMANENT SEEDING IMMEDIATELY UPON CONSTRUCTION.




NOTES:
1. THIS OUTLET DESIGN TO BE USED AT ANY LOCATION WHERE THE SLOPE OF THE DISCHARGE PIPE IS GREATER THAN 5%.

SIDE VIEW

TYPICAL

SIDE SLOPE DOWNCHUTE OUTLET DISSIPATOR

DETAIL 4 / C11

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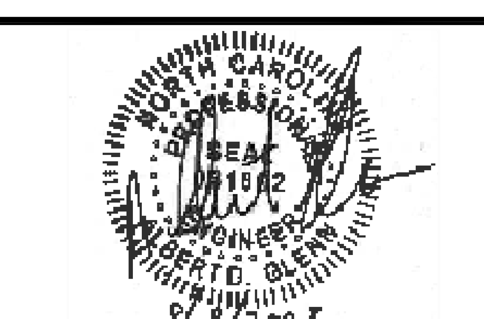
SUBMITTED: ____ PROJECT MANAGER DATE: ____

APPROVED: ____ BROWN AND CALDWELL DATE: ____

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: CJM
DRAWN: DCV
CHECKED:
CHECKED:
APPROVED: ADG

EXTERNAL REFERENCES




REVISIONS

| ZONE | REV. | DESCRIPTION | BY | DATE | APP. |
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BFI - LAKE NORMAN C&D LANDFILL FACILITY
7099 QUARRY LANE, STANLEY, NC

FACILITY PERMIT NUMBER 55-04

CLOSURE AND POST-CLOSURE PLAN
STORMWATER AND EROSION & SEDIMENT CONTROL DETAILS - SHEET 2
LAKE NORMAN C&D LANDFILL FACILITY

FILENAME 135836C-DT-ES.dwg
BC PROJECT NUMBER 135836
SCALE 1"=80'
DRAWING NUMBER C11
SHEET NUMBER 11 OF 13

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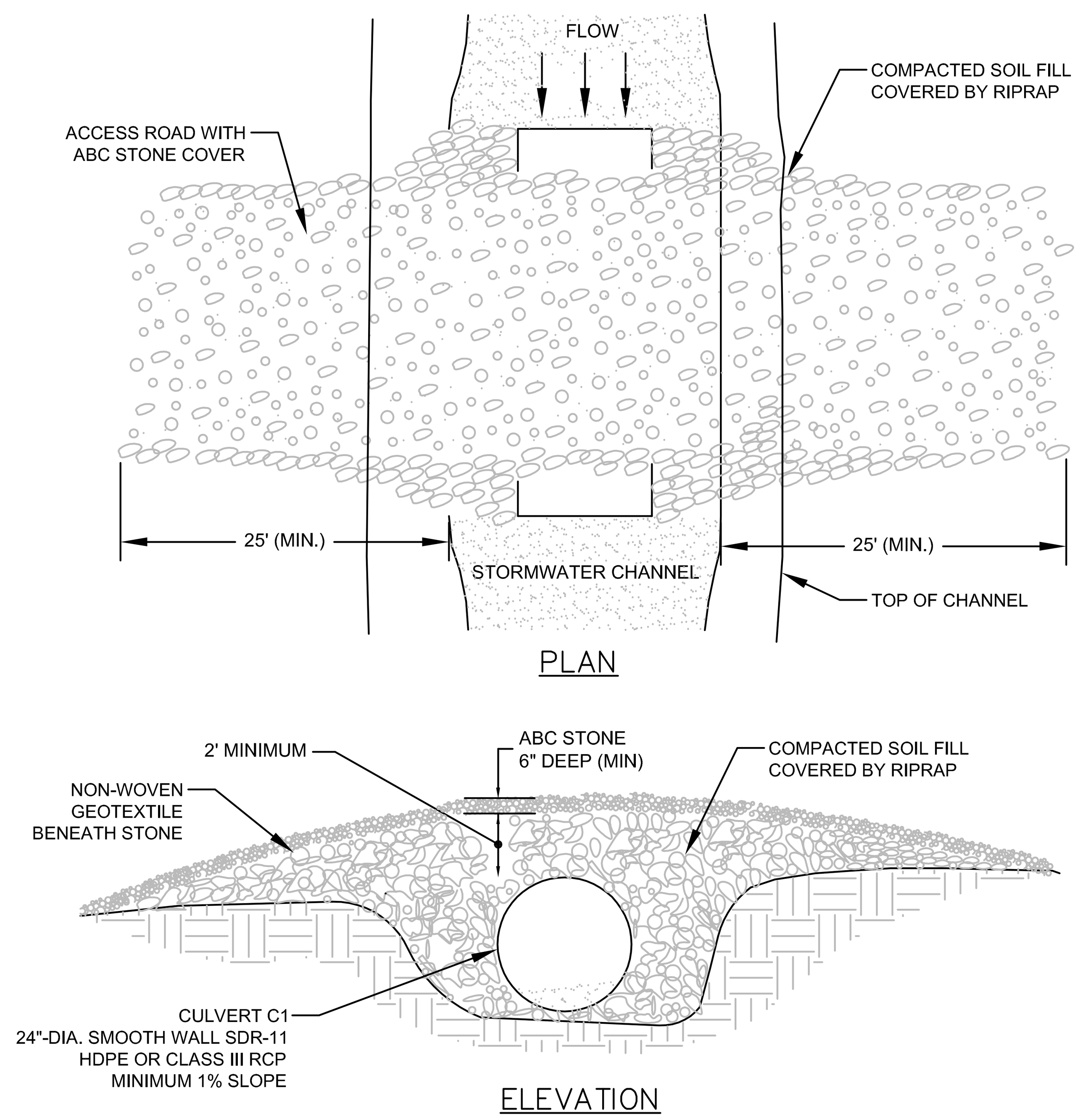
APRIL 12, 2008

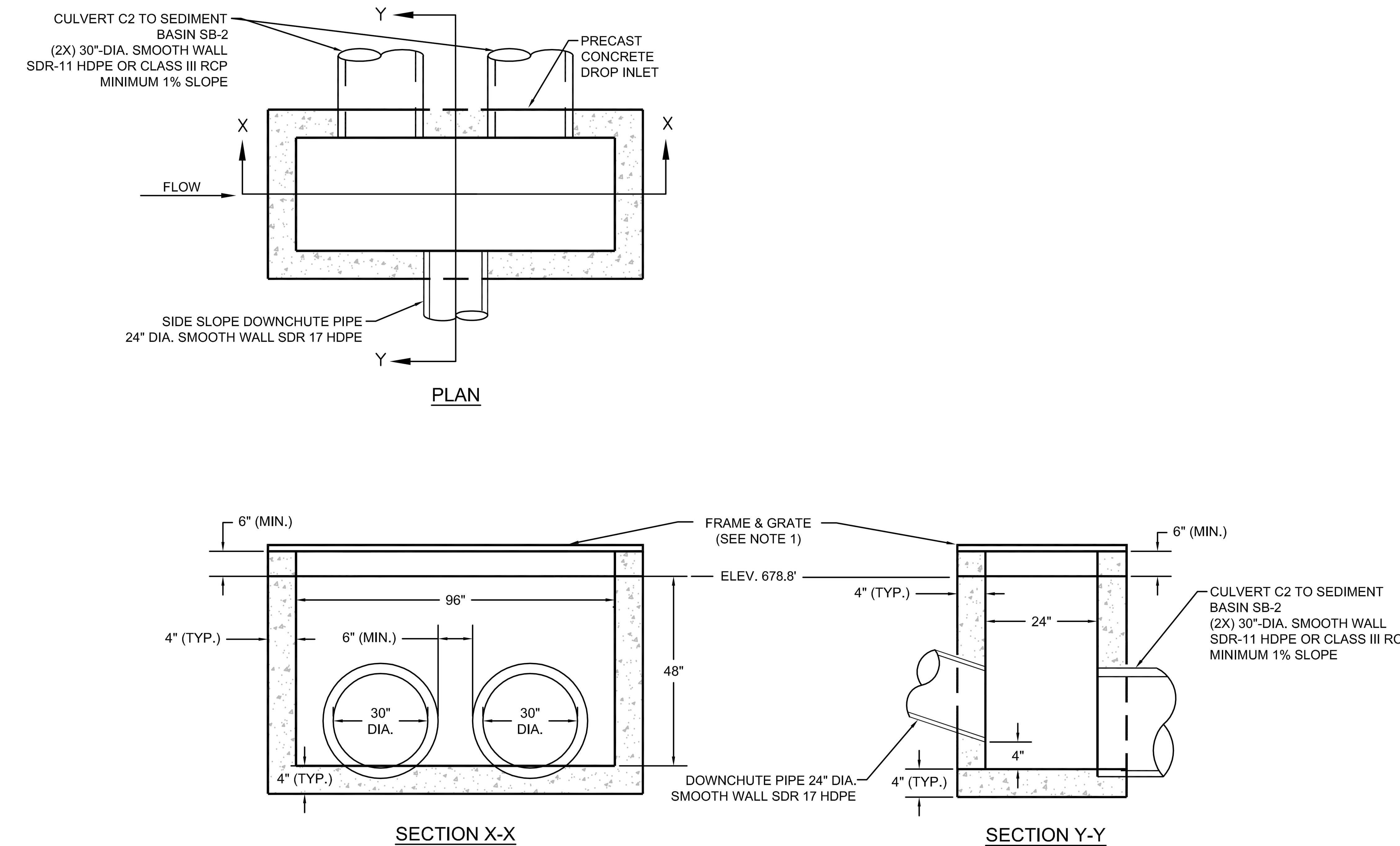
7-17-08




HAUL ROAD CULVERT

DETAIL 1/C12

NOT TO SCALE




DROP INLET

DETAIL 2/C12

NOT TO SCALE

NOTES:
1. STORM GRATE SHALL CONSIST OF AN ELEVATED LID PROVIDING 6" (MIN.) CLEAR SPACE ABOVE DROP INLET.

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APPROVED: ____ BROWN AND CALDWELL DATE: ____

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: CJM
DRAWN: DCV
CHECKED:
CHECKED:
APPROVED: ADG

EXTERNAL REFERENCES

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 21582 ALBERT D. GLENN 8/8/2008

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| ZONE | REV. | DESCRIPTION | BY | DATE | APP. |

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FACILITY PERMIT NUMBER 55-04

CLOSURE AND POST-CLOSURE PLAN
STORMWATER AND EROSION & SEDIMENT CONTROL DETAILS - SHEET 3
LAKE NORMAN C&D LANDFILL FACILITY

FILENAME 135836C-DT-ES.dwg
BC PROJECT NUMBER 135836
SCALE 1"=80'
DRAWING NUMBER C12
SHEET NUMBER 12 OF 13

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APRIL 12, 2008
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DEFINITION: Controlling runoff and erosion on disturbed areas by establishing perennial vegetative cover with seed.

PURPOSE: To reduce erosion and decrease sediment yield from disturbed areas, and to permanently stabilize such areas in a manner that is economical, adapts to site conditions, and allows selection of the most appropriate plant materials.

SPECIFICATIONS:

SEEDBED REQUIREMENTS

Establishment of vegetation should not be attempted on sites that are unsuitable due to inappropriate soil texture (NC Erosion and Sediment Control Planning and Design Manual, 1988), poor drainage, concentrated overland flow, or steepness of slope until measures have been taken to correct these problems.

To maintain a good stand of vegetation, the soil must meet certain minimum requirements as a growth medium. The existing soil should have these criteria:

- Enough fine-grained (silt and clay) material to maintain adequate moisture and nutrient supply (available water capacity of at least .05 inches water to 1 inch of soil).
- Sufficient pore space to permit root penetration.
- Sufficient depth of soil to provide an adequate root zone. The depth to rock or impermeable layers such as hardpans should be 12 inches or more, except on slopes steeper than 2:1 where the addition of soil is not feasible.
- A favorable pH range for plant growth, usually 6.0 - 6.5.
- Free from large roots, branches, stones, large clods of earth, or trash of any kind. Clods and stones may be left on slopes steeper than 3:1 if they are to be hydroseeded.

If any of the above criteria are not met - i.e., if existing soil is too coarse, dense, shallow or acidic to foster vegetation - special amendments are required. The soil conditioners described below may be beneficial or, preferably, topsoil may be applied.

SEEDBED PREPARATION

Install necessary mechanical erosion and sedimentation control practices before seeding, and complete grading according to the approved plan.

Lime and fertilizer needs should be determined by soil tests. Soil testing is performed free of charge by the North Carolina Department of Agriculture soil testing laboratory. Directions, sample cartons, and information sheets are available through county Agricultural Extension offices or from NCDA. Because the NCDA soil testing lab requires 1-6 weeks for sample turn-around, sampling must be planned well in advance of final grading. Testing is also done by commercial laboratories.

When soil tests are not available, follow rates suggested in the seeding specifications shown at right. Application rates usually fall into the following ranges:

- Ground agricultural limestone:
  Light-textured, sandy soils: 1 to 1-1/2 tons/acre
  Heavy-textured, clayey soils: 2-3 tons/acre
- Fertilizer:
  Grasses: 800-1200 lb/acre of 10-10-10 (or the equivalent)
  Grass-legume mixtures: 800-1200 lb/acre of 5-10-10 (or the equivalent)

Apply lime and fertilizer evenly and incorporate into the top 4-6 inches of soil by disking or other suitable means. Operate machinery on the contour. When using a hydroseeder, apply lime and fertilizer to a rough, loose surface.

Roughen surfaces prior to seeding.

Complete seedbed preparation by breaking up large clods and raking into a smooth, uniform surface (slopes less than 3:1). Fill in or level depressions that can collect water. Broadcast seed into a freshly loosened seedbed that has not been sealed by rainfall.

SEEDING

Seeding dates given in the seeding mixture specifications are designated as "best" or "possible". Seedings properly carried out within the "best" dates have a high probability of success. It is also possible to have satisfactory establishment when seeding outside these dates. However, as you deviate from them, the probability of failure increases rapidly. Seeding on the last date shown under "possible" may reduce changes of success by 30-50%. Always take this into account in scheduling land-disturbing activities.

Use certified seed for permanent seeding whenever possible. Certified seed is inspected by the North Carolina Crop Improvement Association. It meets published North Carolina Standards and should bear an official "Certified Seed" label.

Labeling of non-certified seed is also required by law. Labels contain important information on seed purity, germination, and presence of wood seeds. Seeds must meet State standards for content of noxious weeds. Do no accept seed containing "prohibited" noxious weed seed.

Inoculate legume seed with the Rhizobium bacteria appropriate to the species of legume.

Apply seed uniformly with a cyclone seeder, drop-type spreader, drill, cultipacker seeder, or hydroseeder on a firm, friable seedbed.

When using a drill or cultipacker seeder, plant small grains no more than 1 inch deep, grasses and legumes no more than 1/2 inch. Equipment should be calibrated in the field for the desired seeding rate.

When using broadcast-seeding methods, subdivide the area into workable sections and determine the amount of seed needed for each section. Apply one-half the seed while moving back and forth across the area, making a uniform pattern: then apply the second half in the same way, but moving at right angles to the first pass.

Mulch all plantings immediately after seeding.

HYDROSEEDING

Surface roughening is particularly important when hydroseeding, as a roughened slope will provide some natural coverage for lime, fertilizer, and seed. The surface should not be compacted or smooth. Fine seedbed preparation is not necessary for hydroseeding operations: large clods, stones, and irregularities provide cavities in which seeds can lodge.

Rate of wood fiber (cellulose) application should be at least 2,000 lb/acre.

Apply legume inoculates at four time the recommended rate when adding inoculate to a hydroseeder slurry.

If a machinery breakdown of 1/2 to 2 hours occurs, add 50% more seed to the tank, based on the proportion of the slurry remaining. This should compensate for damage to seed. Beyond 2 hours, a full rate of new seed may be necessary.

Lime is not normally applied with a hydraulic seeder because it is abrasive. It can be blown onto steep slopes in dry form.

MAINTENANCE:

Generally, a stand of vegetation cannot be determined to be fully established until soil cover has been maintained for one full year from planting, inspect seeded areas for failure and make necessary repairs and reseedings within the same season, if possible.

Reseeding--If a stand has inadequate cover, re-evaluate choice of plant materials and quantities of lime and fertilizer. Re-establish the stand after seedbed preparation or over-seed the stand. Consider seeding temporary, annual species if the time of year is not appropriate for permanent seeding.

If vegetation fails to grow, soil must be tested to determine if acidity or nutrient imbalance is responsible.

Fertilization--On the typical disturbed site, full establishment usually requires refertilization in the second growing season. Fine turf requires annual maintenance fertilization. Use soil tests if possible or follow the guidelines given for the specific seeding mixture.

TEMPORARY SEEDING SPECIFICATIONS

AREAS LEFT DISTURBED FOR LONGER THAT 30 DAYS BUT LESS THAN ONE YEAR:

| Time Period | Item | Rate of Application (lb./acre) |
|---|---|---|
| January 1 to May 1 | Rye (Grain) | 120 |
| | Annual Lespedeza (Kobe) | 50 |
| | Limestone | 2,000 |
| | 10-10-10 Fertilizer | 750 |
| | Nitrogen (March only) | 50 |
| | Mulch | 4,000 |
| May 1 to August 15 | German Millet | 40 |
| | Limestone | 2,000 |
| | 10-10-10 Fertilizer | 750 |
| | Mulch | 4,000 |
| August 15 to December 30 | Rye (Grain) | 120 |
| | Limestone | 2,000 |
| | 10-10-10 Fertilizer | 750 |
| | Mulch | 4,000 |

If it is necessary to extend temporary cover beyond June 15, the area should be overseeded with 50 lb/acre of Kobe lespedeza in latter February or early March.

Soil amendments

Follow recommendations of soil tests or apply 2,000 lb/acre ground agricultural limestone and 750 lb/acre 10-10-10 fertilizer.

Mulch

Apply 4,000 lb/acre straw. Anchor mulch by tacking with asphalt, roving or a mulch anchoring tool. A disk with blades set nearly straight can be used as a mulch anchoring. tool.

Maintenance

Refertilize if growth is not fully adequate. Reseed, refertilize and mulch immediately following erosion or other damage.

PERMANENT SEEDING SPECIFICATIONS

| Time Period | Item | Rate of Application (lb./acre) |
|---|---|---|
| August 20 to October 25 | Tall Fescue | 100 |
| | Sericea Lespedeza | 30 |
| | Kobe Lespedeza | 10 |
| | Common Bermuda or Pensacola Bahia | 10/25 |
| | Limestone | 4,000 |
| | 10-10-10 Fertilizer | 1,000 |
| | Mulch | 4,000 to 5,000 |
| February 1 to April 15 | Tall Fescue | 100 |
| | Sericea Lespedeza | 30 |
| | Kobe Lespedeza | 10 |
| | Limestone | 4,000 |
| | 10-10-10 Fertilizer | 1,000 |
| | Mulch | 4,000 to 5,000 |

Soil amendments

Apply lime and fertilizer according to soil tests, or apply 4,000 lb/acre ground agricultural limestone and 1,000 lb/acre 10-10-10 fertilizer.

Mulch

Apply 4,000-5,000 lb/acre grain straw or equivalent cover of another suitable mulching material. Anchor mulch by tacking with asphalt, roving, or netting. Netting is the preferred anchoring method on steep slopes.

Maintenance

Refertilize in the second year unless growth is fully adequate. May be mowed one or twice a year, but mowing is not necessary. Reseed, fertilize, and mulch damaged areas immediately.

SEEDING SPECIFICATION

DETAIL 1 / C13

NOT TO SCALE

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APPROVED: ____ BROWN AND CALDWELL DATE: ____

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: CJM

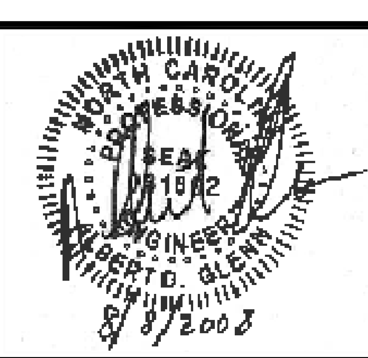
DRAWN: DCV

CHECKED:

CHECKED:

APPROVED: ADG

EXTERNAL REFERENCES




REVISIONS

| ZONE | REV. | DESCRIPTION | BY | DATE | APP. |
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BFI - LAKE NORMAN C&D LANDFILL FACILITY
7099 QUARRY LANE, STANLEY, NC

FACILITY PERMIT NUMBER 55-04

CLOSURE AND POST-CLOSURE PLAN
STORMWATER AND EROSION & SEDIMENT CONTROL DETAILS - SHEET 4
LAKE NORMAN C&D LANDFILL FACILITY

FILENAME 135836C-DT-ES.dwg

BC PROJECT NUMBER 135836

SCALE 1"=80'

DRAWING NUMBER C13

SHEET NUMBER 13 OF 13

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APRIL 12, 2008

7-17-08

# APPENDIX B: CONSTRUCTION QUALITY ASSURANCE PLAN

# CONSTRUCTION QUALITY ASSURANCE PLAN

Prepared for

BFI – Lake Norman C&D Landfill,

Stanley, North Carolina

August 8, 2008

# CONSTRUCTION QUALITY ASSURANCE PLAN

BFI – Lake Norman C&D Landfill, Stanley, North Carolina

August 8, 2008

BROWN AND CALDWELL

309 East Morehead Street, Suite 160

Charlotte, North Carolina 28202

# TABLE OF CONTENTS

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# 1. PROJECT TEAM AND RESPONSIBLITIES

Construction Quality Assurance (CQA) for construction of the Lake Norman Construction and Demolition (C&D) Landfill Closure will be provided by an engineering and testing firm independent of the Contractor specializing in the construction installation observations and testing of soils, geosynthetics, piping, and erosion control measures. Applicable sections of the Technical Specifications shall be adhered to for required construction and testing activities.

## 1.1 CQA Project Team

### 1.1.1 Design Engineer of Record

The Design Engineer of Record (Engineer) is responsible for defining quality assurance requirements compatible with the project objectives, reviewing and approving shop drawings, outlining procedures for the analysis of test data and preparing quality assurance memoranda and quality assurance reports. The Engineer is responsible for design changes (as approved by the State Solid Waste Section), clarifications, and specification addenda. The Engineer also has the ultimate responsibility for approving or disapproving any element of the project. The responsibility to stop work is held by the Owner. CQA documents will be prepared, signed and sealed by the Engineer, assuming the CQA firm is the same as the design firm. The Engineer shall review field and laboratory test data before the data are reported or entered into the data base for analysis. The Engineer will be a registered Professional Engineer in the State of North Carolina and will report to the owner.

### 1.1.2 Construction Quality Assurance Officer

The Construction Quality Assurance Officer (CQAO) will be experienced in quality assurance testing and monitoring. The CQAO will report to the Engineer and can be one and the same individual. The CQAO serves as the on-site representative of the Owner and is responsible for the field implementation of the approved quality assurance program as follows:

- Monitor the quality assurance activities of the field testing and conformance with test procedures and the Technical Specifications;
- Inform the Engineer of non-conformance to the approved CQA program;
- Inventory of geosynthetic materials delivered to site for use on this project;
- Assign and direct field technicians; and,
- Maintain an awareness of the overall field testing operation to identify conditions that may jeopardize the quality of testing.

### 1.1.3 Engineering Technicians

The engineering technicians (technicians) are responsible for field observations and testing under the direction of the CQAO. Technicians will be assigned to the project as deemed necessary by the CQAO. Technicians will be under the direct supervision of the CQAO.

## 1.2 Pre-Construction Meeting

A pre-construction meeting shall be conducted prior to the start of construction. The meeting shall include, but not be limited to, discussion of:

- Project safety;
- The construction management organization;
- Respective duties of the construction management organization and the Contractors;
- Proposed construction schedule;
- Testing requirements and procedures; and,
- The periodic reporting requirements for test results and construction activities.

## 1.3 Progress Meetings

Progress meetings will be held on a weekly basis, or as needed, between the Owner, Engineer, the CQAO, the Contractor, and representatives of other involved parties. The status of the project, planned activities for the following week, and construction-related issues will be discussed.

## 1.4 Troubleshooting Meetings

If problems develop or should deficiencies arise during construction, troubleshooting meetings shall be held between the Owner, Engineer, the CQAO, the Contractor, and representatives of other involved parties. The problem(s) shall be defined and a resolution shall be discussed.

# 2. STRUCTURAL FILL

## 2.1 Material

Structural fill is defined as compacted soil fill required for landfill closure grading including perimeter berms, surface water control systems, roadways or other systems not intended to function as a landfill barrier system. Structural fill may consist of on-site or off-site soils that are free of organic material, refuse or debris and shall be constructed and compacted so as to meet the requirements outlined in Section 02274 of the Technical Specifications.

## 2.2 Construction

Structural fill will be compacted in lifts not exceeding 6 inches compacted thickness. The Engineer may modify maximum allowable lift thickness depending on soil type used, construction equipment and methods employed.

## 2.3 Observations

Prior to fill placement, the base surface or surface of the previous lift shall be visually observed. The borrow soils used for construction shall be monitored to evaluate that they are free of deleterious materials and meet the specification requirements. During fill placement, observations of lift thickness and uniform mixing of soils will be performed.

## 2.4 Testing

The CQAO or his technician representative will monitor the construction of the structural fill and perform field and laboratory tests to verify that the soils and construction methods are capable of meeting the specification performance criteria.

### 2.4.1 In-Place Testing

In-place sampling and testing of the structural fill shall be as follows:

Table 2-1. Structural Fill Laboratory Testing Schedule

| Test | Testing Method | Frequency |
|---|---|---|
| Field Density | ASTM D2937 or<br>ASTM D2922 or<br>ASTM D1556 or | Every 5,000 square feet but no less than one per lift, with at least 1 test per every 300 linear feet of embankment |
| Natural Moisture Content | ASTM D2216 | At every density test location |

### 2.4.2 Laboratory Testing

Laboratory testing will be conducted on samples including:

| Table 2-2. Structural Fill Laboratory Testing Schedule | | |
|---|---|---|
| **Test** | **Testing Method** | **Frequency** |
| Standard Proctor | ASTM D698 | Once per every 10,000 cubic yards at stockpile or borrow area |
| Atterberg Limits | ASTM D4318 | Once per every 10,000 cubic yards at stockpile or borrow area |
| Grain Size with Hydrometer | ASTM D422 | Once per every 10,000 cubic yards at stockpile or borrow area |
| Water (Moisture) Content | ASTM D2216 | Once per every 10,000 cubic yards at stockpile or borrow area |

# 3. LOW PERMEABILITY SOIL BARRIER

The final cover system consists of an 18-inch thick low permeability soil barrier overlain by an 18-inch thick vegetative cover.

## 3.1 Material

The low permeability barrier will consist of on-site or off-site soils meeting the requirements outlined in Technical Specification Section 02278.

## 3.2 Stockpiling, Borrow Area, and Material Approval

Soil material to be used as the low permeability barrier will be approved in advance by the Engineer. Final acceptance is based upon successful completion of CQA testing outlined herein and in the Technical Specifications. Such testing can be performed either during excavation and stockpiling or from existing stockpiles prior to their use.

The procedure for testing during excavation and stockpiling is outlined below:

- Soil will be monitored either at the borrow source or the stockpile area. Unsuitable material will be routed to separate stockpiles consistent with its end use.
- During stockpiling operations, one 50-pound bulk sample will be collected for every 3,000 cubic yards of material stockpiled and tested in accordance with Section 3.4 below.

A test pad shall be constructed in accordance with Technical Specification Section 02278 to evaluate soil suitability and a range of allowable compaction moisture contents.

Approval reports for the material to be used as the low permeability barrier will be prepared by the Engineer and will include a summary of laboratory test data; a drawing showing sample and test locations and limits of stockpile or borrow area investigated; and a summary of construction, sampling and testing methods, and recommendations.

## 3.3 Construction

The low permeability soil barrier will be at least 18 inches thick with a maximum hydraulic conductivity of 1.0 x $10^{-5}$ cm/sec and shall be placed in three 6-inch compacted lifts in accordance with Technical Specification Section 02278. Only soil previously approved by the Engineer will be used in construction of the low permeability barrier. Unsuitable material will be removed prior to acceptance by the Engineer.

Required field density, moisture content, Atterburg limits, and permeability tests will be completed before overlying lifts of soil are placed. The surface preparation, e.g., wetting, drying, scarification, etc., will be completed before the Engineer will allow placement of subsequent lifts.

Moisture content will be monitored by the CQAO or his representative prior to compaction as described in Section 3.4. If the soil is below the specified minimum moisture content, water will be added to the lift and the lift will be disced to distribute the moisture evenly. Conversely, if the soil is above the maximum specified moisture content, the soil shall be disced and dried to within acceptable moisture limits. The surface of each lift will be scarified prior to placement of subsequent lifts.

The thickness of loose lifts will be measured at random locations after spreading and leveling is completed. Final compacted lift thickness should not exceed 6 inches. Lifts will be checked visually for oversized particles which are greater than 1-inch in any dimension. Oversized particles will be identified and removed prior to and during the compaction process.

The exposed surface of the low permeability barrier will be rolled with a smooth drum roller or equivalent at the end of each work day or when required for protection from adverse weather conditions. The low permeability barrier will either be overbuilt a thickness of at least 3 inches or covered with a sacrificial 10 mil plastic sheeting to protect the finished surface from erosion, desiccation, or other damage. Overbuilt conditions are not reflected on construction drawing grading plans.

## 3.4 Testing

The CQAO or his technician will monitor the construction of the low permeability soil barrier and perform field and laboratory tests to verify that the soils and construction methods are capable of meeting the specification performance criteria.

### 3.4.1 In-Place Testing

In-place sampling and testing of the low permeability barrier shall be as follows:

Table 3-1. Low Permeability Soil Barrier In-Place Testing Schedule

| Test | Testing Method | Frequency |
|---|---|---|
| Field Density | ASTM-D-2937 or<br>ASTM-D-2922 or<br>ASTM-D-1556 | 100 foot by 100 foot grid per lift |
| Natural Moisture Content | ASTM-D-2216 | At every density test location and at least once per every 800 cubic yards placed |

### 3.4.2 Laboratory Testing

Laboratory testing will be conducted on samples including:

Table 3-2. Low Permeability Soil Barrier Laboratory Testing Schedule

| Test | Testing Method | Frequency |
|---|---|---|
| Standard Proctor | ASTM-D-698 | Once per every 3,000 cubic yards at stockpile or borrow area |
| Atterberg Limits | ASTM-D-4318 | Once per every 3,000 cubic yards at stockpile or borrow area |
| Grain Size with Hydrometer | ASTM-D-422 | Once per every 3,000 cubic yards at stockpile or borrow area |
| Remolded Permeability | ASTM-D-5084 | Once per every 3,000 cubic yards at stockpile or borrow area |

# 4. GEOTEXTILE

## 4.1 Materials

Geotextile material shall be used for separation and cushioning as part of the passive gas vent system and for soil separation underlayment where coarse aggregate is used.

## 4.2 Geosynthetic Manufacturer and Contractor

The Contractor is the party responsible for installation of the woven or nonwoven geotextile. The Geosynthetic Manufacturer is the party that supplies the geosynthetic products.

### 4.2.1 Manufacturer Submittals

The Contractor shall submit the following as obtained from the Geosynthetic Manufacturer to the CQAO prior to approval or installation:

- Description of MQC Program for testing the geotextile. These tests should include all those presented in Table 1 or Table 2 found in Section 02720 of the Technical Specifications;
- MQC Material Certification for geotextile rolls, resin, and materials used in manufacturing them; and
- Test data for geotextile material and resin. The results of these tests must meet the minimum required physical and hydraulic properties for geotextile specified in Table 1 or Table 2 found in Section 02720 of the Technical Specifications.

### 4.2.2 Contractor Submittals

The Contractor shall submit the following to the Engineer prior to installation for review:

- Proposed sewing details and typical samples of the seam; and
- Representative samples of proposed geotextile material.

The Contractor shall submit the representative samples of the proposed geotextile material within 1week of award of contract.

## 4.3 Geotextile Material Testing

### 4.3.1 Manufacturer Quality Control Testing

The Manufacturer shall sample and test the geotextile material prior to shipment to the site, at minimum frequencies specified in Table 1 or Table 2 found in Section 02720 of the Technical Specifications.

Any geotextile sample that does not comply with the requirements of Section 02720 of the Technical Specifications shall result in rejection of the roll from which the sample was obtained. The Contractor shall replace any rejected roll at no additional cost to the Owner. The Contractor shall require the Manufacturer to sample and test each roll manufactured in the same lot or batch, or at the same time, as the failing roll. Sampling and testing of rolls shall continue until a pattern of acceptable testing results is established.

### 4.3.2 Conformance Testing

The CQAO shall monitor the rolls upon delivery to the site and report observed deviations from the requirements found in Section 02720 of the Technical Specifications to the Contractor. At the Engineer's discretion, the CQAO or his representative may sample rolls from each shipment of geotextile delivered to the site.

## 4.4 Geotextile Installation

Geotextile shall be overlapped a minimum of 6 inches, and no seaming will be required. Any holes or tears in the geotextile shall be repaired with a patch made from the same geotextile with a minimum 12-inch overlap in all directions. The CQAO will observe all repairs.

# 5. HDPE PIPE

HDPE piping shall be used as part of the passive gas vent system and for stormwater and erosion and sediment control structures, and shall conform to the requirements of Section 02623 in the Technical Specifications.

## 5.1 Material

HDPE pipes consist of perforated and non-perforated HDPE piping.

## 5.2 HDPE Pipe Manufacturer and Contractor Submittals

The supplier of the HDPE pipe shall provide the CQAO with the manufacturer's Technical Specifications and quality control information.

## 5.3 HDPE Pipe Installation

Butt fusion welding or mechanical connecting of the pipe shall be observed by the CQAO or his representative.

# 6. AS-BUILT CONDITIONS

The finished lines and grades of the surface of the erosion layer will be presented to the Engineer by the Contractor. Final topographic surveys for the top of subgrade, top of low permeability soil barrier, and top of vegetative soil cover should be performed in the same grid locations as established for density testing, and shall include points at the top and bottom of slopes with a minimum of one point on the slope in between and grade breaks at benches.

As-built location and details of the stormwater systems and passive gas vent locations will also be submitted to the Engineer by the Contractor.

The Contractor shall be responsible for submitting to the Engineer the following:

- Survey drawings verifying that finished lines and grades of the closure cover system have been obtained;
- All material certifications and warranty information for the installed material and equipment;
- Passive gas vent locations;
- Installed stormwater structure elevations and locations; and,
- Survey drawings verifying the depths of low-permeability soil barrier and vegetative soil cover.

# 7. CERTIFICATION REPORT

The certification report will be prepared under the direction of the Engineer and will contain test results and monitoring documentation performed for construction including:

- Low permeability soil barrier, and
- Geotextile installation including, MQC data.

"As-Built" drawings and a narrative of the construction process and CQA activities, including daily reports from the CQAO and documentation of progress meetings, will be included with the certification report. Photographs of key elements for landfill construction shall also be included in the certification report.

The certification report will be submitted within 60 days following completion of construction.

# 8. REFERENCE LIST OF STANDARDS

| Referenced List of Standards | |
|---|---|
| ASTM D422 | Standard Test Method for Particle - Size Analysis of Soils |
| ASTM D698 | Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft 3 ) (600 KN-m/m 3) |
| ASTM D1505 | Standard Test Method for Density of Plastics by the Density Gradient Technique |
| ASTM DI556 | Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method |
| ASTM D2216 | Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass |
| ASTM D2922 | Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth) |
| ASTM D2937 | Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method |
| ASTM D4318 | Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils |
| ASTM D4533 | Test Method for Trapezoidal Tearing Strength of Geotextiles |
| ASTM D4632 | Test Method for Grab Breaking Load and Elongation of Geotextiles |
| ASTM D4716 | Standard Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head |
| ASTM D4751 | Standard Test Method for Determining Apparent Opening Size of a Geotextile |
| ASTM D4833 | Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and other Related Products |
| ASTM D5084 | Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter |
| ASTM D5199 | Standard Test Method for Measuring the Nominal Thickness of Geosynthetics |
| ASTM D5887 | Standard Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter |
| ASTM D5993 | Standard Test Method for Measuring Mass Per Unit of Geosynthetic Clay Liners |
| ASTM D6496 | Standard Test Method for Determining Average Bonding Peel Strength Between the Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners |
| ASTM D6768 | Standard Test Method for Tensile Strength of Geosynthetic Clay Liners |
| ASTM D7005 | Standard Test Method for Determining the Bond Strength (Ply Adhesion) of Geocomposites |

# 9. LIMITATIONS

## 9.1 Report Limitations

This document was prepared solely for BFI—Lake Norman Landfill in accordance with professional standards at the time the services were performed and in accordance with the contract between Allied Waste Industries, Inc. and Brown and Caldwell dated July 11, 2008. This document is governed by the specific scope of work authorized by Allied Waste Industries, Inc.; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by Allied Waste Industries, Inc. and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

# APPENDIX C: TECHNICAL SPECIFICATIONS

LAKE NORMAN C&D LANDFILL
CLOSURE AND POST-CLOSURE PLAN

# LIST OF TECHNICAL SPECIFICATION SECTIONS

DIVISION 17--INSTRUMENTATION AND CONTROLS

NO SECTIONS IN THIS DIVISION

SECTION 02274

STRUCTURAL FILL

## PART 1 – GENERAL

### 1.01 SCOPE OF WORK

The Contractor shall furnish all labor, materials, equipment and incidentals necessary to perform all Structural Fill placement, compaction and grading required to complete the work shown on the Drawings and specified herein. Structural Fill is defined as compacted fill for perimeter berms, surface water control systems, roadways, or other systems not intended to function as closure system barrier. The work shall include backfilling, grading, compaction, and all related work.

### 1.02 RELATED SECTIONS

Section 02278 Low Permeability Soil Barrier

Section 02720 Geotextile Fabric

### 1.03 SUBMITTALS

Samples of the proposed Structural Fill material shall be submitted to testing laboratory in air-tight containers, 50 lb sample of each type of excavated material to determine material.

Contractor shall submit a subgrade elevation survey certified by a Land Surveyor professionally registered in the State of North Carolina.

### 1.04 REFERENCE STANDARDS

A. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):

1. ASTM D421 – Standard Practices for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants.

2. ASTM D422 – Standard test Method for Particle-Size Analysis of Soils (Grain Size with Hydrometer.

3. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3).

4. ASTM D1556 – Standard Test Method for Density of Soil In Place by the Sand-Cone Method.

5. ASTM D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3).

6. ASTM D2216 – Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.

7. ASTM D2922 – Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

8. ASTM D2487 – Standard Practices for Classification of Soil for Engineering Purposes (Unified Soil Classification System)

9. ASTM D2937 – Standard Test Method for Density of Soil in place by the Drive-Cylinder Method Test.

10. ASTM D4318 – Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

Where reference is made to one of the above standards, the revision in effect at the time of construction shall apply.

## 1.05 QUALITY ASSURANCE

The CQA Consultant shall provide direction and testing for the quality assurance testing during earthwork operations.

# PART 2 – PRODUCTS

## 2.01 STRUCTURAL FILL MATERIALS

Fill materials shall consist of excavated and reused material from designated on-site or off-site borrow areas and/or stockpiles. Structural Fill material shall be classified as SP, SM, SW, SC, SW-SM, SW-SC, SP-SM, ML, MH, CH or CL soils according to the Unified Soil Classification System (ASTM D2487).

Material shall be free of topsoil, organic material, roots, stumps, brush, rocks larger than 1 inch, subsoil, debris, vegetation, and other foreign matter.

All material clods will be broken down with tillers and/or discs to provide a homogeneous soil that is free of clay clods greater than 4 inches in diameter with no more than 15% retained on the No. 4 sieve.

Borrow area(s) shall be final graded to slopes as shown on the Drawings.

PART 3 – EXECUTION

3.01 EXAMINATION

The Engineer will assist the Contractor in the determination of Structural Fill material during excavation operations.

The Contractor will be responsible for excavating, transporting, stockpiling, placing and compacting all materials as needed.

3.02 SUBGRADE PREPARATION

Subgrade shall be compacted to density requirements for subsequent backfill materials.

Cut out soft areas of subgrade not capable of compaction in place, backfill with Structural Fill, and compact to density equal to or greater than requirements for subsequent fill material.

Grade surface shall be scarified to depth of 6 inches.

Grade will be proof rolled to identify soft spots; where applicable, fill and compact to density equal to or greater than requirements for subsequent fill material.

3.03 STRUCTURAL FILL PLACEMENT

A. Areas shall be backfilled to contours and elevations as shown on Drawings with unfrozen materials.

B. Backfill shall be placed systematically to allow maximum time for natural settlement and should not be placed over porous, wet, frozen or spongy subgrade surfaces.

C. Structural fill material shall be placed and compacted in equal continuous layers not exceeding 6 inches compacted depth. Manually compacted fill near pipes and other structures will be compacted in loose lifts not exceeding 4 to 6 inches in thickness. Structural Fill over geosynthetic materials shall be compacted by tracking with a low ground pressure bulldozer or other approved equipment with a ground pressure of less than 5 psi.

D. Optimum moisture content of Structural Fill materials shall be maintained to attain required compaction density.

E. Structural Fill shall only be placed against supported structures. Do not backfill against unsupported structures. Backfill simultaneously on each side of unsupported structures until supports are in place.

F. Structural Fill shall be protected from desiccation, crusting, or cracking.

G. Gradual grade changes shall be made.

H. Surplus Structural Fill materials shall be removed from site unless authorized by Owner to dispose of on-site in an Owner designated location.

## 3.04 FIELD QUALITY CONTROL

A. LABORATORY TESTING:

1. Perform laboratory material tests in accordance with ASTM D422, ASTM D698 or ASTM D 1557, ASTM D2216, and ASTM D4318.
2. Test at a frequency of:
    - 10,000 cubic yards of Structural Fill material placed;
    - When materials using for Structural Fill change; and/or
    - As directed by the Engineer.
3. Sample size shall be 50-lb.

B. IN PLACE COMPACTION AND NATURAL MOISTURE CONTENT TESTS:

1. In place compaction tests shall be performed in accordance with ASTM D1556, ASTM D2922, or ASTM D2937. If nuclear methods are to be used (ASTM D2922), conforming tests shall be performed at a minimum frequency of 1 test per every 10 tests using ASTM D1556 or ASTM D2937.

2. In place natural moisture content tests shall be performed in accordance with ASTM D2216.

3. Test at a frequency of 1 per 5000 sq. ft. with at least 1 test per every 300 linear feet of embankment.

C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

## 3.05 TOLERANCES

The top surface of Structural Fill shall be plus or minus 1 inch from required elevations.

## 3.06 PROTECTION

Reshape and re-compact fills subjected to vehicular traffic.

**END OF SECTION**

SECTION 02277

AGGREGATE

PART 1 – GENERAL

1.01 SCOPE OF WORK

The Contractor shall furnish all labor, materials, equipment and incidentals necessary to place aggregate materials for fill, drainage, and grading purposes. The work shall include supplying aggregate materials, hauling, stockpiling, and placement.

1.02 RELATED SECTIONS:

Section 02274 Structural Fill

Section 02278 Low Permeability Soil Barrier

Section 02623 High Density Polyethylene (HPDE) Pipe

Section 02720 Geotextile Fabric

Section 02722 Geocomposite

Section 02800 Passive Gas Vents

1.03 SUBMITTALS

Submit name of imported materials suppliers and description of material.

Manufacturer's Certification that materials meet or exceed specific requirements.

1.04 REFERENCE STANDARDS

A. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO):

1. AASHTO T11 – Standard Method of Test for Materials Finer than 75 μm (No. 200) Sieve in Mineral Aggregates by Washing.

2. AASHTO T27 – Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates.

B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):

1. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregate.

2. ASTM D421 – Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants.

3. ASTM D422 – Standard Test Method for Particle Size Analysis of Soils.

4. ASTM D1556 – Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.

5. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 10 lb Rammer and 18 inch Drop.

6. ASTM D2487 – Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

7. ASTM D3042 – Standard Test Method for Insoluble Residue in Carbonate Aggregate.

8. ASTM D4253 – Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

9. ASTM D4254 – Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

10. ASTM D4373 – Standard Test Method for Calcium Carbonate Content of Soils.

Where reference is made to one of the above standards, the revision in effect at the time of construction shall apply.

## 1.05 QUALITY ASSURANCE

Furnish each aggregate material from single source throughout the Work.

Perform Work in accordance with North Carolina Department of Transportation (NCDOT) Standard Specifications for Roads and Structures.

## PART 2 – PRODUCTS

### 2.01 AGGREGATE MATERIALS

Drainage Aggregate shall be subangular, subrounded, or well rounded particle shaped conforming to No. 57 NCDOT standards. Drainage Aggregate shall be used for pipe vent construction.

Road Subbase Aggregate shall conform to ABC Stone NCDOT standards.

Rock Rip Rap Aggregate shall be placed in locations shown on the Drawings and shall conform to:

1. $D_{50}$ = 4" Class A Riprap NCDOT standards,
2. $D_{50}$ = 8" Class B Riprap NCDOT standards,
3. $D_{50}$ = 10" Class 1 Riprap NCDOT standards, or
4. $D_{50}$ = 14" Class 2 Riprap NCDOT standards.

### 2.02 CONFORMANCE TESTING

Initial conformance testing shall be performed on samples from the source to assure compliance with the specifications. Perform tests in accordance with ASTM C136, ASTM D421, ASTM D422, ASTM D2434, ASTM 3042, ASTM D4253, ASTM D4254, ASTM D4373, AASHTO T11, and/or AASHTO T27.

## PART 3 – EXECUTION

### 3.01 PREPARATION

Installation of the underlying geotextile shall be inspected and approved by the CQA Consultant.

### 3.02 AGGREGATE PLACEMENT

Equipment shall only be operated over previously placed material layers. Equipment shall not be operated directly on geotextile or other geosynthetic material.

## 3.03 FIELD QUALITY CONTROL FOR ROAD SUBBASE

Compaction testing shall be performed in accordance with ASTM D1556, ASTM D1557, ASTM D698, AASHTO T180, ASTM D2167, ASTM D2922, and/or ASTM D3017.

Compaction testing shall be performed at a minimum of one per 2,500 square feet of material placed, and one correction test per compacted lift.

Compact placed materials to achieve compaction of 100 percent.

If tests indicate work does not meet specified requirements, Contractor shall be responsible for removing work, replacing material, and retesting.

## 3.04 TOLERANCES

The top of aggregate shall be within a tolerance of plus 1 inch from the required elevation.

## 3.05 PROTECTION

Any damage to the underlying geosynthetic components or other work performed as part of this project shall be repaired and re-tested in accordance with these specifications at no additional cost to the Owner.

## 3.06 INSPECTION

Verify installation of geotextile has been inspected and approved by the CQA Consultant prior to placement.

**END OF SECTION**

SECTION 02278

LOW PERMEABILITY SOIL BARRIER

## PART 1 – GENERAL

### 1.01 SCOPE OF WORK

The Contractor shall furnish all labor, materials, equipment and incidentals necessary to perform all low permeability soil barrier placement, compaction and grading required to complete the work shown on the Drawings and specified herein. The work shall include backfilling, grading, compaction, and all related work.

### 1.02 RELATED SECTIONS

Section 02274 Structural Fill

Section 02277 Aggregate

### 1.03 SUBMITTALS

Samples of the proposed low permeability soil barrier material shall be submitted to testing laboratory in air-tight containers, 50 lb sample of each type of excavated material to determine material.

Contractor shall submit a low permeability soil barrier record survey certified by a Land Surveyor professionally registered in the State of North Carolina to verify and document the thickness.

### 1.04 REFERENCE STANDARDS

A. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):

1. ASTM D421 – Standard Practices for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants.

2. ASTM D422 – Standard test Method for Particle-Size Analysis of Soils (Grain Size with Hydrometer).

3. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3).

4. ASTM D1556 – Standard Test Method for Density of Soil In Place by the Sand-Cone Method.

5. ASTM D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3)

6. ASTM D2216 – Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.

7. ASTM D2922 – Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

8. ASTM D2487 – Standard Practices for Classification of Soil for Engineering Purposes (Unified Soil Classification System).

9. ASTM D2937 – Standard Test Method for Density of Soil in place by the Drive-Cylinder Method Test.

10. ASTM D4318 – Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

Where reference is made to one of the above standards, the revision in effect at the time of construction shall apply.

## 1.05 QUALITY ASSURANCE

The CQA Consultant shall provide direction and testing for the quality assurance testing during earthwork operations.

# PART 2 – PRODUCTS

## 2.01 LOW PERMEABILITY SOIL BARRIER MATERIALS

Materials shall consist of excavated and reused material from designated on-site or off-site borrow areas and/or stockpiles. Low permeability soil barrier material shall be classified as SC, CL, CH, ML, or MH soils according to the Unified Soil Classification System (ASTM D2487).

Material shall be free of topsoil, organic material, roots, stumps, brush, rocks larger than 1 inch, subsoil, debris, vegetation, and other foreign matter.

All material clods will be broken down with tillers and/or discs to provide a homogeneous soil that is free of clay clods greater than 4 inches in diameter with no more than 15% retained on the No. 4 sieve.

Material shall have a maximum permeability of $1x10^{-5}$ cm/s.

## PART 3 – EXECUTION

### 3.01 EXAMINATION

The Engineer will assist the Contractor in the determination of low permeability barrier soil material during excavation operations.

The Contractor will be responsible for excavating, transporting, stockpiling, placing and compacting all materials as needed.

### 3.02 SUBGRADE (INTERMEDIATE COVER) PREPARATION

A. Subgrade shall be compacted to density requirements for subsequent backfill materials.

B. Cut out soft areas of subgrade not capable of compaction in place, backfill with intermediate cover soils, and compact to density equal to or greater than requirements for subsequent fill material.

C. Grade surface shall be scarified.

D. Grade will be proof-rolled to identify soft spots; where applicable, fill and compact to density equal to or greater than requirements for subsequent fill material.

### 3.03. TEST PAD CONSTRUCTION:

1. A test pad 35 feet x 100 feet in area shall be constructed inside or outside the landfill footprint using the same construction methods, equipment and soil material to be used for the low permeability soil barrier installation.

2. The completed construction of the test pad must precede the beginning of placement of the low permeability soil barrier.

3. Compaction and soil moisture content shall be in accordance with Part 3.03 of this Section.

4. Low permeability barrier soil material shall be placed in three or more compacted lifts of 6-inch maximum thickness for a total thickness of 18 inches.

5. A minimum of six undisturbed samples will be obtained in the test pad by the Engineer or his representative at a frequency of two samples per lift. Laboratory tests will be performed on the undisturbed or remolded samples to document the soil's characteristics and to verify that the material, construction methods, and equipment can achieve required permeability per section 2.01. The following tests shall be conducted at a frequency of 1 test per lift:

a. Atterberg Limits Test (ASTM D4318)
b. Grain Size with Hydrometer (ASTM D422)
c. Remolded Permeability (ASTM D5084
d. Undisturbed Permeability (ASTM D5084)
e. Standard Proctor Test (ASTM D698)

6. Field moisture and field density tests will also be performed by the Engineer or his representative during soil placing and compaction to document the conditions obtained by the construction method, equipment and material to correlate with the required permeability for the low permeability soil barrier test pad.

   a. Field Density Test (ASTM D2937) at frequency of 3 tests per lift.
   b. Natural Moisture Content Test (ASTM D2216) at frequency of 3 tests per lift.

## 3.04 LOW PERMEABILITY SOIL BARRIER PLACEMENT

A. Areas shall be backfilled to contours and elevations as shown on Drawings with unfrozen materials.

B. Material shall be placed systematically to allow maximum time for natural settlement and should not be placed over porous, wet, frozen or spongy subgrade surfaces.

C. Material shall be placed and compacted in equal continuous layers not exceeding 6 inches compacted depth. Manually compacted fill near pipes and other structures will be compacted in loose lifts not exceeding 4 to 6 inches in thickness.

D. Lift thickness may be sampled upon completion (but prior to subsequent lift placement) by hand augering through the lift and measuring the thickness. The resulting penetration shall be promptly backfilled by the Contractor with a hand tamped clayey soil mixture of one part bentonite and three parts low permeability soil barrier material.

E. Samples of the in-place low permeability soil barrier material shall be tested and evaluated in accordance with provisions of the Construction Quality Assurance Plan and Part 3.04 of this Section prior to final acceptance of the low permeability soil barrier. All compaction or permeability test locations shall be filled with a mixture of one part bentonite and three parts low permeability soil barrier material.

F. Equipment or truck traffic shall not be permitted on previous fill lifts during the period between scarifying and compaction of a new fill lift unless approved by the Engineer.

G. After the lift to be compacted is conditioned, representative samples will be taken by the Engineer or his representative and tested for moisture content prior to any compactive efforts. If the moisture content is within the range specified in Part 3.04B of this Section, compaction may begin. If the moisture content is outside of this range, the low permeability soil barrier fill shall be wetted or dried and reworked accordingly. The low permeability soil barrier fill should be sprinkled or sprayed with water, utilizing equipment creating a uniform application and dozed, wind-rowed, and/or disc-plowed to uniformly increase the moisture content of the low permeability soil barrier if the material moisture content is too low. The low permeability soil barrier fill shall be dozed, wind-rowed, and/or disc-plowed to help air dry the soil if the moisture content is too high.

H. Each lift shall be thoroughly compacted and satisfy the moisture and density criteria established from the test pad results. Field testing shall be completed according to Part 3.04B of this Section before a subsequent lift is placed.

I. At the end of each construction day's activities, completed lifts or sections shall be sealed by rolling with rubber tired or smooth drum rollers and sprinkled with water, as needed, to avoid excessive cracking.

J. After completion of a segment of low permeability soil barrier, but before installation of the overlying materials, the surface shall be surveyed by the Contractor to ensure the specified thickness (minimum of 18 inches).

K. Material shall only be placed against supported structures. Do not backfill against unsupported structures. Backfill simultaneously on each side of unsupported structures until supports are in place.

L. Material shall be protected from desiccation, crusting, or cracking.

M. Gradual grade changes shall be made.

N. Surplus materials shall be removed from site unless authorized by Owner to dispose of on-site in an Owner designated location.

3.05 FIELD QUALITY CONTROL

A. LABORATORY TESTING:

1. Perform laboratory material tests in accordance with ASTM D422, ASTM ASTM D 1557, ASTM D2216, and ASTM D4318.

2. Test at a frequency of:
   - 3,000 cubic yards of material placed;

- When materials using for low permeability soil barrier change; and/or
- As directed by the Engineer.

3. Sample size shall be 50-lb.

4. Low permeability soil barrier material must achieve the required permeability per section 2.01 in accordance with laboratory testing.

   a. Bulk samples will be taken by the Engineer at intervals of 1 sample per 3,000 cubic yards of material to be placed. Samples will be transported to a soils laboratory for permeability testing. The samples will be compacted to at least 95 percent of standard Proctor at moisture contents similar to field conditions and/or subsequently specified based on laboratory results.
   b. Undisturbed Permeability Tests will be performed as directed by the Engineer. Areas that are not consistent in density, moisture content, or classification with previously approved low permeability soil barrier material will require additional undisturbed permeability testing of the in-place low permeability soil barrier material prior to final acceptance.
   c. The Engineer may request an in-situ permeability test to be performed on the in-place low permeability soil barrier material if the material being placed is not consistent with the material previously tested and approved for construction.

B. IN PLACE COMPACTION AND NATURAL MOISTURE CONTENT TESTS:

1. In place compaction tests shall be performed in accordance with ASTM D1556, ASTM D2922, or ASTM D2937. If nuclear methods are to be used (ASTM D2922), conforming tests shall be performed at a minimum frequency of 1 test per every 10 tests using ASTM D1556 or ASTM D2937.

2. In place natural moisture content tests shall be performed in accordance with ASTM D2216.

3. Test compaction and moisture content at a minimum frequency of 1 per every 100-foot by 100-foot grid per lift.

When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

## 3.06 TOLERANCES

The top surface of the low permeability soil barrier shall be plus or minus 1 inch from required elevations.

3.07 PROTECTION

Reshape and re-compact fills subjected to vehicular traffic. If excessive dessication cracking becomes evident, the surface will require rewetting and rerolling prior to placement of overlying materials.

**END OF SECTION**

SECTION 02623

HIGH DENSITY POLYETHYLENE (HDPE) PIPE

## PART 1 – GENERAL

### 1.01 SCOPE OF WORK

The Contractor shall furnish all labor, materials, equipment and incidentals required to install high density polyethylene (HDPE) pipe for passive gas vent system.

### 1.02 RELATED SECTIONS

Section 02274 Structural Fill

Section 02278 Low Permeability Soil Barrier

Section 02800 Passive Gas Vents

### 1.03 SUBMITTALS

A. SHOP DRAWINGS:

Submit shop drawings for HDPE Pipe. Indicate piece numbers and locations.

B. PRODUCT DATA:

The Contractor or Supplier shall submit a complete description of and data indicating pipe material used, and pipe accessories and fittings proposed for use to the Engineer for approval at least two weeks prior to installation. Pipe data shall conform to the standards set in Table 1 of this Section.

C. Shop drawings for fabricated fittings shall be submitted to the Engineer at least 2 weeks prior to fabrication for approval.

D. MANUFACTURER'S CERTIFICATES:

a. Certification of the analysis for the HDPE resin.
b. Certify products meet or exceed specified requirements specified in Table 1 of this section.
c. Certifications must be submitted to Engineer for approval at least 2 weeks prior to installation.

E. Manufacturer's Installation Instructions: Indicate special procedures required to install products specified.

## 1.04 REFERENCE STANDARDS

A. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):

1. ASTM D1055 - Standard Specifications for Flexible Cellular Materials – Latex Foam.

2. ASTM D1238 - Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.

3. ASTM D1248 - Standard Specification for Polyethylene Plastics Extrusion Materials For Wire and Cable.

4. ASTM D1505 - Standard Test Method for Density of Plastics by the Density-Gradient Technique.

5. ASTM D2513 - Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.

6. ASTM D2657 - Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.

7. ASTM D2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.

8. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fitting Materials.

9. ASTM F714 - Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

10. ASTM F1055 - Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.

Where reference is made to one of the above standards, the revision in effect at the time of construction shall apply.

## 1.05 QUALITY ASSURANCE

A. The pipe, outlet structure, and/or fitting manufacturer's production facilities shall be open for inspection by the owner or his designated agents with a reasonable advanced notice.

B. During inspection, the manufacturer shall demonstrate that it has facilities capable of manufacturing and testing the pipe, manholes, sumps and/or fittings to standards required by this Specification.

C. Pipe which has been tested by the manufacturer and falls outside of the appropriate limits set forth in Table 1 contained in this specification will be cause for rejection.

D. The owner or the specifying engineer may request certified lab data to verify the physical properties of materials not meeting the requirements of this specification.

## 1.06 DELIVERY

Delivered pipes shall be examined by the Contractor and the CQA Consultant or Engineer. The Engineer or CQA Consultant shall verify that pipes are not broken, cracked, or contain otherwise damaged or unsatisfactory material.

# PART 2 – PRODUCT

## 2.01 HDPE PIPE

A. BASE RESIN (HDPE MATERIAL):

1. HDPE material used for the manufacture of HDPE pipe and fittings under this specification shall be produced from approved pipe material base resin that is high density, high molecular weight polyethylene (HDPE) pipe grade resin with the nominal physical properties:

   a. Equivalent to Type III, Category 5, Class C, Grade PE 3408 in accordance with ASTM D1248.
   b. Equivalent to cell classification PE345464C in accordance with ASTM D3350.
   c. As outlined in Table 1 below.

2. The material shall be listed by PPI (Plastics Pipe Institute, a division of the Society of the Plastics Industry) in PPI TR-4 with a 73°F hydrostatic design basis of 1,600 psi and a 140°F hydrostatic design basis of 800 psi. The PPI listing shall be in the name of the pipe manufacturer and shall be based on ASTM D 2837 testing.

3. The resin shall contain not less than 97% of the base polymer and not less than 2% carbon black as defined in ASTM D1248, Class C to impart maximum weather resistance.

4. The pipe material shall contain no more than 3% carbon black, anti-oxidants, and heat stabilizers combined, and no other additives, fillers or extenders.

5. The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same raw material, including both the base resin and the coextruded resin.

B. PHYSICAL APPEARANCE:

1. All pipes shall have good appearance qualities.

2. The pipe shall be homogeneous throughout and the surfaces shall be smooth and uniform with no visible defects.

3. The pipes shall be free of visible cracks, holes, voids, nicks, cuts, gouges, scratches, blisters, gels, undispersed ingredients, any signs of contamination by foreign inclusions, or other defects that may affect the wall integrity or the pipe's serviceability.

4. Holes for perforated HDPE pipes shall be cleanly cut, identical in geometry, and evenly spaced.

C. PHYSICAL PROPERTIES:

1. Pipe and fitting dimensions, workmanship, standard dimension ratio (SDR) and corresponding pressure rating shall be in accordance with the requirements of ASTM F714.

2. HDPE piping shall have a Standard Dimension Ratio (SDR) of 26 unless otherwise specified on the Drawings.

3. Pipe supplied under this Specification shall have a nominal OD indicated on the Drawings unless otherwise specified.

4. The chemical and corrosion resistance of the PE pipe and all fittings shall be in keeping with typical properties of high quality polyethylene products currently available through commercial sources.

5. All mechanical fasteners or fittings shall be stainless steel.

6. At a minimum, the pipe material shall meet the properties presented in Table 1 below:

**TABLE 1**
**REQUIRED PIPE AND BASE RESIN PHYSICAL PROPERTIES**

| Property | Test Method | Unit | Nominal Value |
|---|---|---|---|
| Material Designation | PPI-TR4 | | PE 3408 |
| Cell Classification | ASTM D3350 | | 345464C |
| Material Classification | ASTM D1248 | | Type III, Category 5, Class C |
| Density | ASTM D1505 | | ≥ 0.945 g/cm$^3$ |
| Melt Index | ASTM D1238 (Condition E) | g/10min | <0.1 |
| Carbon Black Content/Color; UV Stabilzer | ASTM D1603 | % range | 2 to 3 |
| Flexural Modulus | ASTM D790 2% Secant | psi | >125,000 |
| Tensile Strength @ Ultimate | ASTM D638 | psi | 3,200 |
| Tensile Strength @Yield | ASTM D638 (Type IV, 2 ipm) [1] | psi | >3,000 |
| Elongation @ Yield | ASTM D638 (Type IV, 2 ipm) [1] | % | >8 |
| Ultimate Elongation @ Break | ASTM D638 | % | >750 |
| Modulus of Elasticity | ASTM D638 (Type IV, 2 ipm) [1] | Psi | >100,000 |
| Environmental Stress Crack Resistance (ESCR) | ASTM D1693 $F_o$, Condition C | Hrs | >5,000 |
| Hardness | ASTM D2240 | Shore "D" | >60 |
| Compressive Strength at Yield | ASTM D695 | Psi | >1,600 |
| Slow Crack Resistance (SCG) (PENT test) | ASTM F1473 | Hours | >100 |
| Hydrostatic Design Basis @ 73.4°F (23°C) & 140°F (60°C) | ASTM D2837 | Psi | >1,600 &>800 |
| Low Temperature Brittleness | ASTM D746 | °F(°C) | < - 180 (-117) |
| Linear Thermal Expansion Coefficient | ASTM D696 | in/in/°F | 9 x 10$^{-5}$ |

Notes:
1. Dumb-bell tested at a rate of strain of 2 inches/minute (ipm)

D. PIPE FITTINGS:

1. All fittings specified on the Drawings, or otherwise, needed to make pipe connections (ex: 90° elbow) shall be in accordance with ASTM D2513 and ASTM D3261 and shall be manufactured by injection molding, a combination of extrusion and machining, or fabrication from HDPE pipe conforming to this specification.

2. The fittings shall be fully pressure rated and provide a working pressure equal to that of the pipe with an included 2:1 safety factor.

3. The fittings shall be manufactured from the same base resin type and cell classification as the pipe itself as specified in Parts 2.01A, 2.01B, and 2.01C of this section. The fittings shall be homogeneous throughout and free from cracks, holes, foreign inclusions, voids, or other injurious defects.

4. Molded socket fittings shall not be used.

5. Pre-fabricated fittings:

   a. Shall not be permitted unless molded fittings are not available from the pipe Manufacturer, and only after obtaining specific approval from the Engineer.
   b. Shall be made using pipe segments meeting all base resin, physical, and property requirements presented in Parts 2.01A, 2.01B, and 2.01C of this section.
   c. All pipe segments in a pre-fabricated fitting shall be pressure rated to exceed by 20% the highest pipe pressure rating to which they are intended to be connected.

E. HDPE JOINTS:

1. The method of joining for high density polyethylene pipe shall be the heat butt fusion method of high density polyethylene pipe per ASTM D2657 and shall be performed in strict accordance with the pipe manufacturer's recommendations, subject to the Engineer's approval. The heat fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer.

2. All joints shall be made by trained technicians qualified by the Manufacturer and using equipment and controlled procedures approved by the Manufacturer.

3. All pipe joints shall be stronger than the pipe itself under both tension and hydrostatic loading conditions.

4. The joints shall be leak-tight, homogeneous and uniform throughout.

5. Properly executed electrofusion fittings may be used. Extrusion welding or hot gas welding of HDPE shall not be used for pressure pipe applications or fabrications where shear or structural strength is important, as determined by the Engineer. Mechanical joint adapters, flanges, unions, grooved-couplers, transition fittings, and some mechanical couplings may be used to mechanically connect HDPE pipe. Refer to the manufacturer's recommendations.

F. PERFORATED PIPES:

1. The HDPE pipe sections shall be perforated as shown on the Drawings.

2. Perforations shall be cleanly cut, identical in geometry, and evenly spaced.

G. IDENTIFICATION:

1. The following shall be continuously indent printed on the pipe, or spaced at intervals not exceeding 5 feet:

a. Name and/or trademark of the pipe manufacturer.
b. Pipe series designation.
c. Nominal pipe size.
d. Standard dimension ratio (SDR).
e. The letters PE followed by the polyethylene grade per ASTM D1248, followed by the Hydrostatic Design basis in 100's of psi (e.g., PE 3408).
f. Manufacturing Standard Reference (e.g., ASTM F714-1).
g. A production code from which the date and place of manufacture can be determined.

## PART 3 – EXECUTION

### 3.01 EXAMINATION

Verify passive gas vent location is ready to receive work and excavations, dimensions, and elevations are as indicated on the Drawings.

### 3.02 INSTALLATION

A. PIPE AND OUTLET STRUCTURES:

1. Excavate to accommodate installation of passive gas vent system.

2. Place bedding material at trench bottom, level materials in continuous layer not exceeding 8 inches (if applicable).

3. Maintain optimum moisture content of bedding material to attain required compaction density.

4. Install pipe, fittings, and accessories in accordance with the Drawings, these Specifications, and the Manufacturer's recommendations.

5. Route piping in straight line.

6. Pipe shall be fused in lengths not to exceed that which can be moved and placed easily and safely, causing no damage to the fused pipe or welds.

7. Care shall be taken not to drop the pipe while moving it, and to avoid excess stress or strain during installation.

8. Pipe installation and placement of backfill around pipes shall be performed when the pipe is in a contracted state, i.e., during the cool of the morning, at night, or during periods of over-cast skies.

9. Install bedding at sides of pipe as shown on the Drawings.

10. Immediately after placement, the pipe shall be thoroughly and completely embedded and supported.

11. HDPE pipe shall be joined using butt fusion. All butt fusion welds shall be made as described in ASTM D 2657. Electrofusion welding can be used for making pipe welds. Hot air and extrusion welding are not permitted for pipe joining.

B. MISCELLANEOUS HDPE ITEMS:

Install in accordance with the Drawings and the Manufacturer's recommendations.

## 3.03 FIELD QUALITY CONTROL

The Engineer or his representative will undertake observations and inspections to determine compliance of the materials and work with this Specification.

Quality control by the Engineer will include monitoring and/or inspecting:

1. The HDPE pipe and fittings for correct size, SDR rating workmanship, and fabrication.
2. Damage during installation.
3. The installation, alignment and welding of all pipe, and fittings.

Contractor shall request inspection prior to and immediately after placing bedding.

## 3.04 PROTECTION

Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress. Care shall be exercised during construction not to damage the pipes and fittings.

**END OF SECTION**

## SECTION 02720

## GEOTEXTILE FABRIC

### PART 1 – GENERAL

### 1.01 SCOPE OF WORK

The Contractor shall furnish all labor, materials, equipment and incidentals required to install filter fabric complete as shown on the Drawings and as specified herein.

### 1.02 RELATED SECTIONS

Section 02274 Structural Fill

Section 02277 Aggregate

Section 02722 Geocomposite

Section 02800 Passive Gas Vents

### 1.03 SUBMITTALS

A list of guaranteed "minimum average role value" (MARV) properties for the type of geotextile to be supplied.

Written certification signed by the manufacturer that the geotextiles properties meet or exceed the guaranteed MARV.

Manufacturer's quality control certificates illustrating that minimum required material properties have been obtained.

### 1.04 REFERENCE STANDARDS

A. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):

1. ASTM D4491 – Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
2. ASTM D4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
3. ASTM D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

4. ASTM D4751 – Standard Test Method for Determining Apparent Opening Size of a Geotextile.

5. ASTM D4759 – Standard Practice for Determining the Specification Conformance of Geosynthetics.

6. ASTM D4833 – Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

7. ASTM D5261 – Standard Test Methods for Mass Per Unit Area (Weight) of Fabric.

Where reference is made to one of the above standards, the revision in effect at the time of the work shall apply.

## 1.05 FABRIC APPLICATIONS

The non-woven geotextile is to be used for the passive gas vent system and placement beneath drainage features as shown on the Drawings.

The woven geotextile is to be used for placement beneath the access road stone base.

The unit weights of the filter fabric for each application shall be as specified on the Drawings.

## 1.06 DELIVERY, STORAGE AND HANDLING

The geotextile shall be shipped, stored and handled in accordance with manufacturer's recommendations and as specified herein.

The geotextile shall be stored in an area protected from ultraviolet light, precipitation, snow or other inundation, mud, dirt, dust, puncture, cutting, or any other damaging or deleterious conditions.

Geotextile shall not be exposed to precipitation prior to installation. During cold weather events, the non-woven geotextile shall be protected from freezing.

The CQA Consultant shall observe rolls upon delivery and prior to installation. Any deviations from the storage requirements shall be reported to the Engineer and Owner.

## 1.07 MATERIALWARRANTY

The manufacturer shall warrant the material against manufacturing defects and material degradation for a period of twenty (20) years from the date of installation. The manufacturer shall replace any material, which fails within the warranty period. The manufacturer shall furnish a written warranty covering the requirements of this Paragraph.

## PART 2 – PRODUCTS

### 2.01 GENERAL

The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration. Any manufacturer's materials shall be allowed, provided they meet the minimum average roll value requirements.

### 2.02 MATERIALS

All non-woven geotextile shall be a non-woven needle punched polypropylene fabric consisting of filaments formed into a stable network, such as Nicolon Mirafi or approved equal.

All woven geotextile shall be comprised of 100 percent high strength polypropylene.

The unit weight of the non-woven geotextile shall be a specified on the Drawings.

The geotextile shall be nonbiodegradable, nonreactive within a pH range of 3 to 11, resistant to ultraviolet light exposure, and resistant to insects and rodents. Test results from any sampled roll in the lot, when tested in accordance with ASTM D4759, shall meet or exceed the values listed in Tables 1 and 2.

**Table 1. Minimum Average Roll Values Geotextile Fabrics**

| | | | **Minimum Average Roll Values** | | |
|---|---|---|---|---|---|
| **Properties** | **Test Method** | **Unit** | **6 oz./sy** | **8 oz./sy** | **10 oz./sy** |
| Mass Per Unit Area | ASTM D5261 | $oz/yd^2$ | 5.5 | 7.2 | 9.2 |
| Grab Tensile Strength | ASTM D4632 | lbs | 150 | 205 | 250 |
| Grab Elongation | ASTM D4632 | % | 50 | 50 | 50 |
| Puncture Resistance | ASTM D4833 | lbs | 90 | 95 | 125 |
| Trapezoidal Tear Strength | ASTM D4533 | lbs | 70 | 80 | 100 |
| Apparent Opening Size | ASTM D4751 | sieve size | 70-100 | 70-100 | 70-120 |
| Permittivity | ASTM D4491 | $Sec^{-1}$ | 1.05 | 1.05 | 1.3 |

**Table 2. Minimum Average Roll Values Woven Geotextile Fabrics**

| | | | **Minimum Average Roll Values** |
|---|---|---|---|
| **Properties** | **Test Method** | **Unit** | **8 oz./sy** |
| Mass Per Unit Area | ASTM D5261 | $oz/yd^2$ | 7.2 |
| Grab Tensile Strength | ASTM D4632 | lbs | 300 |
| Grab Elongation | ASTM D4632 | % | 15 |
| Puncture Resistance | ASTM D4833 | lbs | 120 |
| Trapezoidal Tear Strength | ASTM D4533 | lbs | 65 |

## 2.03 QUALITY CONTROL DOCUMENTATION

Prior to installation, the Contractor or Owner shall provide the following information certified by the manufacturer for the delivered fabric to the CQA Consultant.

Each roll delivered to the Project site shall have the following identification information:

1. Manufacturer's name
2. Product identification
3. Lot Number
4. Thickness
5. Mass per unit area
6. Roll number
7. Roll weight
8. Roll dimensions

Quality control certificates, signed by the manufacturer's quality assurance manager. Each certificate shall have roll identification number, sampling procedures, frequency, and test results. At a minimum, the geotextile test results shall be provided every 100,000 square feet of manufactured fabric in accordance with test requirements specified in Tables 1 and 2.

# PART 3 – EXECUTION

## 3.01 PREPARATION

Prior to installation, the subgrade shall be inspected and approved by the CQA consultant. The subgrade shall be smooth, uniform and compacted for the installation of the geotextile.

## 3.02 INSTALLATION

The subgrade shall be maintained in a smooth, uniform and compacted condition during installation of the non-woven geotextile. Overlap between adjacent panels of non-woven geotextile shall be a 3 to 6 inches, and no seaming will be required.

Geotextile for roadways shall be anchored with 1/16-inch diameter pins, at least 18 inches long, pointed at one end and have a head that will retain a steel washer having an outside diameter of no less than 1.5 inches, unless otherwise approved by the Engineer.

## 3.03 FIELD QUALITY CONTROL

Geotextile installation and related work shall be inspected by the CQA Consultant. All work in the system therein being inspected shall be complete, clean and ready for use.

Discrepancies shall be noted by the CQA Consultant and repaired by the Contractor at no additional expense to the owner. Final acceptance of the system shall be contingent upon the approval of the Engineer.

**END OF SECTION**

SECTION 02800

PASSIVE GAS VENTS

PART 1 – GENERAL

1.01 SCOPE OF WORK

The Contractor shall furnish all labor, materials, equipment and incidentals necessary to install all Passive Gas Vents as shown on the Drawings and specified herein. The work shall include excavating, placing non-woven geotextile filter, drainage aggregate, installation of perforated and solid pipe and fittings and insect screen, geocomposite, and backfilling.

1.02 RELATED SECTIONS

Section 02277 Aggregate

Section 02278 Low Permeability Soil Barrier

Section 02279 Erosion Layer

Section 02623 High Density Polyethylene (HDPE) Pipe

Section 02720 Geotextile Fabric

Section 02722 Geocomposite

1.03 SUBMITTALS

Upon completion, the Contractor shall submit a survey accurately recording actual locations and elevations of passive gas vents.

1.04 REFERENCE STANDARDS

A. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):

1. ASTM D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications.

2. ASTM F405 – Standard Specification for Corrugated Polyethylene Pipe and Fittings.

3. ASTM F667 – Standard Specification for Large Diameter Corrugated Polyethylene Pipe and Fittings.

B. NORTH CAROLINA DEPARTMENT OF TRANSPORTATION:

1. Standard Specifications for Roads and Structures.

Where reference is made to one of the above standards, the revision in effect at the time of construction shall apply.

## PART 2 – PRODUCTS (NOT USED)

## PART 3 – EXECUTION

### 3.01 EXAMINATION

The Contractor will be responsible for coordinating passive gas vent installation with other portions of the work.

### 3.02 EXCAVATION

Excavate area for passive gas vent to the dimensions shown in the Details and in a location where shown on the Drawings. Remove large stones or other hard matter which could damage geotextile installation.

Perform temporary dewatering as necessary to keep bearing soils from softening.

### 3.03 INSTALLATION

A. Place nonwoven geotextile filter in excavation with a runout of 2 feet on all sides of the excavation.

B. Place base layer of drainage aggregate (NCDOT NO. 57 Washed Stone) in bottom of excavation on top of the nonwoven geotextile.

C. Construct HDPE passive gas vent pipe and install. Installation of HDPE pipe shall be in accordance with ASTM D2321, the manufacturer's recommendations, and as described elsewhere in these specifications.

D. Backfill excavation with drainage aggregate. Ensure that perforated portion of pipe is entirely within the drainage aggregate portion of the passive gas vent system.

E. Install a section of geocomposite one roll wide, 50 feet long, centered on the passive gas vent pipe, with the long side parallel to the slope. Installation of geocomposite shall be in accordance with the manufacturer's recommendations, and as described elsewhere in these specifications.

3.04 FIELD QUALITY CONTROL

Request inspection prior to placing backfill around pipe.

Perform compaction testing in accordance with Section 02277.

When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

3.05 TOLERANCES

Maximum offset of passive pipe vent from indicated alignment is 1 foot.

3.06 PROTECTION

Protect passive gas vents from damage or displacement during backfilling operations and subsequent earthwork operations.

**END OF SECTION**

# APPENDIX D: CALCULATIONS

**Closure System Slope Stability Evaluation**

**Stormwater Management and Erosion and Sedimentation Control Design**

BROWN AND CALDWELL

# Technical Memorandum

309 East Morehead Street, Suite 160
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Prepared for: Lake Norman C&D Landfill Facility

Project Title: Closure and Post Closure Plan

Project No: 135836

**Technical Memorandum**

Subject: Closure System Slope Stability Evaluation

Date: August 6, 2008

Attach: Lake Norman C&D Landfill Facility – Closure and Post-Closure Plan

Prepared by:

Carl McDonald, E.I.

Checked by:

Albert Glenn, P.E.

This technical memorandum presents the results of the closure geotechnical evaluation for the proposed Lake Norman C&D Landfill Facility for the Closure and Post Closure Plan. The evaluation included the analyses of the static and seismic stability of the landfill's proposed waste mass and final cover system. Final design requirements are presented in the attached calculations at the end of this memorandum.

## Static and Seismic Stability

The static and seismic stability of the landfill was evaluated for the proposed waste mass, perimeter berms, native and constructed subgrade, base liner system and the final cover system for two representative landfill closure profile configurations. The computer program Slope/W developed by GeoStudio International was used in calculating the factors of safety for the landfill's static loading and external seismic loading of 0.11g (ref. United States Geological Survey, National Seismic Hazard Map – 2008, peak acceleration %g with 2% probability of exceedance in 50 years). In accordance with Federal Environmental Protection Agency (EPA) guidance document 600/R-95/051 loading factors of 1.0 and 0.5 were applied to the static and earthquake loadings, respectively. EPA's guidance document outlines minimum factors of safety of 1.5 for static loadings and 1.0 for seismic loadings. The results of the factor of safety calculations and input parameters are included in the attached Appendix D-1.

A summary of the slope stability results for landfill profile A-A' is as follows:

- North Slope Static Global Circular Stability Factor of Safety = 2.24 (critical slip surface);
- North Slope Seismic Global Circular Stability Factor of Safety = 1.88 (critical slip surface);
- South Slope Static Global Circular Stability Factor of Safety = 2.45 (critical slip surface); and,
- South Slope Seismic Global Circular Stability Factor of Safety = 2.04 (critical slip surface).

A summary of the results for landfill profile B-B' is as follows:

- East Slope Static Global Circular Stability Factor of Safety = 1.66 (critical slip surface);
- East Slope Seismic Global Circular Stability Factor of Safety = 1.32 (critical slip surface);
- West Slope Static Global Circular Stability Factor of Safety = 1.79 (critical slip surface); and,
- West Slope Seismic Global Circular Stability Factor of Safety = 1.38 (critical slip surface).

Based on the stability evaluation, the completed landfill meets the Federal EPA's guidance document 600/R-95/051 minimum factors of safety against slope failures of 1.5 for static loading and 1.0 for earthquake loading.

## Conclusions and Design Requirements

Based on the geotechnical evaluations presented above it is concluded or recommended that:

1. The waste slopes and final cover of the proposed landfill will be stable for static and seismic loading conditions. The required minimum internal friction angle for the soil components shall be 28 degrees.

**Project:** Lake Norman C&D Landfill Facility
**Subject:** Slope Stability Calculations
**Date:** 7/28/08
**By:** CJM, Charlotte, North Carolina

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**Objective:** The slope stability of the overall waste mass, perimeter berms, and final cover system is addressed in these calculations. The landfill is located within a seismic impact zone ($a_{max}$ = 0.11g, see attached National Seismic Hazard Map – 2008); therefore, slope stability analysis accounting for earthquake (seismic) loading in accordance with Federal Environmental Protection Agency (EPA) guidance document 600/R-95/051 is required.

**Reference:**

1. Federal RCRA Subtitle D Regulation 40 CFR Part 258 (Section 258.14: landfills must be designed for seismic conditions if they are within a seismic impact zone defined as having a peak bedrock acceleration exceeding 0.10g based on a 90 percent probability on non-exceedance over a 250-year time period , corresponding to a 2,500-year return period).
2. Federal Environmental Protection Agency (EPA) guidance document 600/R-95/051 requires that the completed landfill have minimum factors of safety against slope failure of 1.5 for static conditions and 1.0 for earthquake loading with loading factors of 1.0 for static loading and 0.5 for peak bedrock acceleration.
3. United States Geological Survey, National Seismic Hazard Map – 2008, peak horizontal acceleration (%g) with 2 percent probability of exceedance in 50 years (corresponds to an earthquake return of 2,500 years). See attached figure.
4. Construction Plan Application, Construction and Demolition Landfill – Lake Norman Landfill, Inc., prepared by S&ME, inc., dated February 20, 1998.
5. Civil Engineering Reference Manual, eighth edition, Lindeburg.

**Method:** The slope stability evaluations are conducted for static and earthquake loadings using the computer program Slope/W developed by GeoStudio International.

**Known or Assumed Variables:**

1. Peak bedrock acceleration = 0.11g (Ref. 3).
2. Residual, Protective Cover & Erosion Soil unit weight = 110 lbs/ft$^3$ (Ref. 4).
3. Saturated Soil Unit Weight (below GW) = 47.6 lbs/ft$^3$ (Ref. 5).
4. Soil cohesion, $C_{soil}$ = 300 pounds per square foot (Ref. 4 and 5).
5. Soil internal friction angle, $\Phi_{soil}$ = 28 degrees (Ref. 4 and 5).
6. Saturated Soil internal friction angle, $\Phi_{sat}$ = 10 degrees (assumed).
7. C&D unit weight = 44.4 pounds per cubic foot (Ref. field tonnages and volumes).
8. C&D cohesion, $C_{waste}$ = 0 pounds per square foot (assumed).
9. C&D internal friction angle, $\Phi_{waste}$ = 33 degrees (assumed).
10. Bedrock unit weight = 135 pounds per square foot (Ref. 5).
11. Bedrock internal friction angle, $\Phi_{rock}$ = 45 degrees (Ref. 5).
12. Bedrock cohesion, $C_{rock}$ = 9,500 pounds per square foot (Ref. 5).
13. Closure cap system components, from bottom to top: 12 inches thick of intermediate soil cover, 18 inches thick protective soil cover having a maximum permeability of $1x10^{-5}$ cm/sec, and 18 inches thick of erosion soil cover.

**Calculations:**

1. Earthquake (seismic) loading = 0.11 x 0.5 = 0.055.
2. The slope stability evaluations for the landfill were performed using the computer program Slope/W for static loading and earthquake loading. The evaluation was completed for landfill profiles A-A' and B-B' (see attached drawings E5 and E6). These profiles were representative of the total landfill profile. The results of the slope stability analyses are included as an attachment.

A summary of the slope stability results for landfill profile A-A' is as follows:

1. North Slope Static Global Circular Stability Factor of Safety = 2.24 (critical slip surface).
2. North Slope Seismic Global Circular Stability Factor of Safety = 1.88 (critical slip surface).
3. South Slope Static Global Circular Stability Factor of Safety = 2.45 (critical slip surface).
4. South Slope Seismic Global Circular Stability Factor of Safety = 2.04 (critical slip surface).

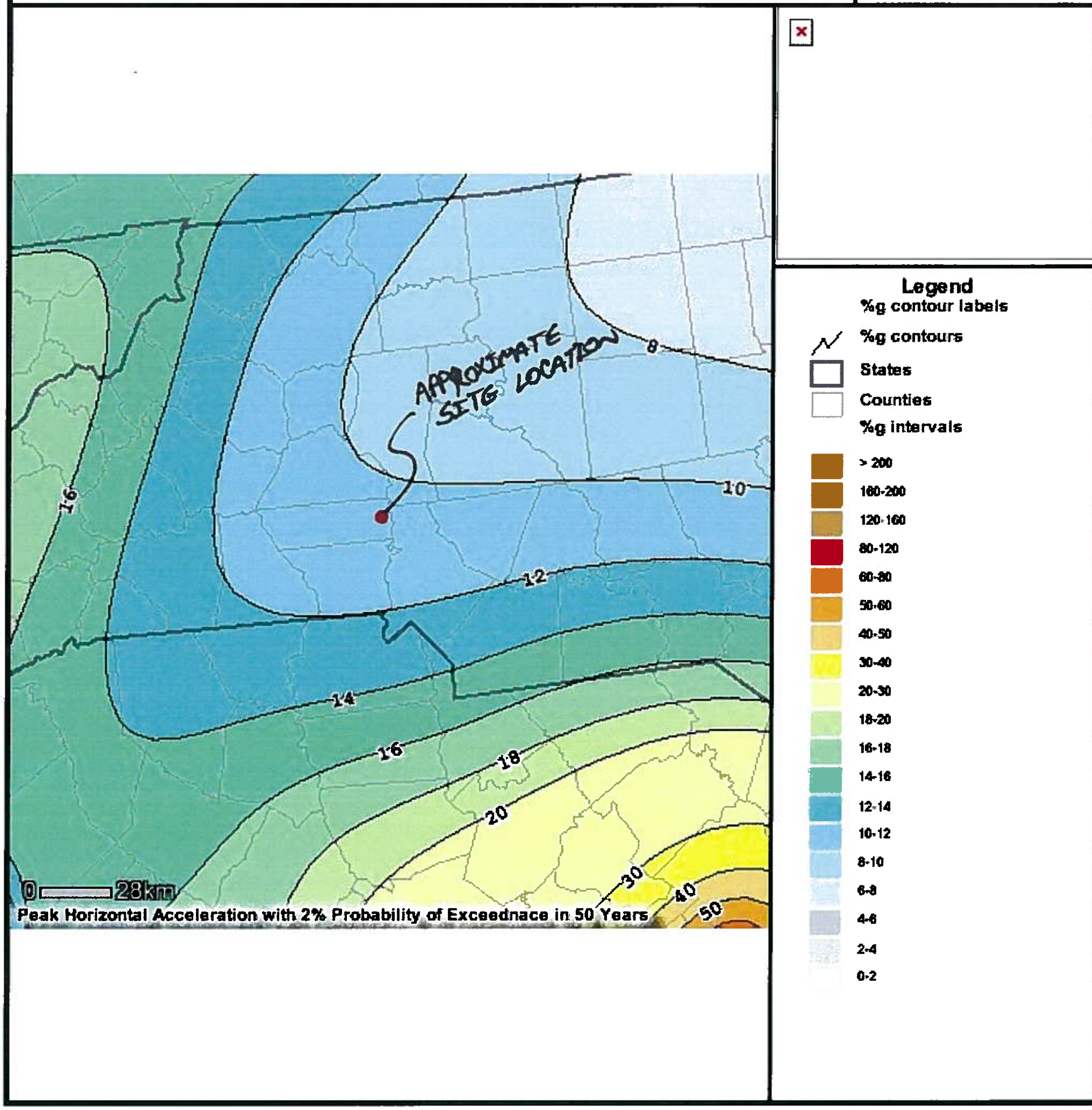
A summary of the results for landfill profile B-B' is as follows:

1. East Slope Static Global Circular Stability Factor of Safety = 1.66 (critical slip surface).
2. East Slope Seismic Global Circular Stability Factor of Safety = 1.32 (critical slip surface).
3. West Slope Static Global Circular Stability Factor of Safety = 1.79 (critical slip surface).
4. West Slope Seismic Global Circular Stability Factor of Safety = 1.38 (critical slip surface).

**Conclusions:**

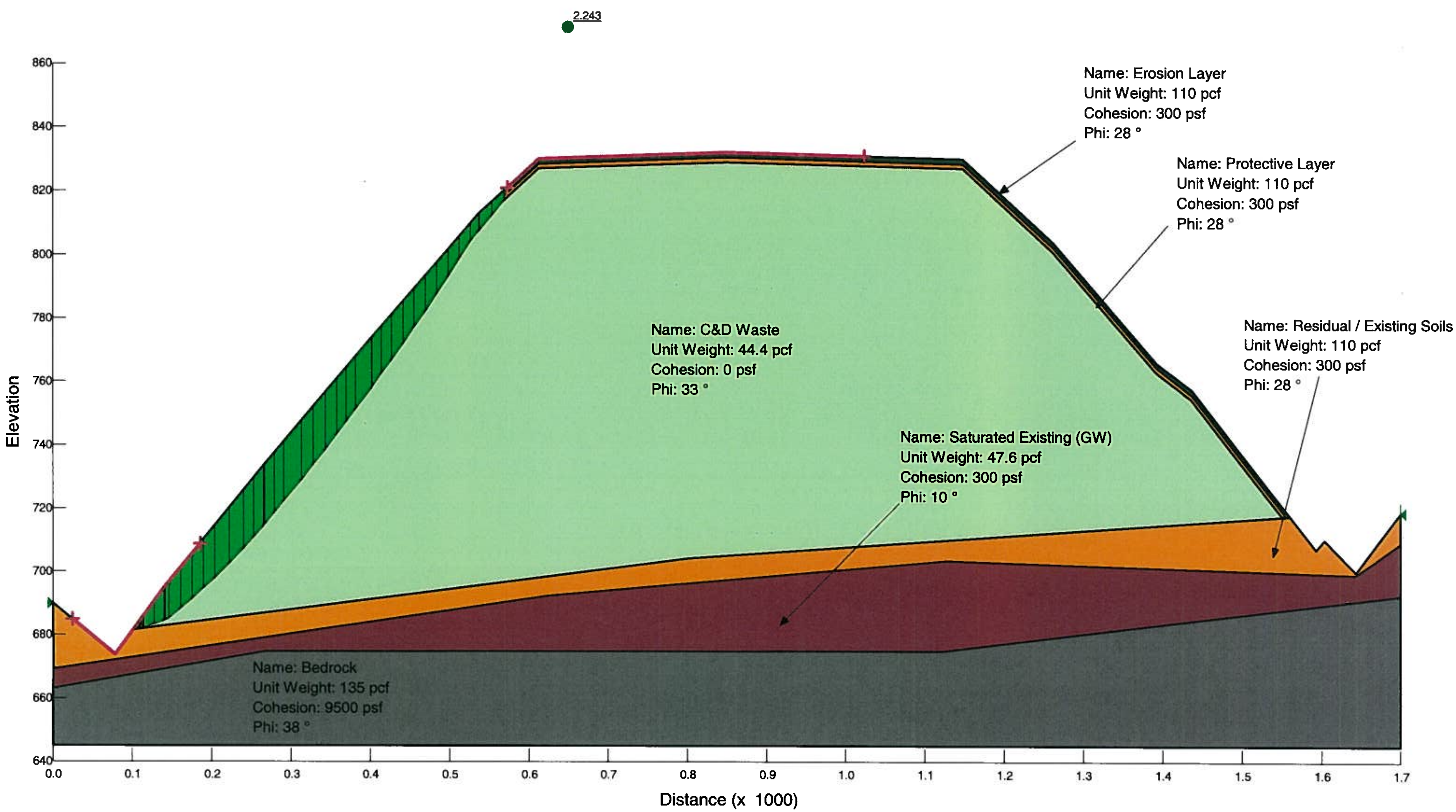
Based on the calculations above the completed landfill meets the Federal EPA's guidance document 600/R-95/051 minimum factors of safety against slope failures of 1.5 for static loading and 1.0 for earthquake loading.

## Lake Norman C&DLF - USGS Seismic Hazard Maps




Peak Horizontal Acceleration with 2% Probability of Exceednace in 50 Years

# Lake Norman A-A' - Static North Slope



# Lake Norman Closure



## File Information

Created By: McDonald, Carl
Revision Number: 56
Last Edited By: McDonald, Carl
Date: 8/6/2008
Time: 1:01:49 PM
File Name: Lake_Norman_A-A'_north.gsz
Directory: P:\135836 - Allied Waste Lake Norman C&D Landfill\Closure and Post-Closure Plan\Calculations\Slope Stability\Geoslope\Final\

## Lake Norman Closure

Kind: SLOPE/W
Method: Morgenstern-Price
Convergence
- Minimum Slice Thickness: 0.1
- Ignore seismic load in strength: No

Number of Slices: 30
Optimization Tolerance: 0.01
Direction of movement: Right to Left
Allow Passive Mode: 1
Slip Surface Option: Entry and Exit
Apply Phreatic Correction: No
Side Function
- Interslice force function option: Half-Sine

FOS Distribution Calculation: Constant
Optimize Critical Slip Surface Location: Yes
Cap Suction: No
Rapid Drawdown: No
PWP Conditions Source: (none)
Critical slip surfaces saved: 1
Optimize Critical Slip Surface
- Optimization Maximum Iterations: 2000
- Optimization Convergence Tolerance: 1e-007
- Starting Optimization Points: 8
- Ending Optimization Points: 16
- Complete Passes per Insertion: 1

## Materials

### Material 1: Residual / Existing Soils

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 300 psf
Phi: 28 °
Phi-B: 0 °

### Material 2: C&D Waste

Model: Mohr-Coulomb
Unit Weight: 44.4 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

### Material 3: Erosion Layer

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 300 psf
Phi: 28 °
Phi-B: 0 °

### Material 4: Protective Layer

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 300 psf
Phi: 28 °
Phi-B: 0 °

### Material 5: Saturated Existing (GW)

Model: Mohr-Coulomb
Unit Weight: 47.6 pcf
Cohesion: 300 psf
Phi: 10 °
Phi-B: 0 °

### Material 6: Bedrock

Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion: 9500 psf
Phi: 38 °
Phi-B: 0 °

## Regions

| | Material | Points | |
|---|---|---|---|
| **Region 1** | Residual / Existing Soils | 1,2,3,4,5,6,7,8,9,10,11,12,13,14 | 1 |

| | | |
|---|---|---|
| **Region 2** | C&D Waste | 15,9,16,17,18,19,20,21,22,23,24,25,26 |
| **Region 3** | Erosion Layer | 27,8,28,29,30,31,32,33,34,35,36,37,10,38,39,40,41,42,43,44,45,46,47,48 |
| **Region 4** | Protective Layer | 27,48,47,46,45,44,43,42,41,40,39,38,15,26,25,24,23,22,21,20,19,18,17,16 |
| **Region 5** | Bedrock | 49,50,51,52,53,54 |
| **Region 6** | Saturated Existing (GW) | 49,50,51,52,1,2,3,4,5 |

# Points

| | X (ft) | Y (ft) |
|---|---|---|
| **Point 1** | 1700 | 709.15984 |
| **Point 2** | 1643.4066 | 699.07441 |
| **Point 3** | 1127.53 | 703.43 |
| **Point 4** | 625.75 | 692.32 |
| **Point 5** | 1.169202 | 669.28588 |
| **Point 6** | 0 | 690 |
| **Point 7** | 78.43 | 673.74 |
| **Point 8** | 101.39068 | 681.6187 |
| **Point 9** | 801.93265 | 704.17209 |
| **Point 10** | 1560.4804 | 717.79977 |
| **Point 11** | 1593.53 | 707.2 |
| **Point 12** | 1603.54 | 710.27 |
| **Point 13** | 1643.3737 | 700 |
| **Point 14** | 1700 | 718.87543 |
| **Point 15** | 1551.1735 | 717.63422 |
| **Point 16** | 111.59742 | 681.94933 |
| **Point 17** | 141.22821 | 692.1168 |
| **Point 18** | 267.13945 | 730.85872 |
| **Point 19** | 402.44219 | 771.1706 |
| **Point 20** | 537.68475 | 809.99263 |
| **Point 21** | 613.04689 | 827.00283 |
| **Point 22** | 849.08266 | 828.99992 |
| **Point 23** | 1147.7728 | 827.00225 |
| **Point 24** | 1261.5758 | 801.08495 |
| **Point 25** | 1392.3457 | 762.90039 |

| | | |
|---|---|---|
| **Point 26** | 1436.2969 | 754.47782 |
| **Point 27** | 106.49405 | 681.78401 |
| **Point 28** | 140.3 | 694.97 |
| **Point 29** | 266.27 | 733.73 |
| **Point 30** | 401.6 | 774.05 |
| **Point 31** | 536.94 | 812.9 |
| **Point 32** | 612.7 | 830 |
| **Point 33** | 849.08 | 832 |
| **Point 34** | 1148.12 | 830 |
| **Point 35** | 1262.33 | 803.99 |
| **Point 36** | 1393.05 | 765.82 |
| **Point 37** | 1437.04 | 757.39 |
| **Point 38** | 1555.8269 | 717.71699 |
| **Point 39** | 1436.6684 | 755.93391 |
| **Point 40** | 1392.6978 | 764.36019 |
| **Point 41** | 1261.9529 | 802.53747 |
| **Point 42** | 1147.9464 | 828.50113 |
| **Point 43** | 849.08133 | 830.49996 |
| **Point 44** | 612.87345 | 828.50141 |
| **Point 45** | 537.31237 | 811.44631 |
| **Point 46** | 402.0211 | 772.6103 |
| **Point 47** | 266.70472 | 732.29436 |
| **Point 48** | 140.76411 | 693.5434 |
| **Point 49** | -6.09e-014 | 663.12536 |
| **Point 50** | 267.51557 | 674.75059 |
| **Point 51** | 1122.01 | 675 |
| **Point 52** | 1700 | 692.49881 |
| **Point 53** | 1700 | 645.12725 |
| **Point 54** | -9.95e-014 | 645.12725 |

# Tension Crack

Tension Crack Option: (none)

# Slip Surface Entry and Exit

Left-Zone Increment: 4
Left Projection: Range
Left-Zone Left Coordinate: (24.541873, 684.91201) ft

Left-Zone Right Coordinate: (185.29201, 708.8137) ft
Right-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (572.76859, 820.98697) ft
Right-Zone Right Coordinate: (1024.2443, 830.82849) ft
Radius Increments: 4

# Slip Surface Limits

Left Coordinate: (0, 690) ft
Right Coordinate: (1700, 718.87543) ft

# Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

# Critical Slip Surfaces

| | Number | FOS | Center (ft) | Radius (ft) | Entry (ft) | Exit (ft) |
|---|---|---|---|---|---|---|
| 1 | Optimized | 2.243 | (-582.171, 3872.79) | 216.4838 | (572.769, 820.987) | (109.52, 684.408) |
| 2 | 51 | 2.375 | (-582.171, 3872.79) | 3263.037 | (572.769, 820.987) | (105.6, 683.063) |

### Slices of Slip Surface: Optimized

| | X (ft) | Y (ft) | PoreWaterPressure (psf) | Base Normal Stress (psf) | Frictional Strength (psf) | Cohesive Strength (psf) |
|---|---|---|---|---|---|---|
| 1 | 110.54525 | 683.96705 | 0 | 162.54176 | 86.424985 | 300 |
| 2 | 112.59615 | 683.08495 | 0 | 360.99786 | 191.94597 | 300 |
| 3 | 114.14 | 682.4209 | 0 | 426.82376 | 277.18259 | 0 |
| 4 | 121.0688 | 682.76165 | 0 | 453.48699 | 294.49789 | 0 |
| 5 | 133.8896 | 683.8891 | 0 | 602.86226 | 391.50333 | 0 |
| 6 | 140.53205 | 684.4732 | 0 | 680.2797 | 441.7788 | 0 |
| 7 | 140.99615 | 684.514 | 0 | 683.99297 | 444.19023 | 0 |
| 8 | 143.8451 | 684.76455 | 0 | 712.86761 | 462.94164 | 0 |
| 9 | 153.701 | 686.58785 | 0 | 732.97779 | 476.00135 | 0 |
| 10 | 168.179 | 689.77415 | 0 | 789.23617 | 512.53596 | 0 |
| 11 | 182.657 | 692.96045 | 0 | 845.562 | 549.11438 | 0 |

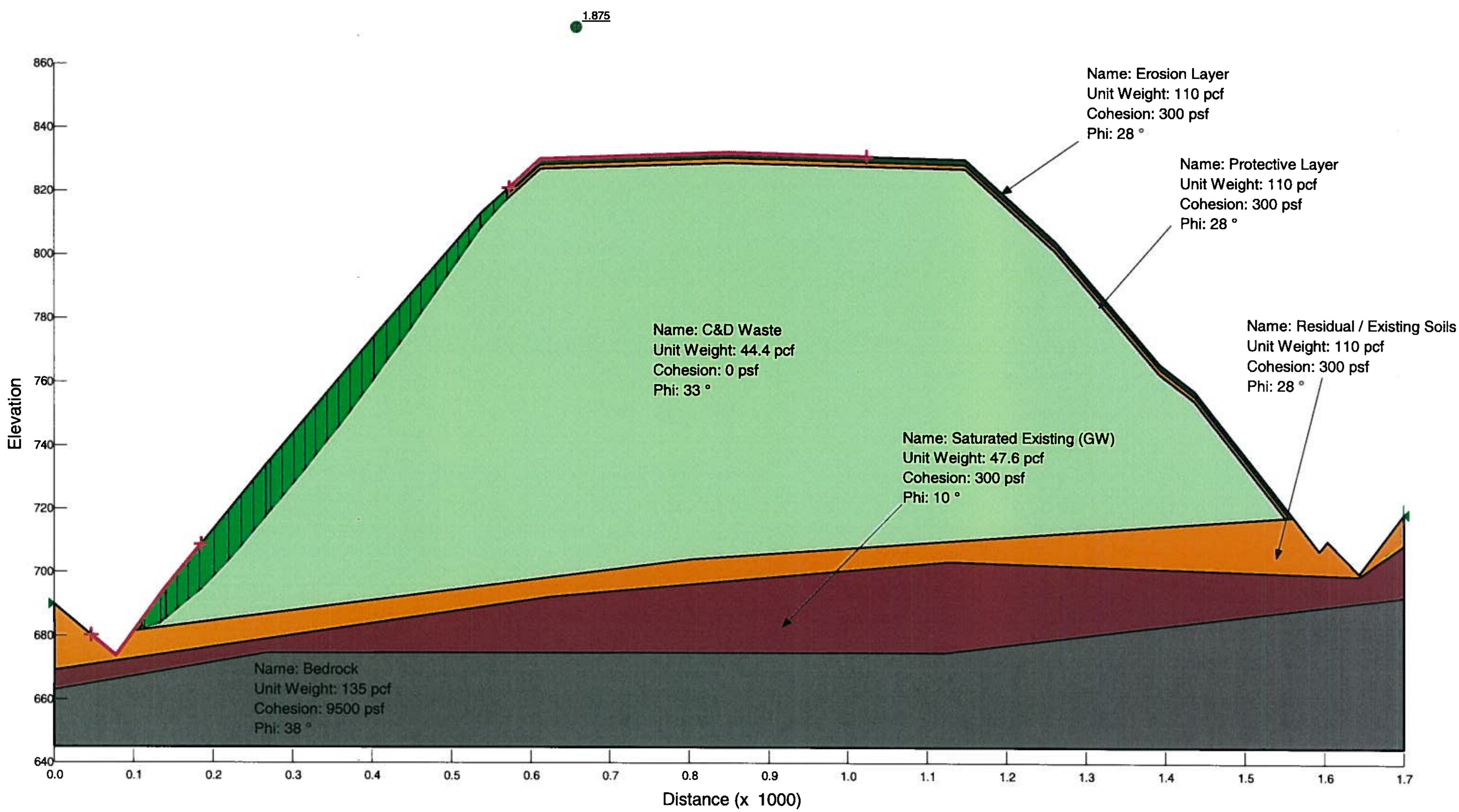
| | | | | | | |
|---|---|---|---|---|---|---|
| **12** | 197.135 | 696.14675 | 0 | 901.82037 | 585.649 | 0 |
| **13** | 213.32295 | 700.09065 | 0 | 927.84831 | 602.55174 | 0 |
| **14** | 231.2209 | 704.7922 | 0 | 961.08225 | 624.13411 | 0 |
| **15** | 246.48465 | 708.94985 | 0 | 970.44069 | 630.21155 | 0 |
| **16** | 259.1141 | 712.56355 | 0 | 980.18468 | 636.53937 | 0 |
| **17** | 265.8494 | 714.4989 | 0 | 974.51106 | 632.85489 | 0 |
| **18** | 266.48735 | 714.69375 | 0 | 974.25897 | 632.69117 | 0 |
| **19** | 266.92205 | 714.8265 | 0 | 973.79698 | 632.39115 | 0 |
| **20** | 273.18815 | 716.74045 | 0 | 970.73486 | 630.40259 | 0 |
| **21** | 285.2856 | 720.4355 | 0 | 965.20091 | 626.8088 | 0 |
| **22** | 302.25965 | 725.6025 | 0 | 959.05725 | 622.81906 | 0 |
| **23** | 320.6879 | 731.32555 | 0 | 937.74374 | 608.97791 | 0 |
| **24** | 335.69375 | 736.1326 | 0 | 922.1316 | 598.83926 | 0 |
| **25** | 350.6996 | 740.9396 | 0 | 906.83678 | 588.90669 | 0 |
| **26** | 364.1353 | 745.29565 | 0 | 886.74596 | 575.85956 | 0 |
| **27** | 376.00095 | 749.2008 | 0 | 871.05559 | 565.67012 | 0 |
| **28** | 391.7669 | 754.511 | 0 | 839.84886 | 545.40423 | 0 |
| **29** | 401.81055 | 757.9405 | 0 | 822.03646 | 533.83672 | 0 |
| **30** | 402.23165 | 758.0843 | 0 | 820.84536 | 533.06321 | 0 |
| **31** | 402.47395 | 758.16705 | 0 | 820.18161 | 532.63216 | 0 |
| **32** | 408.56435 | 760.3092 | 0 | 799.9863 | 519.51718 | 0 |
| **33** | 420.68165 | 764.5718 | 0 | 769.3679 | 499.63336 | 0 |
| **34** | 433.9769 | 769.28215 | 0 | 732.90708 | 475.95542 | 0 |
| **35** | 448.45005 | 774.4403 | 0 | 694.44264 | 450.97632 | 0 |
| **36** | 462.92315 | 779.5985 | 0 | 656.10836 | 426.08175 | 0 |
| **37** | 477.19435 | 784.93225 | 0 | 599.33737 | 389.21424 | 0 |
| **38** | 491.26365 | 790.44155 | 0 | 544.45806 | 353.5752 | 0 |
| **39** | 505.33295 | 795.9509 | 0 | 489.42653 | 317.83731 | 0 |
| **40** | 519.40225 | 801.46025 | 0 | 434.13689 | 281.93179 | 0 |
| **41** | 531.68845 | 805.79985 | 0 | 416.78744 | 270.66493 | 0 |
| **42** | 537.1262 | 807.441 | 0 | 412.48214 | 267.86903 | 0 |
| **43** | 537.49855 | 807.5534 | 0 | 409.96261 | 266.23283 | 0 |
| **44** | 545.48815 | 809.9647 | 0 | 384.64181 | 249.78931 | 0 |
| **45** | 561.09505 | 814.67495 | 0 | 336.48874 | 218.51834 | 0 |
| **46** | 568.90345 | 817.03515 | 0 | 260.59581 | 169.2329 | 0 |
| **47** | 569.87345 | 818.0269 | 0 | 95.245548 | 50.642956 | 300 |
| **48** | 571.80355 | 820.0003 | 0 | -41.360862 | -21.99196 | 300 |

**Slices of Slip Surface: 51**

| | X (ft) | Y (ft) | PoreWaterPressure (psf) | Base Normal Stress (psf) | Frictional Strength (psf) | Cohesive Strength (psf) |
|---|---|---|---|---|---|---|
| 1 | 111.9213 | 684.43925 | 0 | 59.605894 | 31.693016 | 300 |
| 2 | 124.784 | 687.2671 | 0 | 229.24772 | 121.89317 | 300 |
| 3 | 135.81285 | 689.731 | 0 | 355.40971 | 230.80576 | 0 |
| 4 | 140.53205 | 690.79585 | 0 | 377.64314 | 245.24432 | 0 |
| 5 | 140.99615 | 690.9013 | 0 | 378.17697 | 245.59099 | 0 |
| 6 | 149.0433 | 692.751 | 0 | 404.27432 | 262.53881 | 0 |
| 7 | 164.67355 | 696.3855 | 0 | 453.20049 | 294.31184 | 0 |
| 8 | 180.3038 | 700.1012 | 0 | 498.45508 | 323.70051 | 0 |
| 9 | 195.934 | 703.89835 | 0 | 539.99092 | 350.6742 | 0 |
| 10 | 211.5642 | 707.7772 | 0 | 577.78638 | 375.21886 | 0 |
| 11 | 227.19445 | 711.7381 | 0 | 611.82749 | 397.32542 | 0 |
| 12 | 242.8247 | 715.78135 | 0 | 642.08786 | 416.97673 | 0 |
| 13 | 258.4549 | 719.9073 | 0 | 668.69639 | 434.25651 | 0 |
| 14 | 266.48735 | 722.04955 | 0 | 680.67071 | 442.03273 | 0 |
| 15 | 266.92205 | 722.16665 | 0 | 680.86757 | 442.16057 | 0 |
| 16 | 274.60945 | 724.25795 | 0 | 688.35233 | 447.02123 | 0 |
| 17 | 289.54955 | 728.3616 | 0 | 700.61328 | 454.98358 | 0 |
| 18 | 304.4896 | 732.5417 | 0 | 709.66666 | 460.86291 | 0 |
| 19 | 319.42965 | 736.79855 | 0 | 715.45879 | 464.62437 | 0 |
| 20 | 334.36975 | 741.13245 | 0 | 718.06758 | 466.31854 | 0 |
| 21 | 349.3098 | 745.5437 | 0 | 717.56922 | 465.9949 | 0 |
| 22 | 364.24985 | 750.03265 | 0 | 714.04093 | 463.7036 | 0 |
| 23 | 379.1899 | 754.59965 | 0 | 707.43207 | 459.41176 | 0 |
| 24 | 394.12995 | 759.24505 | 0 | 697.88355 | 453.21088 | 0 |
| 25 | 401.81055 | 761.654 | 0 | 691.6255 | 449.14685 | 0 |
| 26 | 402.23165 | 761.7872 | 0 | 690.80347 | 448.61302 | 0 |
| 27 | 409.9143 | 764.2385 | 0 | 680.37966 | 441.84371 | 0 |
| 28 | 424.8585 | 769.0476 | 0 | 658.25904 | 427.47842 | 0 |
| 29 | 439.8027 | 773.9362 | 0 | 633.17556 | 411.18902 | 0 |
| 30 | 454.7469 | 778.9047 | 0 | 605.20811 | 393.02674 | 0 |
| 31 | 469.6911 | 783.9535 | 0 | 574.31576 | 372.96502 | 0 |
| 32 | 484.6353 | 789.083 | 0 | 540.45919 | 350.9783 | 0 |
| 33 | 499.5795 | 794.2936 | 0 | 503.59912 | 327.04109 | 0 |
| 34 | 514.5237 | 799.58565 | 0 | 463.67174 | 301.11195 | 0 |
| 35 | 529.4679 | 804.95965 | 0 | 420.61522 | 273.15072 | 0 |
| 36 | 537.1262 | 807.7352 | 0 | 396.16563 | 257.27297 | 0 |
| 37 | 537.49855 | 807.8712 | 0 | 392.74276 | 255.05013 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **38** | 544.89745 | 810.5939 | 0 | 350.42146 | 227.56636 | 0 |
| **39** | 557.34165 | 815.1983 | 0 | 195.1026 | 103.73789 | 300 |
| **40** | 567.67085 | 819.0675 | 0 | 36.099512 | 19.194451 | 300 |

# Lake Norman A-A' Seismic - North Slope



# Lake Norman Closure



# File Information

Created By: McDonald, Carl
Revision Number: 60
Last Edited By: McDonald, Carl
Date: 8/6/2008
Time: 1:00:00 PM
File Name: Lake_Norman_A-A'_seismic_north.gsz
Directory: P:\135836 - Allied Waste Lake Norman C&D Landfill\Closure and Post-Closure Plan\Calculations\Slope Stability\Geoslope\Final\

# Lake Norman Closure

Kind: SLOPE/W
Method: Morgenstern-Price
Convergence
 Minimum Slice Thickness: 0.1
 Ignore seismic load in strength: No
Number of Slices: 30
Optimization Tolerance: 0.01
Direction of movement: Right to Left
Allow Passive Mode: 1
Slip Surface Option: Entry and Exit
Apply Phreatic Correction: No
Side Function
 Interslice force function option: Half-Sine
FOS Distribution Calculation: Constant
Optimize Critical Slip Surface Location: Yes
Cap Suction: No
Rapid Drawdown: No
PWP Conditions Source: (none)
Critical slip surfaces saved: 1
Optimize Critical Slip Surface
 Optimization Maximum Iterations: 2000
 Optimization Convergence Tolerance: 1e-007
 Starting Optimization Points: 8
 Ending Optimization Points: 16
 Complete Passes per Insertion: 1

# Materials

### Material 1: Residual / Existing Soils

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 300 psf
Phi: 28 °
Phi-B: 0 °

### Material 2: C&D Waste

Model: Mohr-Coulomb
Unit Weight: 44.4 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

### Material 3: Erosion Layer

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 300 psf
Phi: 28 °
Phi-B: 0 °

### Material 4: Protective Layer

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 300 psf
Phi: 28 °
Phi-B: 0 °

### Material 5: Saturated Existing (GW)

Model: Mohr-Coulomb
Unit Weight: 47.6 pcf
Cohesion: 300 psf
Phi: 10 °
Phi-B: 0 °

### Material 6: Bedrock

Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion: 9500 psf
Phi: 38 °
Phi-B: 0 °

## Regions

| | Material | Points | A |
|---|---|---|---|
| **Region 1** | Residual / Existing Soils | 1,2,3,4,5,6,7,8,9,10,11,12,13,14 | 14 |

| | | | |
|---|---|---|---|
| **Region 2** | C&D Waste | 15,9,16,17,18,19,20,21,22,23,24,25,26 | 1 |
| **Region 3** | Erosion Layer | 27,8,28,29,30,31,32,33,34,35,36,37,10,38,39,40,41,42,43,44,45,46,47,48 | 2 |
| **Region 4** | Protective Layer | 27,48,47,46,45,44,43,42,41,40,39,38,15,26,25,24,23,22,21,20,19,18,17,16 | 2 |
| **Region 5** | Bedrock | 49,50,51,52,53,54 | 5 |
| **Region 6** | Saturated Existing (GW) | 49,50,51,52,1,2,3,4,5 | 2 |

## Points

| | X (ft) | Y (ft) |
|---|---|---|
| **Point 1** | 1700 | 709.15984 |
| **Point 2** | 1643.4066 | 699.07441 |
| **Point 3** | 1127.53 | 703.43 |
| **Point 4** | 625.75 | 692.32 |
| **Point 5** | 1.169202 | 669.28588 |
| **Point 6** | 0 | 690 |
| **Point 7** | 78.43 | 673.74 |
| **Point 8** | 101.39068 | 681.6187 |
| **Point 9** | 801.93265 | 704.17209 |
| **Point 10** | 1560.4804 | 717.79977 |
| **Point 11** | 1593.53 | 707.2 |
| **Point 12** | 1603.54 | 710.27 |
| **Point 13** | 1643.3737 | 700 |
| **Point 14** | 1700 | 718.87543 |
| **Point 15** | 1551.1735 | 717.63422 |
| **Point 16** | 111.59742 | 681.94933 |
| **Point 17** | 141.22821 | 692.1168 |
| **Point 18** | 267.13945 | 730.85872 |
| **Point 19** | 402.44219 | 771.1706 |
| **Point 20** | 537.68475 | 809.99263 |
| **Point 21** | 613.04689 | 827.00283 |
| **Point 22** | 849.08266 | 828.99992 |
| **Point 23** | 1147.7728 | 827.00225 |
| **Point 24** | 1261.5758 | 801.08495 |
| **Point 25** | 1392.3457 | 762.90039 |

| | | |
|---|---|---|
| **Point 26** | 1436.2969 | 754.47782 |
| **Point 27** | 106.49405 | 681.78401 |
| **Point 28** | 140.3 | 694.97 |
| **Point 29** | 266.27 | 733.73 |
| **Point 30** | 401.6 | 774.05 |
| **Point 31** | 536.94 | 812.9 |
| **Point 32** | 612.7 | 830 |
| **Point 33** | 849.08 | 832 |
| **Point 34** | 1148.12 | 830 |
| **Point 35** | 1262.33 | 803.99 |
| **Point 36** | 1393.05 | 765.82 |
| **Point 37** | 1437.04 | 757.39 |
| **Point 38** | 1555.8269 | 717.71699 |
| **Point 39** | 1436.6684 | 755.93391 |
| **Point 40** | 1392.6978 | 764.36019 |
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| **Point 44** | 612.87345 | 828.50141 |
| **Point 45** | 537.31237 | 811.44631 |
| **Point 46** | 402.0211 | 772.6103 |
| **Point 47** | 266.70472 | 732.29436 |
| **Point 48** | 140.76411 | 693.5434 |
| **Point 49** | -6.09e-014 | 663.12536 |
| **Point 50** | 267.51557 | 674.75059 |
| **Point 51** | 1122.01 | 675 |
| **Point 52** | 1700 | 692.49881 |
| **Point 53** | 1700 | 645.12725 |
| **Point 54** | -9.95e-014 | 645.12725 |

# Tension Crack

Tension Crack Option: (none)

# Slip Surface Entry and Exit

Left-Zone Increment: 4
Left Projection: Range
Left-Zone Left Coordinate: (46.995876, 680.25688) ft

Left-Zone Right Coordinate: (185.29201, 708.8137) ft
Right-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (572.76859, 820.98697) ft
Right-Zone Right Coordinate: (1024.2443, 830.82849) ft
Radius Increments: 4

# Slip Surface Limits

Left Coordinate: (0, 690) ft
Right Coordinate: (1700, 718.87543) ft

# Seismic Loads

Horz Seismic Load: 0.055
Vert Seismic Load: 0.055

# Critical Slip Surfaces

| | Number | FOS | Center (ft) | Radius (ft) | Entry (ft) | Exit (ft) |
|---|---|---|---|---|---|---|
| 1 | Optimized | 1.875 | (-550.908, 3798.87) | 215.989 | (572.769, 820.987) | (108.921, 684.203) |
| 2 | 51 | 1.996 | (-550.908, 3798.87) | 3182.836 | (572.769, 820.987) | (116.445, 686.784) |

### Slices of Slip Surface: Optimized

| | X (ft) | Y (ft) | PoreWaterPressure (psf) | Base Normal Stress (psf) | Frictional Strength (psf) | Cohesive Strength (psf) |
|---|---|---|---|---|---|---|
| 1 | 110.04495 | 683.79535 | 0 | 169.20365 | 89.967179 | 300 |
| 2 | 112.29225 | 682.98065 | 0 | 380.2491 | 202.18203 | 300 |
| 3 | 113.66875 | 682.48165 | 0 | 440.62045 | 286.14227 | 0 |
| 4 | 124.08085 | 683.15735 | 0 | 512.16113 | 332.60133 | 0 |
| 5 | 137.27005 | 684.5496 | 0 | 630.54953 | 409.48365 | 0 |
| 6 | 140.53205 | 685.22235 | 0 | 650.2582 | 422.28261 | 0 |
| 7 | 140.99615 | 685.31805 | 0 | 651.39775 | 423.02264 | 0 |
| 8 | 148.1539 | 686.7943 | 0 | 685.02778 | 444.86224 | 0 |
| 9 | 162.0053 | 689.65105 | 0 | 751.40017 | 487.96498 | 0 |
| 10 | 175.8567 | 692.50775 | 0 | 818.00589 | 531.21923 | 0 |
| 11 | 191.99855 | 696.3076 | 0 | 849.38117 | 551.59458 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **12** | 210.4308 | 701.05055 | 0 | 890.57348 | 578.34518 | 0 |
| **13** | 227.4174 | 705.73055 | 0 | 891.84877 | 579.17336 | 0 |
| **14** | 242.95845 | 710.3477 | 0 | 896.72158 | 582.3378 | 0 |
| **15** | 258.4995 | 714.96485 | 0 | 901.47104 | 585.42214 | 0 |
| **16** | 266.48735 | 717.338 | 0 | 903.6747 | 586.85321 | 0 |
| **17** | 266.92205 | 717.46715 | 0 | 903.36599 | 586.65273 | 0 |
| **18** | 269.8669 | 718.34205 | 0 | 902.89487 | 586.34678 | 0 |
| **19** | 279.8536 | 721.36795 | 0 | 894.16235 | 580.67582 | 0 |
| **20** | 294.372 | 725.7991 | 0 | 887.37692 | 576.26931 | 0 |
| **21** | 308.48435 | 730.1347 | 0 | 877.10739 | 569.6002 | 0 |
| **22** | 322.19065 | 734.37475 | 0 | 868.53426 | 564.03274 | 0 |
| **23** | 336.29235 | 738.83635 | 0 | 847.27573 | 550.22729 | 0 |
| **24** | 350.7894 | 743.51945 | 0 | 830.47199 | 539.31482 | 0 |
| **25** | 365.28645 | 748.20255 | 0 | 814.0621 | 528.65811 | 0 |
| **26** | 379.80125 | 753.00645 | 0 | 784.46375 | 509.43671 | 0 |
| **27** | 394.33375 | 757.93115 | 0 | 759.69875 | 493.35414 | 0 |
| **28** | 401.81055 | 760.46485 | 0 | 746.88985 | 485.03594 | 0 |
| **29** | 402.23165 | 760.60755 | 0 | 745.72031 | 484.27643 | 0 |
| **30** | 402.6971 | 760.76525 | 0 | 744.58141 | 483.53682 | 0 |
| **31** | 410.8886 | 763.5678 | 0 | 724.61609 | 470.57119 | 0 |
| **32** | 426.76185 | 769.00025 | 0 | 689.33002 | 447.65615 | 0 |
| **33** | 441.42925 | 774.0931 | 0 | 649.81133 | 421.99241 | 0 |
| **34** | 454.89075 | 778.8463 | 0 | 614.97661 | 399.37048 | 0 |
| **35** | 471.0581 | 784.5921 | 0 | 570.60537 | 370.55546 | 0 |
| **36** | 487.4117 | 790.4424 | 0 | 525.22141 | 341.08277 | 0 |
| **37** | 501.2457 | 795.4046 | 0 | 486.74427 | 316.09542 | 0 |
| **38** | 515.0797 | 800.3668 | 0 | 448.15146 | 291.03296 | 0 |
| **39** | 528.9137 | 805.329 | 0 | 409.39536 | 265.86446 | 0 |
| **40** | 536.38535 | 807.9639 | 0 | 403.4675 | 262.01486 | 0 |
| **41** | 537.1262 | 808.16935 | 0 | 402.55507 | 261.42232 | 0 |
| **42** | 537.49855 | 808.27265 | 0 | 400.27782 | 259.94346 | 0 |
| **43** | 545.64265 | 810.5316 | 0 | 381.35111 | 247.65231 | 0 |
| **44** | 561.55855 | 814.9462 | 0 | 345.82365 | 224.5805 | 0 |
| **45** | 569.5291 | 817.1683 | 0 | 253.32978 | 164.51428 | 0 |
| **46** | 570.3484 | 818.1341 | 0 | 60.763475 | 32.308513 | 300 |
| **47** | 571.96185 | 820.03605 | 0 | -73.657921 | -39.164611 | 300 |

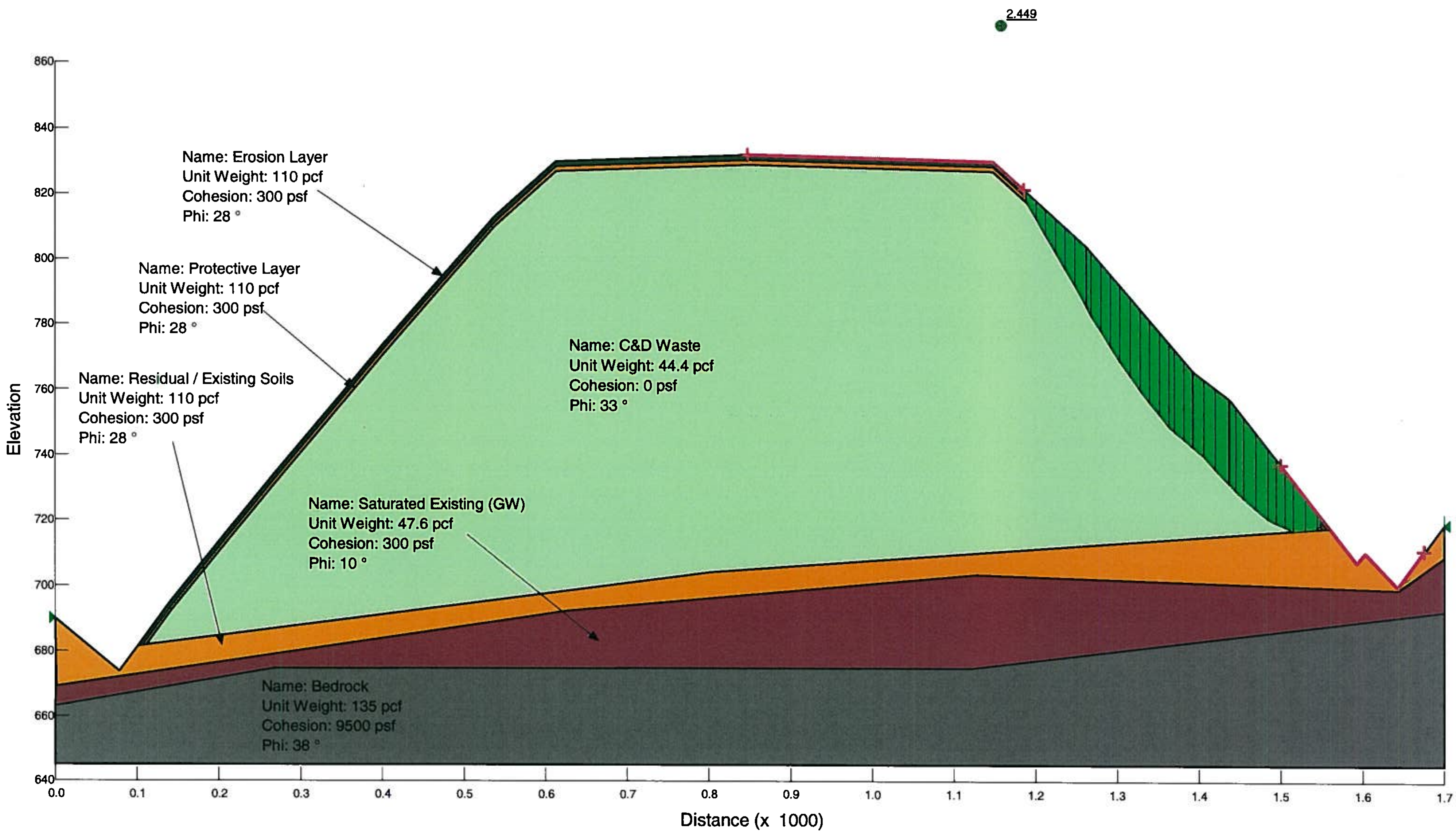
## Slices of Slip Surface: 51

| | X (ft) | Y (ft) | PoreWaterPressure | Base | Frictional | Cohesive |
|---|---|---|---|---|---|---|

| | | | (psf) | Normal Stress (psf) | Strength (psf) | Strength (psf) |
|---|---|---|---|---|---|---|
| **1** | 122.7089 | 688.1409 | 0 | 59.266304 | 31.512453 | 300 |
| **2** | 134.63625 | 690.7465 | 0 | 225.82403 | 120.07277 | 300 |
| **3** | 140.53205 | 692.04735 | 0 | 305.13576 | 162.24356 | 300 |
| **4** | 141.501 | 692.26325 | 0 | 314.40614 | 167.17271 | 300 |
| **5** | 149.9899 | 694.17755 | 0 | 372.85928 | 242.13765 | 0 |
| **6** | 165.4939 | 697.7184 | 0 | 426.29781 | 276.84104 | 0 |
| **7** | 180.9979 | 701.3409 | 0 | 475.87214 | 309.03498 | 0 |
| **8** | 196.5019 | 705.04535 | 0 | 521.53474 | 338.68862 | 0 |
| **9** | 212.00595 | 708.832 | 0 | 563.24587 | 365.77615 | 0 |
| **10** | 227.51 | 712.7012 | 0 | 600.99064 | 390.28789 | 0 |
| **11** | 243.014 | 716.65325 | 0 | 634.78639 | 412.2351 | 0 |
| **12** | 258.518 | 720.68845 | 0 | 664.58363 | 431.58566 | 0 |
| **13** | 266.48735 | 722.78465 | 0 | 678.17478 | 440.41185 | 0 |
| **14** | 266.92205 | 722.9002 | 0 | 678.46053 | 440.59742 | 0 |
| **15** | 274.60945 | 724.9641 | 0 | 687.35431 | 446.37311 | 0 |
| **16** | 289.54955 | 729.01535 | 0 | 702.26542 | 456.05649 | 0 |
| **17** | 304.4896 | 733.1448 | 0 | 713.69948 | 463.48186 | 0 |
| **18** | 319.42965 | 737.3527 | 0 | 721.60468 | 468.61556 | 0 |
| **19** | 334.36975 | 741.63935 | 0 | 726.1234 | 471.55005 | 0 |
| **20** | 349.3098 | 746.00515 | 0 | 727.33366 | 472.336 | 0 |
| **21** | 364.24985 | 750.45045 | 0 | 725.31267 | 471.02355 | 0 |
| **22** | 379.1899 | 754.97555 | 0 | 720.01116 | 467.58072 | 0 |
| **23** | 394.12995 | 759.58085 | 0 | 711.57159 | 462.09999 | 0 |
| **24** | 401.81055 | 761.96965 | 0 | 705.77412 | 458.33508 | 0 |
| **25** | 402.23165 | 762.1018 | 0 | 704.97306 | 457.81486 | 0 |
| **26** | 409.9143 | 764.53395 | 0 | 694.90473 | 451.27641 | 0 |
| **27** | 424.8585 | 769.3066 | 0 | 673.23897 | 437.2065 | 0 |
| **28** | 439.8027 | 774.1606 | 0 | 648.44055 | 421.10222 | 0 |
| **29** | 454.7469 | 779.0964 | 0 | 620.66697 | 403.06585 | 0 |
| **30** | 469.6911 | 784.11435 | 0 | 589.76989 | 383.00104 | 0 |
| **31** | 484.6353 | 789.21485 | 0 | 555.7489 | 360.90755 | 0 |
| **32** | 499.5795 | 794.39835 | 0 | 518.5537 | 336.75271 | 0 |
| **33** | 514.5237 | 799.6653 | 0 | 478.12176 | 310.4959 | 0 |
| **34** | 529.4679 | 805.0161 | 0 | 434.37321 | 282.08526 | 0 |
| **35** | 537.1262 | 807.78025 | 0 | 409.47003 | 265.91294 | 0 |
| **36** | 537.49855 | 807.91575 | 0 | 405.91851 | 263.60656 | 0 |
| **37** | 544.8114 | 810.59665 | 0 | 362.9385 | 235.69502 | 0 |
| **38** | 557.2159 | 815.16995 | 0 | 197.9652 | 105.25996 | 300 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **39** | 567.63115 | 819.05855 | 0 | 32.113189 | 17.074885 | 300 |

# Lake Norman A-A'  - Static South Slope



# Lake Norman Closure



# File Information

Created By: McDonald, Carl
Revision Number: 50
Last Edited By: McDonald, Carl
Date: 8/6/2008
Time: 1:04:16 PM
File Name: Lake_Norman_A-A'_south.gsz
Directory: P:\135836 - Allied Waste Lake Norman C&D Landfill\Closure and Post-Closure Plan\Calculations\Slope Stability\Geoslope\Final\

# Lake Norman Closure

Kind: SLOPE/W
Method: Morgenstern-Price
Convergence
    Minimum Slice Thickness: 0.1
    Ignore seismic load in strength: No
Number of Slices: 30
Optimization Tolerance: 0.01
Direction of movement: Left to Right
Allow Passive Mode: 1
Slip Surface Option: Entry and Exit
Apply Phreatic Correction: No
Side Function
    Interslice force function option: Half-Sine
FOS Distribution Calculation: Constant
Optimize Critical Slip Surface Location: Yes
Cap Suction: No
Rapid Drawdown: No
PWP Conditions Source: (none)
Critical slip surfaces saved: 1
Optimize Critical Slip Surface
    Optimization Maximum Iterations: 2000
    Optimization Convergence Tolerance: 1e-007
    Starting Optimization Points: 8
    Ending Optimization Points: 16
    Complete Passes per Insertion: 1

# Materials

## Material 1: Residual / Existing Soils

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 300 psf
Phi: 28 °
Phi-B: 0 °

### Material 2: C&D Waste

Model: Mohr-Coulomb
Unit Weight: 44.4 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

### Material 3: Erosion Layer

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 300 psf
Phi: 28 °
Phi-B: 0 °

### Material 4: Protective Layer

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 300 psf
Phi: 28 °
Phi-B: 0 °

### Material 5: Saturated Existing (GW)

Model: Mohr-Coulomb
Unit Weight: 47.6 pcf
Cohesion: 300 psf
Phi: 10 °
Phi-B: 0 °

### Material 6: Bedrock

Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion: 9500 psf
Phi: 38 °
Phi-B: 0 °

# Regions

| | Material | Points | A |
|---|---|---|---|
| **Region 1** | Residual / Existing Soils | 1,2,3,4,5,6,7,8,9,10,11,12,13,14 | 1 |

| | | | |
|---|---|---|---|
| **Region 2** | C&D Waste | 15,9,16,17,18,19,20,21,22,23,24,25,26 | 1 |
| **Region 3** | Erosion Layer | 27,8,28,29,30,31,32,33,34,35,36,37,10,38,39,40,41,42,43,44,45,46,47,48 | 2 |
| **Region 4** | Protective Layer | 27,48,47,46,45,44,43,42,41,40,39,38,15,26,25,24,23,22,21,20,19,18,17,16 | 2 |
| **Region 5** | Bedrock | 49,50,51,52,53,54 | 5 |
| **Region 6** | Saturated Existing (GW) | 49,50,51,52,1,2,3,4,5 | 2 |

# Points

| | X (ft) | Y (ft) |
|---|---|---|
| **Point 1** | 1700 | 709.15984 |
| **Point 2** | 1643.4066 | 699.07441 |
| **Point 3** | 1127.53 | 703.43 |
| **Point 4** | 625.75 | 692.32 |
| **Point 5** | 1.169202 | 669.28588 |
| **Point 6** | 0 | 690 |
| **Point 7** | 78.43 | 673.74 |
| **Point 8** | 101.39068 | 681.6187 |
| **Point 9** | 801.93265 | 704.17209 |
| **Point 10** | 1560.4804 | 717.79977 |
| **Point 11** | 1593.53 | 707.2 |
| **Point 12** | 1603.54 | 710.27 |
| **Point 13** | 1643.3737 | 700 |
| **Point 14** | 1700 | 718.87543 |
| **Point 15** | 1551.1735 | 717.63422 |
| **Point 16** | 111.59742 | 681.94933 |
| **Point 17** | 141.22821 | 692.1168 |
| **Point 18** | 267.13945 | 730.85872 |
| **Point 19** | 402.44219 | 771.1706 |
| **Point 20** | 537.68475 | 809.99263 |
| **Point 21** | 613.04689 | 827.00283 |
| **Point 22** | 849.08266 | 828.99992 |
| **Point 23** | 1147.7728 | 827.00225 |
| **Point 24** | 1261.5758 | 801.08495 |
| **Point 25** | 1392.3457 | 762.90039 |

| | | |
|---|---|---|
| **Point 26** | 1436.2969 | 754.47782 |
| **Point 27** | 106.49405 | 681.78401 |
| **Point 28** | 140.3 | 694.97 |
| **Point 29** | 266.27 | 733.73 |
| **Point 30** | 401.6 | 774.05 |
| **Point 31** | 536.94 | 812.9 |
| **Point 32** | 612.7 | 830 |
| **Point 33** | 849.08 | 832 |
| **Point 34** | 1148.12 | 830 |
| **Point 35** | 1262.33 | 803.99 |
| **Point 36** | 1393.05 | 765.82 |
| **Point 37** | 1437.04 | 757.39 |
| **Point 38** | 1555.8269 | 717.71699 |
| **Point 39** | 1436.6684 | 755.93391 |
| **Point 40** | 1392.6978 | 764.36019 |
| **Point 41** | 1261.9529 | 802.53747 |
| **Point 42** | 1147.9464 | 828.50113 |
| **Point 43** | 849.08133 | 830.49996 |
| **Point 44** | 612.87345 | 828.50141 |
| **Point 45** | 537.31237 | 811.44631 |
| **Point 46** | 402.0211 | 772.6103 |
| **Point 47** | 266.70472 | 732.29436 |
| **Point 48** | 140.76411 | 693.5434 |
| **Point 49** | -6.09e-014 | 663.12536 |
| **Point 50** | 267.51557 | 674.75059 |
| **Point 51** | 1122.01 | 675 |
| **Point 52** | 1700 | 692.49881 |
| **Point 53** | 1700 | 645.12725 |
| **Point 54** | -9.95e-014 | 645.12725 |

# Tension Crack

Tension Crack Option: (none)

# Slip Surface Entry and Exit

Left-Zone Increment: 4
Left Projection: Range
Left-Zone Left Coordinate: (847.63412, 831.98777) ft

Left-Zone Right Coordinate: (1186.068, 821.35779) ft
Right-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (1500.0038, 737.19605) ft
Right-Zone Right Coordinate: (1676.0659, 710.89739) ft
Radius Increments: 4

# Slip Surface Limits

Left Coordinate: (0, 690) ft
Right Coordinate: (1700, 718.87543) ft

# Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

# Critical Slip Surfaces

| | Number | FOS | Center (ft) | Radius (ft) | Entry (ft) | Exit (ft) |
|---|---|---|---|---|---|---|
| 1 | Optimized | 2.449 | (1476.94, 1180.1) | 171.3509 | (1186.04, 821.364) | (1553.02, 720.193) |
| 2 | 107 | 2.607 | (1476.94, 1180.1) | 461.851 | (1186.07, 821.358) | (1543.87, 723.126) |

### Slices of Slip Surface: Optimized

| | X (ft) | Y (ft) | PoreWaterPressure (psf) | Base Normal Stress (psf) | Frictional Strength (psf) | Cohesive Strength (psf) |
|---|---|---|---|---|---|---|
| 1 | 1186.725 | 820.439 | 0 | -62.102001 | -33.02022 | 300 |
| 2 | 1188.0925 | 818.58915 | 0 | 68.974211 | 36.674238 | 300 |
| 3 | 1188.862 | 817.54785 | 0 | 251.25821 | 163.16899 | 0 |
| 4 | 1194.8385 | 814.89315 | 0 | 357.60531 | 232.2316 | 0 |
| 5 | 1206.619 | 809.81645 | 0 | 448.40987 | 291.20077 | 0 |
| 6 | 1218.399 | 804.73975 | 0 | 538.02168 | 349.39536 | 0 |
| 7 | 1230.179 | 799.66305 | 0 | 626.62005 | 406.93182 | 0 |
| 8 | 1241.959 | 794.5864 | 0 | 714.42325 | 463.95189 | 0 |
| 9 | 1254.7125 | 788.89405 | 0 | 807.00628 | 524.07601 | 0 |
| 10 | 1261.7645 | 785.65335 | 0 | 866.25785 | 562.55442 | 0 |
| 11 | 1262.1415 | 785.48005 | 0 | 870.76371 | 565.48056 | 0 |

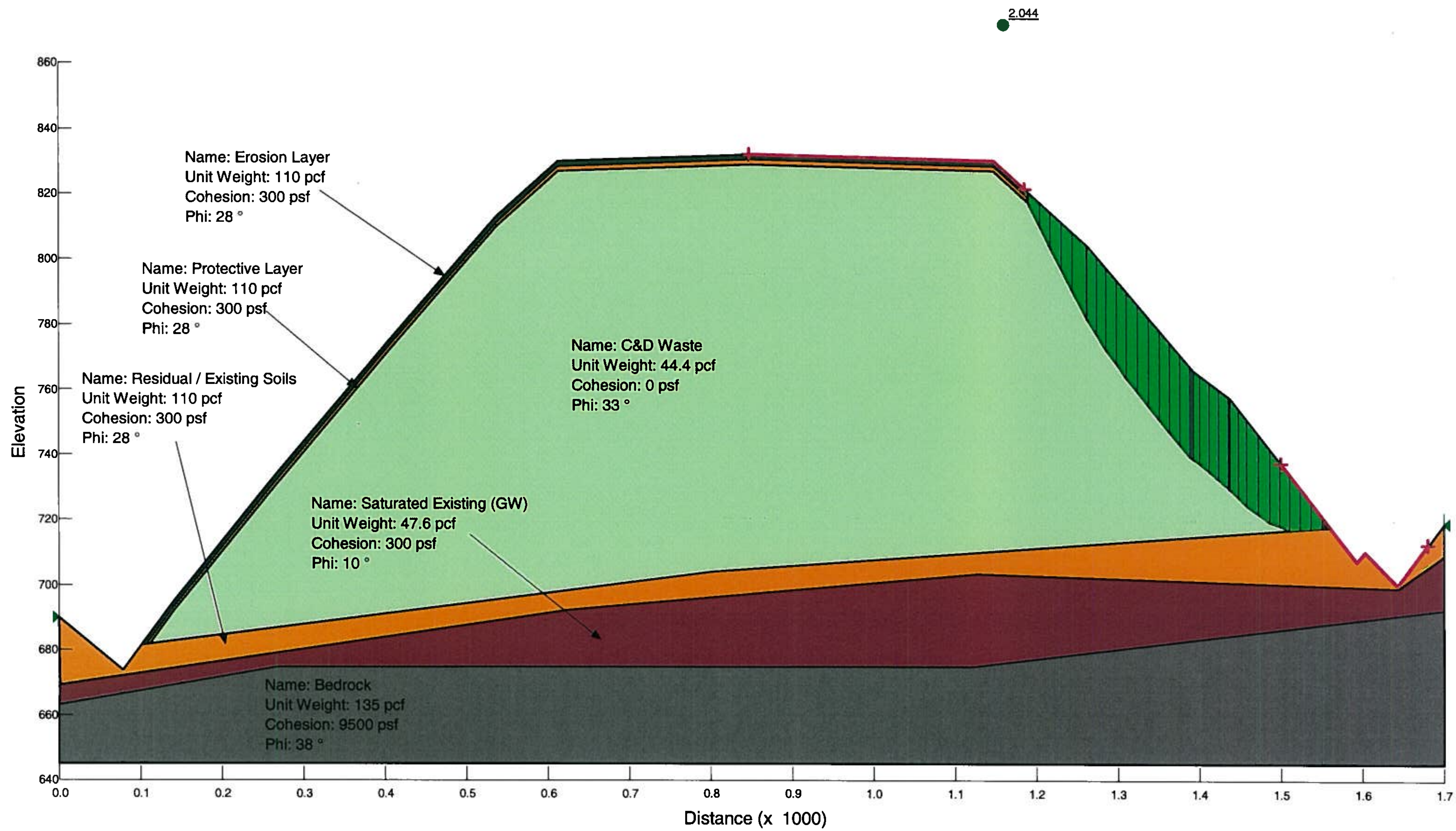
| | | | | | | |
|---|---|---|---|---|---|---|
| **12** | 1265.2125 | 784.06875 | 0 | 889.80774 | 577.8479 | 0 |
| **13** | 1273.9005 | 780.41985 | 0 | 951.94234 | 618.19859 | 0 |
| **14** | 1285.5115 | 775.77135 | 0 | 997.43665 | 647.74293 | 0 |
| **15** | 1297.1225 | 771.1229 | 0 | 1043.5706 | 677.70267 | 0 |
| **16** | 1309.2175 | 766.6077 | 0 | 1108.355 | 719.77413 | 0 |
| **17** | 1321.796 | 762.22565 | 0 | 1137.3345 | 738.59367 | 0 |
| **18** | 1333.866 | 758.1921 | 0 | 1177.699 | 764.80665 | 0 |
| **19** | 1345.4275 | 754.50705 | 0 | 1193.1917 | 774.86778 | 0 |
| **20** | 1356.989 | 750.82195 | 0 | 1209.3438 | 785.35705 | 0 |
| **21** | 1366.2825 | 748.1579 | 0 | 1269.5381 | 824.44769 | 0 |
| **22** | 1375.4325 | 746.1526 | 0 | 1262.2081 | 819.6875 | 0 |
| **23** | 1386.708 | 743.785 | 0 | 1226.6211 | 796.57707 | 0 |
| **24** | 1392.522 | 742.56425 | 0 | 1206.8998 | 783.7699 | 0 |
| **25** | 1392.874 | 742.4903 | 0 | 1203.5373 | 781.58625 | 0 |
| **26** | 1399.3665 | 741.12695 | 0 | 1208.5032 | 784.81116 | 0 |
| **27** | 1412.792 | 737.77405 | 0 | 1195.4153 | 776.31177 | 0 |
| **28** | 1428.099 | 733.62035 | 0 | 1267.5932 | 823.18462 | 0 |
| **29** | 1436.4825 | 731.445 | 0 | 1295.0935 | 841.04355 | 0 |
| **30** | 1436.854 | 731.3486 | 0 | 1299.1834 | 843.69956 | 0 |
| **31** | 1441.038 | 730.263 | 0 | 1292.0608 | 839.07411 | 0 |
| **32** | 1449.5095 | 728.0983 | 0 | 1275.8785 | 828.56518 | 0 |
| **33** | 1461.3945 | 725.382 | 0 | 1254.0312 | 814.37738 | 0 |
| **34** | 1476.2175 | 722.20395 | 0 | 1186.4846 | 770.51212 | 0 |
| **35** | 1488.9015 | 720.0181 | 0 | 1153.1402 | 748.85799 | 0 |
| **36** | 1499.4465 | 718.82445 | 0 | 1049.0202 | 681.24171 | 0 |
| **37** | 1509.992 | 717.6308 | 0 | 945.46565 | 613.99257 | 0 |
| **38** | 1522.4625 | 717.1876 | 0 | 817.5248 | 530.90681 | 0 |
| **39** | 1536.8575 | 717.49485 | 0 | 577.02485 | 374.72432 | 0 |
| **40** | 1545.9315 | 718.1811 | 0 | 439.80636 | 285.61359 | 0 |
| **41** | 1549.1105 | 719.08345 | 0 | 320.08167 | 170.19044 | 300 |
| **42** | 1551.716 | 719.823 | 0 | 130.89467 | 69.597932 | 300 |

## Slices of Slip Surface: 107

| | X (ft) | Y (ft) | PoreWaterPressure (psf) | Base Normal Stress (psf) | Frictional Strength (psf) | Cohesive Strength (psf) |
|---|---|---|---|---|---|---|
| **1** | 1187.401 | 820.28495 | 0 | -5.7224051 | -3.0426567 | 300 |
| **2** | 1190.0965 | 818.1327 | 0 | 141.57708 | 75.277871 | 300 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 3 | 1197.302 | 812.60705 | 0 | 396.28259 | 257.34892 | 0 |
| 4 | 1208.988 | 803.99785 | 0 | 607.90125 | 394.77569 | 0 |
| 5 | 1220.674 | 795.93705 | 0 | 799.09854 | 518.94066 | 0 |
| 6 | 1232.36 | 788.39075 | 0 | 973.09208 | 631.93339 | 0 |
| 7 | 1244.0465 | 781.3297 | 0 | 1132.6457 | 735.5487 | 0 |
| 8 | 1255.733 | 774.72855 | 0 | 1279.7584 | 831.08485 | 0 |
| 9 | 1261.7645 | 771.4407 | 0 | 1352.0711 | 878.04526 | 0 |
| 10 | 1262.1415 | 771.24235 | 0 | 1357.7979 | 881.76427 | 0 |
| 11 | 1268.24 | 768.14925 | 0 | 1413.9228 | 918.21219 | 0 |
| 12 | 1280.0595 | 762.3698 | 0 | 1513.0389 | 982.57893 | 0 |
| 13 | 1291.879 | 756.9994 | 0 | 1602.9467 | 1040.9658 | 0 |
| 14 | 1303.6985 | 752.0227 | 0 | 1683.9891 | 1093.5953 | 0 |
| 15 | 1315.518 | 747.4261 | 0 | 1756.1284 | 1140.4431 | 0 |
| 16 | 1327.338 | 743.19755 | 0 | 1818.9109 | 1181.2146 | 0 |
| 17 | 1339.1575 | 739.32645 | 0 | 1871.7655 | 1215.5387 | 0 |
| 18 | 1350.977 | 735.80345 | 0 | 1913.6665 | 1242.7495 | 0 |
| 19 | 1362.7965 | 732.6204 | 0 | 1943.442 | 1262.086 | 0 |
| 20 | 1374.616 | 729.77 | 0 | 1959.6148 | 1272.5887 | 0 |
| 21 | 1386.436 | 727.24595 | 0 | 1960.8087 | 1273.3641 | 0 |
| 22 | 1392.522 | 726.03205 | 0 | 1954.1466 | 1269.0376 | 0 |
| 23 | 1392.874 | 725.9667 | 0 | 1951.44 | 1267.28 | 0 |
| 24 | 1398.456 | 725.0018 | 0 | 1964.1638 | 1275.5429 | 0 |
| 25 | 1409.2675 | 723.26865 | 0 | 1982.0731 | 1287.1733 | 0 |
| 26 | 1420.079 | 721.79705 | 0 | 1984.8773 | 1288.9944 | 0 |
| 27 | 1430.891 | 720.5845 | 0 | 1971.355 | 1280.2129 | 0 |
| 28 | 1436.4825 | 720.0264 | 0 | 1959.5137 | 1272.5231 | 0 |
| 29 | 1436.854 | 719.9939 | 0 | 1961.6633 | 1273.919 | 0 |
| 30 | 1443.2885 | 719.5211 | 0 | 1904.3188 | 1236.6791 | 0 |
| 31 | 1455.786 | 718.7779 | 0 | 1769.5897 | 1149.185 | 0 |
| 32 | 1468.2835 | 718.37405 | 0 | 1610.178 | 1045.6618 | 0 |
| 33 | 1480.7805 | 718.3087 | 0 | 1427.1769 | 926.81954 | 0 |
| 34 | 1493.2775 | 718.58175 | 0 | 1222.0233 | 793.5912 | 0 |
| 35 | 1505.775 | 719.19375 | 0 | 997.03803 | 647.48407 | 0 |
| 36 | 1518.2725 | 720.14605 | 0 | 754.71668 | 490.11874 | 0 |
| 37 | 1530.7695 | 721.4408 | 0 | 497.98823 | 323.39734 | 0 |
| 38 | 1538.7465 | 722.40745 | 0 | 289.38228 | 153.86729 | 300 |
| 39 | 1542.1745 | 722.8833 | 0 | 108.01848 | 57.434442 | 300 |

# Lake Norman A-A'  - Seismic South Slope



# Lake Norman Closure



# File Information

Created By: McDonald, Carl
Revision Number: 56
Last Edited By: McDonald, Carl
Date: 8/6/2008
Time: 1:03:09 PM
File Name: Lake_Norman_A-A'_seismic_south.gsz
Directory: P:\135836 - Allied Waste Lake Norman C&D Landfill\Closure and Post-Closure Plan\Calculations\Slope Stability\Geoslope\Final\

# Lake Norman Closure

Kind: SLOPE/W
Method: Morgenstern-Price
Convergence
- Minimum Slice Thickness: 0.1
- Ignore seismic load in strength: No

Number of Slices: 30
Optimization Tolerance: 0.01
Direction of movement: Left to Right
Allow Passive Mode: 1
Slip Surface Option: Entry and Exit
Apply Phreatic Correction: No
Side Function
- Interslice force function option: Half-Sine

FOS Distribution Calculation: Constant
Optimize Critical Slip Surface Location: Yes
Cap Suction: No
Rapid Drawdown: No
PWP Conditions Source: (none)
Critical slip surfaces saved: 1
Optimize Critical Slip Surface
- Optimization Maximum Iterations: 2000
- Optimization Convergence Tolerance: 1e-007
- Starting Optimization Points: 8
- Ending Optimization Points: 16
- Complete Passes per Insertion: 1

# Materials

## Material 1: Residual / Existing Soils

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 300 psf
Phi: 28 °
Phi-B: 0 °

### Material 2: C&D Waste

Model: Mohr-Coulomb
Unit Weight: 44.4 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

### Material 3: Erosion Layer

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 300 psf
Phi: 28 °
Phi-B: 0 °

### Material 4: Protective Layer

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 300 psf
Phi: 28 °
Phi-B: 0 °

### Material 5: Saturated Existing (GW)

Model: Mohr-Coulomb
Unit Weight: 47.6 pcf
Cohesion: 300 psf
Phi: 10 °
Phi-B: 0 °

### Material 6: Bedrock

Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion: 9500 psf
Phi: 38 °
Phi-B: 0 °

## Regions

| | Material | Points | |
|---|---|---|---|
| Region 1 | Residual / Existing Soils | 1,2,3,4,5,6,7,8,9,10,11,12,13,14 | 1 |

| | | | |
|---|---|---|---|
| **Region 2** | C&D Waste | 15,9,16,17,18,19,20,21,22,23,24,25,26 | 1 |
| **Region 3** | Erosion Layer | 27,8,28,29,30,31,32,33,34,35,36,37,10,38,39,40,41,42,43,44,45,46,47,48 | 2 |
| **Region 4** | Protective Layer | 27,48,47,46,45,44,43,42,41,40,39,38,15,26,25,24,23,22,21,20,19,18,17,16 | 2 |
| **Region 5** | Bedrock | 49,50,51,52,53,54 | 5 |
| **Region 6** | Saturated Existing (GW) | 49,50,51,52,1,2,3,4,5 | 2 |

# Points

| | X (ft) | Y (ft) |
|---|---|---|
| **Point 1** | 1700 | 709.15984 |
| **Point 2** | 1643.4066 | 699.07441 |
| **Point 3** | 1127.53 | 703.43 |
| **Point 4** | 625.75 | 692.32 |
| **Point 5** | 1.169202 | 669.28588 |
| **Point 6** | 0 | 690 |
| **Point 7** | 78.43 | 673.74 |
| **Point 8** | 101.39068 | 681.6187 |
| **Point 9** | 801.93265 | 704.17209 |
| **Point 10** | 1560.4804 | 717.79977 |
| **Point 11** | 1593.53 | 707.2 |
| **Point 12** | 1603.54 | 710.27 |
| **Point 13** | 1643.3737 | 700 |
| **Point 14** | 1700 | 718.87543 |
| **Point 15** | 1551.1735 | 717.63422 |
| **Point 16** | 111.59742 | 681.94933 |
| **Point 17** | 141.22821 | 692.1168 |
| **Point 18** | 267.13945 | 730.85872 |
| **Point 19** | 402.44219 | 771.1706 |
| **Point 20** | 537.68475 | 809.99263 |
| **Point 21** | 613.04689 | 827.00283 |
| **Point 22** | 849.08266 | 828.99992 |
| **Point 23** | 1147.7728 | 827.00225 |
| **Point 24** | 1261.5758 | 801.08495 |
| **Point 25** | 1392.3457 | 762.90039 |

| | | |
|---|---|---|
| **Point 26** | 1436.2969 | 754.47782 |
| **Point 27** | 106.49405 | 681.78401 |
| **Point 28** | 140.3 | 694.97 |
| **Point 29** | 266.27 | 733.73 |
| **Point 30** | 401.6 | 774.05 |
| **Point 31** | 536.94 | 812.9 |
| **Point 32** | 612.7 | 830 |
| **Point 33** | 849.08 | 832 |
| **Point 34** | 1148.12 | 830 |
| **Point 35** | 1262.33 | 803.99 |
| **Point 36** | 1393.05 | 765.82 |
| **Point 37** | 1437.04 | 757.39 |
| **Point 38** | 1555.8269 | 717.71699 |
| **Point 39** | 1436.6684 | 755.93391 |
| **Point 40** | 1392.6978 | 764.36019 |
| **Point 41** | 1261.9529 | 802.53747 |
| **Point 42** | 1147.9464 | 828.50113 |
| **Point 43** | 849.08133 | 830.49996 |
| **Point 44** | 612.87345 | 828.50141 |
| **Point 45** | 537.31237 | 811.44631 |
| **Point 46** | 402.0211 | 772.6103 |
| **Point 47** | 266.70472 | 732.29436 |
| **Point 48** | 140.76411 | 693.5434 |
| **Point 49** | -6.09e-014 | 663.12536 |
| **Point 50** | 267.51557 | 674.75059 |
| **Point 51** | 1122.01 | 675 |
| **Point 52** | 1700 | 692.49881 |
| **Point 53** | 1700 | 645.12725 |
| **Point 54** | -9.95e-014 | 645.12725 |

# Tension Crack

Tension Crack Option: (none)

# Slip Surface Entry and Exit

Left-Zone Increment: 4
Left Projection: Range
Left-Zone Left Coordinate: (847.63412, 831.98777) ft

Left-Zone Right Coordinate: (1186.068, 821.35779) ft
Right-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (1500.0038, 737.19605) ft
Right-Zone Right Coordinate: (1680.776, 712.46744) ft
Radius Increments: 4

# Slip Surface Limits

Left Coordinate: (0, 690) ft
Right Coordinate: (1700, 718.87543) ft

# Seismic Loads

Horz Seismic Load: 0.055
Vert Seismic Load: 0.055

# Critical Slip Surfaces

| | Number | FOS | Center (ft) | Radius (ft) | Entry (ft) | Exit (ft) |
|---|---|---|---|---|---|---|
| 1 | Optimized | 2.044 | (1477.99, 1181.33) | 174.2634 | (1185.92, 821.393) | (1555.07, 719.535) |
| 2 | 107 | 2.160 | (1477.99, 1181.33) | 463.457 | (1186.07, 821.358) | (1545.06, 722.747) |

### Slices of Slip Surface: Optimized

| | X (ft) | Y (ft) | PoreWaterPressure (psf) | Base Normal Stress (psf) | Frictional Strength (psf) | Cohesive Strength (psf) |
|---|---|---|---|---|---|---|
| 1 | 1186.82 | 820.4173 | 0 | -52.899577 | -28.127204 | 300 |
| 2 | 1188.6305 | 818.4665 | 0 | 87.14529 | 46.335973 | 300 |
| 3 | 1190.0465 | 816.94115 | 0 | 279.54606 | 181.53934 | 0 |
| 4 | 1197.2515 | 813.08225 | 0 | 411.40558 | 267.16991 | 0 |
| 5 | 1210.6405 | 806.46435 | 0 | 545.37822 | 354.17275 | 0 |
| 6 | 1224.0295 | 799.84645 | 0 | 676.12356 | 439.07977 | 0 |
| 7 | 1237.4185 | 793.22855 | 0 | 804.2777 | 522.30404 | 0 |
| 8 | 1252.838 | 785.78225 | 0 | 951.53819 | 617.93613 | 0 |
| 9 | 1261.5695 | 781.64235 | 0 | 1065.0678 | 691.66314 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **10** | 1261.7645 | 781.56445 | 0 | 1067.0451 | 692.94719 | 0 |
| **11** | 1262.1415 | 781.41375 | 0 | 1070.9111 | 695.45781 | 0 |
| **12** | 1268.088 | 779.0372 | 0 | 1094.7169 | 710.91745 | 0 |
| **13** | 1279.6035 | 774.4348 | 0 | 1139.1474 | 739.77098 | 0 |
| **14** | 1291.675 | 769.9651 | 0 | 1210.5711 | 786.15404 | 0 |
| **15** | 1304.303 | 765.62815 | 0 | 1237.0099 | 803.32364 | 0 |
| **16** | 1317.319 | 761.30545 | 0 | 1276.8856 | 829.2192 | 0 |
| **17** | 1330.723 | 756.997 | 0 | 1296.7726 | 842.13395 | 0 |
| **18** | 1344.127 | 752.68855 | 0 | 1318.08 | 855.97118 | 0 |
| **19** | 1357.0655 | 748.67235 | 0 | 1353.9841 | 879.28753 | 0 |
| **20** | 1369.5385 | 744.9484 | 0 | 1364.4318 | 886.07238 | 0 |
| **21** | 1382.0115 | 741.22445 | 0 | 1375.4942 | 893.25635 | 0 |
| **22** | 1389.051 | 739.16465 | 0 | 1429.0854 | 928.0589 | 0 |
| **23** | 1391.1 | 738.74485 | 0 | 1491.3949 | 968.52319 | 0 |
| **24** | 1392.522 | 738.49155 | 0 | 1483.4777 | 963.38168 | 0 |
| **25** | 1392.874 | 738.4288 | 0 | 1479.4242 | 960.74929 | 0 |
| **26** | 1396.5615 | 737.7718 | 0 | 1476.7386 | 959.00524 | 0 |
| **27** | 1405.915 | 735.90485 | 0 | 1449.3579 | 941.224 | 0 |
| **28** | 1417.5995 | 733.4222 | 0 | 1464.594 | 951.11846 | 0 |
| **29** | 1429.284 | 730.93955 | 0 | 1478.8255 | 960.36054 | 0 |
| **30** | 1435.7115 | 729.55615 | 0 | 1458.8974 | 947.41904 | 0 |
| **31** | 1436.4825 | 729.369 | 0 | 1462.466 | 949.7365 | 0 |
| **32** | 1436.854 | 729.2788 | 0 | 1466.5198 | 952.36909 | 0 |
| **33** | 1442.2065 | 727.97975 | 0 | 1452.5739 | 943.3125 | 0 |
| **34** | 1452.5395 | 725.47185 | 0 | 1420.3153 | 922.36357 | 0 |
| **35** | 1464.794 | 722.95765 | 0 | 1411.4323 | 916.59486 | 0 |
| **36** | 1478.9695 | 720.43715 | 0 | 1315.4477 | 854.26172 | 0 |
| **37** | 1492.0415 | 718.64585 | 0 | 1256.9713 | 816.28669 | 0 |
| **38** | 1504.01 | 717.5838 | 0 | 1112.8228 | 722.67558 | 0 |
| **39** | 1516.704 | 717.14785 | 0 | 971.83663 | 631.11809 | 0 |
| **40** | 1530.1235 | 717.338 | 0 | 732.44279 | 475.65391 | 0 |
| **41** | 1543.543 | 717.5282 | 0 | 501.35683 | 325.58493 | 0 |
| **42** | 1550.4665 | 717.70795 | 0 | 437.51186 | 284.12352 | 0 |
| **43** | 1551.7775 | 718.2282 | 0 | 379.23042 | 201.64039 | 300 |
| **44** | 1553.9725 | 719.09945 | 0 | 169.00509 | 89.861601 | 300 |

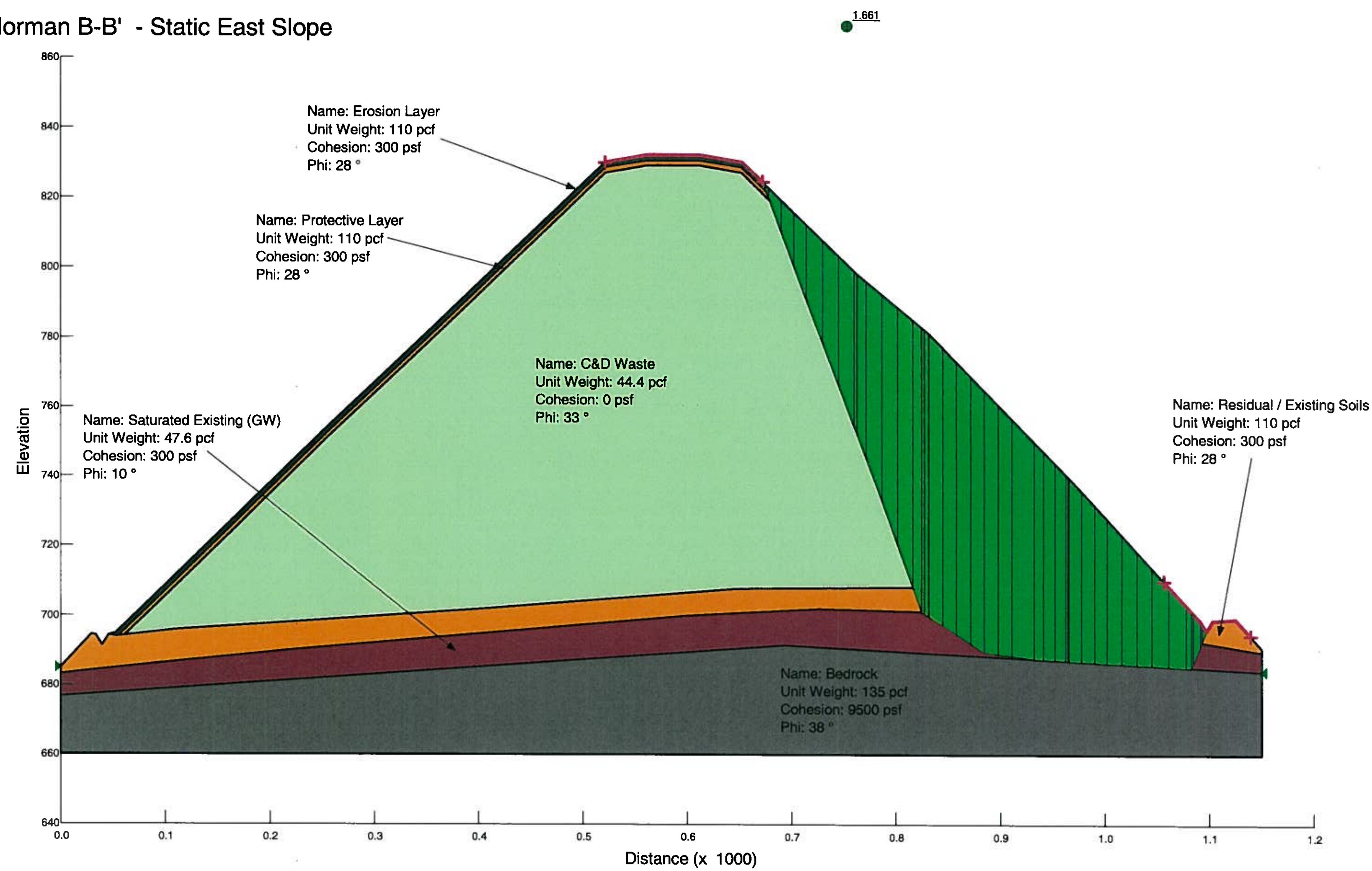
### Slices of Slip Surface: 107

| | X (ft) | Y (ft) | PoreWaterPressure (psf) | Base Normal Stress | Frictional Strength (psf) | Cohesive Strength (psf) |
|---|---|---|---|---|---|---|

| | | | | (psf) | | |
|---|---|---|---|---|---|---|
| 1 | 1187.401 | 820.28505 | 0 | -17.314671 | -9.206374 | 300 |
| 2 | 1190.0955 | 818.133 | 0 | 134.23514 | 71.37409 | 300 |
| 3 | 1197.3 | 812.60555 | 0 | 403.60976 | 262.10724 | 0 |
| 4 | 1208.9865 | 803.9918 | 0 | 617.59765 | 401.0726 | 0 |
| 5 | 1220.673 | 795.92495 | 0 | 810.47 | 526.32537 | 0 |
| 6 | 1232.3595 | 788.3712 | 0 | 985.97834 | 640.30182 | 0 |
| 7 | 1244.046 | 781.3015 | 0 | 1147.0812 | 744.92326 | 0 |
| 8 | 1255.7325 | 774.69055 | 0 | 1296.3796 | 841.87874 | 0 |
| 9 | 1261.7645 | 771.39735 | 0 | 1370.0918 | 889.74801 | 0 |
| 10 | 1262.1415 | 771.1987 | 0 | 1375.9656 | 893.56252 | 0 |
| 11 | 1268.24 | 768.09975 | 0 | 1433.5182 | 930.93758 | 0 |
| 12 | 1280.0595 | 762.30845 | 0 | 1536.1466 | 997.58527 | 0 |
| 13 | 1291.879 | 756.92535 | 0 | 1630.8024 | 1059.0555 | 0 |
| 14 | 1303.6985 | 751.93505 | 0 | 1717.7842 | 1115.5421 | 0 |
| 15 | 1315.518 | 747.324 | 0 | 1797.2384 | 1167.1403 | 0 |
| 16 | 1327.338 | 743.08015 | 0 | 1868.6549 | 1213.5187 | 0 |
| 17 | 1339.1575 | 739.19295 | 0 | 1931.2371 | 1254.16 | 0 |
| 18 | 1350.977 | 735.6531 | 0 | 1983.7989 | 1288.2941 | 0 |
| 19 | 1362.7965 | 732.45235 | 0 | 2024.7596 | 1314.8943 | 0 |
| 20 | 1374.616 | 729.5835 | 0 | 2052.4599 | 1332.883 | 0 |
| 21 | 1386.436 | 727.0402 | 0 | 2064.678 | 1340.8176 | 0 |
| 22 | 1392.522 | 725.81615 | 0 | 2063.3961 | 1339.9851 | 0 |
| 23 | 1392.874 | 725.7502 | 0 | 2060.8474 | 1338.3299 | 0 |
| 24 | 1398.456 | 724.77565 | 0 | 2079.3109 | 1350.3203 | 0 |
| 25 | 1409.2675 | 723.0234 | 0 | 2107.6885 | 1368.7489 | 0 |
| 26 | 1420.079 | 721.532 | 0 | 2119.5022 | 1376.4208 | 0 |
| 27 | 1430.891 | 720.299 | 0 | 2113.1316 | 1372.2837 | 0 |
| 28 | 1436.4825 | 719.7301 | 0 | 2104.3495 | 1366.5806 | 0 |
| 29 | 1436.854 | 719.69685 | 0 | 2106.8603 | 1368.2111 | 0 |
| 30 | 1443.3625 | 719.2066 | 0 | 2049.0468 | 1330.6666 | 0 |
| 31 | 1456.007 | 718.4327 | 0 | 1909.6587 | 1240.1469 | 0 |
| 32 | 1468.6515 | 718.0051 | 0 | 1741.0349 | 1130.6413 | 0 |
| 33 | 1481.2965 | 717.9229 | 0 | 1544.5142 | 1003.0193 | 0 |
| 34 | 1493.941 | 718.1859 | 0 | 1322.26 | 858.68566 | 0 |
| 35 | 1506.5855 | 718.79465 | 0 | 1077.2557 | 699.57802 | 0 |
| 36 | 1519.2305 | 719.7505 | 0 | 813.20345 | 528.1005 | 0 |
| 37 | 1531.8755 | 721.05565 | 0 | 533.99217 | 346.77857 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **38** | 1539.9265 | 722.02905 | 0 | 311.37978 | 165.56357 | 300 |
| **39** | 1543.3555 | 722.50445 | 0 | 117.76922 | 62.619005 | 300 |

Lake Norman B-B' - Static East Slope



# Lake Norman Closure



## File Information

Created By: McDonald, Carl
Revision Number: 70
Last Edited By: McDonald, Carl
Date: 8/6/2008
Time: 12:57:22 PM
File Name: LakeNorman_B-B'_east.gsz
Directory: P:\135836 - Allied Waste Lake Norman C&D Landfill\Closure and Post-Closure Plan\Calculations\Slope Stability\Geoslope\Final\

## Lake Norman Closure

Kind: SLOPE/W
Method: Morgenstern-Price
Convergence
    Minimum Slice Thickness: 0.1
    Ignore seismic load in strength: No
Number of Slices: 30
Optimization Tolerance: 0.01
Direction of movement: Left to Right
Allow Passive Mode: 1
Slip Surface Option: Entry and Exit
Apply Phreatic Correction: No
Side Function
    Interslice force function option: Half-Sine
FOS Distribution Calculation: Constant
Optimize Critical Slip Surface Location: Yes
Cap Suction: No
Rapid Drawdown: No
PWP Conditions Source: (none)
Critical slip surfaces saved: 1
Optimize Critical Slip Surface
    Optimization Maximum Iterations: 2000
    Optimization Convergence Tolerance: 1e-007
    Starting Optimization Points: 8
    Ending Optimization Points: 16
    Complete Passes per Insertion: 1

## Materials

### Material 1: Residual / Existing Soils

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 300 psf
Phi: 28 °
Phi-B: 0 °

### Material 2: C&D Waste

Model: Mohr-Coulomb
Unit Weight: 44.4 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

### Material 3: Erosion Layer

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 300 psf
Phi: 28 °
Phi-B: 0 °

### Material 4: Protective Layer

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 300 psf
Phi: 28 °
Phi-B: 0 °

### Material 5: Saturated Existing (GW)

Model: Mohr-Coulomb
Unit Weight: 47.6 pcf
Cohesion: 300 psf
Phi: 10 °
Phi-B: 0 °

### Material 6: Bedrock

Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion: 9500 psf
Phi: 38 °
Phi-B: 0 °

## Regions

| | Material | Points |
|---|---|---|
| **Region 1** | Bedrock | 1,2,3,4,5 |
| **Region 2** | C&D | 6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24 |

| | | |
|---|---|---|
| | Waste | |
| **Region 3** | Erosion Layer | 25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49, |
| **Region 4** | Protective Layer | 6,7,25,50,49,48,47,46,45,44,43,42,41,40,14,15,16,17,18,19,20,21,22,23,24 |
| **Region 5** | Residual / Existing Soils | 51,52,53,54,38,39,40,14,13,12,11,10,9,8,7,25,26,55,56,57,58,59,60,61,62,63,6 |
| **Region 6** | Saturated Existing (GW) | 1,69,68,67,66,65,64,63,62,61,60,59,3,2 |

# Points

| | X (ft) | Y (ft) |
|---|---|---|
| **Point 1** | 0 | 676.63358 |
| **Point 2** | 692.96391 | 691.58584 |
| **Point 3** | 1150 | 683.98355 |
| **Point 4** | 1150 | 660 |
| **Point 5** | 0 | 660 |
| **Point 6** | 1077.5596 | 699.95349 |
| **Point 7** | 1077.665 | 699.93051 |
| **Point 8** | 941.00104 | 705.28224 |
| **Point 9** | 857.90284 | 708.34673 |
| **Point 10** | 647.91273 | 707.85925 |
| **Point 11** | 406.29092 | 701.95001 |
| **Point 12** | 210.77551 | 697.95001 |
| **Point 13** | 110.67281 | 695.88602 |
| **Point 14** | 60.833661 | 694.27034 |
| **Point 15** | 166.48223 | 724.87069 |
| **Point 16** | 257.75837 | 751.81857 |
| **Point 17** | 395.2251 | 790.81994 |
| **Point 18** | 521.89557 | 827.02085 |
| **Point 19** | 561.62907 | 829 |
| **Point 20** | 611.79738 | 829 |
| **Point 21** | 651.917 | 827.02091 |
| **Point 22** | 759.92753 | 795.45833 |
| **Point 23** | 831.04041 | 778.2123 |
| **Point 24** | 964.49348 | 736.64402 |

| | | |
|---|---|---|
| **Point 25** | 1084.1588 | 699.35786 |
| **Point 26** | 1090.9868 | 698.75033 |
| **Point 27** | 965.40258 | 739.50301 |
| **Point 28** | 831.8447 | 781.10395 |
| **Point 29** | 762.39409 | 798.14482 |
| **Point 30** | 652.41493 | 830 |
| **Point 31** | 611.87133 | 832 |
| **Point 32** | 561.5544 | 832 |
| **Point 33** | 521.40235 | 830 |
| **Point 34** | 394.4035 | 793.70524 |
| **Point 35** | 256.9242 | 754.70031 |
| **Point 36** | 165.63988 | 727.75001 |
| **Point 37** | 51.945911 | 694.79367 |
| **Point 38** | 45.733856 | 694.41777 |
| **Point 39** | 51.791811 | 693.96673 |
| **Point 40** | 54.766076 | 694.06135 |
| **Point 41** | 166.06106 | 726.31035 |
| **Point 42** | 257.34129 | 753.25944 |
| **Point 43** | 394.8143 | 792.26259 |
| **Point 44** | 521.64896 | 828.51042 |
| **Point 45** | 561.59173 | 830.5 |
| **Point 46** | 611.83436 | 830.5 |
| **Point 47** | 652.16597 | 828.51046 |
| **Point 48** | 762.80125 | 796.43661 |
| **Point 49** | 831.44256 | 779.65813 |
| **Point 50** | 964.94803 | 738.07351 |
| **Point 51** | 8.38e-014 | 684.96369 |
| **Point 52** | 29.140389 | 694.43184 |
| **Point 53** | 33.268962 | 694.3688 |
| **Point 54** | 39.502593 | 691.38814 |
| **Point 55** | 1097.0074 | 695.73649 |
| **Point 56** | 1103.0273 | 698.73526 |
| **Point 57** | 1125.0356 | 699.14795 |
| **Point 58** | 1149.95 | 690.82331 |
| **Point 59** | 1149.95 | 689.59454 |
| **Point 60** | 1044.4186 | 694.83213 |
| **Point 61** | 910.92956 | 699.78126 |
| **Point 62** | 826.93835 | 701.23805 |
| **Point 63** | 725.98104 | 701.9312 |

| | | |
|---|---|---|
| **Point 64** | 598.11111 | 700 |
| **Point 65** | 466.52805 | 696.46566 |
| **Point 66** | 216.90598 | 690 |
| **Point 67** | 74.363106 | 685.58056 |
| **Point 68** | 17.358695 | 683.6719 |
| **Point 69** | -4.2e-015 | 683.12622 |

# Tension Crack

Tension Crack Option: (none)

# Slip Surface Entry and Exit

Left-Zone Increment: 4
Left Projection: Range
Left-Zone Left Coordinate: (520.99306, 829.88303) ft
Left-Zone Right Coordinate: (672.1526, 824.28303) ft
Right-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (1056.5646, 709.92049) ft
Right-Zone Right Coordinate: (1139.5473, 694.29916) ft
Radius Increments: 4

# Slip Surface Limits

Left Coordinate: (8.38e-014, 684.96369) ft
Right Coordinate: (1150, 683.98355) ft

# Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

# Critical Slip Surfaces

| | Number | FOS | Center (ft) | Radius (ft) | Entry (ft) | Exit (ft) |
|---|---|---|---|---|---|---|
| **1** | Optimized | 1.661 | (1001.82, 1332.87) | 218.7891 | (671.615, 824.439) | (1097.12, 695.794) |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2 | 62 | 2.038 | (1001.82, 1332.87) | 644.03 | (596.97, 832) | (1096.74, 695.87) |

## Slices of Slip Surface: Optimized

| | X (ft) | Y (ft) | PoreWaterPressure (psf) | Base Normal Stress (psf) | Frictional Strength (psf) | Cohesive Strength (psf) |
|---|---|---|---|---|---|---|
| 1 | 673.1529 | 823.20955 | 0 | -45.178149 | -24.021648 | 300 |
| 2 | 676.2827 | 820.708 | 0 | 95.955563 | 51.020478 | 300 |
| 3 | 683.90415 | 814.6164 | 0 | 369.4599 | 239.93006 | 0 |
| 4 | 695.96325 | 804.978 | 0 | 569.36701 | 369.75126 | 0 |
| 5 | 708.0224 | 795.33955 | 0 | 765.01182 | 496.80448 | 0 |
| 6 | 721.6979 | 784.45945 | 0 | 983.0625 | 638.40825 | 0 |
| 7 | 736.98975 | 772.33775 | 0 | 1218.9504 | 791.59562 | 0 |
| 8 | 752.2816 | 760.21605 | 0 | 1451.1485 | 942.38683 | 0 |
| 9 | 761.1608 | 753.17755 | 0 | 1581.9186 | 1027.31 | 0 |
| 10 | 762.59765 | 752.03855 | 0 | 1600.8055 | 1039.5752 | 0 |
| 11 | 767.05895 | 748.50215 | 0 | 1672.8739 | 1086.377 | 0 |
| 12 | 778.8871 | 738.93445 | 0 | 1849.4785 | 1201.0654 | 0 |
| 13 | 794.02795 | 726.54915 | 0 | 2101.866 | 1364.9677 | 0 |
| 14 | 808.80675 | 714.303 | 0 | 2331.7641 | 1514.2653 | 0 |
| 15 | 820.179 | 704.7527 | 0 | 2692.8983 | 1431.8394 | 300 |
| 16 | 824.36835 | 701.23455 | 0 | 3218.2965 | 567.4725 | 300 |
| 17 | 825.6661 | 700.96795 | 0 | 4052.6028 | 714.58322 | 300 |
| 18 | 828.9894 | 700.3274 | 0 | 4052.8394 | 714.62493 | 300 |
| 19 | 831.2415 | 699.89335 | 0 | 4054.2444 | 714.87268 | 300 |
| 20 | 831.64365 | 699.8158 | 0 | 4056.1978 | 715.21712 | 300 |
| 21 | 838.35925 | 698.5214 | 0 | 4042.3909 | 712.78259 | 300 |
| 22 | 851.3883 | 696.01015 | 0 | 4013.9786 | 707.77272 | 300 |
| 23 | 864.5147 | 693.4801 | 0 | 3970.7763 | 700.15499 | 300 |
| 24 | 877.73845 | 690.93125 | 0 | 3912.6348 | 689.90307 | 300 |
| 25 | 890.9951 | 689.3735 | 0 | 4061.9651 | 716.23403 | 300 |
| 26 | 904.28475 | 688.80685 | 0 | 3901.5343 | 687.94577 | 300 |
| 27 | 921.46955 | 688.07405 | 0 | 3701.7289 | 652.71468 | 300 |
| 28 | 936.50525 | 687.54805 | 0 | 3562.4846 | 628.16215 | 300 |
| 29 | 946.353 | 687.38035 | 0 | 3431.4106 | 605.05026 | 300 |
| 30 | 957.057 | 687.1981 | 0 | 3285.9714 | 579.40542 | 300 |
| 31 | 963.45125 | 687.08965 | 0 | 3198.5695 | 563.9941 | 300 |
| 32 | 964.72075 | 687.0685 | 0 | 3181.1449 | 560.92167 | 300 |
| 33 | 965.1753 | 687.06095 | 0 | 3175.2058 | 559.87445 | 300 |

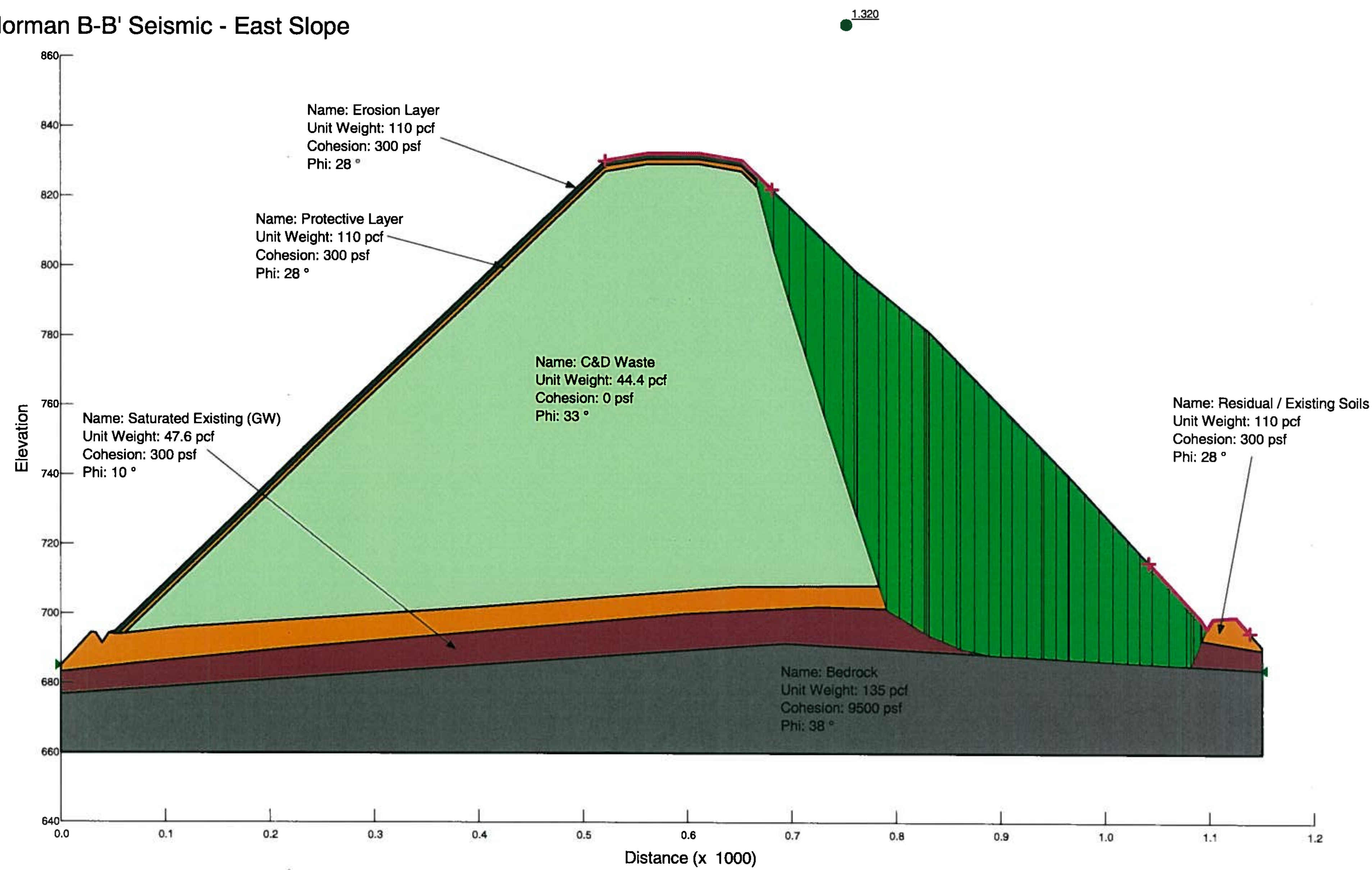
| | | | | | | |
|---|---|---|---|---|---|---|
| 34 | 971.513 | 686.95555 | 0 | 3083.486 | 543.70177 | 300 |
| 35 | 983.73385 | 686.75225 | 0 | 2904.3905 | 512.12241 | 300 |
| 36 | 995.95465 | 686.54895 | 0 | 2723.1678 | 480.16795 | 300 |
| 37 | 1009.124 | 686.33035 | 0 | 2526.0326 | 445.40771 | 300 |
| 38 | 1023.242 | 686.0965 | 0 | 2312.9272 | 407.83147 | 300 |
| 39 | 1037.36 | 685.8627 | 0 | 2098.7594 | 370.06791 | 300 |
| 40 | 1052.704 | 685.60855 | 0 | 1871.8612 | 330.05963 | 300 |
| 41 | 1069.2745 | 685.3341 | 0 | 1632.7949 | 287.9058 | 300 |
| 42 | 1077.6125 | 685.196 | 0 | 1512.3234 | 266.66342 | 300 |
| 43 | 1080.04 | 685.1558 | 0 | 1432.5267 | 252.59311 | 300 |
| 44 | 1083.287 | 685.74935 | 0 | 1585.0317 | 279.48386 | 300 |
| 45 | 1087.573 | 688.86075 | 0 | 1240.3976 | 218.71557 | 300 |
| 46 | 1091.7485 | 691.8923 | 0 | 894.77889 | 157.77366 | 300 |
| 47 | 1094.7585 | 694.07775 | 0 | 579.51644 | 308.13435 | 300 |
| 48 | 1097.065 | 695.75205 | 0 | 172.62905 | 91.788492 | 300 |

## Slices of Slip Surface: 62

| | X (ft) | Y (ft) | PoreWaterPressure (psf) | Base Normal Stress (psf) | Frictional Strength (psf) | Cohesive Strength (psf) |
|---|---|---|---|---|---|---|
| 1 | 597.9014 | 831.25 | 0 | -29.120348 | -15.483564 | 300 |
| 2 | 599.77135 | 829.75 | 0 | 108.69054 | 57.791785 | 300 |
| 3 | 606.25365 | 824.68475 | 0 | 415.76962 | 270.00395 | 0 |
| 4 | 611.8159 | 820.35545 | 0 | 565.69817 | 367.36869 | 0 |
| 5 | 611.85285 | 820.3273 | 0 | 566.76235 | 368.05978 | 0 |
| 6 | 621.88275 | 812.9965 | 0 | 809.62062 | 525.77378 | 0 |
| 7 | 641.9056 | 798.9313 | 0 | 1266.9078 | 822.73957 | 0 |
| 8 | 652.0415 | 792.10225 | 0 | 1487.8227 | 966.20337 | 0 |
| 9 | 652.29045 | 791.9413 | 0 | 1496.2951 | 971.7054 | 0 |
| 10 | 661.3743 | 786.2804 | 0 | 1612.072 | 1046.8918 | 0 |
| 11 | 679.2931 | 775.5153 | 0 | 1820.1138 | 1181.9958 | 0 |
| 12 | 697.21185 | 765.52035 | 0 | 2010.2296 | 1305.4584 | 0 |
| 13 | 715.1306 | 756.2554 | 0 | 2184.5153 | 1418.6408 | 0 |
| 14 | 733.0494 | 747.68575 | 0 | 2344.2635 | 1522.3825 | 0 |
| 15 | 750.96815 | 739.7812 | 0 | 2490.0765 | 1617.0746 | 0 |
| 16 | 761.1608 | 735.49485 | 0 | 2563.1364 | 1664.5202 | 0 |
| 17 | 762.59765 | 734.91655 | 0 | 2570.4104 | 1669.244 | 0 |
| 18 | 771.3311 | 731.5654 | 0 | 2644.163 | 1717.1395 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **19** | 788.3909 | 725.29925 | 0 | 2778.171 | 1804.1654 | 0 |
| **20** | 805.4507 | 719.5716 | 0 | 2898.0855 | 1882.0387 | 0 |
| **21** | 822.5105 | 714.36745 | 0 | 3001.9974 | 1949.5199 | 0 |
| **22** | 831.2415 | 711.83925 | 0 | 3049.3573 | 1980.2758 | 0 |
| **23** | 831.64365 | 711.7289 | 0 | 3053.017 | 1982.6524 | 0 |
| **24** | 838.2375 | 709.99485 | 0 | 3068.8092 | 1992.908 | 0 |
| **25** | 851.26655 | 706.72025 | 0 | 3187.4471 | 1694.7957 | 300 |
| **26** | 869.37215 | 702.71385 | 0 | 3422.4018 | 1819.7233 | 300 |
| **27** | 888.3635 | 698.9568 | 0 | 3434.9507 | 605.67448 | 300 |
| **28** | 903.40755 | 696.4473 | 0 | 3377.4064 | 595.52787 | 300 |
| **29** | 918.44745 | 694.3025 | 0 | 3308.2273 | 583.32974 | 300 |
| **30** | 933.48315 | 692.51855 | 0 | 3226.0091 | 568.83245 | 300 |
| **31** | 952.74725 | 690.8184 | 0 | 3084.0394 | 543.79936 | 300 |
| **32** | 964.72075 | 689.90745 | 0 | 2975.997 | 524.74856 | 300 |
| **33** | 965.1753 | 689.88135 | 0 | 2971.9448 | 524.03405 | 300 |
| **34** | 973.3042 | 689.51815 | 0 | 2883.5359 | 508.44517 | 300 |
| **35** | 989.1074 | 689.01185 | 0 | 2690.255 | 474.36454 | 300 |
| **36** | 1004.9105 | 688.89365 | 0 | 2468.5866 | 435.27843 | 300 |
| **37** | 1020.7135 | 689.1634 | 0 | 2219.1722 | 391.29993 | 300 |
| **38** | 1036.517 | 689.8216 | 0 | 1943.3131 | 342.65853 | 300 |
| **39** | 1052.526 | 690.8882 | 0 | 1645.3621 | 290.12174 | 300 |
| **40** | 1068.7405 | 692.37555 | 0 | 1326.6485 | 233.92392 | 300 |
| **41** | 1077.204 | 693.26455 | 0 | 1181.0681 | 627.98506 | 300 |
| **42** | 1077.6125 | 693.31275 | 0 | 1167.1809 | 620.60109 | 300 |
| **43** | 1080.912 | 693.72075 | 0 | 993.26236 | 528.12696 | 300 |
| **44** | 1087.573 | 694.58115 | 0 | 636.78171 | 338.58284 | 300 |
| **45** | 1093.8635 | 695.45515 | 0 | 237.91308 | 126.50063 | 300 |

# Lake Norman B-B' Seismic - East Slope



# Lake Norman Closure



# File Information

Created By: McDonald, Carl
Revision Number: 72
Last Edited By: McDonald, Carl
Date: 8/6/2008
Time: 12:54:26 PM
File Name: LakeNorman_B-B'_seismic_east.gsz
Directory: P:\135836 - Allied Waste Lake Norman C&D Landfill\Closure and Post-Closure Plan\Calculations\Slope Stability\Geoslope\Final\

# Lake Norman Closure

Kind: SLOPE/W
Method: Morgenstern-Price
Convergence
    Minimum Slice Thickness: 0.1
    Ignore seismic load in strength: No
Number of Slices: 30
Optimization Tolerance: 0.01
Direction of movement: Left to Right
Allow Passive Mode: 1
Slip Surface Option: Entry and Exit
Apply Phreatic Correction: No
Side Function
    Interslice force function option: Half-Sine
FOS Distribution Calculation: Constant
Optimize Critical Slip Surface Location: Yes
Cap Suction: No
Rapid Drawdown: No
PWP Conditions Source: (none)
Critical slip surfaces saved: 1
Optimize Critical Slip Surface
    Optimization Maximum Iterations: 2000
    Optimization Convergence Tolerance: 1e-007
    Starting Optimization Points: 8
    Ending Optimization Points: 16
    Complete Passes per Insertion: 1

# Materials

### Material 1: Residual / Existing Soils

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 300 psf
Phi: 28 °
Phi-B: 0 °

### Material 2: C&D Waste

Model: Mohr-Coulomb
Unit Weight: 44.4 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

### Material 3: Erosion Layer

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 300 psf
Phi: 28 °
Phi-B: 0 °

### Material 4: Protective Layer

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 300 psf
Phi: 28 °
Phi-B: 0 °

### Material 5: Saturated Existing (GW)

Model: Mohr-Coulomb
Unit Weight: 47.6 pcf
Cohesion: 300 psf
Phi: 10 °
Phi-B: 0 °

### Material 6: Bedrock

Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion: 9500 psf
Phi: 38 °
Phi-B: 0 °

## Regions

| | Material | Points |
|---|---|---|
| **Region 1** | Bedrock | 1,2,3,4,5 |
| **Region 2** | C&D | 6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24 |

| | | |
|---|---|---|
| | Waste | |
| **Region 3** | Erosion Layer | 25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49, |
| **Region 4** | Protective Layer | 6,7,25,50,49,48,47,46,45,44,43,42,41,40,14,15,16,17,18,19,20,21,22,23,24 |
| **Region 5** | Residual / Existing Soils | 51,52,53,54,38,39,40,14,13,12,11,10,9,8,7,25,26,55,56,57,58,59,60,61,62,63,6 |
| **Region 6** | Saturated Existing (GW) | 1,69,68,67,66,65,64,63,62,61,60,59,3,2 |

# Points

| | X (ft) | Y (ft) |
|---|---|---|
| **Point 1** | 0 | 676.63358 |
| **Point 2** | 692.96391 | 691.58584 |
| **Point 3** | 1150 | 683.98355 |
| **Point 4** | 1150 | 660 |
| **Point 5** | 0 | 660 |
| **Point 6** | 1077.5596 | 699.95349 |
| **Point 7** | 1077.665 | 699.93051 |
| **Point 8** | 941.00104 | 705.28224 |
| **Point 9** | 857.90284 | 708.34673 |
| **Point 10** | 647.91273 | 707.85925 |
| **Point 11** | 406.29092 | 701.95001 |
| **Point 12** | 210.77551 | 697.95001 |
| **Point 13** | 110.67281 | 695.88602 |
| **Point 14** | 60.833661 | 694.27034 |
| **Point 15** | 166.48223 | 724.87069 |
| **Point 16** | 257.75837 | 751.81857 |
| **Point 17** | 395.2251 | 790.81994 |
| **Point 18** | 521.89557 | 827.02085 |
| **Point 19** | 561.62907 | 829 |
| **Point 20** | 611.79738 | 829 |
| **Point 21** | 651.917 | 827.02091 |
| **Point 22** | 759.92753 | 795.45833 |
| **Point 23** | 831.04041 | 778.2123 |
| **Point 24** | 964.49348 | 736.64402 |

| | | |
|---|---|---|
| **Point 25** | 1084.1588 | 699.35786 |
| **Point 26** | 1090.9868 | 698.75033 |
| **Point 27** | 965.40258 | 739.50301 |
| **Point 28** | 831.8447 | 781.10395 |
| **Point 29** | 762.39409 | 798.14482 |
| **Point 30** | 652.41493 | 830 |
| **Point 31** | 611.87133 | 832 |
| **Point 32** | 561.5544 | 832 |
| **Point 33** | 521.40235 | 830 |
| **Point 34** | 394.4035 | 793.70524 |
| **Point 35** | 256.9242 | 754.70031 |
| **Point 36** | 165.63988 | 727.75001 |
| **Point 37** | 51.945911 | 694.79367 |
| **Point 38** | 45.733856 | 694.41777 |
| **Point 39** | 51.791811 | 693.96673 |
| **Point 40** | 54.766076 | 694.06135 |
| **Point 41** | 166.06106 | 726.31035 |
| **Point 42** | 257.34129 | 753.25944 |
| **Point 43** | 394.8143 | 792.26259 |
| **Point 44** | 521.64896 | 828.51042 |
| **Point 45** | 561.59173 | 830.5 |
| **Point 46** | 611.83436 | 830.5 |
| **Point 47** | 652.16597 | 828.51046 |
| **Point 48** | 762.80125 | 796.43661 |
| **Point 49** | 831.44256 | 779.65813 |
| **Point 50** | 964.94803 | 738.07351 |
| **Point 51** | 8.38e-014 | 684.96369 |
| **Point 52** | 29.140389 | 694.43184 |
| **Point 53** | 33.268962 | 694.3688 |
| **Point 54** | 39.502593 | 691.38814 |
| **Point 55** | 1097.0074 | 695.73649 |
| **Point 56** | 1103.0273 | 698.73526 |
| **Point 57** | 1125.0356 | 699.14795 |
| **Point 58** | 1149.95 | 690.82331 |
| **Point 59** | 1149.95 | 689.59454 |
| **Point 60** | 1044.4186 | 694.83213 |
| **Point 61** | 910.92956 | 699.78126 |
| **Point 62** | 826.93835 | 701.23805 |
| **Point 63** | 725.98104 | 701.9312 |

| | | |
|---|---|---|
| **Point 64** | 598.11111 | 700 |
| **Point 65** | 466.52805 | 696.46566 |
| **Point 66** | 216.90598 | 690 |
| **Point 67** | 74.363106 | 685.58056 |
| **Point 68** | 17.358695 | 683.6719 |
| **Point 69** | -4.2e-015 | 683.12622 |

# Tension Crack

Tension Crack Option: (none)

# Slip Surface Entry and Exit

Left-Zone Increment: 4
Left Projection: Range
Left-Zone Left Coordinate: (520.99306, 829.88303) ft
Left-Zone Right Coordinate: (680.94602, 821.73604) ft
Right-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (1041.537, 714.79703) ft
Right-Zone Right Coordinate: (1138.2853, 694.72084) ft
Radius Increments: 4

# Slip Surface Limits

Left Coordinate: (8.38e-014, 684.96369) ft
Right Coordinate: (1150, 683.98355) ft

# Seismic Loads

Horz Seismic Load: 0.055
Vert Seismic Load: 0.055

# Critical Slip Surfaces

| | Number | FOS | Center (ft) | Radius (ft) | Entry (ft) | Exit (ft) |
|---|---|---|---|---|---|---|
| **1** | Optimized | 1.320 | (922.892, 976.146) | 223.5176 | (663.031, 826.925) | (1097.23, 695.849) |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2 | 103 | 1.642 | (922.892, 976.146) | 287.019 | (680.946, 821.736) | (1041.54, 714.797) |

## Slices of Slip Surface: Optimized

| | X (ft) | Y (ft) | PoreWaterPressure (psf) | Base Normal Stress (psf) | Frictional Strength (psf) | Cohesive Strength (psf) |
|---|---|---|---|---|---|---|
| 1 | 663.92185 | 825.88455 | 0 | -117.54011 | -62.497187 | 300 |
| 2 | 665.72095 | 823.7829 | 0 | 8.6256173 | 4.5863221 | 300 |
| 3 | 674.53595 | 813.48535 | 0 | 431.5161 | 280.22983 | 0 |
| 4 | 690.1559 | 796.692 | 0 | 821.51478 | 533.49794 | 0 |
| 5 | 705.5827 | 781.57805 | 0 | 1120.1717 | 727.44798 | 0 |
| 6 | 722.3112 | 765.4172 | 0 | 1440.4281 | 935.42496 | 0 |
| 7 | 740.34145 | 748.2094 | 0 | 1757.5141 | 1141.343 | 0 |
| 8 | 754.64205 | 734.7162 | 0 | 2027.2579 | 1316.5167 | 0 |
| 9 | 761.1608 | 728.68605 | 0 | 2132.9945 | 1385.1828 | 0 |
| 10 | 762.59765 | 727.3569 | 0 | 2154.3549 | 1399.0544 | 0 |
| 11 | 773.0682 | 717.6711 | 0 | 2339.5645 | 1519.3309 | 0 |
| 12 | 786.94895 | 704.8307 | 0 | 2736.5285 | 1455.038 | 300 |
| 13 | 790.6118 | 701.44235 | 0 | 3315.8384 | 584.67178 | 300 |
| 14 | 796.70715 | 700.2817 | 0 | 4494.2203 | 792.45229 | 300 |
| 15 | 808.79965 | 698.05125 | 0 | 4485.2746 | 790.87493 | 300 |
| 16 | 820.89215 | 695.82075 | 0 | 4479.338 | 789.82814 | 300 |
| 17 | 827.9786 | 694.51365 | 0 | 4477.6592 | 789.53213 | 300 |
| 18 | 830.0296 | 694.1904 | 0 | 4603.8086 | 811.77568 | 300 |
| 19 | 831.2415 | 694.03285 | 0 | 4602.6494 | 811.57128 | 300 |
| 20 | 831.64365 | 693.9806 | 0 | 4603.8824 | 811.78868 | 300 |
| 21 | 838.35925 | 693.1077 | 0 | 4575.041 | 806.70317 | 300 |
| 22 | 851.3883 | 691.4141 | 0 | 4517.0443 | 796.47679 | 300 |
| 23 | 859.71195 | 690.33215 | 0 | 4475.5433 | 789.15904 | 300 |
| 24 | 868.2922 | 689.65675 | 0 | 4555.7474 | 803.30118 | 300 |
| 25 | 881.8344 | 688.77625 | 0 | 4413.3089 | 778.18543 | 300 |
| 26 | 894.1865 | 688.24275 | 0 | 4386.3091 | 773.42464 | 300 |
| 27 | 905.34855 | 688.05625 | 0 | 4230.4454 | 745.94166 | 300 |
| 28 | 917.96245 | 687.8455 | 0 | 4058.8071 | 715.67721 | 300 |
| 29 | 932.02815 | 687.6105 | 0 | 3869.8634 | 682.36133 | 300 |
| 30 | 940.031 | 687.47685 | 0 | 3760.0995 | 663.00699 | 300 |
| 31 | 946.87415 | 687.3629 | 0 | 3663.3937 | 645.95516 | 300 |
| 32 | 958.6204 | 687.16735 | 0 | 3494.4266 | 616.1617 | 300 |
| 33 | 964.72075 | 687.0658 | 0 | 3405.5085 | 600.48303 | 300 |

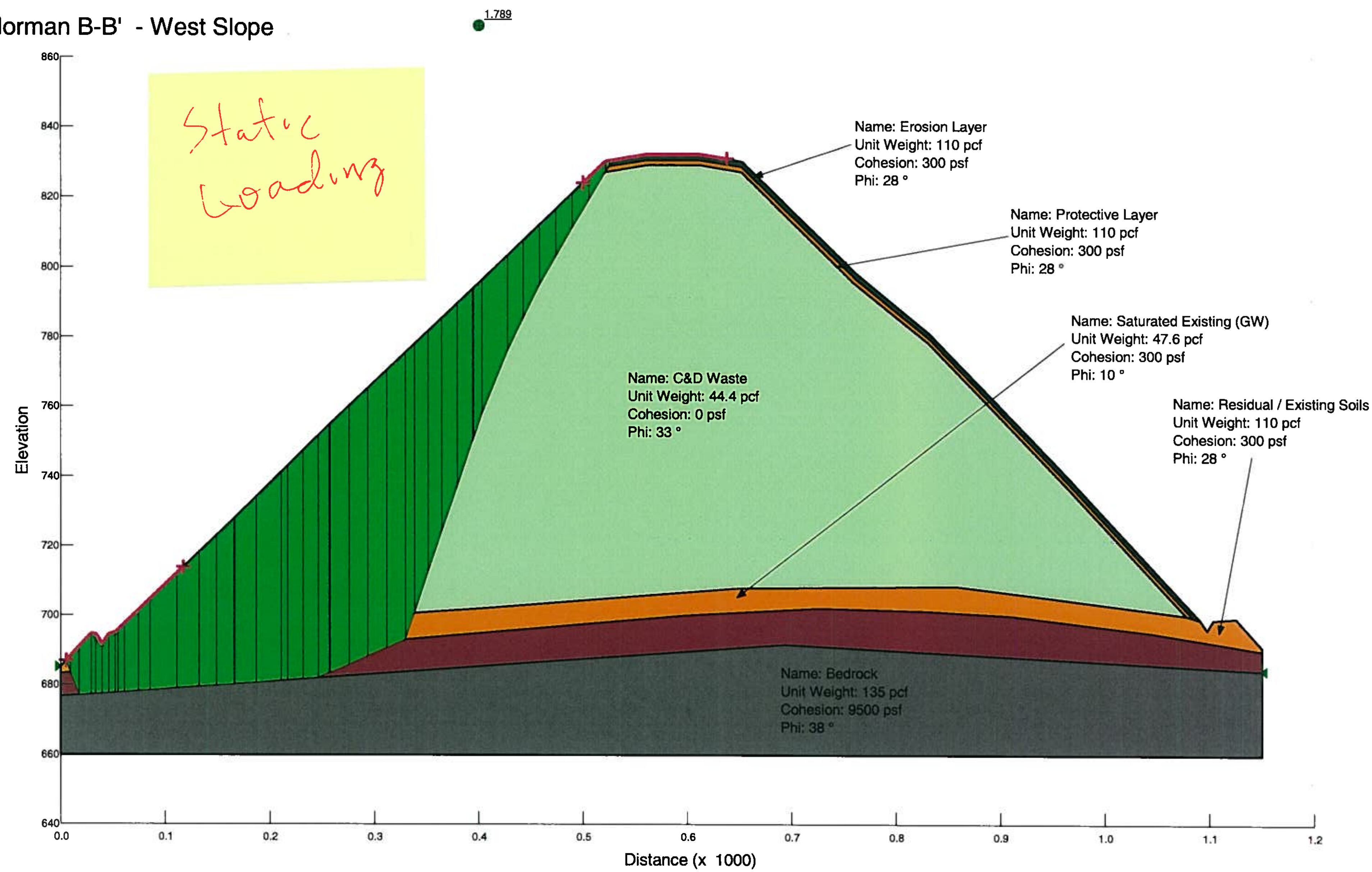
| | | | | | | |
|---|---|---|---|---|---|---|
| **34** | 965.1753 | 687.0582 | 0 | 3399.3494 | 599.39702 | 300 |
| **35** | 972.7633 | 686.93185 | 0 | 3282.6612 | 578.82174 | 300 |
| **36** | 986.9265 | 686.6975 | 0 | 3061.535 | 539.83122 | 300 |
| **37** | 1000.5315 | 686.4739 | 0 | 2845.1741 | 501.68097 | 300 |
| **38** | 1014.1365 | 686.25035 | 0 | 2626.0941 | 463.05125 | 300 |
| **39** | 1026.809 | 686.04675 | 0 | 2420.7169 | 426.8377 | 300 |
| **40** | 1038.549 | 685.86305 | 0 | 2228.1463 | 392.88231 | 300 |
| **41** | 1052.704 | 685.6416 | 0 | 2001.9237 | 352.99315 | 300 |
| **42** | 1069.2745 | 685.3824 | 0 | 1742.3983 | 307.23183 | 300 |
| **43** | 1077.6125 | 685.25195 | 0 | 1611.5618 | 284.16182 | 300 |
| **44** | 1079.549 | 685.22165 | 0 | 1543.6267 | 272.18304 | 300 |
| **45** | 1082.796 | 686.11135 | 0 | 1741.4884 | 307.0714 | 300 |
| **46** | 1087.573 | 689.33315 | 0 | 1333.309 | 235.09836 | 300 |
| **47** | 1091.598 | 692.04805 | 0 | 983.89054 | 173.48645 | 300 |
| **48** | 1094.608 | 694.07845 | 0 | 683.3384 | 363.33747 | 300 |
| **49** | 1097.12 | 695.77285 | 0 | 213.56717 | 113.55568 | 300 |

### Slices of Slip Surface: 103

| | X (ft) | Y (ft) | PoreWaterPressure (psf) | Base Normal Stress (psf) | Frictional Strength (psf) | Cohesive Strength (psf) |
|---|---|---|---|---|---|---|
| **1** | 681.56705 | 820.77145 | 0 | -126.92692 | -67.488238 | 300 |
| **2** | 682.8496 | 818.79775 | 0 | 1.1215055 | 0.59631504 | 300 |
| **3** | 689.87915 | 808.9156 | 0 | 449.19393 | 291.70995 | 0 |
| **4** | 702.61525 | 792.4082 | 0 | 836.11527 | 542.97961 | 0 |
| **5** | 715.3513 | 778.1005 | 0 | 1170.6907 | 760.25545 | 0 |
| **6** | 728.08735 | 765.53705 | 0 | 1466.3286 | 952.2449 | 0 |
| **7** | 740.82345 | 754.4179 | 0 | 1732.9962 | 1125.4209 | 0 |
| **8** | 753.5595 | 744.53325 | 0 | 1978.1581 | 1284.6309 | 0 |
| **9** | 761.1608 | 739.0364 | 0 | 2113.4921 | 1372.5178 | 0 |
| **10** | 762.59765 | 738.0581 | 0 | 2136.1749 | 1387.2482 | 0 |
| **11** | 768.50675 | 734.27915 | 0 | 2247.0333 | 1459.2405 | 0 |
| **12** | 779.9178 | 727.35845 | 0 | 2454.9754 | 1594.2797 | 0 |
| **13** | 791.3288 | 721.1361 | 0 | 2655.6708 | 1724.6128 | 0 |
| **14** | 802.7398 | 715.56185 | 0 | 2850.097 | 1850.8746 | 0 |
| **15** | 814.1508 | 710.59475 | 0 | 3037.965 | 1972.8776 | 0 |
| **16** | 825.44835 | 706.23955 | 0 | 3342.7182 | 1777.3548 | 300 |
| **17** | 831.2415 | 704.15295 | 0 | 3556.1762 | 1890.8524 | 300 |
| **18** | 831.64365 | 704.01775 | 0 | 3572.3253 | 1899.4391 | 300 |
| **19** | 836.53515 | 702.47025 | 0 | 3733.75 | 1985.2701 | 300 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **20** | 849.5642 | 698.7857 | 0 | 3910.0809 | 689.45276 | 300 |
| **21** | 864.53115 | 695.2043 | 0 | 4021.7297 | 709.13945 | 300 |
| **22** | 877.78785 | 692.77235 | 0 | 4076.4169 | 718.78228 | 300 |
| **23** | 891.04455 | 690.9771 | 0 | 4099.7609 | 722.89847 | 300 |
| **24** | 904.30125 | 689.80655 | 0 | 4084.3669 | 720.18408 | 300 |
| **25** | 915.9415 | 689.2548 | 0 | 4039.9789 | 712.35729 | 300 |
| **26** | 925.9653 | 689.18705 | 0 | 3976.7938 | 701.21604 | 300 |
| **27** | 935.9891 | 689.4697 | 0 | 3880.8984 | 684.30709 | 300 |
| **28** | 946.87415 | 690.19125 | 0 | 3735.826 | 658.72691 | 300 |
| **29** | 958.6204 | 691.4208 | 0 | 3529.8897 | 622.4148 | 300 |
| **30** | 964.72075 | 692.1913 | 0 | 3403.7872 | 600.17953 | 300 |
| **31** | 965.1753 | 692.25865 | 0 | 3394.0585 | 598.46409 | 300 |
| **32** | 971.3411 | 693.30975 | 0 | 3245.564 | 572.28051 | 300 |
| **33** | 983.2181 | 695.604 | 0 | 2921.5362 | 515.14566 | 300 |
| **34** | 994.3085 | 698.20475 | 0 | 2719.9695 | 1446.2334 | 300 |
| **35** | 1004.6122 | 701.059 | 0 | 2056.0122 | 1093.2011 | 300 |
| **36** | 1016.682 | 704.9823 | 0 | 1378.0475 | 894.91454 | 0 |
| **37** | 1030.518 | 710.17445 | 0 | 769.58994 | 499.77755 | 0 |
| **38** | 1038.455 | 713.42195 | 0 | 425.65789 | 226.32631 | 300 |
| **39** | 1040.5055 | 714.33355 | 0 | 207.36498 | 110.25792 | 300 |

Lake Norman B-B' - West Slope



# Lake Norman Closure



## File Information

Created By: McDonald, Carl
Revision Number: 73
Last Edited By: McDonald, Carl
Date: 8/6/2008
Time: 12:52:23 PM
File Name: LakeNorman_B-B'_west.gsz
Directory: P:\135836 - Allied Waste Lake Norman C&D Landfill\Closure and Post-Closure Plan\Calculations\Slope Stability\Geoslope\Final\

## Lake Norman Closure

Kind: SLOPE/W
Method: Morgenstern-Price
Convergence
- Minimum Slice Thickness: 0.1
- Ignore seismic load in strength: No

Number of Slices: 30
Optimization Tolerance: 0.01
Direction of movement: Right to Left
Allow Passive Mode: 1
Slip Surface Option: Entry and Exit
Apply Phreatic Correction: No
Side Function
- Interslice force function option: Half-Sine

FOS Distribution Calculation: Constant
Optimize Critical Slip Surface Location: Yes
Cap Suction: No
Rapid Drawdown: No
PWP Conditions Source: (none)
Critical slip surfaces saved: 1
Optimize Critical Slip Surface
- Optimization Maximum Iterations: 2000
- Optimization Convergence Tolerance: 1e-007
- Starting Optimization Points: 8
- Ending Optimization Points: 16
- Complete Passes per Insertion: 1

## Materials

### Material 1: Residual / Existing Soils

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 300 psf
Phi: 28 °
Phi-B: 0 °

### Material 2: C&D Waste

Model: Mohr-Coulomb
Unit Weight: 44.4 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

### Material 3: Erosion Layer

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 300 psf
Phi: 28 °
Phi-B: 0 °

### Material 4: Protective Layer

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 300 psf
Phi: 28 °
Phi-B: 0 °

### Material 5: Saturated Existing (GW)

Model: Mohr-Coulomb
Unit Weight: 47.6 pcf
Cohesion: 300 psf
Phi: 10 °
Phi-B: 0 °

### Material 6: Bedrock

Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion: 9500 psf
Phi: 38 °
Phi-B: 0 °

## Regions

| | Material | Points |
|---|---|---|
| **Region 1** | Bedrock | 1,2,3,4,5 |
| **Region 2** | C&D | 6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24 |

| | | |
|---|---|---|
| | Waste | |
| **Region 3** | Erosion Layer | 25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49, |
| **Region 4** | Protective Layer | 6,7,25,50,49,48,47,46,45,44,43,42,41,40,14,15,16,17,18,19,20,21,22,23,24 |
| **Region 5** | Residual / Existing Soils | 51,52,53,54,38,39,40,14,13,12,11,10,9,8,7,25,26,55,56,57,58,59,60,61,62,63,6 |
| **Region 6** | Saturated Existing (GW) | 1,69,68,67,66,65,64,63,62,61,60,59,3,2 |

# Points

| | X (ft) | Y (ft) |
|---|---|---|
| **Point 1** | 0 | 676.63358 |
| **Point 2** | 692.96391 | 691.58584 |
| **Point 3** | 1150 | 683.98355 |
| **Point 4** | 1150 | 660 |
| **Point 5** | 0 | 660 |
| **Point 6** | 1077.5596 | 699.95349 |
| **Point 7** | 1077.665 | 699.93051 |
| **Point 8** | 941.00104 | 705.28224 |
| **Point 9** | 857.90284 | 708.34673 |
| **Point 10** | 647.91273 | 707.85925 |
| **Point 11** | 406.29092 | 701.95001 |
| **Point 12** | 210.77551 | 697.95001 |
| **Point 13** | 110.67281 | 695.88602 |
| **Point 14** | 60.833661 | 694.27034 |
| **Point 15** | 166.48223 | 724.87069 |
| **Point 16** | 257.75837 | 751.81857 |
| **Point 17** | 395.2251 | 790.81994 |
| **Point 18** | 521.89557 | 827.02085 |
| **Point 19** | 561.62907 | 829 |
| **Point 20** | 611.79738 | 829 |
| **Point 21** | 651.917 | 827.02091 |
| **Point 22** | 759.92753 | 795.45833 |
| **Point 23** | 831.04041 | 778.2123 |
| **Point 24** | 964.49348 | 736.64402 |

| | | |
|---|---|---|
| **Point 25** | 1084.1588 | 699.35786 |
| **Point 26** | 1090.9868 | 698.75033 |
| **Point 27** | 965.40258 | 739.50301 |
| **Point 28** | 831.8447 | 781.10395 |
| **Point 29** | 762.39409 | 798.14482 |
| **Point 30** | 652.41493 | 830 |
| **Point 31** | 611.87133 | 832 |
| **Point 32** | 561.5544 | 832 |
| **Point 33** | 521.40235 | 830 |
| **Point 34** | 394.4035 | 793.70524 |
| **Point 35** | 256.9242 | 754.70031 |
| **Point 36** | 165.63988 | 727.75001 |
| **Point 37** | 51.945911 | 694.79367 |
| **Point 38** | 45.733856 | 694.41777 |
| **Point 39** | 51.791811 | 693.96673 |
| **Point 40** | 54.766076 | 694.06135 |
| **Point 41** | 166.06106 | 726.31035 |
| **Point 42** | 257.34129 | 753.25944 |
| **Point 43** | 394.8143 | 792.26259 |
| **Point 44** | 521.64896 | 828.51042 |
| **Point 45** | 561.59173 | 830.5 |
| **Point 46** | 611.83436 | 830.5 |
| **Point 47** | 652.16597 | 828.51046 |
| **Point 48** | 762.80125 | 796.43661 |
| **Point 49** | 831.44256 | 779.65813 |
| **Point 50** | 964.94803 | 738.07351 |
| **Point 51** | 8.38e-014 | 684.96369 |
| **Point 52** | 29.140389 | 694.43184 |
| **Point 53** | 33.268962 | 694.3688 |
| **Point 54** | 39.502593 | 691.38814 |
| **Point 55** | 1097.0074 | 695.73649 |
| **Point 56** | 1103.0273 | 698.73526 |
| **Point 57** | 1125.0356 | 699.14795 |
| **Point 58** | 1149.95 | 690.82331 |
| **Point 59** | 1149.95 | 689.59454 |
| **Point 60** | 1044.4186 | 694.83213 |
| **Point 61** | 910.92956 | 699.78126 |
| **Point 62** | 826.93835 | 701.23805 |
| **Point 63** | 725.98104 | 701.9312 |

| | | |
|---|---|---|
| **Point 64** | 598.11111 | 700 |
| **Point 65** | 466.52805 | 696.46566 |
| **Point 66** | 216.90598 | 690 |
| **Point 67** | 74.363106 | 685.58056 |
| **Point 68** | 17.358695 | 683.6719 |
| **Point 69** | -4.2e-015 | 683.12622 |

# Tension Crack

Tension Crack Option: (none)

# Slip Surface Entry and Exit

Left-Zone Increment: 4
Left Projection: Range
Left-Zone Left Coordinate: (5.1047618, 686.6223) ft
Left-Zone Right Coordinate: (117.12718, 713.68769) ft
Right-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (500.05267, 823.89851) ft
Right-Zone Right Coordinate: (637.74018, 830.7239) ft
Radius Increments: 4

# Slip Surface Limits

Left Coordinate: (8.38e-014, 684.96369) ft
Right Coordinate: (1150, 683.98355) ft

# Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

# Critical Slip Surfaces

| | Number | FOS | Center (ft) | Radius (ft) | Entry (ft) | Exit (ft) |
|---|---|---|---|---|---|---|
| 1 | Optimized | 1.789 | (105.71, 1359.93) | 257.0112 | (528.549, 830.356) | (5.10476, 686.622) |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2 | 7 | 2.115 | (105.71, 1359.93) | 680.779 | (533.838, 830.619) | (5.10476, 686.622) |

### Slices of Slip Surface: Optimized

| | X (ft) | Y (ft) | PoreWaterPressure (psf) | Base Normal Stress (psf) | Frictional Strength (psf) | Cohesive Strength (psf) |
|---|---|---|---|---|---|---|
| 1 | 7.2310165 | 685.02135 | 0 | 493.07002 | 262.16998 | 300 |
| 2 | 13.357981 | 680.40805 | 0 | 1007.5909 | 177.66546 | 300 |
| 3 | 17.606405 | 677.20915 | 0 | 1347.6507 | 237.62718 | 300 |
| 4 | 23.497255 | 677.1451 | 0 | 1301.3634 | 229.46547 | 300 |
| 5 | 31.204675 | 677.3124 | 0 | 1481.9308 | 261.30439 | 300 |
| 6 | 36.385775 | 677.42485 | 0 | 1302.3209 | 229.63432 | 300 |
| 7 | 42.618225 | 677.56015 | 0 | 1290.3816 | 227.52909 | 300 |
| 8 | 48.762835 | 677.6935 | 0 | 1463.2185 | 258.0049 | 300 |
| 9 | 51.86886 | 677.7609 | 0 | 1476.6791 | 260.37837 | 300 |
| 10 | 53.355995 | 677.7932 | 0 | 1518.8443 | 267.81323 | 300 |
| 11 | 57.79987 | 677.88965 | 0 | 1650.68 | 291.05942 | 300 |
| 12 | 67.598385 | 678.1023 | 0 | 1827.0654 | 322.16092 | 300 |
| 13 | 79.95745 | 678.37055 | 0 | 1985.5567 | 350.10721 | 300 |
| 14 | 98.112295 | 678.7597 | 0 | 2219.9068 | 391.42947 | 300 |
| 15 | 121.3698 | 679.25535 | 0 | 2510.323 | 442.63767 | 300 |
| 16 | 140.46005 | 679.66515 | 0 | 2738.1588 | 482.81127 | 300 |
| 17 | 157.2466 | 680.02885 | 0 | 2936.6046 | 517.80261 | 300 |
| 18 | 165.8505 | 680.2153 | 0 | 3037.7063 | 535.62958 | 300 |
| 19 | 166.27165 | 680.22445 | 0 | 3042.6912 | 536.50855 | 300 |
| 20 | 176.67065 | 680.44975 | 0 | 3166.0342 | 558.25724 | 300 |
| 21 | 198.8173 | 680.93215 | 0 | 3424.5264 | 603.8364 | 300 |
| 22 | 213.84075 | 681.26085 | 0 | 3597.232 | 634.28906 | 300 |
| 23 | 224.2476 | 681.48855 | 0 | 3717.2256 | 655.44716 | 300 |
| 24 | 238.93085 | 681.80985 | 0 | 3885.8128 | 685.17364 | 300 |
| 25 | 251.59835 | 682.6683 | 0 | 3830.9522 | 675.50023 | 300 |
| 26 | 257.13275 | 683.3934 | 0 | 3861.6666 | 680.91601 | 300 |
| 27 | 257.54985 | 683.44805 | 0 | 3863.5684 | 681.25135 | 300 |
| 28 | 266.76625 | 684.6556 | 0 | 3910.1868 | 689.47144 | 300 |
| 29 | 284.782 | 687.01605 | 0 | 4001.5476 | 705.58081 | 300 |
| 30 | 302.79775 | 689.3765 | 0 | 4092.7983 | 721.67078 | 300 |
| 31 | 320.81345 | 691.73695 | 0 | 4184.1591 | 737.78015 | 300 |
| 32 | 329.82565 | 692.92105 | 0 | 3270.2701 | 576.63685 | 300 |
| 33 | 334.0716 | 696.7421 | 0 | 2714.4441 | 1443.2955 | 300 |

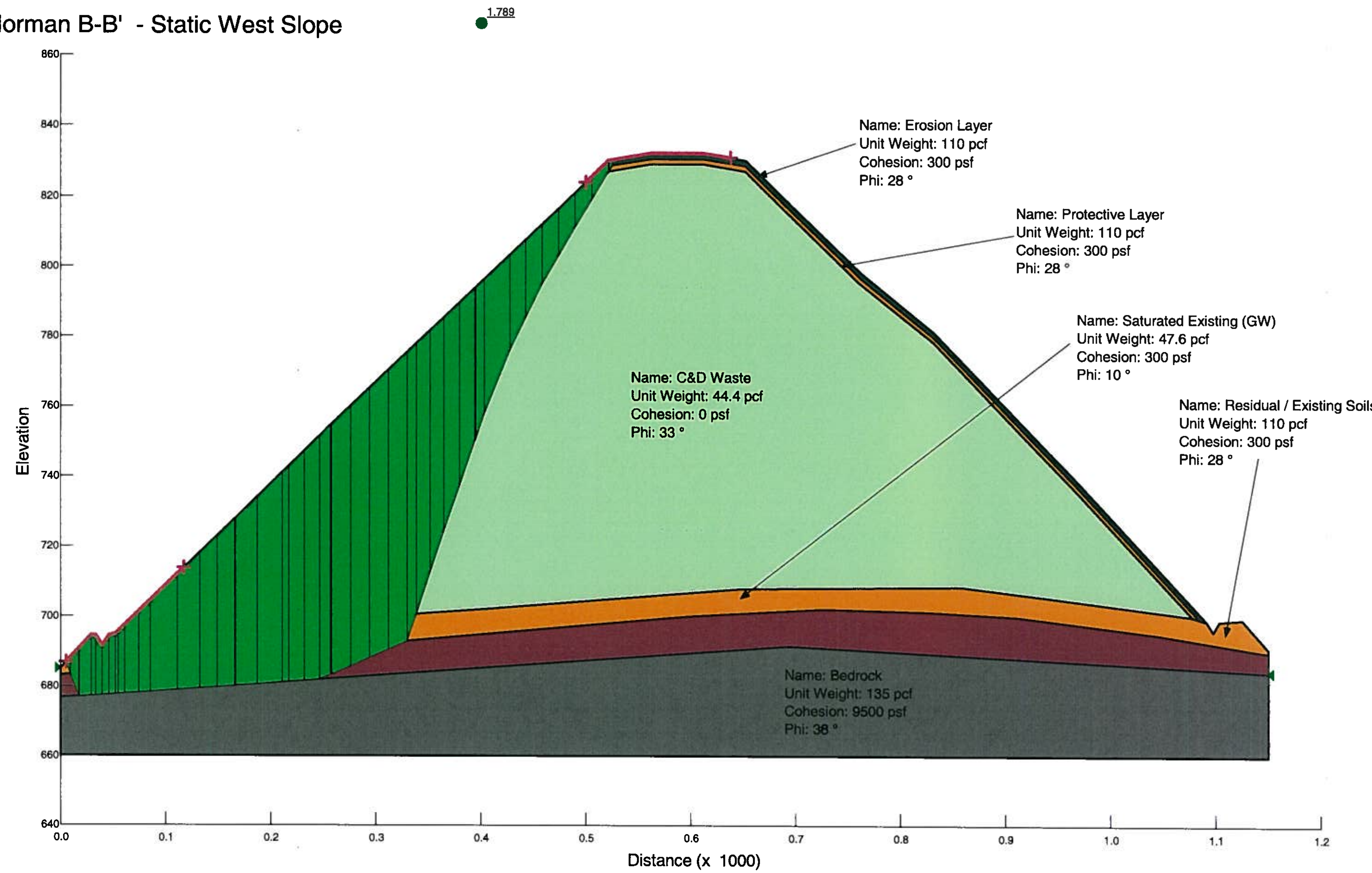
| | | | | | | |
|---|---|---|---|---|---|---|
| **34** | 344.8985 | 706.4856 | 0 | 2344.7033 | 1522.6681 | 0 |
| **35** | 358.06915 | 718.33825 | 0 | 2106.762 | 1368.1473 | 0 |
| **36** | 372.09175 | 730.72005 | 0 | 1885.1812 | 1224.251 | 0 |
| **37** | 386.96625 | 743.63095 | 0 | 1627.4164 | 1056.8566 | 0 |
| **38** | 394.6089 | 750.26465 | 0 | 1494.7016 | 970.6706 | 0 |
| **39** | 395.0197 | 750.6212 | 0 | 1487.6056 | 966.06234 | 0 |
| **40** | 399.25505 | 754.29745 | 0 | 1414.0831 | 918.31631 | 0 |
| **41** | 415.42545 | 766.84245 | 0 | 1234.2613 | 801.53867 | 0 |
| **42** | 435.1746 | 780.6042 | 0 | 1025.301 | 665.83825 | 0 |
| **43** | 450.392 | 790.0336 | 0 | 853.25376 | 554.10947 | 0 |
| **44** | 465.92285 | 798.8332 | 0 | 732.61388 | 475.76502 | 0 |
| **45** | 481.76715 | 807.003 | 0 | 601.6297 | 390.7029 | 0 |
| **46** | 497.61755 | 815.01905 | 0 | 478.61653 | 310.81721 | 0 |
| **47** | 513.4741 | 822.8813 | 0 | 356.0314 | 231.20949 | 0 |
| **48** | 521.5257 | 826.87355 | 0 | 290.74298 | 188.8107 | 0 |
| **49** | 521.6862 | 826.9532 | 0 | 285.9635 | 185.70687 | 0 |
| **50** | 523.45255 | 827.82905 | 0 | 147.55006 | 78.453756 | 300 |
| **51** | 526.8653 | 829.5212 | 0 | 0.33069959 | 0.17583609 | 300 |

## Slices of Slip Surface: 7

| | X (ft) | Y (ft) | PoreWaterPressure (psf) | Base Normal Stress (psf) | Frictional Strength (psf) | Cohesive Strength (psf) |
|---|---|---|---|---|---|---|
| **1** | 15.121296 | 685.27735 | 0 | 566.25242 | 301.08175 | 300 |
| **2** | 27.13911 | 683.69985 | 0 | 1148.905 | 202.58295 | 300 |
| **3** | 31.204675 | 683.24 | 0 | 1235.937 | 217.92903 | 300 |
| **4** | 36.385775 | 682.69365 | 0 | 1085.6453 | 191.42856 | 300 |
| **5** | 42.618225 | 682.08465 | 0 | 1109.7728 | 195.68288 | 300 |
| **6** | 48.762835 | 681.5404 | 0 | 1318.6423 | 232.51222 | 300 |
| **7** | 51.86886 | 681.28 | 0 | 1347.8721 | 237.66622 | 300 |
| **8** | 53.355995 | 681.16515 | 0 | 1397.8928 | 246.48622 | 300 |
| **9** | 57.79987 | 680.84235 | 0 | 1552.3732 | 273.72527 | 300 |
| **10** | 67.598385 | 680.249 | 0 | 1770.5071 | 312.18817 | 300 |
| **11** | 83.440535 | 679.57255 | 0 | 2021.7318 | 356.48586 | 300 |
| **12** | 101.59538 | 679.22055 | 0 | 2281.3747 | 402.26791 | 300 |
| **13** | 119.834 | 679.3558 | 0 | 2501.6847 | 441.11451 | 300 |
| **14** | 138.15635 | 679.9831 | 0 | 2681.7294 | 472.86124 | 300 |
| **15** | 156.4787 | 681.10545 | 0 | 2827.623 | 498.58623 | 300 |
| **16** | 165.8505 | 681.80925 | 0 | 2889.8412 | 509.55698 | 300 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **17** | 166.27165 | 681.84675 | 0 | 2892.5192 | 510.02917 | 300 |
| **18** | 173.86445 | 682.6084 | 0 | 2937.5414 | 517.96781 | 300 |
| **19** | 188.6289 | 684.25715 | 0 | 3009.7832 | 530.70599 | 300 |
| **20** | 203.3933 | 686.2335 | 0 | 3062.312 | 539.96823 | 300 |
| **21** | 213.84075 | 687.79705 | 0 | 3088.4224 | 544.5722 | 300 |
| **22** | 222.66335 | 689.29425 | 0 | 3104.9912 | 547.49372 | 300 |
| **23** | 235.54655 | 691.6828 | 0 | 3113.463 | 1655.4577 | 300 |
| **24** | 249.7983 | 694.61055 | 0 | 2955.2647 | 1571.3421 | 300 |
| **25** | 257.13275 | 696.2014 | 0 | 2860.921 | 1521.1787 | 300 |
| **26** | 257.54985 | 696.2967 | 0 | 2854.9011 | 1517.9779 | 300 |
| **27** | 263.64425 | 697.74825 | 0 | 2766.7145 | 1471.0882 | 300 |
| **28** | 278.44965 | 701.4921 | 0 | 2658.8503 | 1726.6776 | 0 |
| **29** | 296.2887 | 706.4333 | 0 | 2606.5572 | 1692.718 | 0 |
| **30** | 314.12775 | 711.90325 | 0 | 2534.6339 | 1646.0105 | 0 |
| **31** | 331.9668 | 717.9154 | 0 | 2445.09 | 1587.86 | 0 |
| **32** | 349.80585 | 724.4851 | 0 | 2339.3325 | 1519.1803 | 0 |
| **33** | 367.6449 | 731.6299 | 0 | 2218.5051 | 1440.714 | 0 |
| **34** | 385.48395 | 739.36975 | 0 | 2083.2024 | 1352.8474 | 0 |
| **35** | 394.6089 | 743.48735 | 0 | 2008.3611 | 1304.2449 | 0 |
| **36** | 395.0197 | 743.68005 | 0 | 2004.9787 | 1302.0484 | 0 |
| **37** | 404.23775 | 748.17455 | 0 | 1926.238 | 1250.9136 | 0 |
| **38** | 422.26305 | 757.3069 | 0 | 1760.3664 | 1143.1953 | 0 |
| **39** | 440.2884 | 767.128 | 0 | 1578.0503 | 1024.7978 | 0 |
| **40** | 458.31375 | 777.67275 | 0 | 1377.495 | 894.55574 | 0 |
| **41** | 476.33905 | 788.98125 | 0 | 1156.1995 | 750.84476 | 0 |
| **42** | 494.36435 | 801.09995 | 0 | 911.05052 | 591.64312 | 0 |
| **43** | 512.3897 | 814.08295 | 0 | 637.92221 | 414.27152 | 0 |
| **44** | 521.5257 | 820.89295 | 0 | 485.20108 | 315.09326 | 0 |
| **45** | 521.7723 | 821.0833 | 0 | 475.88251 | 309.04172 | 0 |
| **46** | 525.87205 | 824.29775 | 0 | 369.12602 | 239.71324 | 0 |
| **47** | 530.85005 | 828.2178 | 0 | 113.06953 | 60.120138 | 300 |
| **48** | 532.845 | 829.819 | 0 | -25.697786 | -13.663755 | 300 |

# Lake Norman B-B'  - Static West Slope



# Lake Norman Closure



## File Information

Created By: McDonald, Carl
Revision Number: 79
Last Edited By: McDonald, Carl
Date: 8/6/2008
Time: 12:47:20 PM
File Name: LakeNorman_B-B'_seismic_west.gsz
Directory: P:\135836 - Allied Waste Lake Norman C&D Landfill\Closure and Post-Closure Plan\Calculations\Slope Stability\Geoslope\Final\

## Lake Norman Closure

Kind: SLOPE/W
Method: Morgenstern-Price
Convergence
- Minimum Slice Thickness: 0.1
- Ignore seismic load in strength: No

Number of Slices: 30
Optimization Tolerance: 0.01
Direction of movement: Right to Left
Allow Passive Mode: 1
Slip Surface Option: Entry and Exit
Apply Phreatic Correction: No
Side Function
- Interslice force function option: Half-Sine

FOS Distribution Calculation: Constant
Optimize Critical Slip Surface Location: Yes
Cap Suction: No
Rapid Drawdown: No
PWP Conditions Source: (none)
Critical slip surfaces saved: 1
Optimize Critical Slip Surface
- Optimization Maximum Iterations: 2000
- Optimization Convergence Tolerance: 1e-007
- Starting Optimization Points: 8
- Ending Optimization Points: 16
- Complete Passes per Insertion: 1

## Materials

### Material 1: Residual / Existing Soils

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 300 psf
Phi: 28 °
Phi-B: 0 °

### Material 2: C&D Waste

Model: Mohr-Coulomb
Unit Weight: 44.4 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

### Material 3: Erosion Layer

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 300 psf
Phi: 28 °
Phi-B: 0 °

### Material 4: Protective Layer

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 300 psf
Phi: 28 °
Phi-B: 0 °

### Material 5: Saturated Existing (GW)

Model: Mohr-Coulomb
Unit Weight: 47.6 pcf
Cohesion: 300 psf
Phi: 10 °
Phi-B: 0 °

### Material 6: Bedrock

Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion: 9500 psf
Phi: 38 °
Phi-B: 0 °

## Regions

| | Material | Points |
|---|---|---|
| **Region 1** | Bedrock | 1,2,3,4,5 |
| **Region 2** | C&D | 6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24 |

| | | |
|---|---|---|
| | Waste | |
| **Region 3** | Erosion Layer | 25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49, |
| **Region 4** | Protective Layer | 6,7,25,50,49,48,47,46,45,44,43,42,41,40,14,15,16,17,18,19,20,21,22,23,24 |
| **Region 5** | Residual / Existing Soils | 51,52,53,54,38,39,40,14,13,12,11,10,9,8,7,25,26,55,56,57,58,59,60,61,62,63,6 |
| **Region 6** | Saturated Existing (GW) | 1,69,68,67,66,65,64,63,62,61,60,59,3,2 |

# Points

| | X (ft) | Y (ft) |
|---|---|---|
| **Point 1** | 0 | 676.63358 |
| **Point 2** | 692.96391 | 691.58584 |
| **Point 3** | 1150 | 683.98355 |
| **Point 4** | 1150 | 660 |
| **Point 5** | 0 | 660 |
| **Point 6** | 1077.5596 | 699.95349 |
| **Point 7** | 1077.665 | 699.93051 |
| **Point 8** | 941.00104 | 705.28224 |
| **Point 9** | 857.90284 | 708.34673 |
| **Point 10** | 647.91273 | 707.85925 |
| **Point 11** | 406.29092 | 701.95001 |
| **Point 12** | 210.77551 | 697.95001 |
| **Point 13** | 110.67281 | 695.88602 |
| **Point 14** | 60.833661 | 694.27034 |
| **Point 15** | 166.48223 | 724.87069 |
| **Point 16** | 257.75837 | 751.81857 |
| **Point 17** | 395.2251 | 790.81994 |
| **Point 18** | 521.89557 | 827.02085 |
| **Point 19** | 561.62907 | 829 |
| **Point 20** | 611.79738 | 829 |
| **Point 21** | 651.917 | 827.02091 |
| **Point 22** | 759.92753 | 795.45833 |
| **Point 23** | 831.04041 | 778.2123 |
| **Point 24** | 964.49348 | 736.64402 |

| | | |
|---|---|---|
| **Point 25** | 1084.1588 | 699.35786 |
| **Point 26** | 1090.9868 | 698.75033 |
| **Point 27** | 965.40258 | 739.50301 |
| **Point 28** | 831.8447 | 781.10395 |
| **Point 29** | 762.39409 | 798.14482 |
| **Point 30** | 652.41493 | 830 |
| **Point 31** | 611.87133 | 832 |
| **Point 32** | 561.5544 | 832 |
| **Point 33** | 521.40235 | 830 |
| **Point 34** | 394.4035 | 793.70524 |
| **Point 35** | 256.9242 | 754.70031 |
| **Point 36** | 165.63988 | 727.75001 |
| **Point 37** | 51.945911 | 694.79367 |
| **Point 38** | 45.733856 | 694.41777 |
| **Point 39** | 51.791811 | 693.96673 |
| **Point 40** | 54.766076 | 694.06135 |
| **Point 41** | 166.06106 | 726.31035 |
| **Point 42** | 257.34129 | 753.25944 |
| **Point 43** | 394.8143 | 792.26259 |
| **Point 44** | 521.64896 | 828.51042 |
| **Point 45** | 561.59173 | 830.5 |
| **Point 46** | 611.83436 | 830.5 |
| **Point 47** | 652.16597 | 828.51046 |
| **Point 48** | 762.80125 | 796.43661 |
| **Point 49** | 831.44256 | 779.65813 |
| **Point 50** | 964.94803 | 738.07351 |
| **Point 51** | 8.38e-014 | 684.96369 |
| **Point 52** | 29.140389 | 694.43184 |
| **Point 53** | 33.268962 | 694.3688 |
| **Point 54** | 39.502593 | 691.38814 |
| **Point 55** | 1097.0074 | 695.73649 |
| **Point 56** | 1103.0273 | 698.73526 |
| **Point 57** | 1125.0356 | 699.14795 |
| **Point 58** | 1149.95 | 690.82331 |
| **Point 59** | 1149.95 | 689.59454 |
| **Point 60** | 1044.4186 | 694.83213 |
| **Point 61** | 910.92956 | 699.78126 |
| **Point 62** | 826.93835 | 701.23805 |
| **Point 63** | 725.98104 | 701.9312 |

| | | |
|---|---|---|
| **Point 64** | 598.11111 | 700 |
| **Point 65** | 466.52805 | 696.46566 |
| **Point 66** | 216.90598 | 690 |
| **Point 67** | 74.363106 | 685.58056 |
| **Point 68** | 17.358695 | 683.6719 |
| **Point 69** | -4.2e-015 | 683.12622 |

# Tension Crack

Tension Crack Option: (none)

# Slip Surface Entry and Exit

Left-Zone Increment: 4
Left Projection: Range
Left-Zone Left Coordinate: (33.723747, 694.15134) ft
Left-Zone Right Coordinate: (117.12718, 713.68769) ft
Right-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (500.05267, 823.89851) ft
Right-Zone Right Coordinate: (637.74018, 830.7239) ft
Radius Increments: 4

# Slip Surface Limits

Left Coordinate: (8.38e-014, 684.96369) ft
Right Coordinate: (1150, 683.98355) ft

# Seismic Loads

Horz Seismic Load: 0.055
Vert Seismic Load: 0.055

# Critical Slip Surfaces

| | Number | FOS | Center (ft) | Radius (ft) | Entry (ft) | Exit (ft) |
|---|---|---|---|---|---|---|
| **1** | Optimized | 1.376 | (166.6, 1390.18) | 244.0336 | (524.712, 830.165) | (38.8114, 691.719) |

| | | | | | | |
|---|---|---|---|---|---|---|
| **2** | 17 | 1.780 | (166.6, 1390.18) | 708.594 | (603.116, 832) | (42.0299, 692.617) |

### Slices of Slip Surface: Optimized

| | X (ft) | Y (ft) | PoreWaterPressure (psf) | Base Normal Stress (psf) | Frictional Strength (psf) | Cohesive Strength (psf) |
|---|---|---|---|---|---|---|
| **1** | 39.157005 | 691.5056 | 0 | 184.10139 | 97.888445 | 300 |
| **2** | 42.618225 | 689.37205 | 0 | 733.89054 | 390.21652 | 300 |
| **3** | 47.910685 | 686.1096 | 0 | 1537.381 | 817.43999 | 300 |
| **4** | 50.93966 | 684.24245 | 0 | 1502.5276 | 264.93616 | 300 |
| **5** | 51.86886 | 683.6697 | 0 | 1545.4729 | 272.50857 | 300 |
| **6** | 53.355995 | 682.75295 | 0 | 1656.6644 | 292.11464 | 300 |
| **7** | 57.79987 | 680.0136 | 0 | 2001.192 | 352.86414 | 300 |
| **8** | 60.883345 | 678.1129 | 0 | 2242.9799 | 395.49788 | 300 |
| **9** | 67.64807 | 678.21675 | 0 | 1945.6895 | 343.07756 | 300 |
| **10** | 83.440535 | 678.5329 | 0 | 2169.1782 | 382.48464 | 300 |
| **11** | 101.59538 | 678.89635 | 0 | 2426.6335 | 427.88096 | 300 |
| **12** | 119.42595 | 679.25335 | 0 | 2670.7916 | 470.93262 | 300 |
| **13** | 136.93225 | 679.60385 | 0 | 2900.7772 | 511.48529 | 300 |
| **14** | 155.66265 | 679.99675 | 0 | 3139.5969 | 553.59565 | 300 |
| **15** | 165.8505 | 680.21895 | 0 | 3268.6635 | 576.35356 | 300 |
| **16** | 166.27165 | 680.2281 | 0 | 3274.3605 | 577.3581 | 300 |
| **17** | 173.6862 | 680.38985 | 0 | 3368.715 | 593.99534 | 300 |
| **18** | 188.36155 | 680.70625 | 0 | 3554.1187 | 626.68702 | 300 |
| **19** | 203.3042 | 681.02475 | 0 | 3738.5154 | 659.20112 | 300 |
| **20** | 213.84075 | 681.24935 | 0 | 3866.0355 | 681.68637 | 300 |
| **21** | 218.0494 | 681.3391 | 0 | 3916.6687 | 690.61437 | 300 |
| **22** | 228.62565 | 681.5673 | 0 | 4043.8047 | 713.03188 | 300 |
| **23** | 247.49135 | 681.97495 | 0 | 4266.1671 | 752.24037 | 300 |
| **24** | 256.9493 | 682.17935 | 0 | 4374.9546 | 771.42253 | 300 |
| **25** | 257.15785 | 682.18705 | 0 | 4335.4975 | 764.46518 | 300 |
| **26** | 257.54985 | 682.2024 | 0 | 4338.9857 | 765.08024 | 300 |
| **27** | 265.47185 | 682.51235 | 0 | 4415.4453 | 778.56214 | 300 |
| **28** | 280.8988 | 683.11585 | 0 | 4561.6358 | 804.33946 | 300 |
| **29** | 296.32575 | 683.71935 | 0 | 4703.5513 | 829.363 | 300 |
| **30** | 311.7527 | 684.32285 | 0 | 4841.3862 | 853.66702 | 300 |
| **31** | 327.1763 | 685.7936 | 0 | 4658.499 | 821.41906 | 300 |
| **32** | 342.5965 | 688.1316 | 0 | 4713.768 | 831.16448 | 300 |
| **33** | 358.0167 | 690.4696 | 0 | 4771.7941 | 841.39604 | 300 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **34** | 373.4369 | 692.80765 | 0 | 4832.8336 | 852.15897 | 300 |
| **35** | 381.3204 | 694.1199 | 0 | 3711.4004 | 654.42003 | 300 |
| **36** | 385.9505 | 697.94405 | 0 | 3112.6654 | 1655.0336 | 300 |
| **37** | 392.40535 | 703.2754 | 0 | 2832.219 | 1839.2645 | 0 |
| **38** | 394.6089 | 705.09545 | 0 | 2798.608 | 1817.4373 | 0 |
| **39** | 395.0197 | 705.43475 | 0 | 2792.4143 | 1813.415 | 0 |
| **40** | 396.122 | 706.3452 | 0 | 2775.8388 | 1802.6508 | 0 |
| **41** | 405.9738 | 715.0404 | 0 | 2534.4081 | 1645.8639 | 0 |
| **42** | 423.88355 | 730.94915 | 0 | 2243.7811 | 1457.1285 | 0 |
| **43** | 441.79325 | 746.8579 | 0 | 1951.192 | 1267.1189 | 0 |
| **44** | 458.9526 | 762.55405 | 0 | 1615.6227 | 1049.1977 | 0 |
| **45** | 475.36165 | 778.0376 | 0 | 1317.5415 | 855.62142 | 0 |
| **46** | 493.02525 | 795.9831 | 0 | 901.52509 | 585.45724 | 0 |
| **47** | 511.94335 | 816.39055 | 0 | 472.05459 | 306.55584 | 0 |
| **48** | 521.5257 | 826.7273 | 0 | 243.88637 | 158.38166 | 0 |
| **49** | 521.70575 | 826.92155 | 0 | 236.29263 | 153.45023 | 0 |
| **50** | 522.5076 | 827.78655 | 0 | 21.721457 | 11.549504 | 300 |
| **51** | 523.9825 | 829.3776 | 0 | -103.55585 | -55.061622 | 300 |

**Slices of Slip Surface: 17**

| | X (ft) | Y (ft) | PoreWaterPressure (psf) | Base Normal Stress (psf) | Frictional Strength (psf) | Cohesive Strength (psf) |
|---|---|---|---|---|---|---|
| **1** | 43.881865 | 692.29125 | 0 | 183.97303 | 97.820195 | 300 |
| **2** | 48.762835 | 691.45475 | 0 | 425.57036 | 226.27977 | 300 |
| **3** | 51.86886 | 690.93125 | 0 | 516.13498 | 274.43384 | 300 |
| **4** | 53.355995 | 690.69035 | 0 | 599.07865 | 318.53577 | 300 |
| **5** | 57.79987 | 689.99065 | 0 | 852.46626 | 453.26435 | 300 |
| **6** | 74.24446 | 687.75595 | 0 | 1518.3287 | 807.30966 | 300 |
| **7** | 99.16403 | 684.89225 | 0 | 2132.4571 | 376.00972 | 300 |
| **8** | 119.834 | 683.1858 | 0 | 2520.3522 | 444.40609 | 300 |
| **9** | 138.15635 | 682.21175 | 0 | 2817.4275 | 496.78849 | 300 |
| **10** | 156.4787 | 681.71285 | 0 | 3076.442 | 542.45973 | 300 |
| **11** | 165.8505 | 681.58175 | 0 | 3194.411 | 563.26085 | 300 |
| **12** | 166.27165 | 681.5814 | 0 | 3199.8727 | 564.2239 | 300 |
| **13** | 177.55555 | 681.75255 | 0 | 3328.8654 | 586.96878 | 300 |
| **14** | 199.7022 | 682.4417 | 0 | 3540.6301 | 624.30861 | 300 |
| **15** | 213.84075 | 683.16445 | 0 | 3647.6921 | 643.18653 | 300 |
| **16** | 226.91055 | 684.224 | 0 | 3729.534 | 657.61746 | 300 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **17** | 246.91965 | 686.2202 | 0 | 3824.1058 | 674.29303 | 300 |
| **18** | 257.13275 | 687.38855 | 0 | 3857.997 | 680.26896 | 300 |
| **19** | 257.54985 | 687.4424 | 0 | 3858.6527 | 680.38458 | 300 |
| **20** | 264.95 | 688.47735 | 0 | 3873.2203 | 682.95324 | 300 |
| **21** | 279.33325 | 690.6443 | 0 | 3889.6759 | 685.85482 | 300 |
| **22** | 297.05815 | 693.7765 | 0 | 3952.3127 | 2101.4819 | 300 |
| **23** | 318.12465 | 698.0557 | 0 | 3669.6176 | 1951.1703 | 300 |
| **24** | 336.8761 | 702.39635 | 0 | 3487.5604 | 2264.8482 | 0 |
| **25** | 353.3125 | 706.67595 | 0 | 3422.55 | 2222.6299 | 0 |
| **26** | 369.7489 | 711.38045 | 0 | 3341.4679 | 2169.9747 | 0 |
| **27** | 386.1853 | 716.5188 | 0 | 3246.6469 | 2108.3972 | 0 |
| **28** | 394.6089 | 719.2674 | 0 | 3193.3352 | 2073.7761 | 0 |
| **29** | 395.0197 | 719.40715 | 0 | 3190.5961 | 2071.9973 | 0 |
| **30** | 404.23775 | 722.68575 | 0 | 3129.7412 | 2032.4777 | 0 |
| **31** | 422.26305 | 729.3814 | 0 | 3001.0301 | 1948.8917 | 0 |
| **32** | 440.2884 | 736.64275 | 0 | 2861.0098 | 1857.9615 | 0 |
| **33** | 458.31375 | 744.48895 | 0 | 2710.3366 | 1760.1132 | 0 |
| **34** | 476.33905 | 752.94155 | 0 | 2548.9783 | 1655.3259 | 0 |
| **35** | 494.36435 | 762.02505 | 0 | 2376.314 | 1543.1963 | 0 |
| **36** | 512.3897 | 771.7673 | 0 | 2190.9601 | 1422.8261 | 0 |
| **37** | 521.5257 | 776.87815 | 0 | 2088.8025 | 1356.4842 | 0 |
| **38** | 521.7723 | 777.02095 | 0 | 2080.7017 | 1351.2235 | 0 |
| **39** | 531.8103 | 783.05655 | 0 | 1877.1749 | 1219.0516 | 0 |
| **40** | 551.6397 | 795.4396 | 0 | 1462.2765 | 949.61343 | 0 |
| **41** | 561.57305 | 801.87105 | 0 | 1245.1563 | 808.61399 | 0 |
| **42** | 561.6104 | 801.8961 | 0 | 1244.1695 | 807.97313 | 0 |
| **43** | 571.0349 | 808.4478 | 0 | 1012.87 | 657.7655 | 0 |
| **44** | 589.84645 | 821.9935 | 0 | 527.70325 | 342.6945 | 0 |
| **45** | 600.22155 | 829.75 | 0 | 107.65769 | 57.242611 | 300 |
| **46** | 602.15335 | 831.25 | 0 | -35.183457 | -18.707376 | 300 |

BROWN AND CALDWELL

# Technical Memorandum

309 East Morehead Street, Suite 160
Charlotte, North Carolina 28202
(704) 358-7204

Prepared for: Lake Norman C&D Landfill Facility

Project Title: Closure and Post Closure Plan

Project No: 135836

## Technical Memorandum

Subject: Stormwater Management and Erosion and Sedimentation Control Design

Date: August 6, 2008

Attachment: Lake Norman C&D Landfill Facility
Closure and Post-Closure Plan

Prepared by: ______________________

Carl McDonald, E.I.

Checked by: ______________________

Albert Glenn, P.E.

# STORMWATER MANAGEMENT AND EROSION AND SEDIMENTATION CONTROL DESIGN

## 1. INTRODUCTION

This technical memorandum documents the design of erosion and sedimentation control and stormwater measures management for the Lake Norman C&D Landfill Facility. The E&S measures were designed in general accordance with guidance provided in the *North Carolina Erosion and Sediment Control Planning and Design Manual* (hereafter referred to as the *E&S Manual*). The following analyses provide the basis of design and methodology used to meet the following requirements:

- All stormwater terraces, inlets and downchute pipes are sized to convey peak flows from a NRCS Type II, 25-year, 24-hour storm event.
- All channels and culverts are sized to convey peak flows from a NRCS Type II, 25-year, 24-hour storm event. Erosion control matting was selected using the Permissible Velocity method presented in the *E&S Manual.*to protect against erosion within the channels during a NRCS Type II, 10-year, 24-hour storm event.
- Sediment Basin SB-2 is sized to provide 1,800 cubic feet of sediment storage volume per disturbed acre. Surface areas at the principal spillway elevations are designed to provide 435 square feet of area for every cubic foot per second of peak flow from the NRCS Type II, 10-year, 24-hour storm event.
- Sediment basin emergency spillway elevations are designed to activate only when peak flows from the NRCS Type II, 2-year, 24-hour storm event are exceeded and to provide a minimum of 1 foot of freeboard during a NRCS Type II, 10-year, 24-hour storm event. All sediment basins are designed to contain peak flows from the NRCS Type II, 25- year, 24-hour storm event without overtopping.
- Skimmers for sediment basins are designed to draw down full basin volume within 24 to 72 hours after a storm event.
- Outlet protection aprons are sized per requirements in the *E&S Manual.*
- Temporary diversion ditches are provided to direct runoff from disturbed slopes to sediment basins and traps. Silt fence is designated to reduce soil loss from runoff on slopes.

# 2. RUNOFF ESTIMATION

## 2.1 Basis of Design

Stormwater runoff was estimated using the NRCS Peak Discharge Method (TR-55). Drainage area information was input into PondPack software to obtain peak discharge results for the 2-year, 10-year and 25-year, 24-hour storm events. Rainfall information was obtained from the *E&S Manual, Table 8.03j for Charlotte, NC* and is summarized as follows:

- 2-year, 24-hour rainfall = 3.37in;
- 10-year, 24-hour rainfall = 4.90in; and,
- 25-year, 24- hour rainfall = 5.82in.

The design parameters are summarized as follows and inputs and results are shown in Table 2-1:

### 2.1.1 Runoff Inputs

- Drainage areas were calculated digitally in the design drafting software; inputs are in acre units;
- The runoff cover type used was "Brush – brush-weed-grass mixture with brush the major element, Poor condition, Soil group C" with a curve number of 77 (*E&S Manual, Table 8.03g*); and,
- To be conservative, the time of concentration for all drainage areas was assumed to be the minimum of 5 minutes (.08333 hours).

All runoff parameters were input into the PondPack software to generate hydrographs using the NRCS TR-55 method equation. The runoff inputs and results are shown in Table 2-1.

**Table 2-1. Runoff Inputs and Results for PondPack Software**

| Drainage Area ID | Inputs | | | Results | | |
|---|---|---|---|---|---|---|
| | Drainage Area (acres) | Receiving Channel IDs | Receiving E&S Structure | 2-Year Peak Q (cfs) | 10-Year Peak Q (cfs) | 25-Year Peak Q (cfs) |
| DA-B1A | 1.60 | D2 | SB-2 | 3.21 | 6.10 | 8.01 |
| DA-B1B | 1.07 | DIRECT | SB-2 | 2.15 | 4.08 | 5.36 |
| DA-B2A | 1.52 | D2 | SB-2 | 3.05 | 5.79 | 7.61 |
| DA-B2B | 1.29 | DIRECT | SB-2 | 2.59 | 4.92 | 6.46 |
| DA-B2C | 1.36 | DIRECT | SB-2 | 2.73 | 5.18 | 6.81 |
| DA-B3A | 1.59 | DIRECT | SB-2 | 3.19 | 6.06 | 7.96 |
| DA-B3B | 1.65 | DIRECT | SB-2 | 3.31 | 6.29 | 8.26 |
| DA-B4 | 1.13 | DIRECT | SB-1 | 2.27 | 4.32 | 5.68 |
| DA-B5 | 1.61 | DIRECT | SB-1 | 3.23 | 6.16 | 8.09 |
| DA-B6A | 1.78 | D4 | SB-1 | 3.57 | 6.81 | 8.94 |
| DA-B6B | 1.30 | D4 | SB-1 | 2.61 | 4.97 | 6.53 |
| DA-B6C | 1.78 | DIRECT | SB-1 | 3.57 | 6.81 | 8.94 |
| DA-D1 | 2.89 | D1 | SB-2 | 5.80 | 11.05 | 14.52 |
| DA-D2 | 1.96 | D2 | SB-2 | 3.93 | 7.49 | 9.85 |
| DA-D3 | 1.39 | D3 | SB-1 | 2.79 | 5.31 | 6.98 |
| DA-D4 | 6.43 | D4 | SB-1 | 12.90 | 24.58 | 32.30 |
| DA-HR1 | 2.31 | D2 | SB-2 | 4.63 | 8.83 | 11.60 |
| DA-HR2 | 2.05 | D2 | SB-2 | 4.11 | 7.83 | 10.28 |
| DA-HR3 | 1.78 | D2 | SB-2 | 3.57 | 6.80 | 8.93 |
| SB1-DIRECT | 0.58 | DIRECT | SB-1 | 2.51 | 3.65 | 4.33 |
| SB2-DIRECT | 0.89 | DIRECT | SB-2 | 3.84 | 5.59 | 6.64 |

# 3. SIDE SLOPE TERRACE DESIGN

## 3.1 Basis of Design

All side slope terraces were designed to convey stormwater to a network of downchute pipes. Terraces were designed as grass-lined channels using the Permissible Velocity method in the *E&S Manual*. The following design parameters were used for design of the channels:

- Channel dimensions of 12 feet wide and 2 feet deep were used for the analysis;
- Channels were designed for a minimum 1.5 percent slope; and,
- Channels were analyzed for overtopping using the NRCS Type II, 25-year, 24-hour storm event (8.94 cfs, worst case DA-B6C).

A calculation spreadsheet based on the *E&S Manual* Permissible Velocity method is attached.

## 3.2 Summary of Results

Spreadsheet results show that 12-foot-wide, 2-foot-terraces will adequately convey the peak flow from a NRCS Type II, 25-year, 24-hour storm event (8.94 cfs, worst case DA-B6C).

# 4. STORMWATER DOWNCHUTE DESIGN

## 4.1 Basis of Design

All stormwater downchute pipes were designed to convey peak flows from the NRCS Type II, 25-year, 24-hour storm event. Inlet culverts were designed by analyzing headwater generated under inlet control conditions using AutoDesk's Hydraflow Express Culvert Modeling Software. Manning's equation (computed using Haestad Method's FlowMaster software) was used to determine pipe flow in the downchutes. The following design parameters were used for design of the channels:

- Terrace culvert inlets for downchutes were analyzed using one 18-inch-diameter HDPE pipe, n=.011, slope=1%, Inlet Projecting from slope;
- Peak flows from PondPack channel routing results were used for inlet flows (worst case 8.94 cfs for DA-B6C);
- Peak flows from PondPack junction routing results were used for downchute flows (worst case 32.24 cfs for I3B);
- Manning's "n" (roughness coefficient) of .011 (HDPE smooth pipe) was used for the analysis; and,
- Pipe slope was analyzed at .02 ft/ft (the minimum pipe slope across the terraces).

The culvert inlet design was analyzed at the worst-case drainage area to ensure overtopping would not occur in the terrace (i.e. headwater at worst case peak flow < 2 feet). Downchute pipes were analyzed to ensure that the normal depth within the pipe would not exceed the pipe diameter of 24 inches.

## 4.2 Summary of Results

Using Hydraflow software, it was determined that an 18-inch-diameter pipe inlet pipe, projecting from the slope would convey a flow amount of 8.94 cfs without overtopping the terrace. Manning's equation calculation results show that a 24-inch-pipe will convey 32.94 cfs at a minimum .02 ft/ft slope with a normal depth of 1.42 ft. Software calculation results are attached.

# 5. STORMWATER CONVEYANCE

## 5.1 Basis of Design

All side slope terraces were designed to convey stormwater to a network of downchute pipes. Terraces were designed as grass-lined channels using the Permissible Velocity method in the *E&S Manual.* The following design parameters were used for design of the channels:

- Channel dimensions of 3-foot depth with 2-foot horizontal : 1-foot vertical side slopes;
- Channels were designed for a minimum 1.5 percent slope; and,
- Channels were analyzed for overtopping using the NRCS Type II, 25-year, 24-hour storm event (8.94 cfs, worst case DA-B6C).
- A calculation spreadsheet based on the *E&S Manual* Permissible Velocity method is attached.

Channel flows were calculated using PondPack software to generate elevation-flow rating curves. The Modified Puls method was used for routing flows through the channels, generating storage and flow detention/travel times. The channel input parameters are shown in Table 5-1.

Table 5-1. Permanent Stormwater Channel Design Inputs for PondPack Software

| Channel ID | Total Drainage Area (acres) | Length (ft) | Average Slope (ft/ft) | Design Depth (ft) | Side Slopes (H:V) | Width (ft) |
|---|---|---|---|---|---|---|
| D1 | 2.89 | 1,085 | .015 | 3 | 2:1 | 12 |
| D2 | 14.11 | 691 | .015 | 3 | 2:1 | 12 |
| D3 | 1.39 | 486 | .015 | 3 | 2:1 | 12 |
| D4 | 9.51 | 1,897 | .015 | 3 | 2:1 | 12 |

## 5.2 Summary of Results

Results generated from the PondPack analyses are presented in Table 5-2.

Table 5-2. PondPack Software Results for Permanent Stormwater Channels

| Channel ID | 10-Year Peak Storm Flow (cfs) | 25-Year Peak Storm Flow (cfs) |
|---|---|---|
| D1 | 11.05 | 14.52 |
| D2 | 48.45 | 63.58 |
| D3 | 5.31 | 6.98 |
| D4 | 35.21 | 46.07 |
| BENCHES | 6.81 | 8.94 |

The Permissible Velocity method consists of performing iterative calculations using trial geometries and normal depths in order to obtain a flow condition approximately equal to the required flow. A full explanation of the method is presented in the *E&S Manual* and has been attached for reference.

Erosion control matting selection is based on the calculated velocity in each channel during unvegetated conditions. North American Green products are specified for this analysis and product performance sheets are attached to this calculation. The permanent lining for each channel was selected based on computed velocities under vegetated conditions.

Results generated from the Permissible Velocity method spreadsheet analyses are presented in Table 5-3.

**Table 5-3. Permissible Velocity Design for Permanent Stormwater Channels**

| Channel ID | $Q_{10}$ Peak (cfs) | $Q_{25}$- Peak (cfs) | Design Depth (ft) | Unvegetated Condition ($Q_{10}$) | | | Vegetated Condition ($Q_{25}$) | | | NA Green® Erosion Control Matting | Permanent Lining |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Normal Depth (ft) | Computed Velocity (ft/s) | Computed Flow (ft³/s) | Normal Depth (ft) | Computed Velocity (ft/s) | Computed Flow (ft³/s) | | |
| D1 | 11.05 | 14.52 | 3 | 1.35 | 3.26 | 11.88 | 1.79 | 2.31 | 14.83 | S75BN | GRASS |
| D2 | 48.45 | 63.58 | 3 | 2.20 | 5.16 | 49.93 | 2.91 | 3.92 | 66.38 | S150BN | GRASS |
| D3 | 5.31 | 6.98 | 3 | 1.06 | 2.41 | 5.42 | 1.43 | 1.74 | 7.10 | S75BN | GRASS |
| D4 | 35.21 | 46.07 | 3 | 2.00 | 4.46 | 35.66 | 2.62 | 3.38 | 46.41 | S75BN | GRASS |
| BENCHES | 6.81 | 8.94 | 2 | 0.88 | 2.53 | 6.86 | 1.24 | 1.66 | 8.95 | S75BN | GRASS |

A summary of the results and how they impact the erosion and sedimentation control design follows:

- All channel velocities for the 10-year storm event are greater than 2 feet per second, indicating that temporary erosion control matting will be required for all channels;
- All channel velocities for the 25-year storm event are less than 5 feet per second, indicating that grass lining will be sufficient as permanent channel lining;
- No channel depths are exceeded on any of the channels during the 25-year storm event, indicating that all channels are designed with sufficient depth.

# 6. STORMWATER CULVERT DESIGN

## 6.1 Basis of Design

Stormwater will be conveyed by culverts beneath haul roads in two locations along perimeter channel D1. The design parameters are summarized as follows:

- Provide culverts sized to sufficiently pass flows from the NRCS Type II, 25-year, 24-hour storm event without overtopping the road.

AutoDesk's Hydraflow Express Culvert Modeling Software was used to model the culverts with the following parameters:

- Culvert C1 was analyzed using one 24-inch diameter HDPE pipe, n=.011, slope=1.21 percent projecting; and,
- Culvert C2 was analyzed using one 36-inch diameter HDPE pipe, n=.011, slope=1.8 percent projecting.

## 6.2 Summary of Results

Results generated from the Hydraflow analyses indicate that no overtopping of roads or terraces will occur during peak flows from the 25-year, 24-hour storm event. Software results for the analyses are attached.

# 7. SEDIMENT BASIN DESIGN

## 7.1 Basis of Design

Stormwater will be conveyed to one of three sediment basins in order to efficiently reduce sediment transport off of the construction site. Sediment basins have been designed in general accordance with guidance provided in the *E&S Manual* with the following design parameters:

- Provide 1,800 cubic feet of sediment storage volume (from pond base to crest of principal spillway) per acre of disturbed area;
- Provide 435 square feet of water surface area (at principal spillway crest elevation) per cubic foot per second of runoff peak flow for the NRCS Type II, 10-year, 24-hour storm event;
- Design the basin and principal spillway to pass runoff peak flow for the NRCS Type II, 2-year, 24-hour storm event without activating the emergency spillway;
- Design the basin and spillway system to pass runoff peak flow for the NRCS Type II, 10-year, 24-hour storm event while maintaining 1 foot of freeboard from the top of the basin berm; and,
- Provide skimmers for sediment basins to draw down full basin volume within 24 to 72 hours after a storm event.

PondPack software was used to model the stormwater routing through the basins. Design elevations and areas were input into the program based on volume and surface area requirements as outlined in the *E&S Manual*. Peak flows for storm events were obtained through runoff and channel calculations in Sections 2 and 3. A summary of all design requirements for the sediment basins is provided in Table 7-1.

*Note: Sediment Basin 1 (SB-1) was designed by S&ME, Inc. Refer to "Construction Plan Application – Construction and Demolition Landfill, Lake Norman Landfill, Inc." prepared by S&ME, Inc., (Feb.1998).*

Table 7-1. Sediment Basin Design Requirements

| Basin ID | Total Disturbed Area (acres) | 10-Year Peak Q (cfs) | Required Volume ($ft^3$) | Designed Volume ($ft^3$) | Required Surface Area ($ft^2$) | Designed Surface Area ($ft^2$) |
|---|---|---|---|---|---|---|
| SB-2 | 21.96 | 75.75 | 39,528 | 94,215 | 32,951 | 33,467 |

A summary of the construction method including materials and the impact on design follows:

- All sediment basins will consist of a riser and culvert principal spillway outlet with a rock-lined weir emergency spillway as illustrated in the Construction Drawing Details;
- Risers standpipes and culvert barrel pipes will be constructed from corrugated metal pipe (Manning's "n" coefficient = .022);
- For flow modeling of all risers, weir coefficients of 1.8 and orifice coefficients (for submerged conditions) of 0.6 were used;

- For culvert entrance losses, coefficient Ke=0.900 was based on a "Projecting" culvert entrance;
- All emergency spillway sections are 20-foot wide, 2-foot deep with 3-foot horizontal to 1-foot vertical side slopes; and,
- Emergency spillways were modeled as X-Y cross-section weirs with a coefficient of 2.8.

Through a series of iterations using the PondPack software program, a combination of basin and outlet structure design parameters were analyzed and selected to ensure the basin would meet design requirements. These parameters are summarized in Table 7-2.

Table 7-2. Sediment Basin Design Inputs for PondPack

| Basin ID | Principal Spillway | | | | | | Emergency Spillway Elevation (ft) | Top of Berm Elevation (ft) |
|---|---|---|---|---|---|---|---|---|
| | Riser Diameter (in) | Riser Elevation (ft) | Culvert Diameter (in) | Culvert Upstream Invert (ft) | Culvert Downstream Invert (ft) | Culvert Slope (ft/ft) | | |
| SB-1* | 36 | 673.4 | 30 | 669.0 | 668.0 | .0182 | 674.7 | 676.0 |
| SB-2 | 24 | 678.0 | 15 | 673.0 | 672.0 | .0158 | 679.0 | 681.0 |

**SB-1 inputs taken from "Construction Plan Application – Construction and Demolition Landfill, Lake Norman Landfill, Inc." prepared by S&ME, Inc., (Feb.1998)*

## 7.2 Summary of Results

A summary of the sediment basin routing results is included in Table 7-3.

Table 7-3. Sediment Basin Design Results from PondPack software

| Basin ID | 2-Year Storm Max Elevation (ft) | Freeboard to Emergency Spillway (ft) | 10-Year Storm Max Elevation (ft) | Freeboard to Top of Berm (ft) | 25-Year Storm Max Elevation (ft) | Freeboard to Top of Berm (ft) |
|---|---|---|---|---|---|---|
| SB-1 | 673.52 | 1.18 | 674.09 | 1.91 | 674.60 | 1.40 |
| SB-2 | 677.81 | 1.19 | 678.48 | 2.52 | 678.96 | 2.04 |

Faircloth Skimmers (or approved equivalent) will be used to draw down $Q_{10}$ basin volumes within 24 to 72 hours. Skimmer sizing information is provided by the manufacturer and is based on draw down capabilities over a defined time period. Drawdown volumes are based on pond routing results from PondPack analyses. Note that Sediment basin SB-1 was an orifice designed basin, therefore no skimmer will be constructed for that basin. Skimmers were sized per manufacturer guidance and recommendations and a calculation spreadsheet is attached.

Skimmer sizing information is provided in Table 7-4.

Table 7-4. Sediment Basin Skimmer Sizing

| Basin ID | Maximum 10year Storm Volume ($ft^3$) | Skimmer Size (in) | Skimmer Orifice Radius (in) | Number of Skimmers | Basin Drawdown Time (hours) |
|---|---|---|---|---|---|
| SB-2 | 136,299 | 6 | 2.8 | 1 | 72 |

# 8. SEDIMENT BASIN RISER ANTI-FLOTATION

## 8.1 Basis of Design

An anti-flotation block must be properly sized to counter buoyant forces acting on the riser.

The anti-flotation block has been designed with guidance provided in the *E&S Manual, Section 8.06* with the following design parameter:

- Design a block with a weight equal to or greater than 1.1 times the weight of water displaced by the riser and block.

The anti-flotation block design results for each sediment basin are shown in Table 8-1.

Table 8-1. Anti-Flotation Block Design

| Basin ID | Riser Displacement Weight (lbs) | Anti-Flotation Block Dimensions (ft) | | | Block Displacement Weight (lbs) | Total Displacement Weight (lbs) | Block Weight (lbs) | Factor of Safety |
|---|---|---|---|---|---|---|---|---|
| | | Width 1 | Width 2 | Depth | | | | |
| SB-2 | 980 | 3 | 3 | 2 | 1,123 | 2,103 | 2,700 | 1.3 |

## 8.2 Summary of Results

All anti-flotation blocks are designed to counter buoyancy with greater than a 1.1 factor of safety.

# STORMWATER MANAGEMENT AND EROSION AND SEDIMENTATION CONTROL DESIGN

## 9. RIPRAP OUTLET PROTECTION

### 9.1 Basis of Design

Riprap outlet protection aprons are designed to dissipate energy from basin outlet discharge flows. The goal of a riprap outlet apron is to reduce concentrated discharge velocities to match normal velocities of the receiving channel or area. A riprap outlet protection measure has been designed for each sediment basin outlet.

Riprap outlet protection measures have been designed in general accordance with guidance provided in the *E&S Manual, Section 8.06* with the following design parameters:

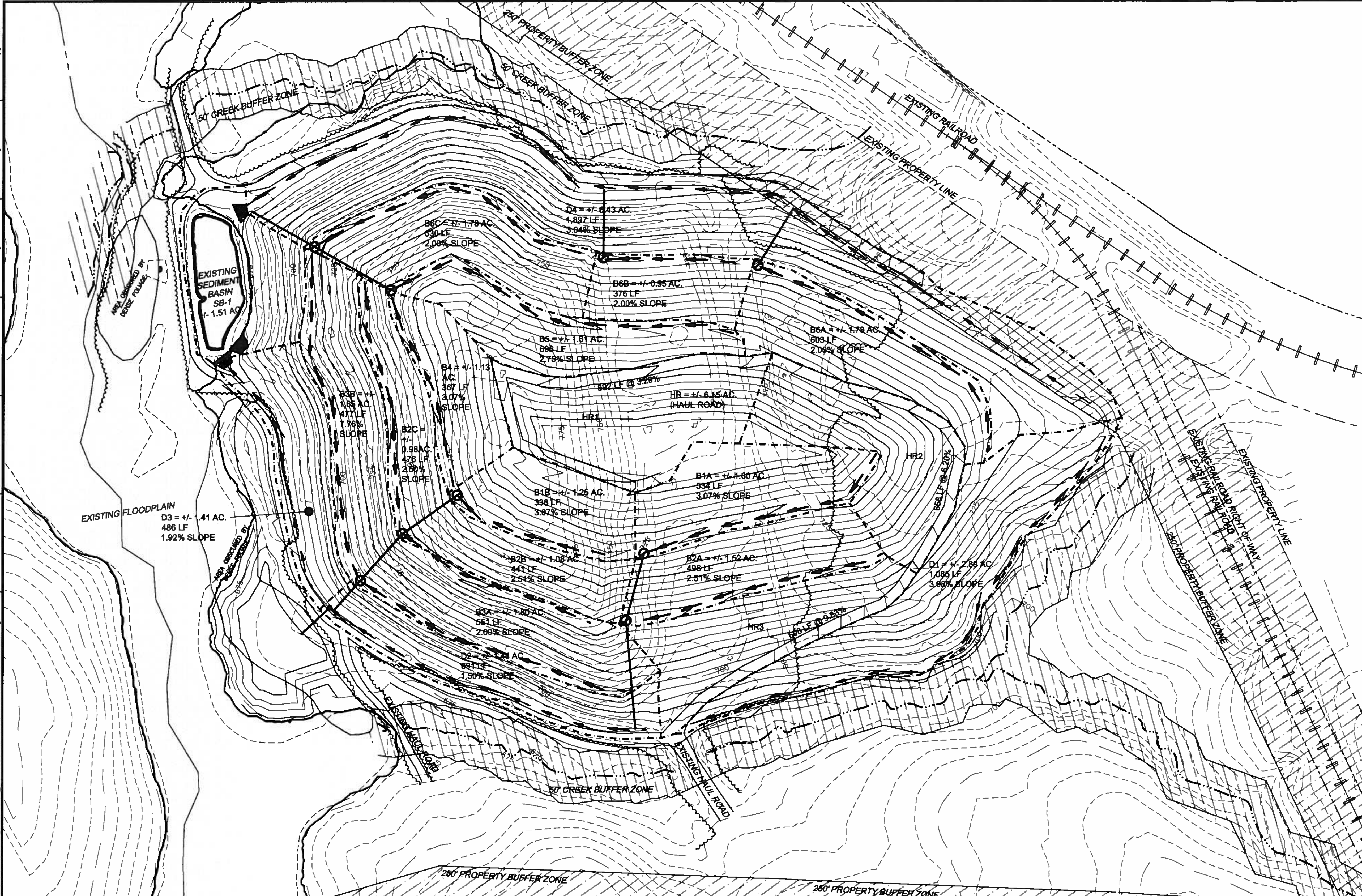
- Riprap outlet protection measures are sized according to the chart shown as Figure 8.06a in the *E&S Manual* (attached);
- All outlet protection aprons are sized assuming minimum tailwater conditions;
- Maximum discharge flows from the 10-year storm event were used to size the aprons;
- The maximum riprap size is determined by multiplying the $d_{50}$ diameter obtained on Figure 8.06a by 1.5 ($d_{max}$=1.5*$d_{50}$); and,
- The apron thickness is determined by multiplying the calculated $d_{max}$ diameter by 1.5.

The riprap outlet protection design for each sediment basin is shown in Table 8-1.

Table 8-1. Riprap Outlet Protection Design*

| Basin ID | Maximum 10-year Storm Discharge (cfs) | Culvert Diameter, Do (in) | $d_{50}$ Riprap Size (in) | $d_{max}$ Riprap Size (in) | Riprap Thickness (in) | Minimum Apron Length, La (ft) | Minimum Apron Downstream Width, W=Do+La (ft) | Apron Width at Culvert=3*Do (ft) |
|---|---|---|---|---|---|---|---|---|
| SB-2 | 4.0 | 15 | 4 | 6 | 9 | 10 | 4 | 11 |

*Refer to attached Figure 8.06a for a schematic of sizing dimensions*




100 0 100 200 300

Scale 1" = 100'

REFERENCE NOTE:

EXISTING PLANIMETRIC AND TOPOGRAPHIC INFORMATION OBTAINED FROM AERIAL SURVEY DATA DATED FEBRUARY 2008 PROVIDED BY IMG AND SEPARATE TOPOGRAPHICAL INFORMATION PROVIDED BY ESP & ASSOCIATES DATED 2004-2005

## LEGEND

**PROPOSED**

- 2 FOOT ELEVATION CONTOUR
280 - 10 FOOT ELEVATION CONTOUR
- WASTE LIMITS

**EXISTING**

- 2 FOOT ELEVATION CONTOUR
280 - 10 FOOT ELEVATION CONTOUR
- APPROXIMATE WASTE LIMITS
- PROPERTY LINE
- RAILROAD RIGHT OF WAY
- WATERCOURSE BUFFER YARD
- PROPERTY BUFFERYARD
- 100 YR FLOODPLAIN
- WATERCOURSE
- PASSIVE GAS VENT (SEE DETAIL 1 /DRAWING E7)

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7-17-08

**BROWN AND CALDWELL**
Environmental Engineering and Consulting
309 East Morehead Street, Suite 160, Charlotte, North Carolina 28202 (704) 358-7204

SUBMITTED: ____ PROJECT MANAGER DATE: ____
APPROVED: ____ BROWN AND CALDWELL DATE: ____

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED: CJM
DRAWN: DCV
CHECKED: ADG
CHECKED:
APPROVED:

EXTERNAL REFERENCES
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135836-V-ET.dwg

REVISIONS

| ZONE | REV. | DESCRIPTION | BY | DATE | APP. |
|---|---|---|---|---|---|
| | | | | | |

BFI - LAKE NORMAN C&D LANDFILL FACILITY
7099 QUARRY LANE, STANLEY, NC
LINCOLN COUNTY NORTH CAROLINA

FACILITY PERMIT NUMBER 55-04

# CLOSURE AND POST-CLOSURE PLAN
# DRAINAGE AREA PLAN

# LAKE NORMAN C&D LANDFILL FACILITY

FILENAME
BC PROJECT NUMBER 135836
SCALE 1"=100'
DRAWING NUMBER C1
SHEET NUMBER OF

# Table 8.03j Precipitation Frequency Estimates

For use with NRCS Method**

**Murphy, North Carolina 35.0961N, 84.0239W**

| ARI* (years) | 5 min. | 10 min. | 15 min. | 30 min. | 60 min. | 120 min. | 3 hr. | 6 hr. | 12 hr. | 24 hr. |
|---|---|---|---|---|---|---|---|---|---|---|
| **2** | 0.41 | 0.66 | 0.83 | 1.14 | 1.43 | 1.71 | 1.85 | 2.29 | 2.90 | 3.48 |
| **10** | 0.56 | 0.90 | 1.14 | 1.66 | 2.16 | 2.57 | 2.76 | 3.32 | 4.14 | 6.08 |
| **25** | 0.66 | 1.05 | 1.33 | 1.97 | 2.62 | 3.14 | 3.38 | 4.05 | 4.95 | 6.08 |
| **100** | 0.80 | 1.27 | 1.61 | 2.47 | 3.40 | 4.13 | 4.50 | 5.38 | 6.33 | 7.93 |

**Asheville, North Carolina 35.4358N, 82.5392W**

| ARI* (years) | 5 min. | 10 min. | 15 min. | 30 min. | 60 min. | 120 min. | 3 hr. | 6 hr. | 12 hr. | 24 hr. |
|---|---|---|---|---|---|---|---|---|---|---|
| **2** | 0.43 | 0.69 | 0.87 | 1.21 | 1.51 | 1.77 | 1.88 | 2.30 | 2.91 | 3.47 |
| **10** | 0.59 | 0.94 | 1.19 | 1.72 | 2.25 | 2.60 | 2.74 | 3.29 | 4.10 | 4.91 |
| **25** | 0.67 | 1.07 | 1.36 | 2.02 | 2.69 | 3.13 | 3.31 | 3.96 | 4.83 | 5.79 |
| **100** | 0.81 | 1.28 | 1.62 | 2.48 | 3.42 | 4.00 | 4.29 | 5.12 | 6.04 | 7.24 |

**Boone, North Carolina 36.2167N, 81.6667W**

| ARI* (years) | 5 min. | 10 min. | 15 min. | 30 min. | 60 min. | 120 min. | 3 hr. | 6 hr. | 12 hr. | 24 hr. |
|---|---|---|---|---|---|---|---|---|---|---|
| **2** | 0.48 | 0.76 | 0.96 | 1.32 | 1.66 | 2.00 | 2.18 | 2.85 | 3.77 | 4.39 |
| **10** | 0.62 | 1.00 | 1.26 | 1.83 | 2.39 | 2.92 | 3.18 | 4.10 | 5.28 | 6.61 |
| **25** | 0.72 | 1.14 | 1.45 | 2.14 | 2.85 | 3.55 | 3.87 | 4.94 | 6.21 | 8.07 |
| **100** | 0.86 | 1.38 | 1.74 | 2.66 | 3.67 | 4.69 | 5.15 | 6.47 | 7.82 | 10.65 |

**Charlotte, North Carolina, 35.2333N, 80.85W**

| ARI* (years) | 5 min. | 10 min. | 15 min. | 30 min. | 60 min. | 120 min. | 3 hr. | 6 hr. | 12 hr. | 24 hr. |
|---|---|---|---|---|---|---|---|---|---|---|
| **2** | 0.47 | 0.76 | 0.95 | 1.31 | 1.65 | 1.92 | 2.04 | 2.46 | 2.91 | 3.37 |
| **10** | 0.60 | 0.97 | 1.22 | 1.77 | 2.31 | 2.72 | 2.93 | 3.55 | 4.23 | 4.90 |
| **25** | 0.67 | 1.06 | 1.35 | 2.00 | 2.66 | 3.17 | 3.46 | 4.19 | 5.04 | 5.82 |
| **100** | 0.75 | 1.19 | 1.51 | 2.31 | 3.18 | 3.85 | 4.29 | 5.22 | 6.36 | 7.30 |

**Greensboro, North Carolina 36.975N, 79.9436W**

| ARI* (years) | 5 min. | 10 min. | 15 min. | 30 min. | 60 min. | 120 min. | 3 hr. | 6 hr. | 12 hr. | 24 hr. |
|---|---|---|---|---|---|---|---|---|---|---|
| **2** | 0.46 | 0.73 | 0.91 | 1.26 | 1.58 | 1.85 | 1.98 | 2.36 | 2.81 | 3.31 |
| **10** | 0.57 | 0.91 | 1.16 | 1.68 | 2.18 | 2.60 | 2.77 | 3.37 | 4.02 | 4.76 |
| **25** | 0.62 | 0.98 | 1.25 | 1.84 | 2.46 | 2.98 | 3.17 | 3.90 | 4.71 | 5.26 |
| **100** | 0.66 | 1.05 | 1.33 | 2.03 | 2.80 | 3.46 | 3.72 | 4.68 | 5.81 | 7.00 |

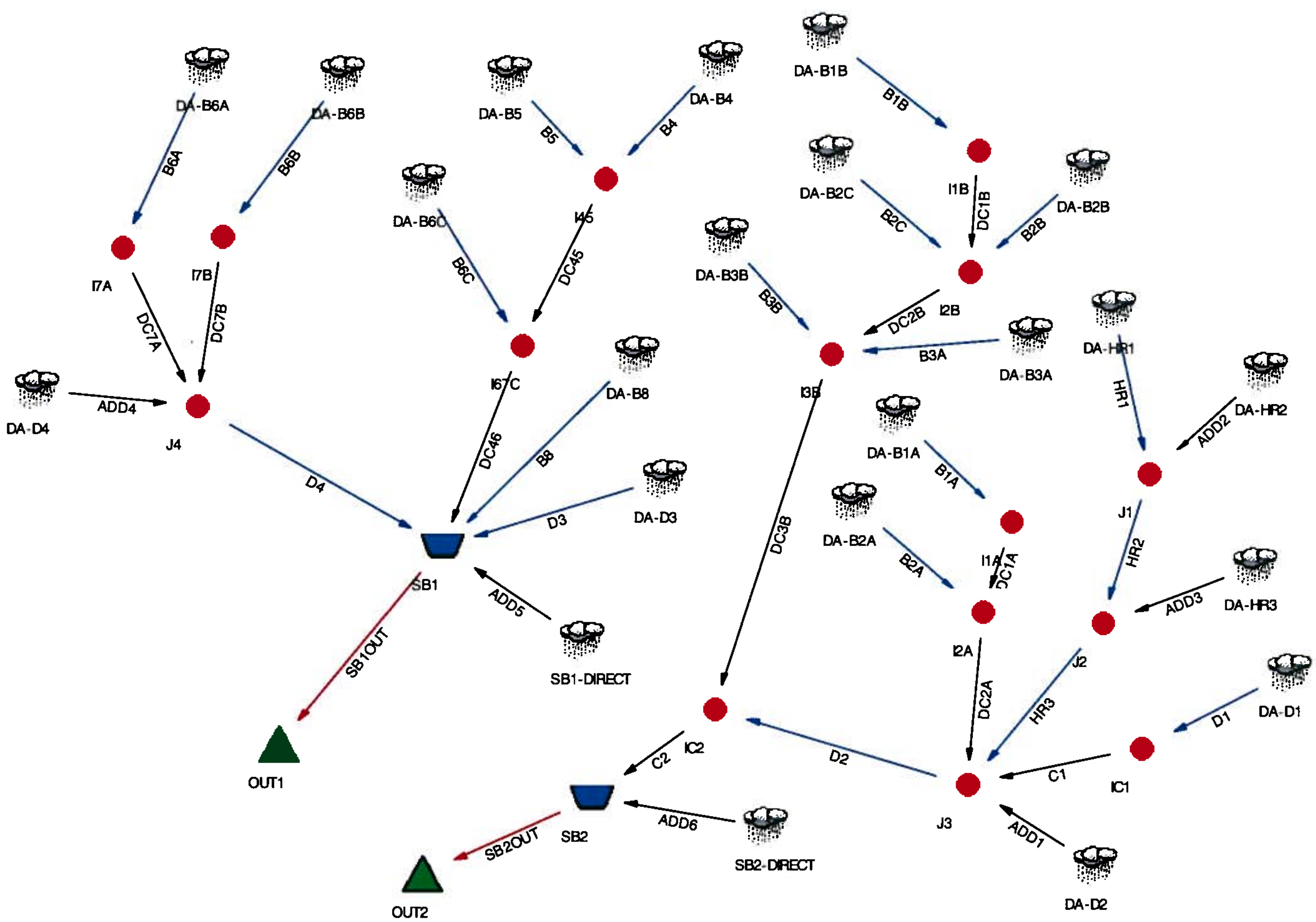
* ARI is the Average Return Interval.

**Precipitation Frequency Estimates are measured in inches.

**Table 8.03g Runoff curve numbers for other agriculture lands[1]**

| ---Cover description--- | | Curve numbers for ---hydrologic soil groups--- | | | |
|---|---|---|---|---|---|
| Cover type | Hydrologic conditions[3] | A | B | C | D |
| Pasture, grassland, or range—continuous forage for grazing. [2] | Poor | 68 | 79 | 86 | 89 |
| | Fair | 49 | 69 | 79 | 84 |
| | Good | 39 | 61 | 74 | 80 |
| Meadow—continuous grass, protected from grazing and generally mowed for hay. | — | 30 | 58 | 71 | 78 |
| Brush—brush-weed-grass mixture with brush the major element. [3] | Poor | 48 | 67 | 77 | 83 |
| | Fair | 35 | 56 | 70 | 77 |
| | Good | 30 [4] | 48 | 65 | 73 |
| Woods—grass combination (orchard or tree farm). [5] | Poor | 57 | 73 | 82 | 86 |
| | Fair | 43 | 65 | 76 | 82 |
| | Good | 32 | 58 | 72 | 79 |
| Woods. [6] | Poor | 45 | 66 | 77 | 83 |
| | Fair | 36 | 60 | 73 | 79 |
| | Good | 30 [4] | 55 | 70 | 77 |
| Farmsteads—buildings, lanes, driveways, and surrounding lots. | — | 59 | 74 | 82 | 86 |

1 Average runoff condition, and $I_a = 0.2S$.
2 *Poor:* <50% ground cover or heavily grazed with no mulch.
*Fair:* 50 to 75% ground cover and not heavily grazed.
*Good:* > 75% ground cover and lightly or only occasionally grazed.
3 *Poor:* <50% ground cover.
*Fair:* 50 to 75% ground cover.
*Good:* >75% ground cover.
4 Actual curve number is less than 30; use CN = 30 for runoff computations.
5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.
6 *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
*Fair:* Woods are grazed but not burned, and some forest litter covers the soil.
*Good:* Woods are protected from grazing, and litter and brush adequately cover the soil.


DA-B6A
DA-B6B
DA-B5
DA-B4
DA-B1B
B6A
B6B
B5
B4
B1B
DA-B2C
I1B
DA-B2B
DA-B6C
I45
B2C
DC1B
B2B
I7A
I7B
B6C
DC45
DA-B3B
I2B
DC7A
DC7B
B3B
DC2B
DA-HR1
B3A
I67C
DA-B3A
DA-D4
ADD4
DA-B8
I3B
HR1
DA-HR2
J4
DC46
DA-B1A
ADD2
D4
B8
B1A
J1
DA-D3
D3
DC3B
DA-B2A
I1A
DC1A
HR2
SB1
B2A
ADD3
DA-HR3
ADD5
I2A
J2
SB1OUT
SB1-DIRECT
DC2A
HR3
DA-D1
D1
IC2
C2
D2
C1
IC1
OUT1
SB2
ADD6
J3
ADD1
SB2OUT
SB2-DIRECT
DA-D2
OUT2

==========================
JOB TITLE
==========================

Project Date: 7/29/2008
Project Engineer: cmcdonald
Project Title: Lake Norman C&D Landfill - Stormwater Calcs
Project Comments:

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MASTER DESIGN STORM SUMMARY

Network Storm Collection: Charlotte-SCS

| Return Event | Total Depth in | Rainfall Type | RNF ID |
|---|---|---|---|
| 2 | 3.3700 | Synthetic Curve | TypeII 24hr |
| 10 | 4.9000 | Synthetic Curve | TypeII 24hr |
| 25 | 5.8200 | Synthetic Curve | TypeII 24hr |

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

| Node ID | Type | Return Event | HYG Vol ac-ft | Trun | Qpeak hrs | Qpeak cfs | Max WSEL ft | Max Pond Storage ac-ft |
|---|---|---|---|---|---|---|---|---|
| DA-B1A | AREA | 2 | .178 | | 11.9500 | 3.21 | | |
| DA-B1A | AREA | 10 | .339 | | 11.9000 | 6.10 | | |
| DA-B1A | AREA | 25 | .443 | | 11.9000 | 8.01 | | |
| DA-B1B | AREA | 2 | .119 | | 11.9500 | 2.15 | | |
| DA-B1B | AREA | 10 | .226 | | 11.9000 | 4.08 | | |
| DA-B1B | AREA | 25 | .296 | | 11.9000 | 5.36 | | |
| DA-B2A | AREA | 2 | .169 | | 11.9500 | 3.05 | | |
| DA-B2A | AREA | 10 | .322 | | 11.9000 | 5.79 | | |
| DA-B2A | AREA | 25 | .421 | | 11.9000 | 7.61 | | |
| DA-B2B | AREA | 2 | .143 | | 11.9500 | 2.59 | | |
| DA-B2B | AREA | 10 | .273 | | 11.9000 | 4.92 | | |
| DA-B2B | AREA | 25 | .357 | | 11.9000 | 6.46 | | |
| DA-B2C | AREA | 2 | .151 | | 11.9500 | 2.73 | | |
| DA-B2C | AREA | 10 | .288 | | 11.9000 | 5.18 | | |
| DA-B2C | AREA | 25 | .376 | | 11.9000 | 6.81 | | |

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

| Node ID | Type | Return Event | HYG Vol ac-ft | Trun | Qpeak hrs | Qpeak cfs | Max WSEL ft | Max Pond Storage ac-ft |
|---|---|---|---|---|---|---|---|---|
| DA-B3A | AREA | 2 | .177 | | 11.9500 | 3.19 | | |
| DA-B3A | AREA | 10 | .336 | | 11.9000 | 6.06 | | |
| DA-B3A | AREA | 25 | .440 | | 11.9000 | 7.96 | | |
| DA-B3B | AREA | 2 | .183 | | 11.9500 | 3.31 | | |
| DA-B3B | AREA | 10 | .349 | | 11.9000 | 6.29 | | |
| DA-B3B | AREA | 25 | .457 | | 11.9000 | 8.26 | | |
| DA-B4 | AREA | 2 | .126 | | 11.9500 | 2.27 | | |
| DA-B4 | AREA | 10 | .239 | | 11.9000 | 4.32 | | |
| DA-B4 | AREA | 25 | .313 | | 11.9000 | 5.68 | | |
| DA-B5 | AREA | 2 | .179 | | 11.9500 | 3.23 | | |
| DA-B5 | AREA | 10 | .341 | | 11.9000 | 6.16 | | |
| DA-B5 | AREA | 25 | .446 | | 11.9000 | 8.09 | | |
| DA-B6A | AREA | 2 | .198 | | 11.9500 | 3.57 | | |
| DA-B6A | AREA | 10 | .377 | | 11.9000 | 6.81 | | |
| DA-B6A | AREA | 25 | .493 | | 11.9000 | 8.94 | | |
| DA-B6B | AREA | 2 | .145 | | 11.9500 | 2.61 | | |
| DA-B6B | AREA | 10 | .275 | | 11.9000 | 4.97 | | |
| DA-B6B | AREA | 25 | .360 | | 11.9000 | 6.53 | | |
| DA-B6C | AREA | 2 | .198 | | 11.9500 | 3.57 | | |
| DA-B6C | AREA | 10 | .377 | | 11.9000 | 6.81 | | |
| DA-B6C | AREA | 25 | .493 | | 11.9000 | 8.94 | | |
| DA-B8 | AREA | 2 | .155 | | 11.9500 | 2.79 | | |
| DA-B8 | AREA | 10 | .294 | | 11.9000 | 5.31 | | |
| DA-B8 | AREA | 25 | .385 | | 11.9000 | 6.98 | | |
| DA-D1 | AREA | 2 | .321 | | 11.9500 | 5.80 | | |
| DA-D1 | AREA | 10 | .612 | | 11.9000 | 11.05 | | |
| DA-D1 | AREA | 25 | .800 | | 11.9000 | 14.52 | | |

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

| Node ID | Type | Return Event | HYG Vol ac-ft | Trun | Qpeak hrs | Qpeak cfs | Max WSEL ft | Max Pond Storage ac-ft |
|---|---|---|---|---|---|---|---|---|
| DA-D2 | AREA | 2 | .218 | | 11.9500 | 3.93 | | |
| DA-D2 | AREA | 10 | .415 | | 11.9000 | 7.49 | | |
| DA-D2 | AREA | 25 | .543 | | 11.9000 | 9.85 | | |
| DA-D3 | AREA | 2 | .155 | | 11.9500 | 2.79 | | |
| DA-D3 | AREA | 10 | .294 | | 11.9000 | 5.31 | | |
| DA-D3 | AREA | 25 | .385 | | 11.9000 | 6.98 | | |
| DA-D4 | AREA | 2 | .715 | | 11.9500 | 12.90 | | |
| DA-D4 | AREA | 10 | 1.361 | | 11.9000 | 24.58 | | |
| DA-D4 | AREA | 25 | 1.780 | | 11.9000 | 32.30 | | |
| DA-HR1 | AREA | 2 | .257 | | 11.9500 | 4.63 | | |
| DA-HR1 | AREA | 10 | .489 | | 11.9000 | 8.83 | | |
| DA-HR1 | AREA | 25 | .639 | | 11.9000 | 11.60 | | |
| DA-HR2 | AREA | 2 | .228 | | 11.9500 | 4.11 | | |
| DA-HR2 | AREA | 10 | .434 | | 11.9000 | 7.83 | | |
| DA-HR2 | AREA | 25 | .568 | | 11.9000 | 10.28 | | |
| DA-HR3 | AREA | 2 | .198 | | 11.9500 | 3.57 | | |
| DA-HR3 | AREA | 10 | .377 | | 11.9000 | 6.80 | | |
| DA-HR3 | AREA | 25 | .493 | | 11.9000 | 8.93 | | |
| I1A | JCT | 2 | .178 | | 12.0000 | 2.93 | | |
| I1A | JCT | 10 | .338 | | 12.0000 | 5.70 | | |
| I1A | JCT | 25 | .443 | | 12.0000 | 7.44 | | |
| I1B | JCT | 2 | .119 | | 12.0000 | 2.02 | | |
| I1B | JCT | 10 | .226 | | 11.9500 | 3.88 | | |
| I1B | JCT | 25 | .296 | | 11.9500 | 5.14 | | |
| I2A | JCT | 2 | .347 | | 12.0000 | 5.74 | | |
| I2A | JCT | 10 | .660 | | 12.0000 | 11.13 | | |
| I2A | JCT | 25 | .864 | | 12.0000 | 14.52 | | |

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

| Node ID | Type | Return Event | HYG Vol ac-ft | Trun | Qpeak hrs | Qpeak cfs | Max WSEL ft | Max Pond Storage ac-ft |
|---|---|---|---|---|---|---|---|---|
| I2B | JCT | 2 | .413 | | 12.0000 | 6.92 | | |
| I2B | JCT | 10 | .787 | | 12.0000 | 13.34 | | |
| I2B | JCT | 25 | 1.030 | | 11.9500 | 17.56 | | |
| I3B | JCT | 2 | .774 | | 12.0000 | 12.68 | | |
| I3B | JCT | 10 | 1.472 | | 12.0000 | 24.69 | | |
| I3B | JCT | 25 | 1.926 | | 12.0000 | 32.24 | | |
| I45 | JCT | 2 | .304 | | 12.0000 | 4.85 | | |
| I45 | JCT | 10 | .580 | | 12.0000 | 9.55 | | |
| I45 | JCT | 25 | .758 | | 12.0000 | 12.52 | | |
| I67C | JCT | 2 | .502 | | 12.0000 | 8.04 | | |
| I67C | JCT | 10 | .956 | | 12.0000 | 15.83 | | |
| I67C | JCT | 25 | 1.251 | | 12.0000 | 20.74 | | |
| I7A | JCT | 2 | .198 | | 12.0000 | 3.16 | | |
| I7A | JCT | 10 | .377 | | 12.0000 | 6.24 | | |
| I7A | JCT | 25 | .493 | | 12.0000 | 8.18 | | |
| I7B | JCT | 2 | .144 | | 12.0000 | 2.46 | | |
| I7B | JCT | 10 | .275 | | 11.9500 | 4.76 | | |
| I7B | JCT | 25 | .360 | | 11.9500 | 6.30 | | |
| IC1 | JCT | 2 | .321 | | 12.0000 | 4.75 | | |
| IC1 | JCT | 10 | .611 | | 12.0000 | 9.65 | | |
| IC1 | JCT | 25 | .800 | | 12.0000 | 12.77 | | |
| IC2 | JCT | 2 | 2.342 | | 12.0000 | 34.94 | | |
| IC2 | JCT | 10 | 4.457 | | 12.0000 | 71.33 | | |
| IC2 | JCT | 25 | 5.832 | | 12.0000 | 94.52 | | |
| J1 | JCT | 2 | .485 | | 12.0000 | 7.75 | | |
| J1 | JCT | 10 | .922 | | 11.9500 | 15.28 | | |
| J1 | JCT | 25 | 1.207 | | 11.9500 | 20.17 | | |

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

| Node ID | | Type | Return Event | HYG Vol ac-ft | Trun | Qpeak hrs | Qpeak cfs | Max WSEL ft | Max Pond Storage ac-ft |
|---|---|---|---|---|---|---|---|---|---|
| J2 | | JCT | 2 | .683 | | 12.0000 | 10.76 | | |
| J2 | | JCT | 10 | 1.299 | | 12.0000 | 21.03 | | |
| J2 | | JCT | 25 | 1.700 | | 11.9500 | 27.66 | | |
| J3 | | JCT | 2 | 1.568 | | 12.0000 | 24.51 | | |
| J3 | | JCT | 10 | 2.985 | | 12.0000 | 48.45 | | |
| J3 | | JCT | 25 | 3.906 | | 12.0000 | 63.58 | | |
| J4 | | JCT | 2 | 1.057 | | 11.9500 | 18.12 | | |
| J4 | | JCT | 10 | 2.012 | | 11.9500 | 35.21 | | |
| J4 | | JCT | 25 | 2.633 | | 11.9500 | 46.07 | | |
| *OUT1 | | JCT | 2 | .672 | | 15.0500 | 1.26 | | |
| *OUT1 | | JCT | 10 | 2.434 | | 12.3000 | 16.90 | | |
| *OUT1 | | JCT | 25 | 3.575 | | 12.1500 | 36.70 | | |
| *OUT2 | | JCT | 2 | .000 | | .0500 | .00 | | |
| *OUT2 | | JCT | 10 | 2.083 | | 13.8500 | 3.71 | | |
| *OUT2 | | JCT | 25 | 3.526 | | 12.6500 | 9.45 | | |
| SB1 | IN | POND | 2 | 2.031 | | 12.0000 | 28.09 | | |
| SB1 | IN | POND | 10 | 3.792 | | 12.0000 | 56.61 | | |
| SB1 | IN | POND | 25 | 4.933 | | 12.0000 | 74.90 | | |
| SB1 | OUT | POND | 2 | .672 | | 15.0500 | 1.26 | 673.52 | 1.413 |
| SB1 | OUT | POND | 10 | 2.434 | | 12.3000 | 16.90 | 674.09 | 1.682 |
| SB1 | OUT | POND | 25 | 3.575 | | 12.1500 | 36.70 | 674.60 | 1.933 |
| SB1-DIRECT | | AREA | 2 | .163 | | 11.9000 | 2.51 | | |
| SB1-DIRECT | | AREA | 10 | .236 | | 11.9000 | 3.65 | | |
| SB1-DIRECT | | AREA | 25 | .281 | | 11.9000 | 4.33 | | |
| SB2 | IN | POND | 2 | 2.591 | | 12.0000 | 37.98 | | |
| SB2 | IN | POND | 10 | 4.819 | | 12.0000 | 75.75 | | |
| SB2 | IN | POND | 25 | 6.262 | | 12.0000 | 99.77 | | |

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

| Node ID | Type | Return Event | HYG Vol ac-ft | Trun | Qpeak hrs | Qpeak cfs | Max WSEL ft | Max Pond Storage ac-ft |
|---|---|---|---|---|---|---|---|---|
| SB2 OUT | POND | 2 | .000 | | .0500 | .00 | 677.81 | 2.591 |
| SB2 OUT | POND | 10 | 2.083 | | 13.8500 | 3.71 | 678.48 | 3.105 |
| SB2 OUT | POND | 25 | 3.526 | | 12.6500 | 9.45 | 678.96 | 3.487 |
| SB2-DIRECT | AREA | 2 | .249 | | 11.9000 | 3.84 | | |
| SB2-DIRECT | AREA | 10 | .362 | | 11.9000 | 5.59 | | |
| SB2-DIRECT | AREA | 25 | .430 | | 11.9000 | 6.64 | | |

NETWORK SUMMARY -- NODES
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File,ID = Charlotte-SCS

Storm Tag Name = 2

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 2 yr
Total Rainfall Depth= 3.3700 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

| Node ID | Type | HYG Vol ac-ft | Trun. | Qpeak hrs | Qpeak cfs | Max WSEL ft |
|---|---|---|---|---|---|---|
| DA-B1A | AREA | .178 | | 11.9500 | 3.21 | |
| DA-B1B | AREA | .119 | | 11.9500 | 2.15 | |
| DA-B2A | AREA | .169 | | 11.9500 | 3.05 | |
| DA-B2B | AREA | .143 | | 11.9500 | 2.59 | |
| DA-B2C | AREA | .151 | | 11.9500 | 2.73 | |
| DA-B3A | AREA | .177 | | 11.9500 | 3.19 | |
| DA-B3B | AREA | .183 | | 11.9500 | 3.31 | |
| DA-B4 | AREA | .126 | | 11.9500 | 2.27 | |
| DA-B5 | AREA | .179 | | 11.9500 | 3.23 | |
| DA-B6A | AREA | .198 | | 11.9500 | 3.57 | |
| DA-B6B | AREA | .145 | | 11.9500 | 2.61 | |
| DA-B6C | AREA | .198 | | 11.9500 | 3.57 | |
| DA-B8 | AREA | .155 | | 11.9500 | 2.79 | |
| DA-D1 | AREA | .321 | | 11.9500 | 5.80 | |
| DA-D2 | AREA | .218 | | 11.9500 | 3.93 | |
| DA-D3 | AREA | .155 | | 11.9500 | 2.79 | |
| DA-D4 | AREA | .715 | | 11.9500 | 12.90 | |
| DA-HR1 | AREA | .257 | | 11.9500 | 4.63 | |
| DA-HR2 | AREA | .228 | | 11.9500 | 4.11 | |
| DA-HR3 | AREA | .198 | | 11.9500 | 3.57 | |
| I1A | JCT | .178 | | 12.0000 | 2.93 | |
| I1B | JCT | .119 | | 12.0000 | 2.02 | |
| I2A | JCT | .347 | | 12.0000 | 5.74 | |
| I2B | JCT | .413 | | 12.0000 | 6.92 | |
| I3B | JCT | .774 | | 12.0000 | 12.68 | |
| I45 | JCT | .304 | | 12.0000 | 4.85 | |
| I67C | JCT | .502 | | 12.0000 | 8.04 | |
| I7A | JCT | .198 | | 12.0000 | 3.16 | |
| I7B | JCT | .144 | | 12.0000 | 2.46 | |
| IC1 | JCT | .321 | | 12.0000 | 4.75 | |
| IC2 | JCT | 2.342 | | 12.0000 | 34.94 | |
| J1 | JCT | .485 | | 12.0000 | 7.75 | |

NETWORK SUMMARY -- NODES
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

| | Node ID | | Type | HYG Vol ac-ft | Trun. | Qpeak hrs | Qpeak cfs | Max WSEL ft |
|---|---|---|---|---|---|---|---|---|
| | J2 | | JCT | .683 | | 12.0000 | 10.76 | |
| | J3 | | JCT | 1.568 | | 12.0000 | 24.51 | |
| | J4 | | JCT | 1.057 | | 11.9500 | 18.12 | |
| Outfall | OUT1 | | JCT | .672 | | 15.0500 | 1.26 | |
| Outfall | OUT2 | | JCT | .000 | | .0500 | .00 | |
| | SB1 | IN | POND | 2.031 | | 12.0000 | 28.09 | |
| | SB1 | OUT | POND | .672 | | 15.0500 | 1.26 | 673.52 |
| | SB1-DIRECT | | AREA | .163 | | 11.9000 | 2.51 | |
| | SB2 | IN | POND | 2.591 | | 12.0000 | 37.98 | |
| | SB2 | OUT | POND | .000 | | .0500 | .00 | 677.81 |
| | SB2-DIRECT | | AREA | .249 | | 11.9000 | 3.84 | |

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File,ID = Charlotte-SCS

Storm Tag Name = 2

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 2 yr
Total Rainfall Depth= 3.3700 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

| Link ID | Type | | HYG Vol ac-ft | Trun. | Peak Time hrs | Peak Q cfs | End Points | |
|---|---|---|---|---|---|---|---|---|
| ADD1 | ADD | UN | .218 | | 11.9500 | 3.93 | DA-D2 | |
| | | DL | .218 | | 11.9500 | 3.93 | | |
| | | DN | 1.568 | | 12.0000 | 24.51 | J3 | |
| ADD2 | ADD | UN | .228 | | 11.9500 | 4.11 | DA-HR2 | |
| | | DL | .228 | | 11.9500 | 4.11 | | |
| | | DN | .485 | | 12.0000 | 7.75 | J1 | |
| ADD3 | ADD | UN | .198 | | 11.9500 | 3.57 | DA-HR3 | |
| | | DL | .198 | | 11.9500 | 3.57 | | |
| | | DN | .683 | | 12.0000 | 10.76 | J2 | |
| ADD4 | ADD | UN | .715 | | 11.9500 | 12.90 | DA-D4 | |
| | | DL | .715 | | 11.9500 | 12.90 | | |
| | | DN | 1.057 | | 11.9500 | 18.12 | J4 | |
| ADD5 | ADD | UN | .163 | | 11.9000 | 2.51 | SB1-DIRECT | |
| | | DL | .163 | | 11.9000 | 2.51 | | |
| | | DN | 2.031 | | 12.0000 | 28.09 | SB1 | IN |
| ADD6 | ADD | UN | .249 | | 11.9000 | 3.84 | SB2-DIRECT | |
| | | DL | .249 | | 11.9000 | 3.84 | | |
| | | DN | 2.591 | | 12.0000 | 37.98 | SB2 | IN |
| B1A | REACH | UN | .178 | | 11.9500 | 3.21 | DA-B1A | |
| | | DL | .178 | | 12.0000 | 2.93 | | |
| | | DN | .178 | | 12.0000 | 2.93 | I1A | |

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

| Link ID | Type | | HYG Vol ac-ft | Trun. | Peak Time hrs | Peak Q cfs | End Points |
|---|---|---|---|---|---|---|---|
| B1B | REACH | UN | .119 | | 11.9500 | 2.15 | DA-B1B |
| | | DL | .119 | | 12.0000 | 2.02 | |
| | | DN | .119 | | 12.0000 | 2.02 | I1B |
| B2A | REACH | UN | .169 | | 11.9500 | 3.05 | DA-B2A |
| | | DL | .169 | | 12.0000 | 2.80 | |
| | | DN | .347 | | 12.0000 | 5.74 | I2A |
| B2B | REACH | UN | .143 | | 11.9500 | 2.59 | DA-B2B |
| | | DL | .143 | | 12.0000 | 2.42 | |
| | | DN | .413 | | 12.0000 | 6.92 | I2B |
| B2C | REACH | UN | .151 | | 11.9500 | 2.73 | DA-B2C |
| | | DL | .151 | | 12.0000 | 2.48 | |
| | | DN | .413 | | 12.0000 | 6.92 | I2B |
| B3A | REACH | UN | .177 | | 11.9500 | 3.19 | DA-B3A |
| | | DL | .177 | | 12.0000 | 2.88 | |
| | | DN | .774 | | 12.0000 | 12.68 | I3B |
| B3B | REACH | UN | .183 | | 11.9500 | 3.31 | DA-B3B |
| | | DL | .183 | | 12.0000 | 2.88 | |
| | | DN | .774 | | 12.0000 | 12.68 | I3B |
| B4 | REACH | UN | .126 | | 11.9500 | 2.27 | DA-B4 |
| | | DL | .126 | | 12.0000 | 2.12 | |
| | | DN | .304 | | 12.0000 | 4.85 | I45 |
| B5 | REACH | UN | .179 | | 11.9500 | 3.23 | DA-B5 |
| | | DL | .179 | | 12.0000 | 2.73 | |
| | | DN | .304 | | 12.0000 | 4.85 | I45 |
| B6A | REACH | UN | .198 | | 11.9500 | 3.57 | DA-B6A |
| | | DL | .198 | | 12.0000 | 3.16 | |
| | | DN | .198 | | 12.0000 | 3.16 | I7A |
| B6B | REACH | UN | .145 | | 11.9500 | 2.61 | DA-B6B |
| | | DL | .144 | | 12.0000 | 2.46 | |
| | | DN | .144 | | 12.0000 | 2.46 | I7B |

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

| Link ID | Type | | HYG Vol ac-ft | Trun. | Peak Time hrs | Peak Q cfs | End Points | |
|---|---|---|---|---|---|---|---|---|
| B6C | REACH | UN | .198 | | 11.9500 | 3.57 | DA-B6C | |
| | | DL | .198 | | 12.0000 | 3.19 | | |
| | | DN | .502 | | 12.0000 | 8.04 | I67C | |
| B8 | REACH | UN | .155 | | 11.9500 | 2.79 | DA-B8 | |
| | | DL | .154 | | 12.0000 | 2.57 | | |
| | | DN | 2.031 | | 12.0000 | 28.09 | SB1 | IN |
| C1 | ADD | UN | .321 | | 12.0000 | 4.75 | IC1 | |
| | | DL | .321 | | 12.0000 | 4.75 | | |
| | | DN | 1.568 | | 12.0000 | 24.51 | J3 | |
| C2 | ADD | UN | 2.342 | | 12.0000 | 34.94 | IC2 | |
| | | DL | 2.342 | | 12.0000 | 34.94 | | |
| | | DN | 2.591 | | 12.0000 | 37.98 | SB2 | IN |
| D1 | REACH | UN | .321 | | 11.9500 | 5.80 | DA-D1 | |
| | | DL | .321 | | 12.0000 | 4.75 | | |
| | | DN | .321 | | 12.0000 | 4.75 | IC1 | |
| D2 | REACH | UN | 1.568 | | 12.0000 | 24.51 | J3 | |
| | | DL | 1.568 | | 12.0500 | 23.26 | | |
| | | DN | 2.342 | | 12.0000 | 34.94 | IC2 | |
| D3 | REACH | UN | .155 | | 11.9500 | 2.79 | DA-D3 | |
| | | DL | .154 | | 12.0000 | 2.62 | | |
| | | DN | 2.031 | | 12.0000 | 28.09 | SB1 | IN |
| D4 | REACH | UN | 1.057 | | 11.9500 | 18.12 | J4 | |
| | | DL | 1.057 | | 12.0500 | 13.78 | | |
| | | DN | 2.031 | | 12.0000 | 28.09 | SB1 | IN |
| DC1A | ADD | UN | .178 | | 12.0000 | 2.93 | I1A | |
| | | DL | .178 | | 12.0000 | 2.93 | | |
| | | DN | .347 | | 12.0000 | 5.74 | I2A | |
| DC1B | ADD | UN | .119 | | 12.0000 | 2.02 | I1B | |
| | | DL | .119 | | 12.0000 | 2.02 | | |
| | | DN | .413 | | 12.0000 | 6.92 | I2B | |

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

| Link ID | Type | | HYG Vol ac-ft | Trun. | Peak Time hrs | Peak Q cfs | End Points | |
|---|---|---|---|---|---|---|---|---|
| DC2A | ADD | UN | .347 | | 12.0000 | 5.74 | I2A | |
| | | DL | .347 | | 12.0000 | 5.74 | | |
| | | DN | 1.568 | | 12.0000 | 24.51 | J3 | |
| DC2B | ADD | UN | .413 | | 12.0000 | 6.92 | I2B | |
| | | DL | .413 | | 12.0000 | 6.92 | | |
| | | DN | .774 | | 12.0000 | 12.68 | I3B | |
| DC3B | ADD | UN | .774 | | 12.0000 | 12.68 | I3B | |
| | | DL | .774 | | 12.0000 | 12.68 | | |
| | | DN | 2.342 | | 12.0000 | 34.94 | IC2 | |
| DC45 | ADD | UN | .304 | | 12.0000 | 4.85 | I45 | |
| | | DL | .304 | | 12.0000 | 4.85 | | |
| | | DN | .502 | | 12.0000 | 8.04 | I67C | |
| DC46 | ADD | UN | .502 | | 12.0000 | 8.04 | I67C | |
| | | DL | .502 | | 12.0000 | 8.04 | | |
| | | DN | 2.031 | | 12.0000 | 28.09 | SB1 | IN |
| DC7A | ADD | UN | .198 | | 12.0000 | 3.16 | I7A | |
| | | DL | .198 | | 12.0000 | 3.16 | | |
| | | DN | 1.057 | | 11.9500 | 18.12 | J4 | |
| DC7B | ADD | UN | .144 | | 12.0000 | 2.46 | I7B | |
| | | DL | .144 | | 12.0000 | 2.46 | | |
| | | DN | 1.057 | | 11.9500 | 18.12 | J4 | |
| HR1 | REACH | UN | .257 | | 11.9500 | 4.63 | DA-HR1 | |
| | | DL | .257 | | 12.0000 | 3.98 | | |
| | | DN | .485 | | 12.0000 | 7.75 | J1 | |
| HR2 | REACH | UN | .485 | | 12.0000 | 7.75 | J1 | |
| | | DL | .485 | | 12.0000 | 7.49 | | |
| | | DN | .683 | | 12.0000 | 10.76 | J2 | |
| HR3 | REACH | UN | .683 | | 12.0000 | 10.76 | J2 | |
| | | DL | .683 | | 12.0000 | 10.42 | | |
| | | DN | 1.568 | | 12.0000 | 24.51 | J3 | |

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

| Link ID | Type | | HYG Vol ac-ft | Trun. | Peak Time hrs | Peak Q cfs | End Points | |
|---|---|---|---|---|---|---|---|---|
| SB1OUT | PONDrt | UN | 2.031 | | 12.0000 | 28.09 | SB1 | IN |
| SB1OUT | | | .672 | | 15.0500 | 1.26 | SB1 | OUT |
| | | DL | .672 | | 15.0500 | 1.26 | | |
| | | DN | .672 | | 15.0500 | 1.26 | OUT1 | |
| SB2OUT | PONDrt | UN | 2.591 | | 12.0000 | 37.98 | SB2 | IN |
| SB2OUT | | | .000 | | .0500 | .00 | SB2 | OUT |
| | | DL | .000 | | .0500 | .00 | | |
| | | DN | .000 | | .0500 | .00 | OUT2 | |

NETWORK SUMMARY -- NODES
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File,ID =   Charlotte-SCS

Storm Tag Name      =     10

Data Type, File, ID = Synthetic Storm    TypeII  24hr
Storm Frequency     = 10 yr
Total Rainfall Depth= 4.9000 in
Duration Multiplier =  1
Resulting Duration  = 24.0000 hrs
Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs

| Node ID | Type | HYG Vol ac-ft | Trun. | Qpeak hrs | Qpeak cfs | Max WSEL ft |
|---|---|---|---|---|---|---|
| DA-B1A | AREA | .339 | | 11.9000 | 6.10 | |
| DA-B1B | AREA | .226 | | 11.9000 | 4.08 | |
| DA-B2A | AREA | .322 | | 11.9000 | 5.79 | |
| DA-B2B | AREA | .273 | | 11.9000 | 4.92 | |
| DA-B2C | AREA | .288 | | 11.9000 | 5.18 | |
| DA-B3A | AREA | .336 | | 11.9000 | 6.06 | |
| DA-B3B | AREA | .349 | | 11.9000 | 6.29 | |
| DA-B4 | AREA | .239 | | 11.9000 | 4.32 | |
| DA-B5 | AREA | .341 | | 11.9000 | 6.16 | |
| DA-B6A | AREA | .377 | | 11.9000 | 6.81 | |
| DA-B6B | AREA | .275 | | 11.9000 | 4.97 | |
| DA-B6C | AREA | .377 | | 11.9000 | 6.81 | |
| DA-B8 | AREA | .294 | | 11.9000 | 5.31 | |
| DA-D1 | AREA | .612 | | 11.9000 | 11.05 | |
| DA-D2 | AREA | .415 | | 11.9000 | 7.49 | |
| DA-D3 | AREA | .294 | | 11.9000 | 5.31 | |
| DA-D4 | AREA | 1.361 | | 11.9000 | 24.58 | |
| DA-HR1 | AREA | .489 | | 11.9000 | 8.83 | |
| DA-HR2 | AREA | .434 | | 11.9000 | 7.83 | |
| DA-HR3 | AREA | .377 | | 11.9000 | 6.80 | |
| I1A | JCT | .338 | | 12.0000 | 5.70 | |
| I1B | JCT | .226 | | 11.9500 | 3.88 | |
| I2A | JCT | .660 | | 12.0000 | 11.13 | |
| I2B | JCT | .787 | | 12.0000 | 13.34 | |
| I3B | JCT | 1.472 | | 12.0000 | 24.69 | |
| I45 | JCT | .580 | | 12.0000 | 9.55 | |
| I67C | JCT | .956 | | 12.0000 | 15.83 | |
| I7A | JCT | .377 | | 12.0000 | 6.24 | |
| I7B | JCT | .275 | | 11.9500 | 4.76 | |
| IC1 | JCT | .611 | | 12.0000 | 9.65 | |
| IC2 | JCT | 4.457 | | 12.0000 | 71.33 | |
| J1 | JCT | .922 | | 11.9500 | 15.28 | |

NETWORK SUMMARY -- NODES
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

| | Node ID | | Type | HYG Vol ac-ft | Trun. | Qpeak hrs | Qpeak cfs | Max WSEL ft |
|---|---|---|---|---|---|---|---|---|
| | J2 | | JCT | 1.299 | | 12.0000 | 21.03 | |
| | J3 | | JCT | 2.985 | | 12.0000 | 48.45 | |
| | J4 | | JCT | 2.012 | | 11.9500 | 35.21 | |
| Outfall | OUT1 | | JCT | 2.434 | | 12.3000 | 16.90 | |
| Outfall | OUT2 | | JCT | 2.083 | | 13.8500 | 3.71 | |
| | SB1 | IN | POND | 3.792 | | 12.0000 | 56.61 | |
| | SB1 | OUT | POND | 2.434 | | 12.3000 | 16.90 | 674.09 |
| | SB1-DIRECT | | AREA | .236 | | 11.9000 | 3.65 | |
| | SB2 | IN | POND | 4.819 | | 12.0000 | 75.75 | |
| | SB2 | OUT | POND | 2.083 | | 13.8500 | 3.71 | 678.48 |
| | SB2-DIRECT | | AREA | .362 | | 11.9000 | 5.59 | |

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File,ID = Charlotte-SCS

Storm Tag Name = 10

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 10 yr
Total Rainfall Depth= 4.9000 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

| Link ID | Type | | HYG Vol ac-ft | Trun. | Peak Time hrs | Peak Q cfs | End Points | |
|---|---|---|---|---|---|---|---|---|
| ADD1 | ADD | UN | .415 | | 11.9000 | 7.49 | DA-D2 | |
| | | DL | .415 | | 11.9000 | 7.49 | | |
| | | DN | 2.985 | | 12.0000 | 48.45 | J3 | |
| ADD2 | ADD | UN | .434 | | 11.9000 | 7.83 | DA-HR2 | |
| | | DL | .434 | | 11.9000 | 7.83 | | |
| | | DN | .922 | | 11.9500 | 15.28 | J1 | |
| ADD3 | ADD | UN | .377 | | 11.9000 | 6.80 | DA-HR3 | |
| | | DL | .377 | | 11.9000 | 6.80 | | |
| | | DN | 1.299 | | 12.0000 | 21.03 | J2 | |
| ADD4 | ADD | UN | 1.361 | | 11.9000 | 24.58 | DA-D4 | |
| | | DL | 1.361 | | 11.9000 | 24.58 | | |
| | | DN | 2.012 | | 11.9500 | 35.21 | J4 | |
| ADD5 | ADD | UN | .236 | | 11.9000 | 3.65 | SB1-DIRECT | |
| | | DL | .236 | | 11.9000 | 3.65 | | |
| | | DN | 3.792 | | 12.0000 | 56.61 | SB1 | IN |
| ADD6 | ADD | UN | .362 | | 11.9000 | 5.59 | SB2-DIRECT | |
| | | DL | .362 | | 11.9000 | 5.59 | | |
| | | DN | 4.819 | | 12.0000 | 75.75 | SB2 | IN |
| B1A | REACH | UN | .339 | | 11.9000 | 6.10 | DA-B1A | |
| | | DL | .338 | | 12.0000 | 5.70 | | |
| | | DN | .338 | | 12.0000 | 5.70 | I1A | |

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

| Link ID | Type | | HYG Vol ac-ft | Trun. | Peak Time hrs | Peak Q cfs | End Points |
|---|---|---|---|---|---|---|---|
| B1B | REACH | UN | .226 | | 11.9000 | 4.08 | DA-B1B |
| | | DL | .226 | | 11.9500 | 3.88 | |
| | | DN | .226 | | 11.9500 | 3.88 | I1B |
| B2A | REACH | UN | .322 | | 11.9000 | 5.79 | DA-B2A |
| | | DL | .322 | | 12.0000 | 5.43 | |
| | | DN | .660 | | 12.0000 | 11.13 | I2A |
| B2B | REACH | UN | .273 | | 11.9000 | 4.92 | DA-B2B |
| | | DL | .273 | | 12.0000 | 4.64 | |
| | | DN | .787 | | 12.0000 | 13.34 | I2B |
| B2C | REACH | UN | .288 | | 11.9000 | 5.18 | DA-B2C |
| | | DL | .288 | | 12.0000 | 4.84 | |
| | | DN | .787 | | 12.0000 | 13.34 | I2B |
| B3A | REACH | UN | .336 | | 11.9000 | 6.06 | DA-B3A |
| | | DL | .336 | | 12.0000 | 5.63 | |
| | | DN | 1.472 | | 12.0000 | 24.69 | I3B |
| B3B | REACH | UN | .349 | | 11.9000 | 6.29 | DA-B3B |
| | | DL | .349 | | 12.0000 | 5.72 | |
| | | DN | 1.472 | | 12.0000 | 24.69 | I3B |
| B4 | REACH | UN | .239 | | 11.9000 | 4.32 | DA-B4 |
| | | DL | .239 | | 12.0000 | 4.07 | |
| | | DN | .580 | | 12.0000 | 9.55 | I45 |
| B5 | REACH | UN | .341 | | 11.9000 | 6.16 | DA-B5 |
| | | DL | .341 | | 12.0000 | 5.48 | |
| | | DN | .580 | | 12.0000 | 9.55 | I45 |
| B6A | REACH | UN | .377 | | 11.9000 | 6.81 | DA-B6A |
| | | DL | .377 | | 12.0000 | 6.24 | |
| | | DN | .377 | | 12.0000 | 6.24 | I7A |
| B6B | REACH | UN | .275 | | 11.9000 | 4.97 | DA-B6B |
| | | DL | .275 | | 11.9500 | 4.76 | |
| | | DN | .275 | | 11.9500 | 4.76 | I7B |

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

| Link ID | Type | | HYG Vol ac-ft | Trun. | Peak Time hrs | Peak Q cfs | End Points | |
|---|---|---|---|---|---|---|---|---|
| B6C | REACH | UN | .377 | | 11.9000 | 6.81 | DA-B6C | |
| | | DL | .377 | | 12.0000 | 6.28 | | |
| | | DN | .956 | | 12.0000 | 15.83 | I67C | |
| B8 | REACH | UN | .294 | | 11.9000 | 5.31 | DA-B8 | |
| | | DL | .294 | | 12.0000 | 4.98 | | |
| | | DN | 3.792 | | 12.0000 | 56.61 | SB1 | IN |
| C1 | ADD | UN | .611 | | 12.0000 | 9.65 | IC1 | |
| | | DL | .611 | | 12.0000 | 9.65 | | |
| | | DN | 2.985 | | 12.0000 | 48.45 | J3 | |
| C2 | ADD | UN | 4.457 | | 12.0000 | 71.33 | IC2 | |
| | | DL | 4.457 | | 12.0000 | 71.33 | | |
| | | DN | 4.819 | | 12.0000 | 75.75 | SB2 | IN |
| D1 | REACH | UN | .612 | | 11.9000 | 11.05 | DA-D1 | |
| | | DL | .611 | | 12.0000 | 9.65 | | |
| | | DN | .611 | | 12.0000 | 9.65 | IC1 | |
| D2 | REACH | UN | 2.985 | | 12.0000 | 48.45 | J3 | |
| | | DL | 2.985 | | 12.0000 | 46.64 | | |
| | | DN | 4.457 | | 12.0000 | 71.33 | IC2 | |
| D3 | REACH | UN | .294 | | 11.9000 | 5.31 | DA-D3 | |
| | | DL | .294 | | 11.9500 | 5.03 | | |
| | | DN | 3.792 | | 12.0000 | 56.61 | SB1 | IN |
| D4 | REACH | UN | 2.012 | | 11.9500 | 35.21 | J4 | |
| | | DL | 2.012 | | 12.0500 | 28.23 | | |
| | | DN | 3.792 | | 12.0000 | 56.61 | SB1 | IN |
| DC1A | ADD | UN | .338 | | 12.0000 | 5.70 | I1A | |
| | | DL | .338 | | 12.0000 | 5.70 | | |
| | | DN | .660 | | 12.0000 | 11.13 | I2A | |
| DC1B | ADD | UN | .226 | | 11.9500 | 3.88 | I1B | |
| | | DL | .226 | | 11.9500 | 3.88 | | |
| | | DN | .787 | | 12.0000 | 13.34 | I2B | |

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

| Link ID | Type | | HYG Vol ac-ft | Trun. | Peak Time hrs | Peak Q cfs | End Points | |
|---|---|---|---|---|---|---|---|---|
| DC2A | ADD | UN | .660 | | 12.0000 | 11.13 | I2A | |
| | | DL | .660 | | 12.0000 | 11.13 | | |
| | | DN | 2.985 | | 12.0000 | 48.45 | J3 | |
| DC2B | ADD | UN | .787 | | 12.0000 | 13.34 | I2B | |
| | | DL | .787 | | 12.0000 | 13.34 | | |
| | | DN | 1.472 | | 12.0000 | 24.69 | I3B | |
| DC3B | ADD | UN | 1.472 | | 12.0000 | 24.69 | I3B | |
| | | DL | 1.472 | | 12.0000 | 24.69 | | |
| | | DN | 4.457 | | 12.0000 | 71.33 | IC2 | |
| DC45 | ADD | UN | .580 | | 12.0000 | 9.55 | I45 | |
| | | DL | .580 | | 12.0000 | 9.55 | | |
| | | DN | .956 | | 12.0000 | 15.83 | I67C | |
| DC46 | ADD | UN | .956 | | 12.0000 | 15.83 | I67C | |
| | | DL | .956 | | 12.0000 | 15.83 | | |
| | | DN | 3.792 | | 12.0000 | 56.61 | SB1 | IN |
| DC7A | ADD | UN | .377 | | 12.0000 | 6.24 | I7A | |
| | | DL | .377 | | 12.0000 | 6.24 | | |
| | | DN | 2.012 | | 11.9500 | 35.21 | J4 | |
| DC7B | ADD | UN | .275 | | 11.9500 | 4.76 | I7B | |
| | | DL | .275 | | 11.9500 | 4.76 | | |
| | | DN | 2.012 | | 11.9500 | 35.21 | J4 | |
| HR1 | REACH | UN | .489 | | 11.9000 | 8.83 | DA-HR1 | |
| | | DL | .489 | | 12.0000 | 7.96 | | |
| | | DN | .922 | | 11.9500 | 15.28 | J1 | |
| HR2 | REACH | UN | .922 | | 11.9500 | 15.28 | J1 | |
| | | DL | .922 | | 12.0000 | 14.99 | | |
| | | DN | 1.299 | | 12.0000 | 21.03 | J2 | |
| HR3 | REACH | UN | 1.299 | | 12.0000 | 21.03 | J2 | |
| | | DL | 1.299 | | 12.0000 | 21.00 | | |
| | | DN | 2.985 | | 12.0000 | 48.45 | J3 | |

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

| Link ID | Type | | HYG Vol ac-ft | Trun. | Peak Time hrs | Peak Q cfs | End Points | |
|---|---|---|---|---|---|---|---|---|
| SB1OUT | PONDrt | UN | 3.792 | | 12.0000 | 56.61 | SB1 | IN |
| SB1OUT | | | 2.434 | | 12.3000 | 16.90 | SB1 | OUT |
| | | DL | 2.434 | | 12.3000 | 16.90 | | |
| | | DN | 2.434 | | 12.3000 | 16.90 | OUT1 | |
| SB2OUT | PONDrt | UN | 4.819 | | 12.0000 | 75.75 | SB2 | IN |
| SB2OUT | | | 2.083 | | 13.8500 | 3.71 | SB2 | OUT |
| | | DL | 2.083 | | 13.8500 | 3.71 | | |
| | | DN | 2.083 | | 13.8500 | 3.71 | OUT2 | |

NETWORK SUMMARY -- NODES
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File,ID = Charlotte-SCS

Storm Tag Name = 25

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 25 yr
Total Rainfall Depth= 5.8200 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

| Node ID | Type | HYG Vol ac-ft | Trun. | Qpeak hrs | Qpeak cfs | Max WSEL ft |
|---|---|---|---|---|---|---|
| DA-B1A | AREA | .443 | | 11.9000 | 8.01 | |
| DA-B1B | AREA | .296 | | 11.9000 | 5.36 | |
| DA-B2A | AREA | .421 | | 11.9000 | 7.61 | |
| DA-B2B | AREA | .357 | | 11.9000 | 6.46 | |
| DA-B2C | AREA | .376 | | 11.9000 | 6.81 | |
| DA-B3A | AREA | .440 | | 11.9000 | 7.96 | |
| DA-B3B | AREA | .457 | | 11.9000 | 8.26 | |
| DA-B4 | AREA | .313 | | 11.9000 | 5.68 | |
| DA-B5 | AREA | .446 | | 11.9000 | 8.09 | |
| DA-B6A | AREA | .493 | | 11.9000 | 8.94 | |
| DA-B6B | AREA | .360 | | 11.9000 | 6.53 | |
| DA-B6C | AREA | .493 | | 11.9000 | 8.94 | |
| DA-B8 | AREA | .385 | | 11.9000 | 6.98 | |
| DA-D1 | AREA | .800 | | 11.9000 | 14.52 | |
| DA-D2 | AREA | .543 | | 11.9000 | 9.85 | |
| DA-D3 | AREA | .385 | | 11.9000 | 6.98 | |
| DA-D4 | AREA | 1.780 | | 11.9000 | 32.30 | |
| DA-HR1 | AREA | .639 | | 11.9000 | 11.60 | |
| DA-HR2 | AREA | .568 | | 11.9000 | 10.28 | |
| DA-HR3 | AREA | .493 | | 11.9000 | 8.93 | |
| I1A | JCT | .443 | | 12.0000 | 7.44 | |
| I1B | JCT | .296 | | 11.9500 | 5.14 | |
| I2A | JCT | .864 | | 12.0000 | 14.52 | |
| I2B | JCT | 1.030 | | 11.9500 | 17.56 | |
| I3B | JCT | 1.926 | | 12.0000 | 32.24 | |
| I45 | JCT | .758 | | 12.0000 | 12.52 | |
| I67C | JCT | 1.251 | | 12.0000 | 20.74 | |
| I7A | JCT | .493 | | 12.0000 | 8.18 | |
| I7B | JCT | .360 | | 11.9500 | 6.30 | |
| IC1 | JCT | .800 | | 12.0000 | 12.77 | |
| IC2 | JCT | 5.832 | | 12.0000 | 94.52 | |
| J1 | JCT | 1.207 | | 11.9500 | 20.17 | |

NETWORK SUMMARY -- NODES
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

| | Node ID | | Type | HYG Vol ac-ft | Trun. | Qpeak hrs | Qpeak cfs | Max WSEL ft |
|---|---|---|---|---|---|---|---|---|
| | J2 | | JCT | 1.700 | | 11.9500 | 27.66 | |
| | J3 | | JCT | 3.906 | | 12.0000 | 63.58 | |
| | J4 | | JCT | 2.633 | | 11.9500 | 46.07 | |
| Outfall | OUT1 | | JCT | 3.575 | | 12.1500 | 36.70 | |
| Outfall | OUT2 | | JCT | 3.526 | | 12.6500 | 9.45 | |
| | SB1 | IN | POND | 4.933 | | 12.0000 | 74.90 | |
| | SB1 | OUT | POND | 3.575 | | 12.1500 | 36.70 | 674.60 |
| | SB1-DIRECT | | AREA | .281 | | 11.9000 | 4.33 | |
| | SB2 | IN | POND | 6.262 | | 12.0000 | 99.77 | |
| | SB2 | OUT | POND | 3.526 | | 12.6500 | 9.45 | 678.96 |
| | SB2-DIRECT | | AREA | .430 | | 11.9000 | 6.64 | |

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File,ID = Charlotte-SCS

Storm Tag Name = 25

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 25 yr
Total Rainfall Depth= 5.8200 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

| Link ID | Type | | HYG Vol ac-ft | Trun. | Peak Time hrs | Peak Q cfs | End Points | |
|---|---|---|---|---|---|---|---|---|
| ADD1 | ADD | UN | .543 | | 11.9000 | 9.85 | DA-D2 | |
| | | DL | .543 | | 11.9000 | 9.85 | | |
| | | DN | 3.906 | | 12.0000 | 63.58 | J3 | |
| ADD2 | ADD | UN | .568 | | 11.9000 | 10.28 | DA-HR2 | |
| | | DL | .568 | | 11.9000 | 10.28 | | |
| | | DN | 1.207 | | 11.9500 | 20.17 | J1 | |
| ADD3 | ADD | UN | .493 | | 11.9000 | 8.93 | DA-HR3 | |
| | | DL | .493 | | 11.9000 | 8.93 | | |
| | | DN | 1.700 | | 11.9500 | 27.66 | J2 | |
| ADD4 | ADD | UN | 1.780 | | 11.9000 | 32.30 | DA-D4 | |
| | | DL | 1.780 | | 11.9000 | 32.30 | | |
| | | DN | 2.633 | | 11.9500 | 46.07 | J4 | |
| ADD5 | ADD | UN | .281 | | 11.9000 | 4.33 | SB1-DIRECT | |
| | | DL | .281 | | 11.9000 | 4.33 | | |
| | | DN | 4.933 | | 12.0000 | 74.90 | SB1 | IN |
| ADD6 | ADD | UN | .430 | | 11.9000 | 6.64 | SB2-DIRECT | |
| | | DL | .430 | | 11.9000 | 6.64 | | |
| | | DN | 6.262 | | 12.0000 | 99.77 | SB2 | IN |
| B1A | REACH | UN | .443 | | 11.9000 | 8.01 | DA-B1A | |
| | | DL | .443 | | 12.0000 | 7.44 | | |
| | | DN | .443 | | 12.0000 | 7.44 | I1A | |

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

| Link ID | Type | | HYG Vol ac-ft | Trun. | Peak Time hrs | Peak Q cfs | End Points |
|---|---|---|---|---|---|---|---|
| B1B | REACH | UN | .296 | | 11.9000 | 5.36 | DA-B1B |
| | | DL | .296 | | 11.9500 | 5.14 | |
| | | DN | .296 | | 11.9500 | 5.14 | I1B |
| B2A | REACH | UN | .421 | | 11.9000 | 7.61 | DA-B2A |
| | | DL | .421 | | 11.9500 | 7.08 | |
| | | DN | .864 | | 12.0000 | 14.52 | I2A |
| B2B | REACH | UN | .357 | | 11.9000 | 6.46 | DA-B2B |
| | | DL | .357 | | 11.9500 | 6.14 | |
| | | DN | 1.030 | | 11.9500 | 17.56 | I2B |
| B2C | REACH | UN | .376 | | 11.9000 | 6.81 | DA-B2C |
| | | DL | .376 | | 12.0000 | 6.32 | |
| | | DN | 1.030 | | 11.9500 | 17.56 | I2B |
| B3A | REACH | UN | .440 | | 11.9000 | 7.96 | DA-B3A |
| | | DL | .440 | | 12.0000 | 7.37 | |
| | | DN | 1.926 | | 12.0000 | 32.24 | I3B |
| B3B | REACH | UN | .457 | | 11.9000 | 8.26 | DA-B3B |
| | | DL | .457 | | 12.0000 | 7.52 | |
| | | DN | 1.926 | | 12.0000 | 32.24 | I3B |
| B4 | REACH | UN | .313 | | 11.9000 | 5.68 | DA-B4 |
| | | DL | .313 | | 11.9500 | 5.38 | |
| | | DN | .758 | | 12.0000 | 12.52 | I45 |
| B5 | REACH | UN | .446 | | 11.9000 | 8.09 | DA-B5 |
| | | DL | .446 | | 12.0000 | 7.23 | |
| | | DN | .758 | | 12.0000 | 12.52 | I45 |
| B6A | REACH | UN | .493 | | 11.9000 | 8.94 | DA-B6A |
| | | DL | .493 | | 12.0000 | 8.18 | |
| | | DN | .493 | | 12.0000 | 8.18 | I7A |
| B6B | REACH | UN | .360 | | 11.9000 | 6.53 | DA-B6B |
| | | DL | .360 | | 11.9500 | 6.30 | |
| | | DN | .360 | | 11.9500 | 6.30 | I7B |

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

| Link ID | Type | | HYG Vol ac-ft | Trun. | Peak Time hrs | Peak Q cfs | End Points | |
|---|---|---|---|---|---|---|---|---|
| B6C | REACH | UN | .493 | | 11.9000 | 8.94 | DA-B6C | |
| | | DL | .493 | | 12.0000 | 8.22 | | |
| | | DN | 1.251 | | 12.0000 | 20.74 | I67C | |
| B8 | REACH | UN | .385 | | 11.9000 | 6.98 | DA-B8 | |
| | | DL | .385 | | 11.9500 | 6.51 | | |
| | | DN | 4.933 | | 12.0000 | 74.90 | SB1 | IN |
| C1 | ADD | UN | .800 | | 12.0000 | 12.77 | IC1 | |
| | | DL | .800 | | 12.0000 | 12.77 | | |
| | | DN | 3.906 | | 12.0000 | 63.58 | J3 | |
| C2 | ADD | UN | 5.832 | | 12.0000 | 94.52 | IC2 | |
| | | DL | 5.832 | | 12.0000 | 94.52 | | |
| | | DN | 6.262 | | 12.0000 | 99.77 | SB2 | IN |
| D1 | REACH | UN | .800 | | 11.9000 | 14.52 | DA-D1 | |
| | | DL | .800 | | 12.0000 | 12.77 | | |
| | | DN | .800 | | 12.0000 | 12.77 | IC1 | |
| D2 | REACH | UN | 3.906 | | 12.0000 | 63.58 | J3 | |
| | | DL | 3.905 | | 12.0000 | 62.27 | | |
| | | DN | 5.832 | | 12.0000 | 94.52 | IC2 | |
| D3 | REACH | UN | .385 | | 11.9000 | 6.98 | DA-D3 | |
| | | DL | .385 | | 11.9500 | 6.66 | | |
| | | DN | 4.933 | | 12.0000 | 74.90 | SB1 | IN |
| D4 | REACH | UN | 2.633 | | 11.9500 | 46.07 | J4 | |
| | | DL | 2.632 | | 12.0000 | 37.74 | | |
| | | DN | 4.933 | | 12.0000 | 74.90 | SB1 | IN |
| DC1A | ADD | UN | .443 | | 12.0000 | 7.44 | I1A | |
| | | DL | .443 | | 12.0000 | 7.44 | | |
| | | DN | .864 | | 12.0000 | 14.52 | I2A | |
| DC1B | ADD | UN | .296 | | 11.9500 | 5.14 | I1B | |
| | | DL | .296 | | 11.9500 | 5.14 | | |
| | | DN | 1.030 | | 11.9500 | 17.56 | I2B | |

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

| Link ID | Type | | HYG Vol ac-ft | Trun. | Peak Time hrs | Peak Q cfs | End Points | |
|---|---|---|---|---|---|---|---|---|
| DC2A | ADD | UN | .864 | | 12.0000 | 14.52 | I2A | |
| | | DL | .864 | | 12.0000 | 14.52 | | |
| | | DN | 3.906 | | 12.0000 | 63.58 | J3 | |
| DC2B | ADD | UN | 1.030 | | 11.9500 | 17.56 | I2B | |
| | | DL | 1.030 | | 11.9500 | 17.56 | | |
| | | DN | 1.926 | | 12.0000 | 32.24 | I3B | |
| DC3B | ADD | UN | 1.926 | | 12.0000 | 32.24 | I3B | |
| | | DL | 1.926 | | 12.0000 | 32.24 | | |
| | | DN | 5.832 | | 12.0000 | 94.52 | IC2 | |
| DC45 | ADD | UN | .758 | | 12.0000 | 12.52 | I45 | |
| | | DL | .758 | | 12.0000 | 12.52 | | |
| | | DN | 1.251 | | 12.0000 | 20.74 | I67C | |
| DC46 | ADD | UN | 1.251 | | 12.0000 | 20.74 | I67C | |
| | | DL | 1.251 | | 12.0000 | 20.74 | | |
| | | DN | 4.933 | | 12.0000 | 74.90 | SB1 | IN |
| DC7A | ADD | UN | .493 | | 12.0000 | 8.18 | I7A | |
| | | DL | .493 | | 12.0000 | 8.18 | | |
| | | DN | 2.633 | | 11.9500 | 46.07 | J4 | |
| DC7B | ADD | UN | .360 | | 11.9500 | 6.30 | I7B | |
| | | DL | .360 | | 11.9500 | 6.30 | | |
| | | DN | 2.633 | | 11.9500 | 46.07 | J4 | |
| HR1 | REACH | UN | .639 | | 11.9000 | 11.60 | DA-HR1 | |
| | | DL | .639 | | 12.0000 | 10.47 | | |
| | | DN | 1.207 | | 11.9500 | 20.17 | J1 | |
| HR2 | REACH | UN | 1.207 | | 11.9500 | 20.17 | J1 | |
| | | DL | 1.207 | | 12.0000 | 19.74 | | |
| | | DN | 1.700 | | 11.9500 | 27.66 | J2 | |
| HR3 | REACH | UN | 1.700 | | 11.9500 | 27.66 | J2 | |
| | | DL | 1.699 | | 12.0000 | 27.72 | | |
| | | DN | 3.906 | | 12.0000 | 63.58 | J3 | |

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

| Link ID | Type | | HYG Vol ac-ft | Trun. | Peak Time hrs | Peak Q cfs | End Points | |
|---|---|---|---|---|---|---|---|---|
| SB1OUT | PONDrt | UN | 4.933 | | 12.0000 | 74.90 | SB1 | IN |
| SB1OUT | | | 3.575 | | 12.1500 | 36.70 | SB1 | OUT |
| | | DL | 3.575 | | 12.1500 | 36.70 | | |
| | | DN | 3.575 | | 12.1500 | 36.70 | OUT1 | |
| SB2OUT | PONDrt | UN | 6.262 | | 12.0000 | 99.77 | SB2 | IN |
| SB2OUT | | | 3.526 | | 12.6500 | 9.45 | SB2 | OUT |
| | | DL | 3.526 | | 12.6500 | 9.45 | | |
| | | DN | 3.526 | | 12.6500 | 9.45 | OUT2 | |

NETWORK RUNOFF NODE SEQUENCE

| Runoff Data | Apply to Node | Receiving Link |
|---|---|---|
| SCS UH DA-D2 | Subarea DA-D2 | Add Hyd DA-D2 |
| SCS UH DA-HR3 | Subarea DA-HR3 | Add Hyd DA-HR3 |
| SCS UH DA-HR2 | Subarea DA-HR2 | Add Hyd DA-HR2 |
| SCS UH DA-D4 | Subarea DA-D4 | Add Hyd DA-D4 |
| SCS UH SB1-DIRECT | Subarea SB1-DIRECT | Add Hyd SB1-DIRECT |
| SCS UH SB2-DIRECT | Subarea SB2-DIRECT | Add Hyd SB2-DIRECT |
| SCS UH DA-HR1 | Subarea DA-HR1 | Reach DA-HR1 |
| SCS UH DA-D1 | Subarea DA-D1 | Reach DA-D1 |
| SCS UH DA-B4 | Subarea DA-B4 | Reach DA-B4 |
| SCS UH DA-B8 | Subarea DA-B8 | Reach DA-B8 |
| SCS UH DA-B6C | Subarea DA-B6C | Reach DA-B6C |
| SCS UH DA-B5 | Subarea DA-B5 | Reach DA-B5 |
| SCS UH DA-D3 | Subarea DA-D3 | Reach DA-D3 |
| SCS UH DA-B1B | Subarea DA-B1B | Reach DA-B1B |
| SCS UH DA-B2B | Subarea DA-B2B | Reach DA-B2B |
| SCS UH DA-B3A | Subarea DA-B3A | Reach DA-B3A |
| SCS UH DA-B1A | Subarea DA-B1A | Reach DA-B1A |
| SCS UH DA-B2A | Subarea DA-B2A | Reach DA-B2A |
| SCS UH DA-B6A | Subarea DA-B6A | Reach DA-B6A |
| SCS UH DA-B6B | Subarea DA-B6B | Reach DA-B6B |
| SCS UH DA-B2C | Subarea DA-B2C | Reach DA-B2C |
| SCS UH DA-B3B | Subarea DA-B3B | Reach DA-B3B |

NETWORK ROUTING SEQUENCE

| Link Operation | UPstream Node | DNstream Node |
|---|---|---|
| Reach HR1 | Subarea DA-HR1 | Jct J1 |
| Add Hyd ADD2 | Subarea DA-HR2 | Jct J1 |
| Reach B1A | Subarea DA-B1A | Jct I1A |
| Reach B1B | Subarea DA-B1B | Jct I1B |
| Reach HR2 | Jct J1 | Jct J2 |
| Add Hyd ADD3 | Subarea DA-HR3 | Jct J2 |
| Reach D1 | Subarea DA-D1 | Jct IC1 |
| Reach B2A | Subarea DA-B2A | Jct I2A |
| Add Hyd DC1A | Jct I1A | Jct I2A |
| Reach B2C | Subarea DA-B2C | Jct I2B |
| Reach B2B | Subarea DA-B2B | Jct I2B |
| Add Hyd DC1B | Jct I1B | Jct I2B |
| Add Hyd DC2A | Jct I2A | Jct J3 |
| Add Hyd ADD1 | Subarea DA-D2 | Jct J3 |
| Add Hyd C1 | Jct IC1 | Jct J3 |
| Reach HR3 | Jct J2 | Jct J3 |
| Reach B3A | Subarea DA-B3A | Jct I3B |
| Reach B3B | Subarea DA-B3B | Jct I3B |
| Add Hyd DC2B | Jct I2B | Jct I3B |
| Reach B4 | Subarea DA-B4 | Jct I45 |
| Reach B5 | Subarea DA-B5 | Jct I45 |
| Reach B6B | Subarea DA-B6B | Jct I7B |
| Reach B6A | Subarea DA-B6A | Jct I7A |
| Add Hyd DC3B | Jct I3B | Jct IC2 |
| Reach D2 | Jct J3 | Jct IC2 |
| Add Hyd DC45 | Jct I45 | Jct I67C |
| Reach B6C | Subarea DA-B6C | Jct I67C |
| Add Hyd DC7A | Jct I7A | Jct J4 |
| Add Hyd DC7B | Jct I7B | Jct J4 |
| Add Hyd ADD4 | Subarea DA-D4 | Jct J4 |

NETWORK ROUTING SEQUENCE

| Link Operation | UPstream Node | | | DNstream Node | | |
|---|---|---|---|---|---|---|
| Add Hyd C2 | Jct | IC2 | | Pond | SB2 | IN |
| Add Hyd ADD6 | Subarea | SB2-DIRECT | | Pond | SB2 | IN |
| POND ROUTE TOTAL OUTFLOW... | | | | | | |
| Total Pond Outflow | Pond | SB2 | IN | Outflow | SB2 | OUT |
| SET POND ROUTING LINK TO TOTAL POND OUTFLOW... | | | | | | |
| Outlet SB2OUT | Outflow | SB2 | OUT | Jct | OUT2 | |
| Reach D4 | Jct | J4 | | Pond | SB1 | IN |
| Reach B8 | Subarea | DA-B8 | | Pond | SB1 | IN |
| Add Hyd ADD5 | Subarea | SB1-DIRECT | | Pond | SB1 | IN |
| Add Hyd DC46 | Jct | I67C | | Pond | SB1 | IN |
| Reach D3 | Subarea | DA-D3 | | Pond | SB1 | IN |
| POND ROUTE TOTAL OUTFLOW... | | | | | | |
| Total Pond Outflow | Pond | SB1 | IN | Outflow | SB1 | OUT |
| SET POND ROUTING LINK TO TOTAL POND OUTFLOW... | | | | | | |
| Outlet SB1OUT | Outflow | SB1 | OUT | Jct | OUT1 | |

Title... Project Date: 7/29/2008
Project Engineer: cmcdonald
Project Title: Lake Norman C&D Landfill - Stormwater Calcs
Project Comments:

DESIGN STORMS SUMMARY

```
Design Storm File,ID =              Charlotte-SCS


Storm Tag Name      = 2
----------------------------------------------------------------------
Data Type, File, ID = Synthetic Storm    TypeII  24hr
Storm Frequency     = 2 yr
Total Rainfall Depth= 3.3700 in
Duration Multiplier =  1
Resulting Duration  = 24.0000 hrs
Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs


Storm Tag Name      =     10
----------------------------------------------------------------------
Data Type, File, ID = Synthetic Storm    TypeII  24hr
Storm Frequency     = 10 yr
Total Rainfall Depth= 4.9000 in
Duration Multiplier =  1
Resulting Duration  = 24.0000 hrs
Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs


Storm Tag Name      =     25
----------------------------------------------------------------------
Data Type, File, ID = Synthetic Storm    TypeII  24hr
Storm Frequency     = 25 yr
Total Rainfall Depth= 5.8200 in
Duration Multiplier =  1
Resulting Duration  = 24.0000 hrs
Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs
```

DESIGN STORMS SUMMARY

Design Storm File,ID = Charlotte-SCS

Storm Tag Name = 2

---

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 2 yr
Total Rainfall Depth= 3.3700 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Storm Tag Name = 10

---

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 10 yr
Total Rainfall Depth= 4.9000 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Storm Tag Name = 25

---

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 25 yr
Total Rainfall Depth= 5.8200 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

CUMULATIVE RAINFALL FRACTIONS
Output Time increment = .1000 hrs
Time on left represents time for first value in each row.

| Time hrs | | | | | |
|---|---|---|---|---|---|
| .0000 | .000 | .001 | .002 | .003 | .004 |
| .5000 | .005 | .006 | .007 | .008 | .009 |
| 1.0000 | .011 | .012 | .013 | .014 | .015 |
| 1.5000 | .016 | .017 | .018 | .020 | .021 |
| 2.0000 | .022 | .023 | .024 | .026 | .027 |
| 2.5000 | .028 | .029 | .031 | .032 | .033 |
| 3.0000 | .035 | .036 | .037 | .038 | .040 |
| 3.5000 | .041 | .042 | .044 | .045 | .047 |
| 4.0000 | .048 | .049 | .051 | .052 | .054 |
| 4.5000 | .055 | .057 | .058 | .060 | .061 |
| 5.0000 | .063 | .065 | .066 | .068 | .070 |
| 5.5000 | .071 | .073 | .075 | .076 | .078 |
| 6.0000 | .080 | .082 | .084 | .085 | .087 |
| 6.5000 | .089 | .091 | .093 | .095 | .097 |
| 7.0000 | .099 | .101 | .103 | .105 | .107 |
| 7.5000 | .109 | .111 | .113 | .116 | .118 |
| 8.0000 | .120 | .122 | .125 | .127 | .130 |
| 8.5000 | .132 | .135 | .138 | .141 | .144 |
| 9.0000 | .147 | .150 | .153 | .157 | .160 |
| 9.5000 | .163 | .166 | .170 | .173 | .177 |
| 10.0000 | .181 | .185 | .189 | .194 | .199 |
| 10.5000 | .204 | .209 | .215 | .221 | .228 |
| 11.0000 | .235 | .243 | .251 | .261 | .271 |
| 11.5000 | .283 | .307 | .354 | .431 | .568 |
| 12.0000 | .663 | .682 | .699 | .713 | .725 |
| 12.5000 | .735 | .743 | .751 | .759 | .766 |
| 13.0000 | .772 | .778 | .784 | .789 | .794 |
| 13.5000 | .799 | .804 | .808 | .812 | .816 |
| 14.0000 | .820 | .824 | .827 | .831 | .834 |
| 14.5000 | .838 | .841 | .844 | .847 | .850 |
| 15.0000 | .854 | .856 | .859 | .862 | .865 |
| 15.5000 | .868 | .870 | .873 | .875 | .878 |
| 16.0000 | .880 | .882 | .885 | .887 | .889 |
| 16.5000 | .891 | .893 | .895 | .898 | .900 |
| 17.0000 | .902 | .904 | .906 | .908 | .910 |
| 17.5000 | .912 | .914 | .915 | .917 | .919 |
| 18.0000 | .921 | .923 | .925 | .926 | .928 |
| 18.5000 | .930 | .931 | .933 | .935 | .936 |
| 19.0000 | .938 | .939 | .941 | .942 | .944 |
| 19.5000 | .945 | .947 | .948 | .949 | .951 |
| 20.0000 | .952 | .953 | .955 | .956 | .957 |
| 20.5000 | .958 | .960 | .961 | .962 | .964 |
| 21.0000 | .965 | .966 | .967 | .968 | .970 |
| 21.5000 | .971 | .972 | .973 | .975 | .976 |

CUMULATIVE RAINFALL FRACTIONS
Output Time increment = .1000 hrs
Time on left represents time for first value in each row.

| Time hrs | | | | | |
|---|---|---|---|---|---|
| 22.0000 | .977 | .978 | .979 | .981 | .982 |
| 22.5000 | .983 | .984 | .985 | .986 | .988 |
| 23.0000 | .989 | .990 | .991 | .992 | .993 |
| 23.5000 | .994 | .996 | .997 | .998 | .999 |
| 24.0000 | 1.000 | | | | |

CUMULATIVE RAINFALL FRACTIONS
Output Time increment = .1000 hrs
Time on left represents time for first value in each row.

| Time hrs | | | | | |
|---|---|---|---|---|---|
| .0000 | .000 | .001 | .002 | .003 | .004 |
| .5000 | .005 | .006 | .007 | .008 | .009 |
| 1.0000 | .011 | .012 | .013 | .014 | .015 |
| 1.5000 | .016 | .017 | .018 | .020 | .021 |
| 2.0000 | .022 | .023 | .024 | .026 | .027 |
| 2.5000 | .028 | .029 | .031 | .032 | .033 |
| 3.0000 | .035 | .036 | .037 | .038 | .040 |
| 3.5000 | .041 | .042 | .044 | .045 | .047 |
| 4.0000 | .048 | .049 | .051 | .052 | .054 |
| 4.5000 | .055 | .057 | .058 | .060 | .061 |
| 5.0000 | .063 | .065 | .066 | .068 | .070 |
| 5.5000 | .071 | .073 | .075 | .076 | .078 |
| 6.0000 | .080 | .082 | .084 | .085 | .087 |
| 6.5000 | .089 | .091 | .093 | .095 | .097 |
| 7.0000 | .099 | .101 | .103 | .105 | .107 |
| 7.5000 | .109 | .111 | .113 | .116 | .118 |
| 8.0000 | .120 | .122 | .125 | .127 | .130 |
| 8.5000 | .132 | .135 | .138 | .141 | .144 |
| 9.0000 | .147 | .150 | .153 | .157 | .160 |
| 9.5000 | .163 | .166 | .170 | .173 | .177 |
| 10.0000 | .181 | .185 | .189 | .194 | .199 |
| 10.5000 | .204 | .209 | .215 | .221 | .228 |
| 11.0000 | .235 | .243 | .251 | .261 | .271 |
| 11.5000 | .283 | .307 | .354 | .431 | .568 |
| 12.0000 | .663 | .682 | .699 | .713 | .725 |
| 12.5000 | .735 | .743 | .751 | .759 | .766 |
| 13.0000 | .772 | .778 | .784 | .789 | .794 |
| 13.5000 | .799 | .804 | .808 | .812 | .816 |
| 14.0000 | .820 | .824 | .827 | .831 | .834 |
| 14.5000 | .838 | .841 | .844 | .847 | .850 |
| 15.0000 | .854 | .856 | .859 | .862 | .865 |
| 15.5000 | .868 | .870 | .873 | .875 | .878 |
| 16.0000 | .880 | .882 | .885 | .887 | .889 |
| 16.5000 | .891 | .893 | .895 | .898 | .900 |
| 17.0000 | .902 | .904 | .906 | .908 | .910 |
| 17.5000 | .912 | .914 | .915 | .917 | .919 |
| 18.0000 | .921 | .923 | .925 | .926 | .928 |
| 18.5000 | .930 | .931 | .933 | .935 | .936 |
| 19.0000 | .938 | .939 | .941 | .942 | .944 |
| 19.5000 | .945 | .947 | .948 | .949 | .951 |
| 20.0000 | .952 | .953 | .955 | .956 | .957 |
| 20.5000 | .958 | .960 | .961 | .962 | .964 |
| 21.0000 | .965 | .966 | .967 | .968 | .970 |
| 21.5000 | .971 | .972 | .973 | .975 | .976 |

CUMULATIVE RAINFALL FRACTIONS
Output Time increment = .1000 hrs
Time on left represents time for first value in each row.

| Time hrs | | | | | |
|---|---|---|---|---|---|
| 22.0000 | .977 | .978 | .979 | .981 | .982 |
| 22.5000 | .983 | .984 | .985 | .986 | .988 |
| 23.0000 | .989 | .990 | .991 | .992 | .993 |
| 23.5000 | .994 | .996 | .997 | .998 | .999 |
| 24.0000 | 1.000 | | | | |

CUMULATIVE RAINFALL FRACTIONS
Output Time increment = .1000 hrs
Time on left represents time for first value in each row.

| Time hrs | | | | | |
|---|---|---|---|---|---|
| .0000 | .000 | .001 | .002 | .003 | .004 |
| .5000 | .005 | .006 | .007 | .008 | .009 |
| 1.0000 | .011 | .012 | .013 | .014 | .015 |
| 1.5000 | .016 | .017 | .018 | .020 | .021 |
| 2.0000 | .022 | .023 | .024 | .026 | .027 |
| 2.5000 | .028 | .029 | .031 | .032 | .033 |
| 3.0000 | .035 | .036 | .037 | .038 | .040 |
| 3.5000 | .041 | .042 | .044 | .045 | .047 |
| 4.0000 | .048 | .049 | .051 | .052 | .054 |
| 4.5000 | .055 | .057 | .058 | .060 | .061 |
| 5.0000 | .063 | .065 | .066 | .068 | .070 |
| 5.5000 | .071 | .073 | .075 | .076 | .078 |
| 6.0000 | .080 | .082 | .084 | .085 | .087 |
| 6.5000 | .089 | .091 | .093 | .095 | .097 |
| 7.0000 | .099 | .101 | .103 | .105 | .107 |
| 7.5000 | .109 | .111 | .113 | .116 | .118 |
| 8.0000 | .120 | .122 | .125 | .127 | .130 |
| 8.5000 | .132 | .135 | .138 | .141 | .144 |
| 9.0000 | .147 | .150 | .153 | .157 | .160 |
| 9.5000 | .163 | .166 | .170 | .173 | .177 |
| 10.0000 | .181 | .185 | .189 | .194 | .199 |
| 10.5000 | .204 | .209 | .215 | .221 | .228 |
| 11.0000 | .235 | .243 | .251 | .261 | .271 |
| 11.5000 | .283 | .307 | .354 | .431 | .568 |
| 12.0000 | .663 | .682 | .699 | .713 | .725 |
| 12.5000 | .735 | .743 | .751 | .759 | .766 |
| 13.0000 | .772 | .778 | .784 | .789 | .794 |
| 13.5000 | .799 | .804 | .808 | .812 | .816 |
| 14.0000 | .820 | .824 | .827 | .831 | .834 |
| 14.5000 | .838 | .841 | .844 | .847 | .850 |
| 15.0000 | .854 | .856 | .859 | .862 | .865 |
| 15.5000 | .868 | .870 | .873 | .875 | .878 |
| 16.0000 | .880 | .882 | .885 | .887 | .889 |
| 16.5000 | .891 | .893 | .895 | .898 | .900 |
| 17.0000 | .902 | .904 | .906 | .908 | .910 |
| 17.5000 | .912 | .914 | .915 | .917 | .919 |
| 18.0000 | .921 | .923 | .925 | .926 | .928 |
| 18.5000 | .930 | .931 | .933 | .935 | .936 |
| 19.0000 | .938 | .939 | .941 | .942 | .944 |
| 19.5000 | .945 | .947 | .948 | .949 | .951 |
| 20.0000 | .952 | .953 | .955 | .956 | .957 |
| 20.5000 | .958 | .960 | .961 | .962 | .964 |
| 21.0000 | .965 | .966 | .967 | .968 | .970 |
| 21.5000 | .971 | .972 | .973 | .975 | .976 |

CUMULATIVE RAINFALL FRACTIONS
Output Time increment = .1000 hrs
Time on left represents time for first value in each row.

| Time hrs | | | | | |
|---|---|---|---|---|---|
| 22.0000 | .977 | .978 | .979 | .981 | .982 |
| 22.5000 | .983 | .984 | .985 | .986 | .988 |
| 23.0000 | .989 | .990 | .991 | .992 | .993 |
| 23.5000 | .994 | .996 | .997 | .998 | .999 |
| 24.0000 | 1.000 | | | | |

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration       = 24.0000 hrs     Rain Depth = 3.3700 in
Rain Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir        = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B1A 2
Tc             = .0833 hrs
Drainage Area = 1.600 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9286 hrs
Computed Peak Flow             =     3.32 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9500 hrs
Peak Flow, Interpolated Output =     3.21 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                 DRAINAGE AREA
               -------------------
               ID:DA-B1A
               CN   =   77
               Area =        1.600 acres
               S    =   2.9870 in
               0.2S =    .5974 in

                Cumulative Runoff
               -------------------
                       1.3347 in
                         .178 ac-ft

HYG Volume...            .178 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: DA-B1A)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    21.76 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration       = 24.0000 hrs     Rain Depth = 4.9000 in
Rain Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID  =  - TypeII  24hr
Unit Hyd Type  = Default Curvilinear
HYG Dir        = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID  =  - DA-B1A 10
Tc             = .0833 hrs
Drainage Area  = 1.600 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9286 hrs
Computed Peak Flow             =     6.39 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     6.10 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                 DRAINAGE AREA
              -------------------
              ID:DA-B1A
              CN   =   77
              Area =       1.600 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                     2.5396 in
                       .339 ac-ft

HYG Volume...           .339 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: DA-B1A)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    21.76 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration       = 24.0000 hrs     Rain Depth = 5.8200 in
Rain Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir        = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B1A 25
Tc             = .0833 hrs
Drainage Area = 1.600 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9175 hrs
Computed Peak Flow             =     8.34 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     8.01 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
              -------------------
              ID:DA-B1A
              CN   =   77
              Area =        1.600 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                      3.3224 in
                        .443 ac-ft

HYG Volume...            .443 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: DA-B1A)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    21.76 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration      = 24.0000 hrs     Rain Depth = 3.3700 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B1B 2
Tc            = .0833 hrs
Drainage Area = 1.070 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9286 hrs
Computed Peak Flow             =     2.22 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9500 hrs
Peak Flow, Interpolated Output =     2.15 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                 DRAINAGE AREA
              -------------------
              ID:DA-B1B
              CN   =   77
              Area =       1.070 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                      1.3347 in
                        .119 ac-ft

HYG Volume...           .119 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: DA-B1B)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    14.55 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration       = 24.0000 hrs     Rain Depth = 4.9000 in
Rain Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir        = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B1B 10
Tc             = .0833 hrs
Drainage Area = 1.070 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9286 hrs
Computed Peak Flow             =     4.27 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     4.08 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
             -------------------
             ID:DA-B1B
             CN   =   77
             Area =       1.070 acres
             S    =   2.9870 in
             0.2S =    .5974 in

              Cumulative Runoff
             -------------------
                     2.5396 in
                       .226 ac-ft

HYG Volume...           .226 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: DA-B1B)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    14.55 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 5.8200 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B1B 25
Tc            = .0833 hrs
Drainage Area = 1.070 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9175 hrs
Computed Peak Flow             =     5.57 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     5.36 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
              -------------------
              ID:DA-B1B
              CN   =   77
              Area =       1.070 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                      3.3224 in
                        .296 ac-ft

HYG Volume...           .296 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: DA-B1B)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    14.55 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration       = 24.0000 hrs     Rain Depth = 3.3700 in
Rain Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir        = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B2A 2
Tc             = .0833 hrs
Drainage Area = 1.520 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9286 hrs
Computed Peak Flow             =     3.15 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9500 hrs
Peak Flow, Interpolated Output =     3.05 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                 DRAINAGE AREA
              -------------------
              ID:DA-B2A
              CN   =   77
              Area =       1.520 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                      1.3347 in
                        .169 ac-ft

HYG Volume...            .169 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: DA-B2A)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   20.67 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration       = 24.0000 hrs     Rain Depth = 4.9000 in
Rain Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID  =  - TypeII  24hr
Unit Hyd Type  = Default Curvilinear
HYG Dir        = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID  =  - DA-B2A 10
Tc             = .0833 hrs
Drainage Area  = 1.520 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9286 hrs
Computed Peak Flow             =     6.07 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     5.79 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
              -------------------
              ID:DA-B2A
              CN   =   77
              Area =        1.520 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                      2.5396 in
                        .322 ac-ft

HYG Volume...           .322 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: DA-B2A)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    20.67 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration       = 24.0000 hrs     Rain Depth = 5.8200 in
Rain Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID  =  - TypeII  24hr
Unit Hyd Type  = Default Curvilinear
HYG Dir        = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID  =  - DA-B2A 25
Tc             = .0833 hrs
Drainage Area  = 1.520 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9175 hrs
Computed Peak Flow             =     7.92 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     7.61 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
            -------------------
            ID:DA-B2A
            CN    =   77
            Area =        1.520 acres
            S     =   2.9870 in
            0.2S =    .5974 in

             Cumulative Runoff
            -------------------
                    3.3224 in
                      .421 ac-ft

HYG Volume...           .421 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: DA-B2A)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    20.67 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration      = 24.0000 hrs     Rain Depth = 3.3700 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B2B 2
Tc            = .0833 hrs
Drainage Area = 1.290 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9286 hrs
Computed Peak Flow             =     2.68 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9500 hrs
Peak Flow, Interpolated Output =     2.59 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                 DRAINAGE AREA
              -------------------
              ID:DA-B2B
              CN   =   77
              Area =       1.290 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                      1.3347 in
                        .143 ac-ft

HYG Volume...           .143 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: DA-B2B)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =    .7491)

Unit peak,          qp =    17.55 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.9000 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B2B 10
Tc            = .0833 hrs
Drainage Area = 1.290 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9286 hrs
Computed Peak Flow             =     5.15 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     4.92 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

               DRAINAGE AREA
              -------------------
              ID:DA-B2B
              CN   =   77
              Area =       1.290 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                      2.5396 in
                        .273 ac-ft

HYG Volume...           .273 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: DA-B2B)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    17.55 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 5.8200 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B2B 25
Tc            = .0833 hrs
Drainage Area = 1.290 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9175 hrs
Computed Peak Flow             =     6.72 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     6.46 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                 DRAINAGE AREA
              -------------------
              ID:DA-B2B
              CN   =   77
              Area =       1.290 acres
              S    =   2.9870 in
              0.2S =    .5974 in

                Cumulative Runoff
              -------------------
                     3.3224 in
                       .357 ac-ft

HYG Volume...            .357 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: DA-B2B)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    17.55 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration       = 24.0000 hrs     Rain Depth = 3.3700 in
Rain Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir        = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B2C 2
Tc             = .0833 hrs
Drainage Area = 1.360 acres  Runoff CN= 77

============================================
Computational Time Increment  =   .01111 hrs
Computed Peak Time            =  11.9286 hrs
Computed Peak Flow            =     2.82 cfs

Time Increment for HYG File   =    .0500 hrs
Peak Time, Interpolated Output =  11.9500 hrs
Peak Flow, Interpolated Output =     2.73 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                 DRAINAGE AREA
              -------------------
              ID:DA-B2C
              CN   =   77
              Area =       1.360 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                      1.3347 in
                        .151 ac-ft

HYG Volume...           .151 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: DA-B2C)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    18.50 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.9000 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B2C 10
Tc            = .0833 hrs
Drainage Area = 1.360 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9286 hrs
Computed Peak Flow             =     5.43 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     5.18 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
              -------------------
              ID:DA-B2C
              CN   =   77
              Area =        1.360 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                      2.5396 in
                        .288 ac-ft

HYG Volume...            .288 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: DA-B2C)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    18.50 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration       = 24.0000 hrs     Rain Depth = 5.8200 in
Rain Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir        = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B2C 25
Tc             = .0833 hrs
Drainage Area = 1.360 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9175 hrs
Computed Peak Flow             =     7.08 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     6.81 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
           -------------------
           ID:DA-B2C
           CN   =   77
           Area =       1.360 acres
           S    =   2.9870 in
           0.2S =    .5974 in

            Cumulative Runoff
           -------------------
                  3.3224 in
                    .377 ac-ft

HYG Volume...           .376 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: DA-B2C)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    18.50 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration      = 24.0000 hrs     Rain Depth = 3.3700 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B3A 2
Tc            = .0833 hrs
Drainage Area = 1.590 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9286 hrs
Computed Peak Flow             =     3.30 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9500 hrs
Peak Flow, Interpolated Output =     3.19 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
              -------------------
              ID:DA-B3A
              CN   =   77
              Area =       1.590 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                      1.3347 in
                        .177 ac-ft

HYG Volume...            .177 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: DA-B3A)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    21.63 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration       = 24.0000 hrs     Rain Depth = 4.9000 in
Rain Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir        = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B3A 10
Tc             = .0833 hrs
Drainage Area = 1.590 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9286 hrs
Computed Peak Flow             =     6.35 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     6.06 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
              -------------------
              ID:DA-B3A
              CN   =   77
              Area =       1.590 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                      2.5396 in
                        .336 ac-ft

HYG Volume...            .336 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: DA-B3A)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    21.63 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration       = 24.0000 hrs     Rain Depth = 5.8200 in
Rain Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir        = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B3A 25
Tc             = .0833 hrs
Drainage Area = 1.590 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9175 hrs
Computed Peak Flow             =     8.28 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     7.96 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
             -------------------
             ID:DA-B3A
             CN   =   77
             Area =       1.590 acres
             S    =   2.9870 in
             0.2S =    .5974 in

              Cumulative Runoff
             -------------------
                    3.3224 in
                      .440 ac-ft

HYG Volume...           .440 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: DA-B3A)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =    .7491)

Unit peak,          qp =    21.63 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration       = 24.0000 hrs     Rain Depth = 3.3700 in
Rain Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID  =  - TypeII  24hr
Unit Hyd Type  = Default Curvilinear
HYG Dir        = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID  =  - DA-B3B 2
Tc             = .0833 hrs
Drainage Area  = 1.650 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9286 hrs
Computed Peak Flow             =     3.42 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9500 hrs
Peak Flow, Interpolated Output =     3.31 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
           -------------------
           ID:DA-B3B
           CN   =   77
           Area =        1.650 acres
           S    =   2.9870 in
           0.2S =    .5974 in

            Cumulative Runoff
           -------------------
                   1.3347 in
                     .184 ac-ft

HYG Volume...            .183 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: DA-B3B)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    22.44 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration       = 24.0000 hrs     Rain Depth = 4.9000 in
Rain Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID  =  - TypeII  24hr
Unit Hyd Type  = Default Curvilinear
HYG Dir        = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID  =  - DA-B3B 10
Tc             = .0833 hrs
Drainage Area  = 1.650 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9286 hrs
Computed Peak Flow             =     6.59 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     6.29 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
           -------------------
           ID:DA-B3B
           CN   =   77
           Area =       1.650 acres
           S    =   2.9870 in
           0.2S =    .5974 in

            Cumulative Runoff
           -------------------
                 2.5396 in
                   .349 ac-ft

HYG Volume...            .349 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: DA-B3B)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    22.44 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration       = 24.0000 hrs     Rain Depth = 5.8200 in
Rain Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID  =  - TypeII  24hr
Unit Hyd Type  = Default Curvilinear
HYG Dir        = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID  =  - DA-B3B 25
Tc             = .0833 hrs
Drainage Area  = 1.650 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9175 hrs
Computed Peak Flow             =     8.60 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     8.26 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
              -------------------
              ID:DA-B3B
              CN   =   77
              Area =        1.650 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                      3.3224 in
                        .457 ac-ft

HYG Volume...           .457 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: DA-B3B)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    22.44 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration      = 24.0000 hrs    Rain Depth = 3.3700 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B4 2
Tc            = .0833 hrs
Drainage Area = 1.130 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =     2.34 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9500 hrs
Peak Flow, Interpolated Output =     2.27 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
              -------------------
              ID:DA-B4
              CN   =   77
              Area =        1.130 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                      1.3347 in
                        .126 ac-ft

HYG Volume...           .126 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-B4)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    15.36 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration       = 24.0000 hrs     Rain Depth = 4.9000 in
Rain Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir        = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B4 10
Tc             = .0833 hrs
Drainage Area = 1.130 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =     4.53 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     4.32 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
              -------------------
              ID:DA-B4
              CN   =   77
              Area =       1.130 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                      2.5396 in
                        .239 ac-ft

HYG Volume...            .239 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-B4)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    15.36 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 5.8200 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B4 25
Tc            = .0833 hrs
Drainage Area = 1.130 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =     5.92 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     5.68 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
              -------------------
              ID:DA-B4
              CN   =   77
              Area =       1.130 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                     3.3224 in
                       .313 ac-ft

HYG Volume...           .313 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-B4)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    15.36 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration       = 24.0000 hrs     Rain Depth = 3.3700 in
Rain Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir        = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B5 2
Tc             = .0833 hrs
Drainage Area = 1.610 acres  Runoff CN= 77

============================================
Computational Time Increment    =   .01111 hrs
Computed Peak Time              =  11.9222 hrs
Computed Peak Flow              =     3.34 cfs

Time Increment for HYG File     =    .0500 hrs
Peak Time, Interpolated Output =  11.9500 hrs
Peak Flow, Interpolated Output =     3.23 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
             ------------------
             ID:DA-B5
             CN    =   77
             Area =        1.610 acres
             S     =   2.9870 in
             0.2S =    .5974 in

              Cumulative Runoff
             ------------------
                     1.3347 in
                       .179 ac-ft

HYG Volume...            .179 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-B5)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    21.89 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.9000 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B5 10
Tc            = .0833 hrs
Drainage Area = 1.610 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =     6.45 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     6.16 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
              -------------------
              ID:DA-B5
              CN   =   77
              Area =       1.610 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                      2.5396 in
                        .341 ac-ft

HYG Volume...            .341 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-B5)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    21.89 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 5.8200 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B5 25
Tc            = .0833 hrs
Drainage Area = 1.610 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =     8.43 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     8.09 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
            -------------------
            ID:DA-B5
            CN    =   77
            Area =       1.610 acres
            S     =   2.9870 in
            0.2S =    .5974 in

             Cumulative Runoff
            -------------------
                    3.3224 in
                      .446 ac-ft

HYG Volume...           .446 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-B5)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    21.89 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration      = 24.0000 hrs     Rain Depth = 3.3700 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B6A 2
Tc            = .0833 hrs
Drainage Area = 1.780 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =     3.69 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9500 hrs
Peak Flow, Interpolated Output =     3.57 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
             -------------------
             ID:DA-B6A
             CN   =   77
             Area =       1.780 acres
             S    =   2.9870 in
             0.2S =    .5974 in

              Cumulative Runoff
             -------------------
                    1.3347 in
                      .198 ac-ft

HYG Volume...           .198 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-B6A)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    24.20 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.9000 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B6A 10
Tc            = .0833 hrs
Drainage Area = 1.780 acres  Runoff CN= 77

============================================
Computational Time Increment  =   .01111 hrs
Computed Peak Time            =  11.9222 hrs
Computed Peak Flow            =     7.14 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     6.81 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
             -------------------
             ID:DA-B6A
             CN   =   77
             Area =       1.780 acres
             S    =   2.9870 in
             0.2S =    .5974 in

              Cumulative Runoff
             -------------------
                     2.5396 in
                       .377 ac-ft

HYG Volume...           .377 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-B6A)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   24.20 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 5.8200 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B6A 25
Tc            = .0833 hrs
Drainage Area = 1.780 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =     9.32 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     8.94 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                 DRAINAGE AREA
              -------------------
              ID:DA-B6A
              CN   =   77
              Area =       1.780 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                      3.3224 in
                        .493 ac-ft

HYG Volume...           .493 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-B6A)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    24.20 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration      = 24.0000 hrs     Rain Depth = 3.3700 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B6B 2
Tc            = .0833 hrs
Drainage Area = 1.300 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =     2.70 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9500 hrs
Peak Flow, Interpolated Output =     2.61 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

               DRAINAGE AREA
              -------------------
              ID:DA-B6B
              CN    =   77
              Area =       1.300 acres
              S     =   2.9870 in
              0.2S =     .5974 in

               Cumulative Runoff
              -------------------
                      1.3347 in
                        .145 ac-ft

HYG Volume...           .145 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-B6B)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    17.68 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.9000 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B6B 10
Tc            = .0833 hrs
Drainage Area = 1.300 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =     5.21 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     4.97 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
              -------------------
              ID:DA-B6B
              CN   =   77
              Area =       1.300 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                     2.5396 in
                       .275 ac-ft

HYG Volume...           .275 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-B6B)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    17.68 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 5.8200 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B6B 25
Tc            = .0833 hrs
Drainage Area = 1.300 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =     6.81 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     6.53 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

               DRAINAGE AREA
             -------------------
             ID:DA-B6B
             CN   =   77
             Area =       1.300 acres
             S    =   2.9870 in
             0.2S =    .5974 in

              Cumulative Runoff
             -------------------
                    3.3224 in
                      .360 ac-ft

HYG Volume...           .360 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-B6B)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    17.68 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration      = 24.0000 hrs     Rain Depth = 3.3700 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B6C 2
Tc            = .0833 hrs
Drainage Area = 1.780 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =     3.69 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9500 hrs
Peak Flow, Interpolated Output =     3.57 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                 DRAINAGE AREA
              -------------------
              ID:DA-B6C
              CN   =   77
              Area =       1.780 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                      1.3347 in
                        .198 ac-ft

HYG Volume...           .198 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-B6C)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    24.20 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.9000 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B6C 10
Tc            = .0833 hrs
Drainage Area = 1.780 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =     7.14 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     6.81 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
           -------------------
           ID:DA-B6C
           CN   =   77
           Area =       1.780 acres
           S    =   2.9870 in
           0.2S =    .5974 in

            Cumulative Runoff
           -------------------
                   2.5396 in
                     .377 ac-ft

HYG Volume...           .377 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-B6C)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =    .7491)

Unit peak,          qp =    24.20 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 5.8200 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B6C 25
Tc            = .0833 hrs
Drainage Area = 1.780 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =     9.32 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     8.94 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

               DRAINAGE AREA
              -------------------
              ID:DA-B6C
              CN   =   77
              Area =       1.780 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                      3.3224 in
                        .493 ac-ft

HYG Volume...           .493 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-B6C)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    24.20 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration      = 24.0000 hrs     Rain Depth = 3.3700 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B8 2
Tc            = .0833 hrs
Drainage Area = 1.390 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =     2.88 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9500 hrs
Peak Flow, Interpolated Output =     2.79 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
             -------------------
             ID:DA-B8
             CN   =   77
             Area =        1.390 acres
             S    =   2.9870 in
             0.2S =    .5974 in

              Cumulative Runoff
             -------------------
                     1.3347 in
                       .155 ac-ft

HYG Volume...            .155 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-B8)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    18.90 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.9000 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B8 10
Tc            = .0833 hrs
Drainage Area = 1.390 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =     5.57 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     5.31 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

               DRAINAGE AREA
              -------------------
              ID:DA-B8
              CN   =   77
              Area =       1.390 acres
              S    =   2.9870 in
              0.2S =    .5974 in

             Cumulative Runoff
              -------------------
                      2.5396 in
                        .294 ac-ft

HYG Volume...           .294 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-B8)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    18.90 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 5.8200 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-B8 25
Tc            = .0833 hrs
Drainage Area = 1.390 acres  Runoff CN= 77

============================================
Computational Time Increment  =   .01111 hrs
Computed Peak Time            =  11.9222 hrs
Computed Peak Flow            =     7.28 cfs

Time Increment for HYG File   =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     6.98 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
             -------------------
             ID:DA-B8
             CN    =   77
             Area =       1.390 acres
             S     =   2.9870 in
             0.2S =    .5974 in

              Cumulative Runoff
             -------------------
                     3.3224 in
                       .385 ac-ft

HYG Volume...           .385 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-B8)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    18.90 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration      = 24.0000 hrs     Rain Depth = 3.3700 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-D1 2
Tc            = .0833 hrs
Drainage Area = 2.890 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =     5.99 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9500 hrs
Peak Flow, Interpolated Output =     5.80 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
              -------------------
              ID:DA-D1
              CN   =   77
              Area =       2.890 acres
              S    =   2.9870 in
              0.2S =    .5974 in

              Cumulative Runoff
              -------------------
                      1.3347 in
                        .321 ac-ft

HYG Volume...           .321 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-D1)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    39.29 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.9000 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-D1 10
Tc            = .0833 hrs
Drainage Area = 2.890 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =    11.59 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =    11.05 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
             -------------------
             ID:DA-D1
             CN   =   77
             Area =       2.890 acres
             S    =   2.9870 in
             0.2S =    .5974 in

              Cumulative Runoff
             -------------------
                     2.5396 in
                       .612 ac-ft

HYG Volume...           .612 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-D1)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    39.29 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration       = 24.0000 hrs     Rain Depth = 5.8200 in
Rain Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID  =  - TypeII  24hr
Unit Hyd Type  = Default Curvilinear
HYG Dir        = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID  =  - DA-D1 25
Tc             = .0833 hrs
Drainage Area  = 2.890 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =    15.13 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =    14.52 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
              -------------------
              ID:DA-D1
              CN    =   77
              Area  =        2.890 acres
              S     =   2.9870 in
              0.2S  =    .5974 in

               Cumulative Runoff
              -------------------
                      3.3224 in
                        .800 ac-ft

HYG Volume...            .800 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-D1)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    39.29 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration      = 24.0000 hrs     Rain Depth = 3.3700 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-D2 2
Tc            = .0833 hrs
Drainage Area = 1.960 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =     4.07 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9500 hrs
Peak Flow, Interpolated Output =     3.93 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
             -------------------
             ID:DA-D2
             CN   =   77
             Area =       1.960 acres
             S    =   2.9870 in
             0.2S =    .5974 in

              Cumulative Runoff
             -------------------
                    1.3347 in
                      .218 ac-ft

HYG Volume...           .218 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-D2)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    26.65 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.9000 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-D2 10
Tc            = .0833 hrs
Drainage Area = 1.960 acres  Runoff CN= 77

============================================
Computational Time Increment  =   .01111 hrs
Computed Peak Time            =  11.9222 hrs
Computed Peak Flow            =     7.86 cfs

Time Increment for HYG File   =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     7.49 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
              -------------------
              ID:DA-D2
              CN   =   77
              Area =       1.960 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                      2.5396 in
                        .415 ac-ft

HYG Volume...           .415 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-D2)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    26.65 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 5.8200 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-D2 25
Tc            = .0833 hrs
Drainage Area = 1.960 acres  Runoff CN= 77

============================================
Computational Time Increment  =   .01111 hrs
Computed Peak Time            =  11.9222 hrs
Computed Peak Flow            =    10.26 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     9.85 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
             -------------------
             ID:DA-D2
             CN   =   77
             Area =       1.960 acres
             S    =   2.9870 in
             0.2S =    .5974 in

              Cumulative Runoff
             -------------------
                     3.3224 in
                       .543 ac-ft

HYG Volume...           .543 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-D2)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    26.65 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration      = 24.0000 hrs     Rain Depth = 3.3700 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-D3 2
Tc            = .0833 hrs
Drainage Area = 1.390 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =     2.88 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9500 hrs
Peak Flow, Interpolated Output =     2.79 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
              -------------------
              ID:DA-D3
              CN   =   77
              Area =       1.390 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                      1.3347 in
                        .155 ac-ft

HYG Volume...           .155 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-D3)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    18.90 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.9000 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-D3 10
Tc            = .0833 hrs
Drainage Area = 1.390 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =     5.57 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     5.31 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
             -------------------
             ID:DA-D3
             CN   =   77
             Area =        1.390 acres
             S    =   2.9870 in
             0.2S =    .5974 in

              Cumulative Runoff
             -------------------
                    2.5396 in
                      .294 ac-ft

HYG Volume...           .294 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-D3)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    18.90 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 5.8200 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-D3 25
Tc            = .0833 hrs
Drainage Area = 1.390 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =     7.28 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     6.98 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
              -------------------
              ID:DA-D3
              CN   =   77
              Area =       1.390 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                      3.3224 in
                        .385 ac-ft

HYG Volume...           .385 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-D3)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    18.90 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration      = 24.0000 hrs     Rain Depth = 3.3700 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-D4 2
Tc            = .0833 hrs
Drainage Area = 6.430 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =    13.34 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9500 hrs
Peak Flow, Interpolated Output =    12.90 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
             -------------------
             ID:DA-D4
             CN    =   77
             Area =        6.430 acres
             S     =   2.9870 in
             0.2S =     .5974 in

              Cumulative Runoff
             -------------------
                     1.3347 in
                       .715 ac-ft

HYG Volume...            .715 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-D4)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,           qp =    87.43 cfs
Unit peak time       Tp =   .05556 hrs
Unit receding limb,  Tr =   .22222 hrs
Total unit time,     Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.9000 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-D4 10
Tc            = .0833 hrs
Drainage Area = 6.430 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =    25.78 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =    24.58 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
              -------------------
              ID:DA-D4
              CN   =   77
              Area =       6.430 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                      2.5396 in
                       1.361 ac-ft

HYG Volume...          1.361 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-D4)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    87.43 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration       = 24.0000 hrs     Rain Depth = 5.8200 in
Rain Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir        = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-D4 25
Tc             = .0833 hrs
Drainage Area = 6.430 acres  Runoff CN= 77

============================================
Computational Time Increment  =   .01111 hrs
Computed Peak Time            =  11.9222 hrs
Computed Peak Flow            =    33.67 cfs

Time Increment for HYG File   =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =    32.30 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

               DRAINAGE AREA
             -------------------
             ID:DA-D4
             CN   =   77
             Area =       6.430 acres
             S    =   2.9870 in
             0.2S =    .5974 in

              Cumulative Runoff
             -------------------
                     3.3224 in
                      1.780 ac-ft

HYG Volume...          1.780 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-D4)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    87.43 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration      = 24.0000 hrs     Rain Depth = 3.3700 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-HR1 2
Tc            = .0833 hrs
Drainage Area = 2.310 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =     4.79 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9500 hrs
Peak Flow, Interpolated Output =     4.63 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
             -------------------
             ID:DA-HR1
             CN   =   77
             Area =       2.310 acres
             S    =   2.9870 in
             0.2S =    .5974 in

              Cumulative Runoff
             -------------------
                     1.3347 in
                       .257 ac-ft

HYG Volume...           .257 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-HR1)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    31.41 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.9000 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-HR1 10
Tc            = .0833 hrs
Drainage Area = 2.310 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =     9.26 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     8.83 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
             -------------------
             ID:DA-HR1
             CN   =   77
             Area =        2.310 acres
             S    =   2.9870 in
             0.2S =    .5974 in

              Cumulative Runoff
             -------------------
                    2.5396 in
                      .489 ac-ft

HYG Volume...           .489 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-HR1)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    31.41 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration       = 24.0000 hrs     Rain Depth = 5.8200 in
Rain Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir        = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-HR1 25
Tc             = .0833 hrs
Drainage Area = 2.310 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =    12.10 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =    11.60 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
              -------------------
              ID:DA-HR1
              CN   =   77
              Area =       2.310 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                     3.3224 in
                       .640 ac-ft

HYG Volume...           .639 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: DA-HR1)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    31.41 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration      = 24.0000 hrs     Rain Depth = 3.3700 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-HR2 2
Tc            = .0830 hrs
Drainage Area = 2.050 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01107 hrs
Computed Peak Time             =  11.9299 hrs
Computed Peak Flow             =     4.26 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9500 hrs
Peak Flow, Interpolated Output =     4.11 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

               DRAINAGE AREA
              -------------------
              ID:DA-HR2
              CN   =   77
              Area =       2.050 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                      1.3347 in
                        .228 ac-ft

HYG Volume...           .228 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08300 hrs (ID: DA-HR2)
Computational Incr, Tm =   .01107 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    27.98 cfs
Unit peak time      Tp =   .05533 hrs
Unit receding limb, Tr =   .22133 hrs
Total unit time,    Tb =   .27667 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.9000 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-HR2 10
Tc            = .0830 hrs
Drainage Area = 2.050 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01107 hrs
Computed Peak Time             =  11.9188 hrs
Computed Peak Flow             =     8.19 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     7.83 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                 DRAINAGE AREA
              -------------------
              ID:DA-HR2
              CN   =   77
              Area =       2.050 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                      2.5396 in
                        .434 ac-ft

HYG Volume...           .434 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08300 hrs (ID: DA-HR2)
Computational Incr, Tm =   .01107 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    27.98 cfs
Unit peak time      Tp =   .05533 hrs
Unit receding limb, Tr =   .22133 hrs
Total unit time,    Tb =   .27667 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration       = 24.0000 hrs     Rain Depth = 5.8200 in
Rain Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID  =  - TypeII  24hr
Unit Hyd Type  = Default Curvilinear
HYG Dir        = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID  =  - DA-HR2 25
Tc             = .0830 hrs
Drainage Area  = 2.050 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01107 hrs
Computed Peak Time             =  11.9188 hrs
Computed Peak Flow             =    10.70 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =    10.28 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
             -------------------
             ID:DA-HR2
             CN   =   77
             Area =        2.050 acres
             S    =   2.9870 in
             0.2S =    .5974 in

              Cumulative Runoff
             -------------------
                    3.3224 in
                      .568 ac-ft

HYG Volume...           .568 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08300 hrs (ID: DA-HR2)
Computational Incr, Tm =   .01107 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    27.98 cfs
Unit peak time      Tp =   .05533 hrs
Unit receding limb, Tr =   .22133 hrs
Total unit time,    Tb =   .27667 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration      = 24.0000 hrs     Rain Depth = 3.3700 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-HR3 2
Tc            = .0830 hrs
Drainage Area = 1.780 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01107 hrs
Computed Peak Time             =  11.9299 hrs
Computed Peak Flow             =     3.69 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9500 hrs
Peak Flow, Interpolated Output =     3.57 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
              -------------------
              ID:DA-HR3
              CN   =   77
              Area =       1.780 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                      1.3347 in
                        .198 ac-ft

HYG Volume...           .198 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08300 hrs (ID: DA-HR3)
Computational Incr, Tm =   .01107 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    24.30 cfs
Unit peak time      Tp =   .05533 hrs
Unit receding limb, Tr =   .22133 hrs
Total unit time,    Tb =   .27667 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.9000 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-HR3 10
Tc            = .0830 hrs
Drainage Area = 1.780 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01107 hrs
Computed Peak Time             =  11.9188 hrs
Computed Peak Flow             =     7.11 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     6.80 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
             -------------------
             ID:DA-HR3
             CN   =   77
             Area =       1.780 acres
             S    =   2.9870 in
             0.2S =    .5974 in

              Cumulative Runoff
             -------------------
                     2.5396 in
                       .377 ac-ft

HYG Volume...           .377 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08300 hrs (ID: DA-HR3)
Computational Incr, Tm =   .01107 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    24.30 cfs
Unit peak time      Tp =   .05533 hrs
Unit receding limb, Tr =   .22133 hrs
Total unit time,    Tb =   .27667 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 5.8200 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - DA-HR3 25
Tc            = .0830 hrs
Drainage Area = 1.780 acres  Runoff CN= 77

============================================
Computational Time Increment   =   .01107 hrs
Computed Peak Time             =  11.9188 hrs
Computed Peak Flow             =     9.29 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     8.93 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
              -------------------
              ID:DA-HR3
              CN   =   77
              Area =       1.780 acres
              S    =   2.9870 in
              0.2S =    .5974 in

               Cumulative Runoff
              -------------------
                      3.3224 in
                        .493 ac-ft

HYG Volume...           .493 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08300 hrs (ID: DA-HR3)
Computational Incr, Tm =   .01107 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    24.30 cfs
Unit peak time      Tp =   .05533 hrs
Unit receding limb, Tr =   .22133 hrs
Total unit time,    Tb =   .27667 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration      = 24.0000 hrs     Rain Depth = 3.3700 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - SB1-DIRECT 2
Tc            = .0830 hrs
Drainage Area = .579 acres  Runoff CN= 100

============================================
Computational Time Increment   =   .01107 hrs
Computed Peak Time             =  11.9188 hrs
Computed Peak Flow             =     2.55 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     2.51 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
             -------------------
             ID:SB1-DIRECT
             CN   =  100
             Area =        .579 acres
             S    =    .0000 in
             0.2S =    .0000 in

              Cumulative Runoff
             -------------------
                     3.3700 in
                       .163 ac-ft

HYG Volume...          .163 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08300 hrs (ID: SB1-DIRECT)
Computational Incr, Tm =   .01107 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,           qp =    7.90 cfs
Unit peak time       Tp =   .05533 hrs
Unit receding limb,  Tr =   .22133 hrs
Total unit time,     Tb =   .27667 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.9000 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - SB1-DIRECT 10
Tc            = .0830 hrs
Drainage Area = .579 acres  Runoff CN= 100

============================================
Computational Time Increment   =   .01107 hrs
Computed Peak Time             =  11.9188 hrs
Computed Peak Flow             =     3.71 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     3.65 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
              -------------------
              ID:SB1-DIRECT
              CN   =  100
              Area =        .579 acres
              S    =    .0000 in
              0.2S =    .0000 in

               Cumulative Runoff
              -------------------
                      4.9000 in
                        .236 ac-ft

HYG Volume...           .236 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08300 hrs (ID: SB1-DIRECT)
Computational Incr, Tm =   .01107 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =     7.90 cfs
Unit peak time      Tp =   .05533 hrs
Unit receding limb, Tr =   .22133 hrs
Total unit time,    Tb =   .27667 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration       = 24.0000 hrs     Rain Depth = 5.8200 in
Rain Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir        = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - SB1-DIRECT 25
Tc             = .0830 hrs
Drainage Area = .579 acres  Runoff CN= 100

============================================
Computational Time Increment   =   .01107 hrs
Computed Peak Time             =  11.9188 hrs
Computed Peak Flow             =     4.41 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     4.33 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
           -------------------
           ID:SB1-DIRECT
           CN   =  100
           Area =         .579 acres
           S    =     .0000 in
           0.2S =     .0000 in

            Cumulative Runoff
           -------------------
                   5.8200 in
                     .281 ac-ft

HYG Volume...           .281 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08300 hrs (ID: SB1-DIRECT)
Computational Incr, Tm =   .01107 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,           qp =    7.90 cfs
Unit peak time       Tp =   .05533 hrs
Unit receding limb,  Tr =   .22133 hrs
Total unit time,     Tb =   .27667 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration       = 24.0000 hrs     Rain Depth = 3.3700 in
Rain Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir        = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - SB2-DIRECT 2
Tc             = .0830 hrs
Drainage Area = .887 acres  Runoff CN= 100

============================================
Computational Time Increment   =   .01107 hrs
Computed Peak Time             =  11.9188 hrs
Computed Peak Flow             =     3.91 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     3.84 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
              -------------------
              ID:SB2-DIRECT
              CN   =  100
              Area =        .887 acres
              S    =    .0000 in
              0.2S =    .0000 in

               Cumulative Runoff
              -------------------
                      3.3700 in
                        .249 ac-ft

HYG Volume...           .249 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08300 hrs (ID: SB2-DIRECT)
Computational Incr, Tm =   .01107 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    12.11 cfs
Unit peak time      Tp =   .05533 hrs
Unit receding limb, Tr =   .22133 hrs
Total unit time,    Tb =   .27667 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.9000 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - SB2-DIRECT 10
Tc            = .0830 hrs
Drainage Area = .887 acres  Runoff CN= 100

============================================
Computational Time Increment   =   .01107 hrs
Computed Peak Time             =  11.9188 hrs
Computed Peak Flow             =     5.69 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     5.59 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
              -------------------
              ID:SB2-DIRECT
              CN   =  100
              Area =        .887 acres
              S    =    .0000 in
              0.2S =    .0000 in

               Cumulative Runoff
              -------------------
                      4.9000 in
                        .362 ac-ft

HYG Volume...            .362 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08300 hrs (ID: SB2-DIRECT)
Computational Incr, Tm =   .01107 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    12.11 cfs
Unit peak time      Tp =   .05533 hrs
Unit receding limb, Tr =   .22133 hrs
Total unit time,    Tb =   .27667 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 5.8200 in
Rain Dir      = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPa
HYG File - ID =  - SB2-DIRECT 25
Tc            = .0830 hrs
Drainage Area = .887 acres  Runoff CN= 100

============================================
Computational Time Increment   =   .01107 hrs
Computed Peak Time             =  11.9188 hrs
Computed Peak Flow             =     6.75 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     6.64 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
              -------------------
              ID:SB2-DIRECT
              CN   =  100
              Area =        .887 acres
              S    =    .0000 in
              0.2S =    .0000 in

               Cumulative Runoff
              -------------------
                     5.8200 in
                       .430 ac-ft

HYG Volume...           .430 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08300 hrs (ID: SB2-DIRECT)
Computational Incr, Tm =   .01107 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    12.11 cfs
Unit peak time      Tp =   .05533 hrs
Unit receding limb, Tr =   .22133 hrs
Total unit time,    Tb =   .27667 hrs
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Solution to Mannings Open Channel Flow Equation
(Computed values are based on normal depth.)

TRAPEZOIDAL CROSS SECTION

Slope = .020000 ft/ft
Mannings n = 0.04000
Invert Elev. = 730.00 ft
Top of Channel = 732.00 ft
Base width = .00 ft
Rt Side slope = 2.000 horizontal :1 vert.
Lt Side slope = 12.000 horizontal :1 vert.

| Elev. (ft) | Depth (ft) | Flow (cfs) | Vel. (ft/sec) | Area (sq.ft) | Top W. (ft) | Wet.P. (ft) | Hd (ft) | Froude No. |
|---|---|---|---|---|---|---|---|---|
| 730.000 | .00 | .00 | .00 | .0000 | .00 | .00 | .00 | 0.00 |
| 730.010 | .01 | .00 | .15 | .0007 | .14 | .14 | .01 | 0.38 |
| 730.040 | .04 | .00 | .38 | .0112 | .56 | .57 | .02 | 0.48 |
| 730.080 | .08 | .03 | .61 | .0448 | 1.12 | 1.14 | .04 | 0.53 |
| 730.120 | .12 | .08 | .79 | .1008 | 1.68 | 1.71 | .06 | 0.57 |
| 730.160 | .16 | .17 | .96 | .1791 | 2.24 | 2.28 | .08 | 0.60 |
| 730.200 | .20 | .31 | 1.12 | .2800 | 2.80 | 2.86 | .10 | 0.62 |
| 730.240 | .24 | .51 | 1.26 | .4032 | 3.36 | 3.43 | .12 | 0.64 |
| 730.280 | .28 | .77 | 1.40 | .5489 | 3.92 | 4.00 | .14 | 0.66 |
| 730.320 | .32 | 1.10 | 1.53 | .7168 | 4.48 | 4.57 | .16 | 0.67 |
| 730.360 | .36 | 1.50 | 1.65 | .9071 | 5.04 | 5.14 | .18 | 0.69 |
| 730.400 | .40 | 1.99 | 1.77 | 1.1201 | 5.60 | 5.71 | .20 | 0.70 |
| 730.440 | .44 | 2.56 | 1.89 | 1.3552 | 6.16 | 6.28 | .22 | 0.71 |
| 730.480 | .48 | 3.23 | 2.00 | 1.6127 | 6.72 | 6.85 | .24 | 0.72 |
| 730.520 | .52 | 4.00 | 2.11 | 1.8929 | 7.28 | 7.42 | .26 | 0.73 |
| 730.560 | .56 | 4.87 | 2.22 | 2.1952 | 7.84 | 8.00 | .28 | 0.74 |
| 730.600 | .60 | 5.86 | 2.32 | 2.5198 | 8.40 | 8.57 | .30 | 0.75 |
| 730.640 | .64 | 6.96 | 2.43 | 2.8673 | 8.96 | 9.14 | .32 | 0.76 |
| 730.680 | .68 | 8.18 | 2.53 | 3.2367 | 9.52 | 9.71 | .34 | 0.76 |
| 730.720 | .72 | 9.52 | 2.62 | 3.6285 | 10.08 | 10.28 | .36 | 0.77 |
| 730.760 | .76 | 11.00 | 2.72 | 4.0433 | 10.64 | 10.85 | .38 | 0.78 |
| 730.800 | .80 | 12.61 | 2.81 | 4.4799 | 11.20 | 11.42 | .40 | 0.78 |
| 730.840 | .84 | 14.36 | 2.91 | 4.9395 | 11.76 | 11.99 | .42 | 0.79 |
| 730.880 | .88 | 16.26 | 3.00 | 5.4209 | 12.32 | 12.56 | .44 | 0.80 |
| 730.920 | .92 | 18.31 | 3.09 | 5.9246 | 12.88 | 13.14 | .46 | 0.80 |
| 730.960 | .96 | 20.51 | 3.18 | 6.4515 | 13.44 | 13.71 | .48 | 0.81 |
| 731.000 | 1.00 | 22.87 | 3.27 | 7.0000 | 14.00 | 14.28 | .50 | 0.81 |
| 731.040 | 1.04 | 25.38 | 3.35 | 7.5709 | 14.56 | 14.85 | .52 | 0.82 |
| 731.080 | 1.08 | 28.08 | 3.44 | 8.1651 | 15.12 | 15.42 | .54 | 0.82 |
| 731.120 | 1.12 | 30.93 | 3.52 | 8.7807 | 15.68 | 15.99 | .56 | 0.83 |
| 731.160 | 1.16 | 33.97 | 3.61 | 9.4188 | 16.24 | 16.56 | .58 | 0.83 |
| 731.200 | 1.20 | 37.18 | 3.69 | 10.0802 | 16.80 | 17.13 | .60 | 0.84 |
| 731.240 | 1.24 | 40.58 | 3.77 | 10.7630 | 17.36 | 17.70 | .62 | 0.84 |
| 731.280 | 1.28 | 44.17 | 3.85 | 11.4693 | 17.92 | 18.28 | .64 | 0.85 |
| 731.320 | 1.32 | 47.94 | 3.93 | 12.1969 | 18.48 | 18.85 | .66 | 0.85 |

Solution to Mannings Open Channel Flow Equation
(Computed values are based on normal depth.)

TRAPEZOIDAL CROSS SECTION

Slope = .020000 ft/ft
Mannings n = 0.04000
Invert Elev. = 730.00 ft
Top of Channel = 732.00 ft
Base width = .00 ft
Rt Side slope = 2.000 horizontal :1 vert.
Lt Side slope = 12.000 horizontal :1 vert.

| Elev. (ft) | Depth (ft) | Flow (cfs) | Vel. (ft/sec) | Area (sq.ft) | Top W. (ft) | Wet.P. (ft) | Hd (ft) | Froude No. |
|---|---|---|---|---|---|---|---|---|
| 731.360 | 1.36 | 51.91 | 4.01 | 12.9469 | 19.04 | 19.42 | .68 | 0.86 |
| 731.400 | 1.40 | 56.09 | 4.09 | 13.7205 | 19.60 | 19.99 | .70 | 0.86 |
| 731.440 | 1.44 | 60.46 | 4.17 | 14.5153 | 20.16 | 20.56 | .72 | 0.87 |
| 731.480 | 1.48 | 65.04 | 4.24 | 15.3324 | 20.72 | 21.13 | .74 | 0.87 |
| 731.520 | 1.52 | 69.84 | 4.32 | 16.1732 | 21.28 | 21.70 | .76 | 0.87 |
| 731.560 | 1.56 | 74.85 | 4.39 | 17.0352 | 21.84 | 22.27 | .78 | 0.88 |
| 731.600 | 1.60 | 80.07 | 4.47 | 17.9195 | 22.40 | 22.84 | .80 | 0.88 |
| 731.640 | 1.64 | 85.53 | 4.54 | 18.8275 | 22.96 | 23.42 | .82 | 0.88 |
| 731.680 | 1.68 | 91.20 | 4.62 | 19.7566 | 23.52 | 23.99 | .84 | 0.89 |
| 731.720 | 1.72 | 97.10 | 4.69 | 20.7081 | 24.08 | 24.56 | .86 | 0.89 |
| 731.760 | 1.76 | 103.25 | 4.76 | 21.6834 | 24.64 | 25.13 | .88 | 0.89 |
| 731.800 | 1.80 | 109.62 | 4.83 | 22.6797 | 25.20 | 25.70 | .90 | 0.90 |
| 731.840 | 1.84 | 116.24 | 4.90 | 23.6999 | 25.76 | 26.27 | .92 | 0.90 |
| 731.880 | 1.88 | 123.10 | 4.98 | 24.7409 | 26.32 | 26.84 | .94 | 0.90 |
| 731.920 | 1.92 | 130.21 | 5.05 | 25.8043 | 26.88 | 27.41 | .96 | 0.91 |
| 731.960 | 1.96 | 137.57 | 5.12 | 26.8918 | 27.44 | 27.98 | .98 | 0.91 |
| 732.000 | 2.00 | 145.19 | 5.19 | 28.0000 | 28.00 | 28.56 | 1.00 | 0.91 |

Solution to Mannings Open Channel Flow Equation
(Computed values are based on normal depth.)

TRAPEZOIDAL CROSS SECTION

Slope = .015000 ft/ft
Mannings n = 0.04000
Invert Elev. = 678.00 ft
Top of Channel = 681.00 ft
Base width = .00 ft
Rt Side slope = 2.000 horizontal :1 vert.
Lt Side slope = 2.000 horizontal :1 vert.

| Elev. (ft) | Depth (ft) | Flow (cfs) | Vel. (ft/sec) | Area (sq.ft) | Top W. (ft) | Wet.P. (ft) | Hd (ft) | Froude No. |
|---|---|---|---|---|---|---|---|---|
| 678.000 | .00 | .00 | .00 | .0000 | .00 | .00 | .00 | 0.00 |
| 678.010 | .01 | .00 | .12 | .0002 | .04 | .04 | .01 | 0.31 |
| 678.060 | .06 | .00 | .41 | .0072 | .24 | .27 | .03 | 0.42 |
| 678.120 | .12 | .02 | .65 | .0288 | .48 | .54 | .06 | 0.47 |
| 678.180 | .18 | .05 | .85 | .0648 | .72 | .80 | .09 | 0.50 |
| 678.240 | .24 | .12 | 1.03 | .1152 | .96 | 1.07 | .12 | 0.52 |
| 678.300 | .30 | .21 | 1.19 | .1800 | 1.20 | 1.34 | .15 | 0.54 |
| 678.360 | .36 | .35 | 1.35 | .2592 | 1.44 | 1.61 | .18 | 0.56 |
| 678.420 | .42 | .53 | 1.49 | .3528 | 1.68 | 1.88 | .21 | 0.57 |
| 678.480 | .48 | .75 | 1.63 | .4608 | 1.92 | 2.15 | .24 | 0.59 |
| 678.540 | .54 | 1.03 | 1.76 | .5832 | 2.16 | 2.41 | .27 | 0.60 |
| 678.600 | .60 | 1.36 | 1.89 | .7199 | 2.40 | 2.68 | .30 | 0.61 |
| 678.660 | .66 | 1.76 | 2.02 | .8711 | 2.64 | 2.95 | .33 | 0.62 |
| 678.720 | .72 | 2.22 | 2.14 | 1.0367 | 2.88 | 3.22 | .36 | 0.63 |
| 678.780 | .78 | 2.74 | 2.25 | 1.2169 | 3.12 | 3.49 | .39 | 0.64 |
| 678.840 | .84 | 3.34 | 2.37 | 1.4113 | 3.36 | 3.76 | .42 | 0.64 |
| 678.900 | .90 | 4.02 | 2.48 | 1.6201 | 3.60 | 4.03 | .45 | 0.65 |
| 678.960 | .96 | 4.77 | 2.59 | 1.8433 | 3.84 | 4.29 | .48 | 0.66 |
| 679.020 | 1.02 | 5.61 | 2.70 | 2.0809 | 4.08 | 4.56 | .51 | 0.67 |
| 679.080 | 1.08 | 6.53 | 2.80 | 2.3329 | 4.32 | 4.83 | .54 | 0.67 |
| 679.140 | 1.14 | 7.55 | 2.90 | 2.5993 | 4.56 | 5.10 | .57 | 0.68 |
| 679.200 | 1.20 | 8.65 | 3.00 | 2.8801 | 4.80 | 5.37 | .60 | 0.68 |
| 679.260 | 1.26 | 9.86 | 3.10 | 3.1752 | 5.04 | 5.63 | .63 | 0.69 |
| 679.320 | 1.32 | 11.16 | 3.20 | 3.4848 | 5.28 | 5.90 | .66 | 0.69 |
| 679.380 | 1.38 | 12.56 | 3.30 | 3.8088 | 5.52 | 6.17 | .69 | 0.70 |
| 679.440 | 1.44 | 14.07 | 3.39 | 4.1472 | 5.76 | 6.44 | .72 | 0.70 |
| 679.500 | 1.50 | 15.69 | 3.49 | 4.5000 | 6.00 | 6.71 | .75 | 0.71 |
| 679.560 | 1.56 | 17.42 | 3.58 | 4.8672 | 6.24 | 6.98 | .78 | 0.71 |
| 679.620 | 1.62 | 19.26 | 3.67 | 5.2488 | 6.48 | 7.24 | .81 | 0.72 |
| 679.680 | 1.68 | 21.22 | 3.76 | 5.6448 | 6.72 | 7.51 | .84 | 0.72 |
| 679.740 | 1.74 | 23.31 | 3.85 | 6.0551 | 6.96 | 7.78 | .87 | 0.73 |
| 679.800 | 1.80 | 25.51 | 3.94 | 6.4799 | 7.20 | 8.05 | .90 | 0.73 |
| 679.860 | 1.86 | 27.84 | 4.02 | 6.9191 | 7.44 | 8.32 | .93 | 0.74 |
| 679.920 | 1.92 | 30.30 | 4.11 | 7.3727 | 7.68 | 8.59 | .96 | 0.74 |
| 679.980 | 1.98 | 32.89 | 4.20 | 7.8406 | 7.92 | 8.85 | .99 | 0.74 |

Solution to Mannings Open Channel Flow Equation
(Computed values are based on normal depth.)

TRAPEZOIDAL CROSS SECTION

Slope = .015000 ft/ft
Mannings n = 0.04000
Invert Elev. = 678.00 ft
Top of Channel = 681.00 ft
Base width = .00 ft
Rt Side slope = 2.000 horizontal :1 vert.
Lt Side slope = 2.000 horizontal :1 vert.

| Elev. (ft) | Depth (ft) | Flow (cfs) | Vel. (ft/sec) | Area (sq.ft) | Top W. (ft) | Wet.P. (ft) | Hd (ft) | Froude No. |
|---|---|---|---|---|---|---|---|---|
| 680.040 | 2.04 | 35.62 | 4.28 | 8.3230 | 8.16 | 9.12 | 1.02 | 0.75 |
| 680.100 | 2.10 | 38.48 | 4.36 | 8.8198 | 8.40 | 9.39 | 1.05 | 0.75 |
| 680.160 | 2.16 | 41.48 | 4.45 | 9.3310 | 8.64 | 9.66 | 1.08 | 0.75 |
| 680.220 | 2.22 | 44.63 | 4.53 | 9.8565 | 8.88 | 9.93 | 1.11 | 0.76 |
| 680.280 | 2.28 | 47.92 | 4.61 | 10.3971 | 9.12 | 10.20 | 1.14 | 0.76 |
| 680.340 | 2.34 | 51.36 | 4.69 | 10.9515 | 9.36 | 10.46 | 1.17 | 0.76 |
| 680.400 | 2.40 | 54.95 | 4.77 | 11.5202 | 9.60 | 10.73 | 1.20 | 0.77 |
| 680.460 | 2.46 | 58.68 | 4.85 | 12.1034 | 9.84 | 11.00 | 1.23 | 0.77 |
| 680.520 | 2.52 | 62.58 | 4.93 | 12.7010 | 10.08 | 11.27 | 1.26 | 0.77 |
| 680.580 | 2.58 | 66.63 | 5.01 | 13.3130 | 10.32 | 11.54 | 1.29 | 0.78 |
| 680.640 | 2.64 | 70.84 | 5.08 | 13.9394 | 10.56 | 11.81 | 1.32 | 0.78 |
| 680.700 | 2.70 | 75.22 | 5.16 | 14.5801 | 10.80 | 12.07 | 1.35 | 0.78 |
| 680.760 | 2.76 | 79.76 | 5.24 | 15.2353 | 11.04 | 12.34 | 1.38 | 0.79 |
| 680.820 | 2.82 | 84.47 | 5.31 | 15.9049 | 11.28 | 12.61 | 1.41 | 0.79 |
| 680.880 | 2.88 | 89.34 | 5.39 | 16.5889 | 11.52 | 12.88 | 1.44 | 0.79 |
| 680.940 | 2.94 | 94.39 | 5.46 | 17.2872 | 11.76 | 13.15 | 1.47 | 0.79 |
| 681.000 | 3.00 | 99.62 | 5.53 | 18.0000 | 12.00 | 13.42 | 1.50 | 0.80 |

Solution to Mannings Open Channel Flow Equation
(Computed values are based on normal depth.)

TRAPEZOIDAL CROSS SECTION

Slope = .032900 ft/ft
Mannings n = 0.04000
Invert Elev. = 793.00 ft
Top of Channel = 794.00 ft
Base width = .00 ft
Rt Side slope = 3.000 horizontal :1 vert.
Lt Side slope = 12.000 horizontal :1 vert.

| Elev. (ft) | Depth (ft) | Flow (cfs) | Vel. (ft/sec) | Area (sq.ft) | Top W. (ft) | Wet.P. (ft) | Hd (ft) | Froude No. |
|---|---|---|---|---|---|---|---|---|
| 793.000 | .00 | .00 | .00 | .0000 | .00 | .00 | .00 | 0.00 |
| 793.010 | .01 | .00 | .20 | .0008 | .15 | .15 | .01 | 0.49 |
| 793.020 | .02 | .00 | .31 | .0030 | .30 | .30 | .01 | 0.55 |
| 793.040 | .04 | .01 | .49 | .0120 | .60 | .61 | .02 | 0.61 |
| 793.060 | .06 | .02 | .64 | .0270 | .90 | .91 | .03 | 0.66 |
| 793.080 | .08 | .04 | .78 | .0480 | 1.20 | 1.22 | .04 | 0.69 |
| 793.100 | .10 | .07 | .91 | .0750 | 1.50 | 1.52 | .05 | 0.71 |
| 793.120 | .12 | .11 | 1.02 | .1080 | 1.80 | 1.82 | .06 | 0.74 |
| 793.140 | .14 | .17 | 1.13 | .1470 | 2.10 | 2.13 | .07 | 0.76 |
| 793.160 | .16 | .24 | 1.24 | .1919 | 2.40 | 2.43 | .08 | 0.77 |
| 793.180 | .18 | .33 | 1.34 | .2430 | 2.70 | 2.74 | .09 | 0.79 |
| 793.200 | .20 | .43 | 1.44 | .3000 | 3.00 | 3.04 | .10 | 0.80 |
| 793.220 | .22 | .56 | 1.53 | .3629 | 3.30 | 3.34 | .11 | 0.81 |
| 793.240 | .24 | .70 | 1.62 | .4320 | 3.60 | 3.65 | .12 | 0.83 |
| 793.260 | .26 | .87 | 1.71 | .5070 | 3.90 | 3.95 | .13 | 0.84 |
| 793.280 | .28 | 1.06 | 1.80 | .5881 | 4.20 | 4.26 | .14 | 0.85 |
| 793.300 | .30 | 1.27 | 1.89 | .6749 | 4.50 | 4.56 | .15 | 0.86 |
| 793.320 | .32 | 1.51 | 1.97 | .7680 | 4.80 | 4.87 | .16 | 0.87 |
| 793.340 | .34 | 1.78 | 2.05 | .8671 | 5.10 | 5.17 | .17 | 0.88 |
| 793.360 | .36 | 2.07 | 2.13 | .9719 | 5.40 | 5.47 | .18 | 0.88 |
| 793.380 | .38 | 2.39 | 2.21 | 1.0830 | 5.70 | 5.78 | .19 | 0.89 |
| 793.400 | .40 | 2.74 | 2.28 | 1.2001 | 6.00 | 6.08 | .20 | 0.90 |
| 793.420 | .42 | 3.12 | 2.36 | 1.3229 | 6.30 | 6.39 | .21 | 0.91 |
| 793.440 | .44 | 3.53 | 2.43 | 1.4520 | 6.60 | 6.69 | .22 | 0.91 |
| 793.460 | .46 | 3.98 | 2.51 | 1.5872 | 6.90 | 6.99 | .23 | 0.92 |
| 793.480 | .48 | 4.46 | 2.58 | 1.7279 | 7.20 | 7.30 | .24 | 0.93 |
| 793.500 | .50 | 4.97 | 2.65 | 1.8750 | 7.50 | 7.60 | .25 | 0.93 |
| 793.520 | .52 | 5.52 | 2.72 | 2.0282 | 7.80 | 7.91 | .26 | 0.94 |
| 793.540 | .54 | 6.10 | 2.79 | 2.1868 | 8.10 | 8.21 | .27 | 0.95 |
| 793.560 | .56 | 6.72 | 2.86 | 2.3520 | 8.40 | 8.51 | .28 | 0.95 |
| 793.580 | .58 | 7.38 | 2.93 | 2.5231 | 8.70 | 8.82 | .29 | 0.96 |
| 793.600 | .60 | 8.08 | 2.99 | 2.6998 | 9.00 | 9.12 | .30 | 0.96 |
| 793.620 | .62 | 8.82 | 3.06 | 2.8830 | 9.30 | 9.43 | .31 | 0.97 |
| 793.640 | .64 | 9.60 | 3.12 | 3.0721 | 9.60 | 9.73 | .32 | 0.97 |
| 793.660 | .66 | 10.42 | 3.19 | 3.2667 | 9.90 | 10.03 | .33 | 0.98 |

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Solution to Mannings Open Channel Flow Equation
(Computed values are based on normal depth.)

TRAPEZOIDAL CROSS SECTION

Slope = .032900 ft/ft
Mannings n = 0.04000
Invert Elev. = 793.00 ft
Top of Channel = 794.00 ft
Base width = .00 ft
Rt Side slope = 3.000 horizontal :1 vert.
Lt Side slope = 12.000 horizontal :1 vert.

| Elev. (ft) | Depth (ft) | Flow (cfs) | Vel. (ft/sec) | Area (sq.ft) | Top W. (ft) | Wet.P. (ft) | Hd (ft) | Froude No. |
|---|---|---|---|---|---|---|---|---|
| 793.680 | .68 | 11.28 | 3.25 | 3.4679 | 10.20 | 10.34 | .34 | 0.98 |
| 793.700 | .70 | 12.19 | 3.32 | 3.6751 | 10.50 | 10.64 | .35 | 0.99 |
| 793.720 | .72 | 13.14 | 3.38 | 3.8877 | 10.80 | 10.95 | .36 | 0.99 |
| 793.740 | .74 | 14.13 | 3.44 | 4.1069 | 11.10 | 11.25 | .37 | 1.00 |
| 793.760 | .76 | 15.18 | 3.50 | 4.3321 | 11.40 | 11.56 | .38 | 1.00 |
| 793.780 | .78 | 16.27 | 3.56 | 4.5633 | 11.70 | 11.86 | .39 | 1.01 |
| 793.800 | .80 | 17.40 | 3.63 | 4.7999 | 12.00 | 12.16 | .40 | 1.01 |
| 793.820 | .82 | 18.59 | 3.69 | 5.0431 | 12.30 | 12.47 | .41 | 1.01 |
| 793.840 | .84 | 19.82 | 3.75 | 5.2923 | 12.60 | 12.77 | .42 | 1.02 |
| 793.860 | .86 | 21.10 | 3.80 | 5.5468 | 12.90 | 13.08 | .43 | 1.02 |
| 793.880 | .88 | 22.44 | 3.86 | 5.8081 | 13.20 | 13.38 | .44 | 1.03 |
| 793.900 | .90 | 23.82 | 3.92 | 6.0753 | 13.50 | 13.68 | .45 | 1.03 |
| 793.920 | .92 | 25.26 | 3.98 | 6.3478 | 13.80 | 13.99 | .46 | 1.03 |
| 793.940 | .94 | 26.75 | 4.04 | 6.6270 | 14.10 | 14.29 | .47 | 1.04 |
| 793.960 | .96 | 28.30 | 4.09 | 6.9123 | 14.40 | 14.60 | .48 | 1.04 |
| 793.980 | .98 | 29.89 | 4.15 | 7.2027 | 14.70 | 14.90 | .49 | 1.05 |
| 794.000 | 1.00 | 31.55 | 4.21 | 7.5000 | 15.00 | 15.20 | .50 | 1.05 |

Solution to Mannings Open Channel Flow Equation
(Computed values are based on normal depth.)

TRAPEZOIDAL CROSS SECTION

Slope = .065800 ft/ft
Mannings n = 0.04000
Invert Elev. = 758.00 ft
Top of Channel = 759.00 ft
Base width = .00 ft
Rt Side slope = 3.000 horizontal :1 vert.
Lt Side slope = 12.000 horizontal :1 vert.

| Elev. (ft) | Depth (ft) | Flow (cfs) | Vel. (ft/sec) | Area (sq.ft) | Top W. (ft) | Wet.P. (ft) | Hd (ft) | Froude No. |
|---|---|---|---|---|---|---|---|---|
| 758.000 | .00 | .00 | .00 | .0000 | .00 | .00 | .00 | 0.00 |
| 758.010 | .01 | .00 | .28 | .0008 | .15 | .15 | .01 | 0.69 |
| 758.020 | .02 | .00 | .44 | .0030 | .30 | .30 | .01 | 0.77 |
| 758.040 | .04 | .01 | .70 | .0120 | .60 | .61 | .02 | 0.87 |
| 758.060 | .06 | .02 | .91 | .0270 | .90 | .91 | .03 | 0.93 |
| 758.080 | .08 | .05 | 1.10 | .0480 | 1.20 | 1.22 | .04 | 0.97 |
| 758.100 | .10 | .10 | 1.28 | .0750 | 1.50 | 1.52 | .05 | 1.01 |
| 758.120 | .12 | .16 | 1.45 | .1080 | 1.80 | 1.82 | .06 | 1.04 |
| 758.140 | .14 | .24 | 1.60 | .1470 | 2.10 | 2.13 | .07 | 1.07 |
| 758.160 | .16 | .34 | 1.75 | .1919 | 2.40 | 2.43 | .08 | 1.09 |
| 758.180 | .18 | .46 | 1.90 | .2430 | 2.70 | 2.74 | .09 | 1.11 |
| 758.200 | .20 | .61 | 2.03 | .3000 | 3.00 | 3.04 | .10 | 1.13 |
| 758.220 | .22 | .79 | 2.17 | .3629 | 3.30 | 3.34 | .11 | 1.15 |
| 758.240 | .24 | .99 | 2.30 | .4320 | 3.60 | 3.65 | .12 | 1.17 |
| 758.260 | .26 | 1.23 | 2.42 | .5070 | 3.90 | 3.95 | .13 | 1.18 |
| 758.280 | .28 | 1.50 | 2.55 | .5881 | 4.20 | 4.26 | .14 | 1.20 |
| 758.300 | .30 | 1.80 | 2.67 | .6749 | 4.50 | 4.56 | .15 | 1.21 |
| 758.320 | .32 | 2.14 | 2.78 | .7680 | 4.80 | 4.87 | .16 | 1.23 |
| 758.340 | .34 | 2.51 | 2.90 | .8671 | 5.10 | 5.17 | .17 | 1.24 |
| 758.360 | .36 | 2.93 | 3.01 | .9719 | 5.40 | 5.47 | .18 | 1.25 |
| 758.380 | .38 | 3.38 | 3.12 | 1.0830 | 5.70 | 5.78 | .19 | 1.26 |
| 758.400 | .40 | 3.88 | 3.23 | 1.2001 | 6.00 | 6.08 | .20 | 1.27 |
| 758.420 | .42 | 4.41 | 3.34 | 1.3229 | 6.30 | 6.39 | .21 | 1.28 |
| 758.440 | .44 | 5.00 | 3.44 | 1.4520 | 6.60 | 6.69 | .22 | 1.29 |
| 758.460 | .46 | 5.63 | 3.55 | 1.5872 | 6.90 | 6.99 | .23 | 1.30 |
| 758.480 | .48 | 6.30 | 3.65 | 1.7279 | 7.20 | 7.30 | .24 | 1.31 |
| 758.500 | .50 | 7.03 | 3.75 | 1.8750 | 7.50 | 7.60 | .25 | 1.32 |
| 758.520 | .52 | 7.80 | 3.85 | 2.0282 | 7.80 | 7.91 | .26 | 1.33 |
| 758.540 | .54 | 8.63 | 3.94 | 2.1868 | 8.10 | 8.21 | .27 | 1.34 |
| 758.560 | .56 | 9.51 | 4.04 | 2.3520 | 8.40 | 8.51 | .28 | 1.35 |
| 758.580 | .58 | 10.44 | 4.14 | 2.5231 | 8.70 | 8.82 | .29 | 1.35 |
| 758.600 | .60 | 11.43 | 4.23 | 2.6998 | 9.00 | 9.12 | .30 | 1.36 |
| 758.620 | .62 | 12.47 | 4.33 | 2.8830 | 9.30 | 9.43 | .31 | 1.37 |
| 758.640 | .64 | 13.57 | 4.42 | 3.0721 | 9.60 | 9.73 | .32 | 1.38 |
| 758.660 | .66 | 14.73 | 4.51 | 3.2667 | 9.90 | 10.03 | .33 | 1.38 |

Solution to Mannings Open Channel Flow Equation
(Computed values are based on normal depth.)

TRAPEZOIDAL CROSS SECTION

Slope = .065800 ft/ft
Mannings n = 0.04000
Invert Elev. = 758.00 ft
Top of Channel = 759.00 ft
Base width = .00 ft
Rt Side slope = 3.000 horizontal :1 vert.
Lt Side slope = 12.000 horizontal :1 vert.

| Elev. (ft) | Depth (ft) | Flow (cfs) | Vel. (ft/sec) | Area (sq.ft) | Top W. (ft) | Wet.P. (ft) | Hd (ft) | Froude No. |
|---|---|---|---|---|---|---|---|---|
| 758.680 | .68 | 15.95 | 4.60 | 3.4679 | 10.20 | 10.34 | .34 | 1.39 |
| 758.700 | .70 | 17.24 | 4.69 | 3.6751 | 10.50 | 10.64 | .35 | 1.40 |
| 758.720 | .72 | 18.58 | 4.78 | 3.8877 | 10.80 | 10.95 | .36 | 1.40 |
| 758.740 | .74 | 19.99 | 4.87 | 4.1069 | 11.10 | 11.25 | .37 | 1.41 |
| 758.760 | .76 | 21.46 | 4.95 | 4.3321 | 11.40 | 11.56 | .38 | 1.42 |
| 758.780 | .78 | 23.00 | 5.04 | 4.5633 | 11.70 | 11.86 | .39 | 1.42 |
| 758.800 | .80 | 24.61 | 5.13 | 4.7999 | 12.00 | 12.16 | .40 | 1.43 |
| 758.820 | .82 | 26.28 | 5.21 | 5.0431 | 12.30 | 12.47 | .41 | 1.43 |
| 758.840 | .84 | 28.03 | 5.30 | 5.2923 | 12.60 | 12.77 | .42 | 1.44 |
| 758.860 | .86 | 29.84 | 5.38 | 5.5468 | 12.90 | 13.08 | .43 | 1.45 |
| 758.880 | .88 | 31.73 | 5.46 | 5.8081 | 13.20 | 13.38 | .44 | 1.45 |
| 758.900 | .90 | 33.69 | 5.55 | 6.0753 | 13.50 | 13.68 | .45 | 1.46 |
| 758.920 | .92 | 35.72 | 5.63 | 6.3478 | 13.80 | 13.99 | .46 | 1.46 |
| 758.940 | .94 | 37.83 | 5.71 | 6.6270 | 14.10 | 14.29 | .47 | 1.47 |
| 758.960 | .96 | 40.02 | 5.79 | 6.9123 | 14.40 | 14.60 | .48 | 1.47 |
| 758.980 | .98 | 42.28 | 5.87 | 7.2027 | 14.70 | 14.90 | .49 | 1.48 |
| 759.000 | 1.00 | 44.62 | 5.95 | 7.5000 | 15.00 | 15.20 | .50 | 1.48 |

Solution to Mannings Open Channel Flow Equation
(Computed values are based on normal depth.)

TRAPEZOIDAL CROSS SECTION

Slope = .098300 ft/ft
Mannings n = 0.04000
Invert Elev. = 691.00 ft
Top of Channel = 692.00 ft
Base width = .00 ft
Rt Side slope = 3.000 horizontal :1 vert.
Lt Side slope = 12.000 horizontal :1 vert.

| Elev. (ft) | Depth (ft) | Flow (cfs) | Vel. (ft/sec) | Area (sq.ft) | Top W. (ft) | Wet.P. (ft) | Hd (ft) | Froude No. |
|---|---|---|---|---|---|---|---|---|
| 691.000 | .00 | .00 | .00 | .0000 | .00 | .00 | .00 | 0.00 |
| 691.010 | .01 | .00 | .34 | .0008 | .15 | .15 | .01 | 0.84 |
| 691.020 | .02 | .00 | .54 | .0030 | .30 | .30 | .01 | 0.94 |
| 691.040 | .04 | .01 | .85 | .0120 | .60 | .61 | .02 | 1.06 |
| 691.060 | .06 | .03 | 1.11 | .0270 | .90 | .91 | .03 | 1.13 |
| 691.080 | .08 | .06 | 1.35 | .0480 | 1.20 | 1.22 | .04 | 1.19 |
| 691.100 | .10 | .12 | 1.57 | .0750 | 1.50 | 1.52 | .05 | 1.24 |
| 691.120 | .12 | .19 | 1.77 | .1080 | 1.80 | 1.82 | .06 | 1.27 |
| 691.140 | .14 | .29 | 1.96 | .1470 | 2.10 | 2.13 | .07 | 1.31 |
| 691.160 | .16 | .41 | 2.14 | .1919 | 2.40 | 2.43 | .08 | 1.34 |
| 691.180 | .18 | .56 | 2.32 | .2430 | 2.70 | 2.74 | .09 | 1.36 |
| 691.200 | .20 | .75 | 2.49 | .3000 | 3.00 | 3.04 | .10 | 1.39 |
| 691.220 | .22 | .96 | 2.65 | .3629 | 3.30 | 3.34 | .11 | 1.41 |
| 691.240 | .24 | 1.21 | 2.81 | .4320 | 3.60 | 3.65 | .12 | 1.43 |
| 691.260 | .26 | 1.50 | 2.96 | .5070 | 3.90 | 3.95 | .13 | 1.45 |
| 691.280 | .28 | 1.83 | 3.11 | .5881 | 4.20 | 4.26 | .14 | 1.47 |
| 691.300 | .30 | 2.20 | 3.26 | .6749 | 4.50 | 4.56 | .15 | 1.48 |
| 691.320 | .32 | 2.61 | 3.40 | .7680 | 4.80 | 4.87 | .16 | 1.50 |
| 691.340 | .34 | 3.07 | 3.54 | .8671 | 5.10 | 5.17 | .17 | 1.51 |
| 691.360 | .36 | 3.58 | 3.68 | .9719 | 5.40 | 5.47 | .18 | 1.53 |
| 691.380 | .38 | 4.13 | 3.81 | 1.0830 | 5.70 | 5.78 | .19 | 1.54 |
| 691.400 | .40 | 4.74 | 3.95 | 1.2001 | 6.00 | 6.08 | .20 | 1.56 |
| 691.420 | .42 | 5.39 | 4.08 | 1.3229 | 6.30 | 6.39 | .21 | 1.57 |
| 691.440 | .44 | 6.11 | 4.21 | 1.4520 | 6.60 | 6.69 | .22 | 1.58 |
| 691.460 | .46 | 6.88 | 4.33 | 1.5872 | 6.90 | 6.99 | .23 | 1.59 |
| 691.480 | .48 | 7.70 | 4.46 | 1.7279 | 7.20 | 7.30 | .24 | 1.60 |
| 691.500 | .50 | 8.59 | 4.58 | 1.8750 | 7.50 | 7.60 | .25 | 1.62 |
| 691.520 | .52 | 9.54 | 4.70 | 2.0282 | 7.80 | 7.91 | .26 | 1.63 |
| 691.540 | .54 | 10.54 | 4.82 | 2.1868 | 8.10 | 8.21 | .27 | 1.64 |
| 691.560 | .56 | 11.62 | 4.94 | 2.3520 | 8.40 | 8.51 | .28 | 1.65 |
| 691.580 | .58 | 12.76 | 5.06 | 2.5231 | 8.70 | 8.82 | .29 | 1.66 |
| 691.600 | .60 | 13.96 | 5.17 | 2.6998 | 9.00 | 9.12 | .30 | 1.66 |
| 691.620 | .62 | 15.24 | 5.29 | 2.8830 | 9.30 | 9.43 | .31 | 1.67 |
| 691.640 | .64 | 16.59 | 5.40 | 3.0721 | 9.60 | 9.73 | .32 | 1.68 |
| 691.660 | .66 | 18.01 | 5.51 | 3.2667 | 9.90 | 10.03 | .33 | 1.69 |

Solution to Mannings Open Channel Flow Equation
(Computed values are based on normal depth.)

TRAPEZOIDAL CROSS SECTION

Slope = .098300 ft/ft
Mannings n = 0.04000
Invert Elev. = 691.00 ft
Top of Channel = 692.00 ft
Base width = .00 ft
Rt Side slope = 3.000 horizontal :1 vert.
Lt Side slope = 12.000 horizontal :1 vert.

| Elev. (ft) | Depth (ft) | Flow (cfs) | Vel. (ft/sec) | Area (sq.ft) | Top W. (ft) | Wet.P. (ft) | Hd (ft) | Froude No. |
|---|---|---|---|---|---|---|---|---|
| 691.680 | .68 | 19.50 | 5.62 | 3.4679 | 10.20 | 10.34 | .34 | 1.70 |
| 691.700 | .70 | 21.07 | 5.73 | 3.6751 | 10.50 | 10.64 | .35 | 1.71 |
| 691.720 | .72 | 22.71 | 5.84 | 3.8877 | 10.80 | 10.95 | .36 | 1.72 |
| 691.740 | .74 | 24.43 | 5.95 | 4.1069 | 11.10 | 11.25 | .37 | 1.72 |
| 691.760 | .76 | 26.23 | 6.06 | 4.3321 | 11.40 | 11.56 | .38 | 1.73 |
| 691.780 | .78 | 28.12 | 6.16 | 4.5633 | 11.70 | 11.86 | .39 | 1.74 |
| 691.800 | .80 | 30.08 | 6.27 | 4.7999 | 12.00 | 12.16 | .40 | 1.75 |
| 691.820 | .82 | 32.13 | 6.37 | 5.0431 | 12.30 | 12.47 | .41 | 1.75 |
| 691.840 | .84 | 34.26 | 6.47 | 5.2923 | 12.60 | 12.77 | .42 | 1.76 |
| 691.860 | .86 | 36.47 | 6.58 | 5.5468 | 12.90 | 13.08 | .43 | 1.77 |
| 691.880 | .88 | 38.78 | 6.68 | 5.8081 | 13.20 | 13.38 | .44 | 1.77 |
| 691.900 | .90 | 41.18 | 6.78 | 6.0753 | 13.50 | 13.68 | .45 | 1.78 |
| 691.920 | .92 | 43.66 | 6.88 | 6.3478 | 13.80 | 13.99 | .46 | 1.79 |
| 691.940 | .94 | 46.24 | 6.98 | 6.6270 | 14.10 | 14.29 | .47 | 1.79 |
| 691.960 | .96 | 48.91 | 7.08 | 6.9123 | 14.40 | 14.60 | .48 | 1.80 |
| 691.980 | .98 | 51.67 | 7.17 | 7.2027 | 14.70 | 14.90 | .49 | 1.81 |
| 692.000 | 1.00 | 54.54 | 7.27 | 7.5000 | 15.00 | 15.20 | .50 | 1.81 |

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-B1A          2
Outflow HYG file = NONE STORED - B1A             2

Reach Link Data  = B1A
Reach Length     = 522.00 ft
Approx. Total Tt = .0959 hrs  (based on Wtd.Q = 1.04 cfs)
Reach Channel    = BNCH  (Chn-Trapz.)
Overflow Elev.   = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev    =   730.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =      3.21 cfs    at   11.9500 hrs
Peak Outflow     =      2.93 cfs    at   12.0000 hrs
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =        .178
- Infiltration =        .000
- HYG Vol OUT  =        .178
- Retained Vol =        .000
                  ----------
  Unrouted Vol =        .000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-B1A          10
Outflow HYG file = NONE STORED - B1A             10

Reach Link Data  = B1A
Reach Length     = 522.00 ft
Approx. Total Tt = .0812 hrs  (based on Wtd.Q = 2.04 cfs)
Reach Channel    = BNCH  (Chn-Trapz.)
Overflow Elev.   = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =   730.00 ft
Starting Volume    =     .000 ac-ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =      6.10 cfs    at   11.9000 hrs
Peak Outflow     =      5.70 cfs    at   12.0000 hrs
=====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol  =       .000
+ HYG Vol IN   =       .339
- Infiltration =       .000
- HYG Vol OUT  =       .338
- Retained Vol =       .000
                 ----------
 Unrouted Vol =      -.000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir          = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-B1A           25
Outflow HYG file = NONE STORED - B1A              25

Reach Link Data  = B1A
Reach Length     = 522.00 ft
Approx. Total Tt = .0759 hrs  (based on Wtd.Q = 2.67 cfs)
Reach Channel    = BNCH  (Chn-Trapz.)
Overflow Elev.   = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev    =   730.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
====================================================
Peak Inflow       =      8.01 cfs    at   11.9000 hrs
Peak Outflow      =      7.44 cfs    at   12.0000 hrs
====================================================


MASS BALANCE (ac-ft)
-------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =        .443
- Infiltration =        .000
- HYG Vol OUT  =        .443
- Retained Vol =        .000
                  ----------
  Unrouted Vol =        .000 ac-ft  (.000% of Inflow Volume)
```

```
                    MODIFIED PULS REACH ROUTING SUMMARY

 HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
 Inflow  HYG file = NONE STORED - DA-B1B          2
 Outflow HYG file = NONE STORED - B1B             2

 Reach Link Data  = B1B
 Reach Length     = 378.00 ft
 Approx. Total Tt = .0767 hrs  (based on Wtd.Q = .70 cfs)
 Reach Channel    = BNCH  (Chn-Trapz.)
 Overflow Elev.   = 732.00 ft
 Overflow Channel = NONE

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev   =   730.00 ft
 Starting Volume    =     .000 ac-ft
 Starting Outflow   =      .00 cfs
 Starting Infiltr.  =      .00 cfs
 Starting Total Qout=      .00 cfs
 Time Increment     =    .0500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 ====================================================
 Peak Inflow      =      2.15 cfs    at   11.9500 hrs
 Peak Outflow     =      2.02 cfs    at   12.0000 hrs
 ====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol   =       .000
+ HYG Vol IN    =       .119
- Infiltration =       .000
- HYG Vol OUT   =       .119
- Retained Vol =       .000
                   ----------
 Unrouted Vol =       .000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir             = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-B1B           10
Outflow HYG file = NONE STORED - B1B              10

Reach Link Data   = B1B
Reach Length      = 378.00 ft
Approx. Total Tt = .0649 hrs  (based on Wtd.Q = 1.37 cfs)
Reach Channel     = BNCH  (Chn-Trapz.)
Overflow Elev.    = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
-----------------------------------
Starting WS Elev    =   730.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =      4.08 cfs    at   11.9000 hrs
Peak Outflow      =      3.88 cfs    at   11.9500 hrs
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol   =       .000
+ HYG Vol IN    =       .226
- Infiltration =        .000
- HYG Vol OUT   =       .226
- Retained Vol =        .000
                  ----------
  Unrouted Vol =       -.000 ac-ft  (.000% of Inflow Volume)
```

```
                    MODIFIED PULS REACH ROUTING SUMMARY

 HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
 Inflow  HYG file = NONE STORED - DA-B1B          25
 Outflow HYG file = NONE STORED - B1B             25

 Reach Link Data  = B1B
 Reach Length     = 378.00 ft
 Approx. Total Tt = .0607 hrs  (based on Wtd.Q = 1.79 cfs)
 Reach Channel    = BNCH  (Chn-Trapz.)
 Overflow Elev.   = 732.00 ft
 Overflow Channel = NONE

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev    =   730.00 ft
 Starting Volume     =     .000 ac-ft
 Starting Outflow    =      .00 cfs
 Starting Infiltr.   =      .00 cfs
 Starting Total Qout=       .00 cfs
 Time Increment      =    .0500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 =====================================================
 Peak Inflow      =      5.36 cfs    at   11.9000 hrs
 Peak Outflow     =      5.14 cfs    at   11.9500 hrs
 =====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol   =       .000
+ HYG Vol IN    =       .296
- Infiltration =        .000
- HYG Vol OUT   =       .296
- Retained Vol =        .000
                  ----------
 Unrouted Vol =       -.000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-B2A            2
Outflow HYG file = NONE STORED - B2A               2

Reach Link Data  = B2A
Reach Length     = 496.00 ft
Approx. Total Tt = .0922 hrs  (based on Wtd.Q = .99 cfs)
Reach Channel    = BNCH  (Chn-Trapz.)
Overflow Elev.   = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
---------------------------------
Starting WS Elev    =   730.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =      3.05 cfs    at   11.9500 hrs
Peak Outflow      =      2.80 cfs    at   12.0000 hrs
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =        .169
- Infiltration =         .000
- HYG Vol OUT   =        .169
- Retained Vol =         .000
                  ----------
  Unrouted Vol =         .000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-B2A          10
Outflow HYG file = NONE STORED - B2A             10

Reach Link Data  = B2A
Reach Length     = 496.00 ft
Approx. Total Tt = .0781 hrs  (based on Wtd.Q = 1.94 cfs)
Reach Channel    = BNCH  (Chn-Trapz.)
Overflow Elev.   = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =   730.00 ft
Starting Volume    =     .000 ac-ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =      5.79 cfs    at   11.9000 hrs
Peak Outflow      =      5.43 cfs    at   12.0000 hrs
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =        .322
- Infiltration =        .000
- HYG Vol OUT  =        .322
- Retained Vol =        .000
                 ----------
  Unrouted Vol =       -.000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-B2A          25
Outflow HYG file = NONE STORED - B2A             25

Reach Link Data  = B2A
Reach Length     = 496.00 ft
Approx. Total Tt = .0731 hrs  (based on Wtd.Q = 2.54 cfs)
Reach Channel    = BNCH  (Chn-Trapz.)
Overflow Elev.   = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =   730.00 ft
Starting Volume    =     .000 ac-ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =      7.61 cfs    at   11.9000 hrs
Peak Outflow      =      7.08 cfs    at   11.9500 hrs
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =        .421
- Infiltration =        .000
- HYG Vol OUT  =        .421
- Retained Vol =        .000
                  ----------
Unrouted Vol =        .000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-B2B           2
Outflow HYG file = NONE STORED - B2B              2

Reach Link Data  = B2B
Reach Length     = 419.00 ft
Approx. Total Tt = .0812 hrs  (based on Wtd.Q = .84 cfs)
Reach Channel    = BNCH  (Chn-Trapz.)
Overflow Elev.   = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =   730.00 ft
Starting Volume    =     .000 ac-ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =      2.59 cfs    at   11.9500 hrs
Peak Outflow      =      2.42 cfs    at   12.0000 hrs
=====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =        .143
- Infiltration =        .000
- HYG Vol OUT  =        .143
- Retained Vol =        .000
                  ----------
 Unrouted Vol =        .000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir          = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-B2B          10
Outflow HYG file = NONE STORED - B2B             10

Reach Link Data  = B2B
Reach Length     = 419.00 ft
Approx. Total Tt = .0687 hrs  (based on Wtd.Q = 1.65 cfs)
Reach Channel    = BNCH  (Chn-Trapz.)
Overflow Elev.   = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
-----------------------------------
Starting WS Elev    =   730.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =      4.92 cfs    at   11.9000 hrs
Peak Outflow     =      4.64 cfs    at   12.0000 hrs
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =        .273
- Infiltration =        .000
- HYG Vol OUT  =        .273
- Retained Vol =        .000
                  ----------
  Unrouted Vol =        .000 ac-ft  (.000% of Inflow Volume)
```

```
                    MODIFIED PULS REACH ROUTING SUMMARY

 HYG Dir          = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
 Inflow  HYG file = NONE STORED - DA-B2B           25
 Outflow HYG file = NONE STORED - B2B              25

 Reach Link Data  = B2B
 Reach Length     = 419.00 ft
 Approx. Total Tt = .0642 hrs  (based on Wtd.Q = 2.15 cfs)
 Reach Channel    = BNCH  (Chn-Trapz.)
 Overflow Elev.   = 732.00 ft
 Overflow Channel = NONE

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev   =   730.00 ft
 Starting Volume    =     .000 ac-ft
 Starting Outflow   =      .00 cfs
 Starting Infiltr.  =      .00 cfs
 Starting Total Qout=      .00 cfs
 Time Increment     =    .0500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 =====================================================
 Peak Inflow       =      6.46 cfs    at   11.9000 hrs
 Peak Outflow      =      6.14 cfs    at   11.9500 hrs
 =====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =        .357
- Infiltration =        .000
- HYG Vol OUT  =        .357
- Retained Vol =        .000
                ----------
 Unrouted Vol =       -.000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-B2C           2
Outflow HYG file = NONE STORED - B2C              2

Reach Link Data  = B2C
Reach Length     = 507.00 ft
Approx. Total Tt = .0969 hrs  (based on Wtd.Q = .89 cfs)
Reach Channel    = BNCH  (Chn-Trapz.)
Overflow Elev.   = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
---------------------------------
Starting WS Elev   =   730.00 ft
Starting Volume    =     .000 ac-ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =      2.73 cfs    at   11.9500 hrs
Peak Outflow     =      2.48 cfs    at   12.0000 hrs
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol  =       .000
+ HYG Vol IN   =       .151
- Infiltration =       .000
- HYG Vol OUT  =       .151
- Retained Vol =       .000
                 ----------
  Unrouted Vol =      -.000 ac-ft  (.000% of Inflow Volume)
```

```
                   MODIFIED PULS REACH ROUTING SUMMARY

 HYG Dir          = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
 Inflow  HYG file = NONE STORED - DA-B2C            10
 Outflow HYG file = NONE STORED - B2C               10

 Reach Link Data  = B2C
 Reach Length     = 507.00 ft
 Approx. Total Tt = .0820 hrs  (based on Wtd.Q = 1.74 cfs)
 Reach Channel    = BNCH  (Chn-Trapz.)
 Overflow Elev.   = 732.00 ft
 Overflow Channel = NONE

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev    =   730.00 ft
 Starting Volume     =     .000 ac-ft
 Starting Outflow    =      .00 cfs
 Starting Infiltr.   =      .00 cfs
 Starting Total Qout=       .00 cfs
 Time Increment      =    .0500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 =====================================================
 Peak Inflow       =      5.18 cfs    at   11.9000 hrs
 Peak Outflow      =      4.84 cfs    at   12.0000 hrs
 =====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =        .288
- Infiltration =         .000
- HYG Vol OUT   =        .288
- Retained Vol =         .000
                  ----------
 Unrouted Vol =          .000 ac-ft  (.000% of Inflow Volume)
```

```
                    MODIFIED PULS REACH ROUTING SUMMARY

 HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
 Inflow  HYG file = NONE STORED - DA-B2C           25
 Outflow HYG file = NONE STORED - B2C              25

 Reach Link Data  = B2C
 Reach Length     = 507.00 ft
 Approx. Total Tt = .0767 hrs  (based on Wtd.Q = 2.27 cfs)
 Reach Channel    = BNCH  (Chn-Trapz.)
 Overflow Elev.   = 732.00 ft
 Overflow Channel = NONE

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev   =   730.00 ft
 Starting Volume    =     .000 ac-ft
 Starting Outflow   =      .00 cfs
 Starting Infiltr.  =      .00 cfs
 Starting Total Qout=      .00 cfs
 Time Increment     =    .0500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 =====================================================
 Peak Inflow       =      6.81 cfs    at   11.9000 hrs
 Peak Outflow      =      6.32 cfs    at   12.0000 hrs
 =====================================================


 MASS BALANCE (ac-ft)
 -------------------------
+ Initial Vol  =       .000
+ HYG Vol IN   =       .376
- Infiltration =       .000
- HYG Vol OUT  =       .376
- Retained Vol =       .000
                 ----------
 Unrouted Vol =      -.000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-B3A         2
Outflow HYG file = NONE STORED - B3A            2

Reach Link Data  = B3A
Reach Length     = 552.00 ft
Approx. Total Tt = .1016 hrs  (based on Wtd.Q = 1.04 cfs)
Reach Channel    = BNCH  (Chn-Trapz.)
Overflow Elev.   = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev    =   730.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =      3.19 cfs    at   11.9500 hrs
Peak Outflow     =      2.88 cfs    at   12.0000 hrs
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =        .177
- Infiltration =        .000
- HYG Vol OUT   =        .177
- Retained Vol =        .000
                 ----------
 Unrouted Vol =        .000 ac-ft  (.000% of Inflow Volume)
```

```
                    MODIFIED PULS REACH ROUTING SUMMARY

 HYG Dir          = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
 Inflow  HYG file = NONE STORED - DA-B3A           10
 Outflow HYG file = NONE STORED - B3A              10

 Reach Link Data  = B3A
 Reach Length     = 552.00 ft
 Approx. Total Tt = .0860 hrs  (based on Wtd.Q = 2.03 cfs)
 Reach Channel    = BNCH  (Chn-Trapz.)
 Overflow Elev.   = 732.00 ft
 Overflow Channel = NONE

 No Infiltration

 INITIAL CONDITIONS
 ---------------------------------
 Starting WS Elev   =   730.00 ft
 Starting Volume    =     .000 ac-ft
 Starting Outflow   =      .00 cfs
 Starting Infiltr.  =      .00 cfs
 Starting Total Qout=      .00 cfs
 Time Increment     =    .0500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 ======================================================
 Peak Inflow      =      6.06 cfs    at   11.9000 hrs
 Peak Outflow     =      5.63 cfs    at   12.0000 hrs
 ======================================================


 MASS BALANCE (ac-ft)
 -------------------------
+ Initial Vol  =       .000
+ HYG Vol IN   =       .336
- Infiltration =       .000
- HYG Vol OUT  =       .336
- Retained Vol =       .000
                 ----------
 Unrouted Vol =      -.000 ac-ft  (.000% of Inflow Volume)
```

```
                    MODIFIED PULS REACH ROUTING SUMMARY

 HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
 Inflow  HYG file = NONE STORED - DA-B3A            25
 Outflow HYG file = NONE STORED - B3A               25

 Reach Link Data  = B3A
 Reach Length     = 552.00 ft
 Approx. Total Tt = .0804 hrs  (based on Wtd.Q = 2.65 cfs)
 Reach Channel    = BNCH  (Chn-Trapz.)
 Overflow Elev.   = 732.00 ft
 Overflow Channel = NONE

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev   =   730.00 ft
 Starting Volume    =     .000 ac-ft
 Starting Outflow   =      .00 cfs
 Starting Infiltr.  =      .00 cfs
 Starting Total Qout=      .00 cfs
 Time Increment     =    .0500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 =====================================================
 Peak Inflow       =      7.96 cfs    at   11.9000 hrs
 Peak Outflow      =      7.37 cfs    at   12.0000 hrs
 =====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol   =       .000
+ HYG Vol IN    =       .440
- Infiltration =       .000
- HYG Vol OUT   =       .440
- Retained Vol =       .000
                 ----------
 Unrouted Vol =       .000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-B3B          2
Outflow HYG file = NONE STORED - B3B             2

Reach Link Data  = B3B
Reach Length     = 661.00 ft
Approx. Total Tt = .1206 hrs  (based on Wtd.Q = 1.08 cfs)
Reach Channel    = BNCH  (Chn-Trapz.)
Overflow Elev.   = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev    =   730.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =      3.31 cfs    at   11.9500 hrs
Peak Outflow      =      2.88 cfs    at   12.0000 hrs
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =        .183
- Infiltration =        .000
- HYG Vol OUT  =        .183
- Retained Vol =        .000
                  ----------
  Unrouted Vol =       -.000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-B3B          10
Outflow HYG file = NONE STORED - B3B             10

Reach Link Data  = B3B
Reach Length     = 661.00 ft
Approx. Total Tt = .1019 hrs  (based on Wtd.Q = 2.11 cfs)
Reach Channel    = BNCH  (Chn-Trapz.)
Overflow Elev.   = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =   730.00 ft
Starting Volume    =     .000 ac-ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =      6.29 cfs    at   11.9000 hrs
Peak Outflow     =      5.72 cfs    at   12.0000 hrs
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =        .349
- Infiltration =        .000
- HYG Vol OUT  =        .349
- Retained Vol =        .000
                 ----------
Unrouted Vol =       -.000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir          = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-B3B          25
Outflow HYG file = NONE STORED - B3B             25

Reach Link Data  = B3B
Reach Length     = 661.00 ft
Approx. Total Tt = .0953 hrs  (based on Wtd.Q = 2.75 cfs)
Reach Channel    = BNCH  (Chn-Trapz.)
Overflow Elev.   = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
-----------------------------------
Starting WS Elev    =   730.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =      8.26 cfs    at   11.9000 hrs
Peak Outflow     =      7.52 cfs    at   12.0000 hrs
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =        .457
- Infiltration  =        .000
- HYG Vol OUT   =        .457
- Retained Vol  =        .000
                     ----------
  Unrouted Vol =        .000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-B4            2
Outflow HYG file = NONE STORED - B4               2

Reach Link Data  = B4
Reach Length     = 408.00 ft
Approx. Total Tt = .0817 hrs  (based on Wtd.Q = .74 cfs)
Reach Channel    = BNCH  (Chn-Trapz.)
Overflow Elev.   = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev    =   730.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow        =      2.27 cfs    at   11.9500 hrs
Peak Outflow       =      2.12 cfs    at   12.0000 hrs
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =        .126
- Infiltration =        .000
- HYG Vol OUT   =        .126
- Retained Vol =        .000
                  ----------
Unrouted Vol =        .000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-B4            10
Outflow HYG file = NONE STORED - B4               10

Reach Link Data  = B4
Reach Length     = 408.00 ft
Approx. Total Tt = .0691 hrs  (based on Wtd.Q = 1.44 cfs)
Reach Channel    = BNCH  (Chn-Trapz.)
Overflow Elev.   = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev    =   730.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs

INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =      4.32 cfs    at   11.9000 hrs
Peak Outflow     =      4.07 cfs    at   12.0000 hrs
=====================================================

MASS BALANCE (ac-ft)
-------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =        .239
- Infiltration =        .000
- HYG Vol OUT  =        .239
- Retained Vol =        .000
                  ----------
  Unrouted Vol =       -.000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir          = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-B4           25
Outflow HYG file = NONE STORED - B4              25

Reach Link Data  = B4
Reach Length     = 408.00 ft
Approx. Total Tt = .0646 hrs  (based on Wtd.Q = 1.89 cfs)
Reach Channel    = BNCH  (Chn-Trapz.)
Overflow Elev.   = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
---------------------------------
Starting WS Elev    =   730.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
====================================================
Peak Inflow       =      5.68 cfs    at   11.9000 hrs
Peak Outflow      =      5.38 cfs    at   11.9500 hrs
====================================================


  MASS BALANCE (ac-ft)
  -------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =        .313
- Infiltration =        .000
- HYG Vol OUT  =        .313
- Retained Vol =        .000
                  ----------
  Unrouted Vol =        .000 ac-ft  (.000% of Inflow Volume)
```

```
                    MODIFIED PULS REACH ROUTING SUMMARY

 HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
 Inflow  HYG file = NONE STORED - DA-B5            2
 Outflow HYG file = NONE STORED - B5               2

 Reach Link Data  = B5
 Reach Length     = 731.00 ft
 Approx. Total Tt = .1341 hrs  (based on Wtd.Q = 1.05 cfs)
 Reach Channel    = BNCH  (Chn-Trapz.)
 Overflow Elev.   = 732.00 ft
 Overflow Channel = NONE

 No Infiltration

 INITIAL CONDITIONS
 ---------------------------------
 Starting WS Elev   =   730.00 ft
 Starting Volume    =     .000 ac-ft
 Starting Outflow   =      .00 cfs
 Starting Infiltr.  =      .00 cfs
 Starting Total Qout=      .00 cfs
 Time Increment     =    .0500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 ====================================================
 Peak Inflow       =      3.23 cfs    at   11.9500 hrs
 Peak Outflow      =      2.73 cfs    at   12.0000 hrs
 ====================================================


 MASS BALANCE (ac-ft)
 -------------------------
+ Initial Vol  =       .000
+ HYG Vol IN   =       .179
- Infiltration =       .000
- HYG Vol OUT  =       .179
- Retained Vol =       .000
                 ----------
 Unrouted Vol =       .000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-B5           10
Outflow HYG file = NONE STORED - B5              10

Reach Link Data  = B5
Reach Length     = 731.00 ft
Approx. Total Tt = .1134 hrs  (based on Wtd.Q = 2.06 cfs)
Reach Channel    = BNCH  (Chn-Trapz.)
Overflow Elev.   = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =   730.00 ft
Starting Volume    =     .000 ac-ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =      6.16 cfs    at   11.9000 hrs
Peak Outflow      =      5.48 cfs    at   12.0000 hrs
=====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol  =       .000
+ HYG Vol IN   =       .341
- Infiltration =       .000
- HYG Vol OUT  =       .341
- Retained Vol =       .000
                ----------
 Unrouted Vol =       .000 ac-ft  (.000% of Inflow Volume)
```

Type.... Reach Routing Summary
Event: 25 yr
Name.... B5 Tag: 25
File.... P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\LNC&Dclose.ppw
Storm... TypeII 24hr Tag: 25

MODIFIED PULS REACH ROUTING SUMMARY

HYG Dir = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow HYG file = NONE STORED - DA-B5 25
Outflow HYG file = NONE STORED - B5 25

Reach Link Data = B5
Reach Length = 731.00 ft
Approx. Total Tt = .1061 hrs (based on Wtd.Q = 2.69 cfs)
Reach Channel = BNCH (Chn-Trapz.)
Overflow Elev. = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS

| | | |
|---|---|---|
| Starting WS Elev | = | 730.00 ft |
| Starting Volume | = | .000 ac-ft |
| Starting Outflow | = | .00 cfs |
| Starting Infiltr. | = | .00 cfs |
| Starting Total Qout | = | .00 cfs |
| Time Increment | = | .0500 hrs |

INFLOW/OUTFLOW HYDROGRAPH SUMMARY

| | | | | |
|---|---|---|---|---|
| Peak Inflow | = | 8.09 cfs | at | 11.9000 hrs |
| Peak Outflow | = | 7.23 cfs | at | 12.0000 hrs |

MASS BALANCE (ac-ft)

| | | |
|---|---|---|
| + Initial Vol | = | .000 |
| + HYG Vol IN | = | .446 |
| - Infiltration | = | .000 |
| - HYG Vol OUT | = | .446 |
| - Retained Vol | = | .000 |

Unrouted Vol = .000 ac-ft (.000% of Inflow Volume)

```
                    MODIFIED PULS REACH ROUTING SUMMARY

HYG Dir            = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-B6A          2
Outflow HYG file = NONE STORED - B6A             2

Reach Link Data  = B6A
Reach Length     = 627.00 ft
Approx. Total Tt = .1121 hrs  (based on Wtd.Q = 1.16 cfs)
Reach Channel    = BNCH  (Chn-Trapz.)
Overflow Elev.   = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
---------------------------------
Starting WS Elev   =   730.00 ft
Starting Volume    =     .000 ac-ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
====================================================
Peak Inflow      =      3.57 cfs    at   11.9500 hrs
Peak Outflow     =      3.16 cfs    at   12.0000 hrs
====================================================


MASS BALANCE (ac-ft)
-------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =        .198
- Infiltration =        .000
- HYG Vol OUT   =        .198
- Retained Vol =        .000
                    ----------
  Unrouted Vol =       -.000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file  = NONE STORED - DA-B6A           10
Outflow HYG file  = NONE STORED - B6A              10

Reach Link Data   = B6A
Reach Length      = 627.00 ft
Approx. Total Tt  = .0948 hrs  (based on Wtd.Q = 2.28 cfs)
Reach Channel     = BNCH  (Chn-Trapz.)
Overflow Elev.    = 732.00 ft
Overflow Channel  = NONE

No Infiltration

INITIAL CONDITIONS
---------------------------------
Starting WS Elev    =   730.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
====================================================
Peak Inflow      =      6.81 cfs    at   11.9000 hrs
Peak Outflow     =      6.24 cfs    at   12.0000 hrs
====================================================


MASS BALANCE (ac-ft)
-------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =        .377
- Infiltration  =        .000
- HYG Vol OUT   =        .377
- Retained Vol  =        .000
                    ----------
Unrouted Vol =           .000 ac-ft  (.000% of Inflow Volume)
```

```
                   MODIFIED PULS REACH ROUTING SUMMARY

  HYG Dir          = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
  Inflow  HYG file = NONE STORED - DA-B6A          25
  Outflow HYG file = NONE STORED - B6A             25

  Reach Link Data  = B6A
  Reach Length     = 627.00 ft
  Approx. Total Tt = .0887 hrs  (based on Wtd.Q = 2.98 cfs)
  Reach Channel    = BNCH  (Chn-Trapz.)
  Overflow Elev.   = 732.00 ft
  Overflow Channel = NONE

  No Infiltration

  INITIAL CONDITIONS
  ---------------------------------
  Starting WS Elev    =   730.00 ft
  Starting Volume     =     .000 ac-ft
  Starting Outflow    =      .00 cfs
  Starting Infiltr.   =      .00 cfs
  Starting Total Qout=       .00 cfs
  Time Increment      =    .0500 hrs


  INFLOW/OUTFLOW HYDROGRAPH SUMMARY
  ====================================================
  Peak Inflow       =      8.94 cfs    at   11.9000 hrs
  Peak Outflow      =      8.18 cfs    at   12.0000 hrs
  ====================================================


  MASS BALANCE (ac-ft)
  --------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =        .493
- Infiltration =        .000
- HYG Vol OUT  =        .493
- Retained Vol =        .000
                  ----------
  Unrouted Vol =        .000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-B6B          2
Outflow HYG file = NONE STORED - B6B             2

Reach Link Data  = B6B
Reach Length     = 376.00 ft
Approx. Total Tt = .0727 hrs  (based on Wtd.Q = .85 cfs)
Reach Channel    = BNCH  (Chn-Trapz.)
Overflow Elev.   = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev    =   730.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =      2.61 cfs    at   11.9500 hrs
Peak Outflow     =      2.46 cfs    at   12.0000 hrs
=====================================================


MASS BALANCE (ac-ft)
-------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =        .145
- Infiltration  =        .000
- HYG Vol OUT   =        .144
- Retained Vol  =        .000
                 ----------
  Unrouted Vol  =       -.000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-B6B          10
Outflow HYG file = NONE STORED - B6B             10

Reach Link Data  = B6B
Reach Length     = 376.00 ft
Approx. Total Tt = .0615 hrs  (based on Wtd.Q = 1.66 cfs)
Reach Channel    = BNCH  (Chn-Trapz.)
Overflow Elev.   = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =   730.00 ft
Starting Volume    =     .000 ac-ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =      4.97 cfs    at   11.9000 hrs
Peak Outflow     =      4.76 cfs    at   11.9500 hrs
=====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =        .275
- Infiltration  =        .000
- HYG Vol OUT   =        .275
- Retained Vol  =        .000
                    ----------
  Unrouted Vol =        .000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-B6B          25
Outflow HYG file = NONE STORED - B6B             25

Reach Link Data  = B6B
Reach Length     = 376.00 ft
Approx. Total Tt = .0575 hrs  (based on Wtd.Q = 2.17 cfs)
Reach Channel    = BNCH  (Chn-Trapz.)
Overflow Elev.   = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
---------------------------------
Starting WS Elev   =   730.00 ft
Starting Volume    =     .000 ac-ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
====================================================
Peak Inflow      =      6.53 cfs    at   11.9000 hrs
Peak Outflow     =      6.30 cfs    at   11.9500 hrs
====================================================


MASS BALANCE (ac-ft)
-------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =        .360
- Infiltration =        .000
- HYG Vol OUT   =        .360
- Retained Vol =        .000
                   ----------
Unrouted Vol =       -.000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-B6C          2
Outflow HYG file = NONE STORED - B6C             2

Reach Link Data  = B6C
Reach Length     = 598.00 ft
Approx. Total Tt = .1069 hrs  (based on Wtd.Q = 1.16 cfs)
Reach Channel    = BNCH  (Chn-Trapz.)
Overflow Elev.   = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev    =   730.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =      3.57 cfs    at   11.9500 hrs
Peak Outflow     =      3.19 cfs    at   12.0000 hrs
=====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =        .198
- Infiltration =        .000
- HYG Vol OUT  =        .198
- Retained Vol =        .000
                  ----------
 Unrouted Vol =       -.000 ac-ft  (.000% of Inflow Volume)
```

```
                    MODIFIED PULS REACH ROUTING SUMMARY

 HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
 Inflow  HYG file = NONE STORED - DA-B6C           10
 Outflow HYG file = NONE STORED - B6C              10

 Reach Link Data  = B6C
 Reach Length     = 598.00 ft
 Approx. Total Tt = .0904 hrs  (based on Wtd.Q = 2.28 cfs)
 Reach Channel    = BNCH  (Chn-Trapz.)
 Overflow Elev.   = 732.00 ft
 Overflow Channel = NONE

 No Infiltration

 INITIAL CONDITIONS
 ---------------------------------
 Starting WS Elev   =   730.00 ft
 Starting Volume    =     .000 ac-ft
 Starting Outflow   =      .00 cfs
 Starting Infiltr.  =      .00 cfs
 Starting Total Qout=      .00 cfs
 Time Increment     =    .0500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 =====================================================
 Peak Inflow      =      6.81 cfs    at   11.9000 hrs
 Peak Outflow     =      6.28 cfs    at   12.0000 hrs
 =====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol   =       .000
+ HYG Vol IN    =       .377
- Infiltration =        .000
- HYG Vol OUT   =       .377
- Retained Vol =        .000
                  ----------
 Unrouted Vol =       -.000 ac-ft  (.000% of Inflow Volume)
```

```
                    MODIFIED PULS REACH ROUTING SUMMARY

HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-B6C           25
Outflow HYG file = NONE STORED - B6C              25

Reach Link Data  = B6C
Reach Length     = 598.00 ft
Approx. Total Tt = .0846 hrs  (based on Wtd.Q = 2.98 cfs)
Reach Channel    = BNCH  (Chn-Trapz.)
Overflow Elev.   = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev    =   730.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =      8.94 cfs    at   11.9000 hrs
Peak Outflow     =      8.22 cfs    at   12.0000 hrs
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =        .493
- Infiltration =        .000
- HYG Vol OUT   =        .493
- Retained Vol =        .000
                  ----------
Unrouted Vol =        .000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file  = NONE STORED - DA-B8          2
Outflow HYG file  = NONE STORED - B8             2

Reach Link Data   = B8
Reach Length      = 477.00 ft
Approx. Total Tt  = .0906 hrs  (based on Wtd.Q = .91 cfs)
Reach Channel     = BNCH  (Chn-Trapz.)
Overflow Elev.    = 732.00 ft
Overflow Channel  = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev    =   730.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =      2.79 cfs    at   11.9500 hrs
Peak Outflow     =      2.57 cfs    at   12.0000 hrs
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol    =        .000
+ HYG Vol IN     =        .155
- Infiltration   =        .000
- HYG Vol OUT    =        .154
- Retained Vol   =        .000
                    ----------
  Unrouted Vol   =        .000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-B8           10
Outflow HYG file = NONE STORED - B8              10

Reach Link Data  = B8
Reach Length     = 477.00 ft
Approx. Total Tt = .0767 hrs  (based on Wtd.Q = 1.78 cfs)
Reach Channel    = BNCH  (Chn-Trapz.)
Overflow Elev.   = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =   730.00 ft
Starting Volume    =     .000 ac-ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =      5.31 cfs    at   11.9000 hrs
Peak Outflow     =      4.98 cfs    at   12.0000 hrs
=====================================================


  MASS BALANCE (ac-ft)
  --------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =        .294
- Infiltration =        .000
- HYG Vol OUT  =        .294
- Retained Vol =        .000
                  ----------
  Unrouted Vol =       -.000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-B8            25
Outflow HYG file = NONE STORED - B8               25

Reach Link Data  = B8
Reach Length     = 477.00 ft
Approx. Total Tt = .0717 hrs  (based on Wtd.Q = 2.32 cfs)
Reach Channel    = BNCH  (Chn-Trapz.)
Overflow Elev.   = 732.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev    =    730.00 ft
Starting Volume     =      .000 ac-ft
Starting Outflow    =       .00 cfs
Starting Infiltr.   =       .00 cfs
Starting Total Qout=        .00 cfs
Time Increment      =     .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =      6.98 cfs    at   11.9000 hrs
Peak Outflow      =      6.51 cfs    at   11.9500 hrs
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =        .385
- Infiltration =         .000
- HYG Vol OUT   =        .385
- Retained Vol =         .000
                   ----------
  Unrouted Vol =       -.000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-D1            2
Outflow HYG file = NONE STORED - D1               2

Reach Link Data  = D1
Reach Length     = 1085.00 ft
Approx. Total Tt = .1466 hrs  (based on Wtd.Q = 1.89 cfs)
Reach Channel    = D  (Chn-Trapz.)
Overflow Elev.   = 681.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =   678.00 ft
Starting Volume    =     .000 ac-ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =      5.80 cfs    at   11.9500 hrs
Peak Outflow      =      4.75 cfs    at   12.0000 hrs
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =        .321
- Infiltration =        .000
- HYG Vol OUT  =        .321
- Retained Vol =        .000
                  ----------
  Unrouted Vol =        .000 ac-ft  (.000% of Inflow Volume)
```

```
                 MODIFIED PULS REACH ROUTING SUMMARY

 HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
 Inflow  HYG file = NONE STORED - DA-D1             10
 Outflow HYG file = NONE STORED - D1                10

 Reach Link Data  = D1
 Reach Length     = 1085.00 ft
 Approx. Total Tt = .1240 hrs  (based on Wtd.Q = 3.69 cfs)
 Reach Channel    = D  (Chn-Trapz.)
 Overflow Elev.   = 681.00 ft
 Overflow Channel = NONE

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev   =   678.00 ft
 Starting Volume    =     .000 ac-ft
 Starting Outflow   =      .00 cfs
 Starting Infiltr.  =      .00 cfs
 Starting Total Qout=      .00 cfs
 Time Increment     =    .0500 hrs

 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 =====================================================
 Peak Inflow      =     11.05 cfs    at   11.9000 hrs
 Peak Outflow     =      9.65 cfs    at   12.0000 hrs
 =====================================================

 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =        .612
- Infiltration =        .000
- HYG Vol OUT  =        .611
- Retained Vol =        .000
               ----------
 Unrouted Vol =       -.000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir            = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-D1          25
Outflow HYG file = NONE STORED - D1             25

Reach Link Data  = D1
Reach Length     = 1085.00 ft
Approx. Total Tt = .1160 hrs  (based on Wtd.Q = 4.83 cfs)
Reach Channel    = D  (Chn-Trapz.)
Overflow Elev.   = 681.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =   678.00 ft
Starting Volume    =     .000 ac-ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =     14.52 cfs    at   11.9000 hrs
Peak Outflow     =     12.77 cfs    at   12.0000 hrs
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =        .800
- Infiltration =        .000
- HYG Vol OUT  =        .800
- Retained Vol =        .000
                  ----------
Unrouted Vol =       -.000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - J3                2
Outflow HYG file = NONE STORED - D2                2

Reach Link Data  = D2
Reach Length     = 691.00 ft
Approx. Total Tt = .0653 hrs  (based on Wtd.Q = 7.90 cfs)
Reach Channel    = D  (Chn-Trapz.)
Overflow Elev.   = 681.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
-----------------------------------
Starting WS Elev    =   678.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs

INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =     24.51 cfs    at   12.0000 hrs
Peak Outflow      =     23.26 cfs    at   12.0500 hrs
=====================================================

MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =       1.568
- Infiltration =         .000
- HYG Vol OUT   =       1.568
- Retained Vol =         .000
                    ----------
  Unrouted Vol =        -.000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - J3                10
Outflow HYG file = NONE STORED - D2                10

Reach Link Data  = D2
Reach Length     = 691.00 ft
Approx. Total Tt = .0547 hrs  (based on Wtd.Q = 16.10 cfs)
Reach Channel    = D  (Chn-Trapz.)
Overflow Elev.   = 681.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev    =   678.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =     48.45 cfs    at   12.0000 hrs
Peak Outflow     =     46.64 cfs    at   12.0000 hrs
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =       2.985
- Infiltration =        .000
- HYG Vol OUT  =       2.985
- Retained Vol =        .000
                  ----------
Unrouted Vol =        -.000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file  = NONE STORED - J3                 25
Outflow HYG file  = NONE STORED - D2                 25

Reach Link Data   = D2
Reach Length      = 691.00 ft
Approx. Total Tt  = .0510 hrs  (based on Wtd.Q = 21.33 cfs)
Reach Channel     = D  (Chn-Trapz.)
Overflow Elev.    = 681.00 ft
Overflow Channel  = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev    =   678.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =     63.58 cfs     at   12.0000 hrs
Peak Outflow     =     62.27 cfs     at   12.0000 hrs
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol   =       .000
+ HYG Vol IN    =      3.906
- Infiltration  =       .000
- HYG Vol OUT   =      3.905
- Retained Vol  =       .000
                  ----------
Unrouted Vol    =     -.000 ac-ft  (.000% of Inflow Volume)
```

```
                    MODIFIED PULS REACH ROUTING SUMMARY

 HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
 Inflow  HYG file = NONE STORED - DA-D3            2
 Outflow HYG file = NONE STORED - D3               2

 Reach Link Data  = D3
 Reach Length     = 486.00 ft
 Approx. Total Tt = .0788 hrs  (based on Wtd.Q = .91 cfs)
 Reach Channel    = D  (Chn-Trapz.)
 Overflow Elev.   = 681.00 ft
 Overflow Channel = NONE

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev   =   678.00 ft
 Starting Volume    =     .000 ac-ft
 Starting Outflow   =      .00 cfs
 Starting Infiltr.  =      .00 cfs
 Starting Total Qout=      .00 cfs
 Time Increment     =    .0500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 =====================================================
 Peak Inflow       =      2.79 cfs    at   11.9500 hrs
 Peak Outflow      =      2.62 cfs    at   12.0000 hrs
 =====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol   =       .000
+ HYG Vol IN    =       .155
- Infiltration =        .000
- HYG Vol OUT   =       .154
- Retained Vol =        .000
                ----------
 Unrouted Vol =       -.000 ac-ft  (.000% of Inflow Volume)
```

```
                    MODIFIED PULS REACH ROUTING SUMMARY

 HYG Dir            = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
 Inflow  HYG file = NONE STORED - DA-D3              10
 Outflow HYG file = NONE STORED - D3                 10

 Reach Link Data  = D3
 Reach Length     = 486.00 ft
 Approx. Total Tt = .0667 hrs  (based on Wtd.Q = 1.78 cfs)
 Reach Channel    = D  (Chn-Trapz.)
 Overflow Elev.   = 681.00 ft
 Overflow Channel = NONE

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev    =   678.00 ft
 Starting Volume     =     .000 ac-ft
 Starting Outflow    =      .00 cfs
 Starting Infiltr.   =      .00 cfs
 Starting Total Qout=       .00 cfs
 Time Increment      =    .0500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 =====================================================
 Peak Inflow       =      5.31 cfs    at   11.9000 hrs
 Peak Outflow      =      5.03 cfs    at   11.9500 hrs
 =====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =        .294
- Infiltration =         .000
- HYG Vol OUT   =        .294
- Retained Vol =         .000
                    ----------
 Unrouted Vol =        -.000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-D3           25
Outflow HYG file = NONE STORED - D3              25

Reach Link Data  = D3
Reach Length     = 486.00 ft
Approx. Total Tt = .0624 hrs  (based on Wtd.Q = 2.32 cfs)
Reach Channel    = D  (Chn-Trapz.)
Overflow Elev.   = 681.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =   678.00 ft
Starting Volume    =     .000 ac-ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =      6.98 cfs    at   11.9000 hrs
Peak Outflow     =      6.66 cfs    at   11.9500 hrs
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =        .385
- Infiltration =        .000
- HYG Vol OUT  =        .385
- Retained Vol =        .000
                  ----------
  Unrouted Vol =       -.000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - J4          2
Outflow HYG file = NONE STORED - D4          2

Reach Link Data  = D4
Reach Length     = 1897.00 ft
Approx. Total Tt = .1931 hrs  (based on Wtd.Q = 5.88 cfs)
Reach Channel    = D  (Chn-Trapz.)
Overflow Elev.   = 681.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =   678.00 ft
Starting Volume    =     .000 ac-ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =     18.12 cfs    at   11.9500 hrs
Peak Outflow     =     13.78 cfs    at   12.0500 hrs
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol   =       .000
+ HYG Vol IN    =      1.057
- Infiltration  =       .000
- HYG Vol OUT   =      1.057
- Retained Vol  =       .000
                  ----------
  Unrouted Vol  =       .000 ac-ft  (.000% of Inflow Volume)
```

```
                    MODIFIED PULS REACH ROUTING SUMMARY

 HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
 Inflow  HYG file = NONE STORED - J4              10
 Outflow HYG file = NONE STORED - D4              10

 Reach Link Data  = D4
 Reach Length     = 1897.00 ft
 Approx. Total Tt = .1626 hrs  (based on Wtd.Q = 11.68 cfs)
 Reach Channel    = D  (Chn-Trapz.)
 Overflow Elev.   = 681.00 ft
 Overflow Channel = NONE

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev    =   678.00 ft
 Starting Volume     =     .000 ac-ft
 Starting Outflow    =      .00 cfs
 Starting Infiltr.   =      .00 cfs
 Starting Total Qout=       .00 cfs
 Time Increment      =    .0500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 ==================================================
 Peak Inflow       =     35.21 cfs    at   11.9500 hrs
 Peak Outflow      =     28.23 cfs    at   12.0500 hrs
 ==================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =       2.012
- Infiltration =        .000
- HYG Vol OUT  =       2.012
- Retained Vol =        .000
                  ----------
 Unrouted Vol =        .000 ac-ft  (.000% of Inflow Volume)
```

```
                    MODIFIED PULS REACH ROUTING SUMMARY

 HYG Dir             = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
 Inflow  HYG file = NONE STORED - J4                  25
 Outflow HYG file = NONE STORED - D4                  25

 Reach Link Data  = D4
 Reach Length     = 1897.00 ft
 Approx. Total Tt = .1519 hrs  (based on Wtd.Q = 15.35 cfs)
 Reach Channel    = D  (Chn-Trapz.)
 Overflow Elev.   = 681.00 ft
 Overflow Channel = NONE

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev    =   678.00 ft
 Starting Volume     =     .000 ac-ft
 Starting Outflow    =      .00 cfs
 Starting Infiltr.   =      .00 cfs
 Starting Total Qout=       .00 cfs
 Time Increment      =    .0500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 =====================================================
 Peak Inflow       =     46.07 cfs    at   11.9500 hrs
 Peak Outflow      =     37.74 cfs    at   12.0000 hrs
 =====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =       2.633
- Infiltration =         .000
- HYG Vol OUT   =       2.632
- Retained Vol =         .000
                   ----------
 Unrouted Vol =         .000 ac-ft  (.000% of Inflow Volume)
```

```
                    MODIFIED PULS REACH ROUTING SUMMARY

 HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
 Inflow  HYG file = NONE STORED - DA-HR1          2
 Outflow HYG file = NONE STORED - HR1             2

 Reach Link Data  = HR1
 Reach Length     = 892.00 ft
 Approx. Total Tt = .1260 hrs  (based on Wtd.Q = 1.51 cfs)
 Reach Channel    = HR1  (Chn-Trapz.)
 Overflow Elev.   = 794.00 ft
 Overflow Channel = NONE

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev   =   793.00 ft
 Starting Volume    =     .000 ac-ft
 Starting Outflow   =      .00 cfs
 Starting Infiltr.  =      .00 cfs
 Starting Total Qout=      .00 cfs
 Time Increment     =    .0500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 =====================================================
 Peak Inflow       =      4.63 cfs    at   11.9500 hrs
 Peak Outflow      =      3.98 cfs    at   12.0000 hrs
 =====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =        .257
- Infiltration =        .000
- HYG Vol OUT  =        .257
- Retained Vol =        .000
                 ----------
 Unrouted Vol =        .000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir            = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-HR1          10
Outflow HYG file = NONE STORED - HR1             10

Reach Link Data  = HR1
Reach Length     = 892.00 ft
Approx. Total Tt = .1065 hrs  (based on Wtd.Q = 2.95 cfs)
Reach Channel    = HR1  (Chn-Trapz.)
Overflow Elev.   = 794.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
---------------------------------
Starting WS Elev    =    793.00 ft
Starting Volume     =      .000 ac-ft
Starting Outflow    =       .00 cfs
Starting Infiltr.   =       .00 cfs
Starting Total Qout=        .00 cfs
Time Increment      =     .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
====================================================
Peak Inflow       =      8.83 cfs    at   11.9000 hrs
Peak Outflow      =      7.96 cfs    at   12.0000 hrs
====================================================


MASS BALANCE (ac-ft)
-------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =        .489
- Infiltration =         .000
- HYG Vol OUT   =        .489
- Retained Vol =         .000
                    ----------
 Unrouted Vol =        -.000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - DA-HR1           25
Outflow HYG file = NONE STORED - HR1              25

Reach Link Data  = HR1
Reach Length     = 892.00 ft
Approx. Total Tt = .0996 hrs  (based on Wtd.Q = 3.86 cfs)
Reach Channel    = HR1  (Chn-Trapz.)
Overflow Elev.   = 794.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =   793.00 ft
Starting Volume    =     .000 ac-ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =     11.60 cfs    at   11.9000 hrs
Peak Outflow     =     10.47 cfs    at   12.0000 hrs
=====================================================


MASS BALANCE (ac-ft)
-------------------------
+ Initial Vol  =       .000
+ HYG Vol IN   =       .639
- Infiltration =       .000
- HYG Vol OUT  =       .639
- Retained Vol =       .000
                 ----------
  Unrouted Vol =      -.000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir            = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - J1                  2
Outflow HYG file = NONE STORED - HR2                 2

Reach Link Data  = HR2
Reach Length     = 658.00 ft
Approx. Total Tt = .0630 hrs  (based on Wtd.Q = 2.53 cfs)
Reach Channel    = HR2  (Chn-Trapz.)
Overflow Elev.   = 759.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
-----------------------------------
Starting WS Elev    =   758.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =      7.75 cfs    at   12.0000 hrs
Peak Outflow      =      7.49 cfs    at   12.0000 hrs
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =        .485
- Infiltration =         .000
- HYG Vol OUT   =        .485
- Retained Vol =         .000
                   ----------
  Unrouted Vol =         .000 ac-ft  (.000% of Inflow Volume)
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - J1                10
Outflow HYG file = NONE STORED - HR2               10

Reach Link Data  = HR2
Reach Length     = 658.00 ft
Approx. Total Tt = .0528 hrs  (based on Wtd.Q = 5.10 cfs)
Reach Channel    = HR2  (Chn-Trapz.)
Overflow Elev.   = 759.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =   758.00 ft
Starting Volume    =     .000 ac-ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =     15.28 cfs    at   11.9500 hrs
Peak Outflow     =     14.99 cfs    at   12.0000 hrs
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =        .922
- Infiltration =        .000
- HYG Vol OUT   =        .922
- Retained Vol =        .000
                 ----------
Unrouted Vol =       -.000 ac-ft  (.000% of Inflow Volume)
```

```
                   MODIFIED PULS REACH ROUTING SUMMARY

 HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
 Inflow  HYG file = NONE STORED - J1                 25
 Outflow HYG file = NONE STORED - HR2                25

 Reach Link Data  = HR2
 Reach Length     = 658.00 ft
 Approx. Total Tt = .0493 hrs  (based on Wtd.Q = 6.74 cfs)
 Reach Channel    = HR2  (Chn-Trapz.)
 Overflow Elev.   = 759.00 ft
 Overflow Channel = NONE

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev   =   758.00 ft
 Starting Volume    =     .000 ac-ft
 Starting Outflow   =      .00 cfs
 Starting Infiltr.  =      .00 cfs
 Starting Total Qout=      .00 cfs
 Time Increment     =    .0500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 =====================================================
 Peak Inflow       =     20.17 cfs    at   11.9500 hrs
 Peak Outflow      =     19.74 cfs    at   12.0000 hrs
 =====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol   =       .000
+ HYG Vol IN    =      1.207
- Infiltration =        .000
- HYG Vol OUT   =      1.207
- Retained Vol =        .000
                 ----------
 Unrouted Vol =        .000 ac-ft  (.000% of Inflow Volume)


 WARNING: For weighted average inflow, the approximate total
 travel time through entire reach is shorter than
 the inflow hydrograph time step. Consider reducing
 calculation time step.
 Wtd.Avg.Q = 6.74 cfs   Approx.Total Tt = .0493 hrs
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - J2              2
Outflow HYG file = NONE STORED - HR3             2

Reach Link Data  = HR3
Reach Length     = 608.00 ft
Approx. Total Tt = .0462 hrs  (based on Wtd.Q = 3.47 cfs)
Reach Channel    = HR3  (Chn-Trapz.)
Overflow Elev.   = 692.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =   691.00 ft
Starting Volume    =     .000 ac-ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =     10.76 cfs    at   12.0000 hrs
Peak Outflow     =     10.42 cfs    at   12.0000 hrs
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =        .683
- Infiltration =        .000
- HYG Vol OUT  =        .683
- Retained Vol =        .000
                  ----------
Unrouted Vol =       -.000 ac-ft  (.000% of Inflow Volume)


WARNING: For weighted average inflow, the approximate total
travel time through entire reach is shorter than
the inflow hydrograph time step. Consider reducing
calculation time step.
Wtd.Avg.Q = 3.47 cfs   Approx.Total Tt = .0462 hrs
```

```
                MODIFIED PULS REACH ROUTING SUMMARY

HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file  = NONE STORED - J2               10
Outflow HYG file  = NONE STORED - HR3              10

Reach Link Data   = HR3
Reach Length      = 608.00 ft
Approx. Total Tt  = .0387 hrs  (based on Wtd.Q = 7.06 cfs)
Reach Channel     = HR3  (Chn-Trapz.)
Overflow Elev.    = 692.00 ft
Overflow Channel  = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev    =   691.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =     21.03 cfs    at   12.0000 hrs
Peak Outflow      =     21.00 cfs    at   12.0000 hrs
=====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =       1.299
- Infiltration =         .000
- HYG Vol OUT   =       1.299
- Retained Vol =         .000
                    ----------
 Unrouted Vol =         .000 ac-ft  (.000% of Inflow Volume)


WARNING: For weighted average inflow, the approximate total
travel time through entire reach is shorter than
the inflow hydrograph time step. Consider reducing
calculation time step.
Wtd.Avg.Q = 7.06 cfs   Approx.Total Tt = .0387 hrs
```

MODIFIED PULS REACH ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - J2               25
Outflow HYG file = NONE STORED - HR3              25

Reach Link Data  = HR3
Reach Length     = 608.00 ft
Approx. Total Tt = .0361 hrs  (based on Wtd.Q = 9.34 cfs)
Reach Channel    = HR3  (Chn-Trapz.)
Overflow Elev.   = 692.00 ft
Overflow Channel = NONE

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev    =   691.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =     27.66 cfs    at   11.9500 hrs
Peak Outflow      =     27.72 cfs    at   12.0000 hrs
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =       1.700
- Infiltration =         .000
- HYG Vol OUT   =       1.699
- Retained Vol =         .000
                   ----------
  Unrouted Vol =        -.000 ac-ft  (.000% of Inflow Volume)


WARNING: For weighted average inflow, the approximate total
travel time through entire reach is shorter than
the inflow hydrograph time step. Consider reducing
calculation time step.
Wtd.Avg.Q = 9.34 cfs   Approx.Total Tt = .0361 hrs
```

REQUESTED POND WS ELEVATIONS:

Min. Elev.= 669.00 ft
Increment = .05 ft
Max. Elev.= 676.00 ft

********************************************
OUTLET CONNECTIVITY
********************************************

---> Forward Flow Only (UpStream to DnStream)
<--- Reverse Flow Only (DnStream to UpStream)
<---> Forward and Reverse Both Allowed

| Structure | No. | | Outfall | E1, ft | E2, ft |
|---|---|---|---|---|---|
| Stand Pipe | R0 | ---> | C0 | 673.400 | 676.000 |
| Culvert-Circular | C0 | ---> | TW | 669.000 | 676.000 |
| Weir-XY Points | W0 | ---> | TW | 674.700 | 676.000 |
| TW SETUP, DS Channel | | | | | |

OUTLET STRUCTURE INPUT DATA

```
Structure ID       = R0
Structure Type     = Stand Pipe
------------------------------------
# of Openings      =         1
Invert Elev.       =    673.40 ft
Diameter           =    3.0000 ft
Orifice Area       =    7.0686 sq.ft
Orifice Coeff.     =      .590
Weir Length        =      9.42 ft
Weir Coeff.        =     3.100
K, Reverse         =     1.000
Mannings n         =     .0000
Kev,Charged Riser  =      .000
Weir Submergence   = No
```

OUTLET STRUCTURE INPUT DATA

```
Structure ID       = CO
Structure Type     = Culvert-Circular
-----------------------------------
No. Barrels        =        1
Barrel Diameter    =    2.5000 ft
Upstream Invert    =    669.00 ft
Dnstream Invert    =    668.00 ft
Horiz. Length      =     55.00 ft
Barrel Length      =     55.01 ft
Barrel Slope       =    .01818 ft/ft

OUTLET CONTROL DATA...
Mannings n         =     .0220
Ke                 =     .9000  (forward entrance loss)
Kb                 =   .026397  (per ft of full flow)
Kr                 =     .9000  (reverse entrance loss)
HW Convergence     =      .001  +/- ft

INLET CONTROL DATA...
Equation form      =         1
Inlet Control K    =     .0340
Inlet Control M    =    1.5000
Inlet Control c    =    .05530
Inlet Control Y    =     .5400
T1 ratio (HW/D)    =     1.254
T2 ratio (HW/D)    =     1.416
Slope Factor       =     -.500
```

```
Use unsubmerged inlet control Form 1 equ. below T1 elev.
Use   submerged inlet control Form 1 equ. above T2 elev.

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...
At T1 Elev =    672.13 ft  --->  Flow =     27.16 cfs
At T2 Elev =    672.54 ft  --->  Flow =     31.05 cfs
```

OUTLET STRUCTURE INPUT DATA

Structure ID = WO
Structure Type = Weir-XY Points

# of Openings = 1
WEIR X-Y GROUND POINTS

| X, ft | Elev, ft |
|---|---|
| .00 | 676.00 |
| 3.90 | 674.70 |
| 19.90 | 674.70 |
| 23.80 | 676.00 |

Lowest Elev. = 674.70 ft

Weir Coeff. = 3.330000

Weir TW effects (Use adjustment equation)

Structure ID = TW
Structure Type = TW SETUP, DS Channel

FREE OUTFALL CONDITIONS SPECIFIED

CONVERGENCE TOLERANCES...
Maximum Iterations= 40
Min. TW tolerance = .01 ft
Max. TW tolerance = .01 ft
Min. HW tolerance = .01 ft
Max. HW tolerance = .01 ft
Min. Q tolerance = .00 cfs
Max. Q tolerance = .00 cfs

REQUESTED POND WS ELEVATIONS:

Min. Elev.= 673.00 ft
Increment = .05 ft
Max. Elev.= 681.00 ft

*********************************************
OUTLET CONNECTIVITY
*********************************************

---> Forward Flow Only (UpStream to DnStream)
<--- Reverse Flow Only (DnStream to UpStream)
<---> Forward and Reverse Both Allowed

| Structure | No. | | Outfall | E1, ft | E2, ft |
|---|---|---|---|---|---|
| Stand Pipe | R0 | ---> | C0 | 678.000 | 681.000 |
| Culvert-Circular | C0 | ---> | TW | 673.000 | 681.000 |
| Weir-XY Points | W0 | ---> | TW | 679.000 | 681.000 |
| TW SETUP, DS Channel | | | | | |

OUTLET STRUCTURE INPUT DATA

```
Structure ID       = R0
Structure Type     = Stand Pipe
------------------------------------
# of Openings      =          1
Invert Elev.       =     678.00 ft
Diameter           =     2.0000 ft
Orifice Area       =     3.1416 sq.ft
Orifice Coeff.     =       .600
Weir Length        =       6.28 ft
Weir Coeff.        =      1.800
K, Reverse         =      1.000
Mannings n         =      .0000
Kev,Charged Riser  =       .000
Weir Submergence   = No
```

OUTLET STRUCTURE INPUT DATA

```
Structure ID       = CO
Structure Type     = Culvert-Circular
------------------------------------
No. Barrels        =        1
Barrel Diameter    =    1.2500 ft
Upstream Invert    =    673.00 ft
Dnstream Invert    =    672.00 ft
Horiz. Length      =     65.00 ft
Barrel Length      =     65.01 ft
Barrel Slope       =    .01538 ft/ft

OUTLET CONTROL DATA...
Mannings n         =     .0220
Ke                 =     .9000  (forward entrance loss)
Kb                 =   .066516  (per ft of full flow)
Kr                 =     .9000  (reverse entrance loss)
HW Convergence     =      .001  +/- ft

INLET CONTROL DATA...
Equation form      =        1
Inlet Control K    =     .0340
Inlet Control M    =    1.5000
Inlet Control c    =    .05530
Inlet Control Y    =     .5400
T1 ratio (HW/D)    =     1.255
T2 ratio (HW/D)    =     1.417
Slope Factor       =     -.500
```

```
Use unsubmerged inlet control Form 1 equ. below T1 elev.
Use   submerged inlet control Form 1 equ. above T2 elev.

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...
At T1 Elev =    674.57 ft  --->  Flow =       4.80 cfs
At T2 Elev =    674.77 ft  --->  Flow =       5.49 cfs
```

OUTLET STRUCTURE INPUT DATA

```
Structure ID       = W0
Structure Type     = Weir-XY Points
------------------------------------
# of Openings      =         1
WEIR X-Y GROUND POINTS

    X, ft     Elev, ft
 ---------   ---------
       .00      681.00
      6.00      679.00
     16.00      679.00
     22.00      681.00

Lowest Elev.       =    679.00 ft

Weir Coeff.        =  1.600000

Weir TW effects     (Use adjustment equation)



Structure ID       = TW
Structure Type     = TW SETUP, DS Channel
------------------------------------
FREE OUTFALL CONDITIONS SPECIFIED

CONVERGENCE TOLERANCES...
Maximum Iterations=    40
Min. TW tolerance =    .01 ft
Max. TW tolerance =    .01 ft
Min. HW tolerance =    .01 ft
Max. HW tolerance =    .01 ft
Min.  Q tolerance =    .00 cfs
Max.  Q tolerance =    .00 cfs
```

```
                    LEVEL POOL ROUTING SUMMARY

  HYG Dir            = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
  Inflow  HYG file = NONE STORED - SB1          IN  2
  Outflow HYG file = NONE STORED - SB1          OUT 2

  Pond Node   Data = SB1
  Pond Volume Data = SB1
  Pond Outlet Data = RB+WEIR

  No Infiltration

  INITIAL CONDITIONS
  ----------------------------------
  Starting WS Elev   =   669.00 ft
  Starting Volume    =     .000 ac-ft
  Starting Outflow   =      .00 cfs
  Starting Infiltr.  =      .00 cfs
  Starting Total Qout=      .00 cfs
  Time Increment     =    .0500 hrs


  INFLOW/OUTFLOW HYDROGRAPH SUMMARY
  =====================================================
  Peak Inflow      =     28.09 cfs    at   12.0000 hrs
  Peak Outflow     =      1.26 cfs    at   15.0500 hrs
  -----------------------------------------------------
  Peak Elevation   =   673.52 ft
  Peak Storage =          1.413 ac-ft
  =====================================================


  MASS BALANCE (ac-ft)
  --------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =       2.031
- Infiltration  =        .000
- HYG Vol OUT   =        .672
- Retained Vol  =       1.359
                  ----------
  Unrouted Vol =       -.000 ac-ft  (.000% of Inflow Volume)
```

LEVEL POOL ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - SB1          IN  10
Outflow HYG file = NONE STORED - SB1          OUT 10

Pond Node   Data = SB1
Pond Volume Data = SB1
Pond Outlet Data = RB+WEIR

No Infiltration

INITIAL CONDITIONS
-----------------------------------
Starting WS Elev    =   669.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =     56.61 cfs    at   12.0000 hrs
Peak Outflow      =     16.90 cfs    at   12.3000 hrs
-----------------------------------------------------
Peak Elevation    =    674.09 ft
Peak Storage =          1.682 ac-ft
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol   =       .000
+ HYG Vol IN    =      3.792
- Infiltration =       .000
- HYG Vol OUT   =      2.434
- Retained Vol =      1.359
                  ----------
  Unrouted Vol =      -.000 ac-ft  (.000% of Inflow Volume)
```

LEVEL POOL ROUTING SUMMARY

```
HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
Inflow  HYG file = NONE STORED - SB1          IN  25
Outflow HYG file = NONE STORED - SB1          OUT 25

Pond Node   Data = SB1
Pond Volume Data = SB1
Pond Outlet Data = RB+WEIR

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev    =   669.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =     74.90 cfs    at   12.0000 hrs
Peak Outflow      =     36.70 cfs    at   12.1500 hrs
-----------------------------------------------------
Peak Elevation    =   674.60 ft
Peak Storage =          1.933 ac-ft
=====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol   =       .000
+ HYG Vol IN    =      4.933
- Infiltration  =       .000
- HYG Vol OUT   =      3.575
- Retained Vol  =      1.359
                  ----------
 Unrouted Vol =        -.000 ac-ft  (.000% of Inflow Volume)
```

```
                   LEVEL POOL ROUTING SUMMARY

 HYG Dir          = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
 Inflow  HYG file = NONE STORED - SB2          IN  2
 Outflow HYG file = NONE STORED - SB2          OUT 2

 Pond Node   Data = SB2
 Pond Volume Data = SB2
 Pond Outlet Data = SB2-R+W

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev    =   673.00 ft
 Starting Volume     =     .000 ac-ft
 Starting Outflow    =      .00 cfs
 Starting Infiltr.   =      .00 cfs
 Starting Total Qout=       .00 cfs
 Time Increment      =    .0500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 =====================================================
 Peak Inflow       =     37.98 cfs    at   12.0000 hrs
 Peak Outflow      =       .00 cfs    at     .0500 hrs
 -----------------------------------------------------
 Peak Elevation    =    677.81 ft
 Peak Storage =           2.591 ac-ft
 =====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =       2.591
- Infiltration =        .000
- HYG Vol OUT  =        .000
- Retained Vol =       2.591
                  ----------
 Unrouted Vol =       -.000 ac-ft  (.002% of Inflow Volume)
```

```
                  LEVEL POOL ROUTING SUMMARY

 HYG Dir           = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
 Inflow  HYG file = NONE STORED - SB2          IN  10
 Outflow HYG file = NONE STORED - SB2          OUT 10

 Pond Node    Data = SB2
 Pond Volume Data = SB2
 Pond Outlet Data = SB2-R+W

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev    =    673.00 ft
 Starting Volume     =      .000 ac-ft
 Starting Outflow    =       .00 cfs
 Starting Infiltr.   =       .00 cfs
 Starting Total Qout=        .00 cfs
 Time Increment      =     .0500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 ==================================================
 Peak Inflow        =     75.75 cfs    at   12.0000 hrs
 Peak Outflow       =      3.71 cfs    at   13.8500 hrs
 --------------------------------------------------
 Peak Elevation     =    678.48 ft
 Peak Storage =            3.105 ac-ft
 ==================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =       4.819
- Infiltration =         .000
- HYG Vol OUT   =       2.083
- Retained Vol =        2.736
                    ----------
 Unrouted Vol =        -.000 ac-ft  (.000% of Inflow Volume)
```

```
                    LEVEL POOL ROUTING SUMMARY

  HYG Dir          = P:\135836 - Allied Lake Norman C&DLF Closure\Calcs\Storm\PPack\
  Inflow  HYG file = NONE STORED - SB2          IN  25
  Outflow HYG file = NONE STORED - SB2          OUT 25

  Pond Node   Data = SB2
  Pond Volume Data = SB2
  Pond Outlet Data = SB2-R+W

  No Infiltration

  INITIAL CONDITIONS
  ----------------------------------
  Starting WS Elev   =   673.00 ft
  Starting Volume    =     .000 ac-ft
  Starting Outflow   =      .00 cfs
  Starting Infiltr.  =      .00 cfs
  Starting Total Qout=      .00 cfs
  Time Increment     =    .0500 hrs


  INFLOW/OUTFLOW HYDROGRAPH SUMMARY
  =====================================================
  Peak Inflow      =     99.77 cfs    at   12.0000 hrs
  Peak Outflow     =      9.45 cfs    at   12.6500 hrs
  -----------------------------------------------------
  Peak Elevation   =    678.96 ft
  Peak Storage =          3.487 ac-ft
  =====================================================


  MASS BALANCE (ac-ft)
  --------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =       6.262
- Infiltration =        .000
- HYG Vol OUT  =       3.526
- Retained Vol =       2.736
                  ----------
  Unrouted Vol =       -.000 ac-ft  (.000% of Inflow Volume)
```

Index of Starting Page Numbers for ID Names

BROWN AND CALDWELL

Environmental Engineers & Consultants

Lake Norman C/DLF
Proj. #: 135836
08/11/08
C. McDonald

Input Cells | Calculated Cells

## V-Shape Channel Permissible Velocity Design Calculations (Unvegetated Condition)

| | Channel Requirements | | | | | | | | | | | | | Stability & Capacity | | | | | Temporary Channel Lining | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Channel ID | Required Flow ($Q_{10}$, cfs) | Channel Slope (ft/ft) | Permissible Velocity ($V_p$, ft/s) | Left slope ($Z_L$, ft/ft) | Right slope ($Z_R$, ft/ft) | Normal Depth (d, ft) | Left Top Width ($B_L$, ft) | Right Top Width ($B_R$, ft) | Channel Top Width (B, ft) | Computed Flow Area (A, $ft^2$) | Wetted Perimeter (P, ft) | Hydraulic Radius (R, ft) | Retardance Factor ($V_p$*R) | Stability Manning's n | Comp. Velocity (V, ft/s) | "V" OK? | Comp. Flow (Q, cfs) | "Q" OK? | Shear Stress ($\tau$, $lb/ft^2$) | N.A. Green® Matting (Velocity) | N.A. Green® Matting (Shear) | Channel ID |
| **D1** | 11.05 | 0.015 | 5.0 | 2.0 | 2.0 | 1.35 | 2.70 | 2.70 | 5.40 | 3.65 | 6.04 | 0.60 | 3.02 | 0.040 | 3.26 | **OK** | 11.88 | **OK** | 0.57 | **S75BN** | **S75BN** | **D1** |
| **D2** | 48.45 | 0.015 | 6.0 | 2.0 | 2.0 | 2.20 | 4.40 | 4.40 | 8.80 | 9.68 | 9.84 | 0.98 | 5.90 | 0.035 | 5.16 | **OK** | 49.93 | **OK** | 0.92 | **S150BN** | **S75BN** | **D2** |
| **D3** | 5.31 | 0.015 | 5.0 | 2.0 | 2.0 | 1.06 | 2.12 | 2.12 | 4.24 | 2.25 | 4.74 | 0.47 | 2.37 | 0.046 | 2.41 | **OK** | 5.42 | **OK** | 0.44 | **S75BN** | **S75BN** | **D3** |
| **D4** | 35.21 | 0.015 | 5.0 | 2.0 | 2.0 | 2.00 | 4.00 | 4.00 | 8.00 | 8.00 | 8.94 | 0.89 | 4.47 | 0.038 | 4.46 | **OK** | 35.66 | **OK** | 0.84 | **S75BN** | **S75BN** | **D4** |
| **BENCH** | 6.81 | 0.020 | 5.0 | 6.0 | 1.0 | 0.88 | 5.28 | 0.88 | 6.16 | 2.71 | 6.60 | 0.41 | 2.05 | 0.046 | 2.53 | **OK** | 6.86 | **OK** | 0.51 | **S75BN** | **S75BN** | **BENCH** |

BROWN AND CALDWELL
Environmental Engineers & Consultants

Lake Norman C/DLF
Proj. #: 135836
08/11/08
C. McDonald

Input Cells | Calculated Cells

## V-Shape Channel Permissible Velocity Design Calculations (Vegetated Condition)

| Channel ID | Channel Requirements | | | | | | | | | | | | | Stability & Capacity | | | | | Channel Lining | | Channel ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Required Flow ($Q_{25}$, cfs) | Channel Slope (ft/ft) | Permissible Velocity ($V_p$, ft/s) | Left slope ($Z_L$, ft/ft) | Right slope ($Z_R$, ft/ft) | Normal Depth (d, ft) | Left Top Width ($B_L$, ft) | Right Top Width ($B_R$, ft) | Channel Top Width (B, ft) | Computed Flow Area (A, $ft^2$) | Wetted Perimeter (P, ft) | Hydraulic Radius (R, ft) | Retardance Factor ($V_p$*R) | Capacity Manning's n | Comp. Velocity (V, ft/s) | "V" OK? | Comp. Flow (Q, cfs) | "Q" OK? | Shear Stress (τ, $lb/ft^2$) | Permanent Lining | |
| **D1** | 14.52 | 0.015 | 5.0 | 2.0 | 2.0 | 1.79 | 3.58 | 3.58 | 7.16 | 6.41 | 8.01 | 0.80 | 4.00 | 0.068 | 2.31 | **OK** | 14.83 | **OK** | 0.75 | **GRASS** | **D1** |
| **D2** | 63.58 | 0.015 | 5.0 | 2.0 | 2.0 | 2.91 | 5.82 | 5.82 | 11.64 | 16.94 | 13.01 | 1.30 | 6.51 | 0.056 | 3.92 | **OK** | 66.38 | **OK** | 1.22 | **GRASS** | **D2** |
| **D3** | 6.98 | 0.015 | 5.0 | 2.0 | 2.0 | 1.43 | 2.86 | 2.86 | 5.72 | 4.09 | 6.40 | 0.64 | 3.20 | 0.078 | 1.74 | **OK** | 7.10 | **OK** | 0.60 | **GRASS** | **D3** |
| **D4** | 32.30 | 0.015 | 5.0 | 2.0 | 2.0 | 2.62 | 5.24 | 5.24 | 10.48 | 13.73 | 11.72 | 1.17 | 5.86 | 0.060 | 3.38 | **OK** | 46.41 | **OK** | 1.10 | **GRASS** | **D4** |
| **BENCH** | 8.94 | 0.020 | 5.0 | 6.0 | 1.0 | 1.24 | 7.44 | 1.24 | 8.68 | 5.38 | 9.30 | 0.58 | 2.89 | 0.088 | 1.66 | **OK** | 8.95 | **OK** | 0.72 | **GRASS** | **BENCH** |

## Design Procedure-Permissible Velocity

The following is a step-by-step procedure for designing a runoff conveyance channel using Manning's equation and the continuity equation:

**Step 1.** Determine the required flow capacity, Q, by estimating peak runoff rate for the design storm (*Appendix 8.03*).

**Step 2.** Determine the slope and select channel geometry and lining.

**Step 3.** Determine the permissible velocity for the lining selected, or the desired velocity, if paved. (see Table 8.05a, page 8.05.4)

**Step 4.** Make an initial estimate of channel size—divide the required Q by the permissible velocity to reach a "first try" estimate of channel flow area. Then select a geometry, depth, and top width to fit site conditions.

**Step 5.** Calculate the hydraulic radius, R, from channel geometry (Figure 8.05b, page 8.05.5).

**Step 6.** Determine roughness coefficient *n*.

**Structural Linings**—see Table 8.05b, page 8.05.6.

**Grass Lining:**

a. Determine retardance class for vegetation from Table 8.05c, page 8.05.8. To meet stability requirement, use retardance for newly mowed condition (generally C or D). To determine channel capacity, use at least one retardance class higher.

b. Determine *n* from Figure 8.05c, page 8.05.7.

**Step 7.** Calculate the actual channel velocity, V, using Manning's equation (Figure 8.05a, pg. 8.05.3), and calculate channel capacity, Q, using the continuity equation.

**Step 8.** Check results against permissible velocity and required design capacity to determine if design is acceptable.

**Step 9.** If design is not acceptable, alter channel dimensions as appropriate. For trapezoidal channels, this adjustment is usually made by changing the bottom width.

**Table 8.05b**
**Manning's *n* for Structural Channel Linings**

| Channel Lining | Recommended *n* values |
|---|---|
| Asphaltic concrete, machine placed | 0.014 |
| Asphalt, exposed prefabricated | 0.015 |
| Concrete | 0.015 |
| Metal, corrugated | 0.024 |
| Plastic | 0.013 |
| Shotcrete | 0.017 |
| Gabion | 0.030 |
| Earth | 0.020 |

Source: American Society of Civil Engineers (modified)

**Step 10.** For grass-lined channels once the appropriate channel dimensions have been selected for low retardance conditions, repeat steps 6 through 8 using a higher retardance class, corresponding to tall grass. Adjust capacity of the channel by varying depth where site conditions permit.

NOTE 1: If design velocity is greater than 2.0 ft/sec., a temporary lining may be required to stabilize the channel until vegetation is established. The temporary liner may be designed for peak flow from the 2-year storm. If a channel requires a temporary lining, the designer should analyze shear stresses in the channel to select the liner that provides protection and promotes establishment of vegetation. For the design of temporary liners, use tractive force procedure.

NOTE 2: Design Tables—Vegetated Channels and Diversions at the end of this section may be used to design grass-lined channels with parabolic cross-sections.

**Step 11.** Check outlet for carrying capacity and stability. If discharge velocities exceed allowable velocities for the receiving stream, an outlet protection structure will be required (Table 8.05d, page 8.05.9).

Sample Problem 8.05a illustrates the design of a grass-lined channel.

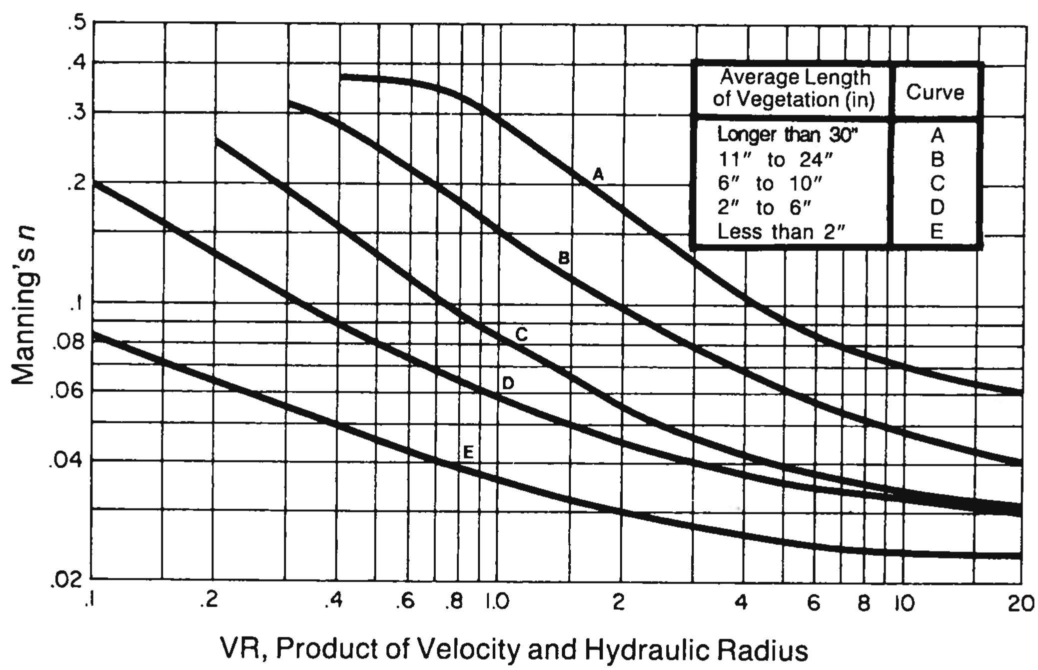



**Figure 8.05c** Manning's *n* related to velocity, hydraulic radius, and vegetal retardance.
**Note:** From Sample Problem 8.05a multiply Vp x Hydralulic Radius (4.5x0.54=2.43), then enter the product of VR and extend a straight line up to Retardance class "D", next project a straight line to the left to determine a trial manning's *n*.

**Table 8.05c**
**Retardance Classification for Vegetal Covers**

| Retardance | Cover | Condition |
|---|---|---|
| A | Reed canarygrass | Excellent stand, tall (average 36") |
| | Weeping lovegrass | Excellent stand, tall (average 30") |
| B | Tall fescue | Good stand, uncut, (average 18") |
| | Bermudagrass | Good stand, tall (average 12") |
| | Grass-legume mixture (tall fescue,red fescue, sericea lespedeza) | Good stand, uncut |
| | Grass mixture (timothy, smooth bromegrass or orchardgrass) | Good stand, uncut (average 20") |
| | Sericea lespedeza | Good stand, not woody, tall (average 19") |
| | Reed canarygrass | Good stand, cut, (average 12-15") |
| | Alfalfa | Good stand, uncut (average 11") |
| C | Tall fescue | Good stand (8-12") |
| | Bermudagrass | Good stand, cut (average 6") |
| | Bahiagrass | Good stand, uncut (6-8") |
| | Grass-legume mixture--summer (orchardgrass, redtop and annual lespedeza) | Good stand, uncut (6-8") |
| | Centipedegrass | Very dense cover (average 6") |
| | Kentucky bluegrass | Good stand, headed (6-12") |
| | Redtop | Good stand, uncut (15-20") |
| D | Tall fescue | Good stand, cut (3-4") |
| | Bermudagrass | Good stand, cut (2.5") |
| | Bahiagrass | Good stand, cut (3-4") |
| | Grass-legume mixture--fall-spring (orchardgrass, redtop, and annual lespedeza) | Good stand, uncut (4-5") |
| | Red fescue | Good stand, uncut (12-18") |
| | Centipedegrass | Good stand, cut (3-4") |
| | Kentucky bluegrass | Good stand, cut (3-4") |
| E | Bermudagrass | Good stand, cut (1.5") |
| | Bermudagrass | Burned stubble |

Modified from: USDA-SCS, 1969. Engineering Field Manual.

**Table 8.05d Maximum Permissible Velocities for Unprotected Soils in Existing Channels.**

| Materials | Maximum Permissible Velocities (fps) |
|---|---|
| Fine Sand (noncolloidal) | 2.5 |
| Sand Loam (noncolloidal) | 2.5 |
| Silt Loam (noncolloidal) | 3.0 |
| Ordinary Firm Loam | 3.5 |
| Fine Gravel | 5.0 |
| Stiff Clay (very colloidal) | 5.0 |
| Graded, Loam to Cobbles (noncolloidal) | 5.0 |
| Graded, Silt to Cobbles (colloidal) | 5.5 |
| Alluvial Silts (noncolloidal) | 3.5 |
| Alluvial Silts (colloidal) | 5.0 |
| Coarse Gravel (noncolloidal) | 6.0 |
| Cobbles and Shingles | 5.5 |

**Sample Problem 8.05a Design of a Grass-lined Channel.**

**Given:**

Design $Q_{10}$ = 16.6 cfs

Proposed channel grade = 2%
Proposed vegetation: Tall fescue
Soil: Creedmoor (easily erodible)
Permissible velocity, $V_p$ = 4.5 ft/s (Table 8.05a)
Retardance class: "B" uncut, "D" cut (Table 8.05c).
Trapezoidal channel dimensions:
designing for low retardance condition (retardance class D)
design to meet $V_p$.

**Find:**

Channel dimensions

**Solution:**

Make an initial estimate of channel size

A = Q/V, 16.6 cfs/4.5 ft/sec = 3.69 ft²
Try bottom width = 3.0 ft w/side slopes of 3:1

$Z = 3$
$A = bd + Zd^2$
$P = b + 2d\sqrt{Z^2 + 1}$
$R = AP$

**An iterative** solution using Figure 8.05a to relate flow depth to Manning's *n* proceeds as follows: Manning's equation is used to check velocities.
*From Fig. 8.05c, pg. 8.05.7, Retardance Class d (VR=4.5x0.54=2.43)

| d (ft) | A (ft²) | R (ft) | *n | Vt (fps) | Q (cfs) | Comments |
|---|---|---|---|---|---|---|
| 0.8 | 4.32 | 0.54 | 0.043 | 3.25 | 14.0 | $V<V_p$ OK, $Q<Q_{10}$ (too small, try deeper channel) |
| 0.9 | 5.13 | 0.59 | 0.042 | 3.53 | 18.10 | $V<V_p$, OK, $Q>Q_{10}$, OK |

Now design for high retardance (class B):

For the ease of construction and maintenance assume and try d = 1.5 ft and trial velocity $V_t$ = 3.0 ft/sec

| d (ft) | A (ft²) | R (ft) | $V_t$ (fps) | n | V (fps) | Q (cfs) | Comments |
|---|---|---|---|---|---|---|---|
| 1.5 | 11.25 | 0.90 | 3.0 | 0.08 | 2.5 | 28 | reduce $V_t$ |
| | | | 2.0 | 0.11 | 1.8 | 20 | reduce $V_t$ |
| | | | 1.6 | 0.12 | 1.6 | 18 | |
| | | | **1.5 | 0.13 | 1.5 | 17 | $Q>Q_{10}$ OK |

** These assumptions = actual V (fps.) (chart continued on next page)

NORTH AMERICAN GREEN®

# PERFORMANCE SPECIFICATION

# S75BN

The North American Green S75BN erosion control blanket is constructed of 100% biodegradable materials containing a 100% agricultural straw fiber matrix and having a functional longevity of approximately 12 months. (NOTE: functional longevity may vary depending upon climatic conditions, soil, geographic location, and elevation). The straw fiber shall be evenly distributed over the entire area of the mat. The blanket shall be covered on the top with 100% biodegradable natural organic fiber netting woven into an approximate 0.50 inch x 1 inch (1.27 cm x 2.54 cm) mesh. The blanket shall be sewn together with biodegradable thread on 1.50 inch (3.81 cm) centers. The following list contains further physical properties of the S75BN erosion control blanket.

| Property | Test Method | Typical |
|---|---|---|
| Thickness | ASTM D5199/ECTC | 0.32 in (8.13 mm) |
| Resiliency | ECTC Guidelines | 81.40% |
| Mass per Unit Area | ASTM D6475 | 7.55 oz/yd$^2$ (256 g/m$^2$) |
| Water Absorption | ASTM D1117/ECTC | 281% |
| Swell | ECTC Guidelines | 15.70% |
| Stiffness/Flexibility | ASTM D1388/ECTC | 6.92 oz-in (77,268 mg-cm) |
| Light Penetration | ECTC Guidelines | 13.60% |
| Smolder Resistance | ECTC Guidelines | Yes** |
| MD Tensile Strength | ASTM D5035 | 267.60 lbs/ft (3.90 kN/m) |
| MD Elongation | ASTM D5035 | 3.00% |
| TD Tensile Strength | ASTM D5035 | 267.60 lbs/ft (3.90 kN/m) |
| TD Elongation | ASTM D5035 | 2.70% |

**Material is smolder resistant according to specified test.
MD - Machine direction
TD - Transverse direction

## Slope Design Data

| Cover Factors (C) | |
|---|---|
| | Slope Gradient (S) |
| Slope Length (L) | ≤ 3:1 |
| ≤20 ft (6 m) | 0.029 |
| 20 - 50 | 0.110 |
| ≥ 50 ft (15.2 m) | 0.190 |

## Channel Design Data

| Channel Roughness Coefficients | |
|---|---|
| Flow Depth | Manning's 'n' |
| ≤ 0.50 ft (0.15 m) | 0.055 |
| 0.50-2.00 ft | 0.055-0.021 |
| ≥ 2.00 ft (0.60 m) | 0.021 |
| Max. Permissible Shear Stress 1.60 lbs/ft$^2$ (76.0 Pa) | |

## Bench Scale Testing†

| | |
|---|---|
| Unvegetated Channel | 2.0 lbs/ft$^2$ |

Approximate Max Flow Velocity
5.00 ft/s (1.52 m/s)

For most accurate design data consult ECMDS™
Manning's 'n' expressed in English units

### †Bench Scale Testing

Bench scale tests are index property tests. These tests are not indicative of field performance and therefore should not be used in design to establish performance levels for rolled erosion control products. Bench scale tests are performed according to methods developed by the Erosion Control Technology Council (ECTC).

Updated 9/2004

# PERFORMANCE SPECIFICATION

# SC150BN

The North American Green SC150BN erosion control blanket is constructed of 100% biodegradable materials with a 70% agricultural straw and 30% coconut fiber blend matrix and has a functional longevity of approximately 18 months. (NOTE: functional longevity may vary depending upon climatic conditions, soil, geographic location, and elevation). The straw and coconut fibers shall be evenly distributed over the entire area of the mat. The blanket shall be covered on the top and bottom with 100% biodegradable natural organic fiber netting woven into an approximate 0.50 inch x 1 inch (1.27 x 2.54 cm) mesh. The blanket shall be sewn together with biodegradable thread on 1.50 inch (3.81 cm) centers. The following list contains further physical properties of the SC150BN erosion control blanket.

| Property | Test Method | Typical |
|---|---|---|
| Thickness | ASTM D5199/ECTC | 0.29 in (7.47 mm) |
| Resiliency | ECTC Guidelines | 86 % |
| Mass per Unit Area | ASTM D6475 | 9.66 oz/yd$^2$ (328 g/m$^2$) |
| Water Absorption | ASTM D1117/ECTC | 158 % |
| Swell | ECTC Guidelines | 46 % |
| Stiffness/Flexibility | ASTM D1388/ECTC | 0.42 oz-in (4,737 mg-cm) |
| Light Penetration | ECTC Guidelines | 11.70 % |
| Smolder Resistance | ECTC Guidelines | Yes** |
| MD Tensile Strength | ASTM D5035 | 280.80 lbs/ft (4.10 kN/m) |
| MD Elongation | ASTM D5035 | 9.50% |
| TD Tensile Strength | ASTM D5035 | 205.20 lbs/ft (2.99 kN/m) |
| TD Elongation | ASTM D5035 | 13.20 % |

**Material is smolder resistant according to specified test
MD - Machine direction
TD - Transverse direction

**Slope Design Data**

| Cover Factors (C) | | | |
|---|---|---|---|
| | Slope Gradient (S) | | |
| Slope Length (L) | ≤ 3:1 | 3:1 – 2:1 | ≥ 2:1 |
| ≤ 20 ft (6 m) | 0.00009 | 0.029 | 0.063 |
| 20 – 50 | 0.005 | 0.055 | 0.092 |
| ≥ 50 ft (15.2 m) | 0.010 | 0.080 | 0.120 |

**Channel Design Data**

| Channel Roughness Coefficients | |
|---|---|
| Flow Depth | Manning's 'n' |
| ≤ 0.50 ft (0.15 m) | 0.050 |
| 0.50-2.00 ft | 0.050-0.018 |
| ≥ 2.00 ft (0.60 m) | 0.018 |
| Max. Permissible Shear Stress 2.10 lbs/ft$^2$ (100.0 Pa) | |

**Bench Scale Testing†**

| | |
|---|---|
| Unvegetated Channel | 3.9 lbs/ft$^2$ |

Approximate Max Flow Velocity
8.00 ft/s (2.44 m/s)

For most accurate design data consult ECMDS™
Manning's 'n' expressed in English units

**†Bench Scale Testing**

Bench scale tests are index property tests. These tests are not indicative of field performance and therefore should not be used in design to establish performance levels for rolled erosion control products. Bench scale tests are performed according to methods developed by the Erosion Control Technology Council (ECTC).

Updated 9/2004

# Downchute Pipe Sizing

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.011 | |
| Channel Slope | 0.02000 | ft/ft |
| Diameter | 2.00 | ft |
| Discharge | 32.24 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.42 | ft |
| Flow Area | 2.39 | ft² |
| Wetted Perimeter | 4.01 | ft |
| Top Width | 1.82 | ft |
| Critical Depth | 1.89 | ft |
| Percent Full | 71.0 | % |
| Critical Slope | 0.01258 | ft/ft |
| Velocity | 13.52 | ft/s |
| Velocity Head | 2.84 | ft |
| Specific Energy | 4.26 | ft |
| Froude Number | 2.08 | |
| Maximum Discharge | 40.67 | ft³/s |
| Discharge Full | 37.81 | ft³/s |
| Slope Full | 0.01454 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 71.00 | % |
| Downstream Velocity | Infinity | ft/s |

# Downchute Pipe Sizing

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.42 | ft |
| Critical Depth | 1.89 | ft |
| Channel Slope | 0.02000 | ft/ft |
| Critical Slope | 0.01258 | ft/ft |

# Culvert Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. Monday, Aug 11 2008

## Bench Inlet

| | |
|---|---|
| Invert Elev Dn (ft) | = 679.90 |
| Pipe Length (ft) | = 10.00 |
| Slope (%) | = 1.00 |
| Invert Elev Up (ft) | = 680.00 |
| Rise (in) | = 18.0 |
| Shape | = Cir |
| Span (in) | = 18.0 |
| No. Barrels | = 1 |
| n-Value | = 0.011 |
| Inlet Edge | = Projecting |
| Coeff. K,M,c,Y,k | = 0.0045, 2, 0.0317, 0.69, 0.5 |

**Embankment**

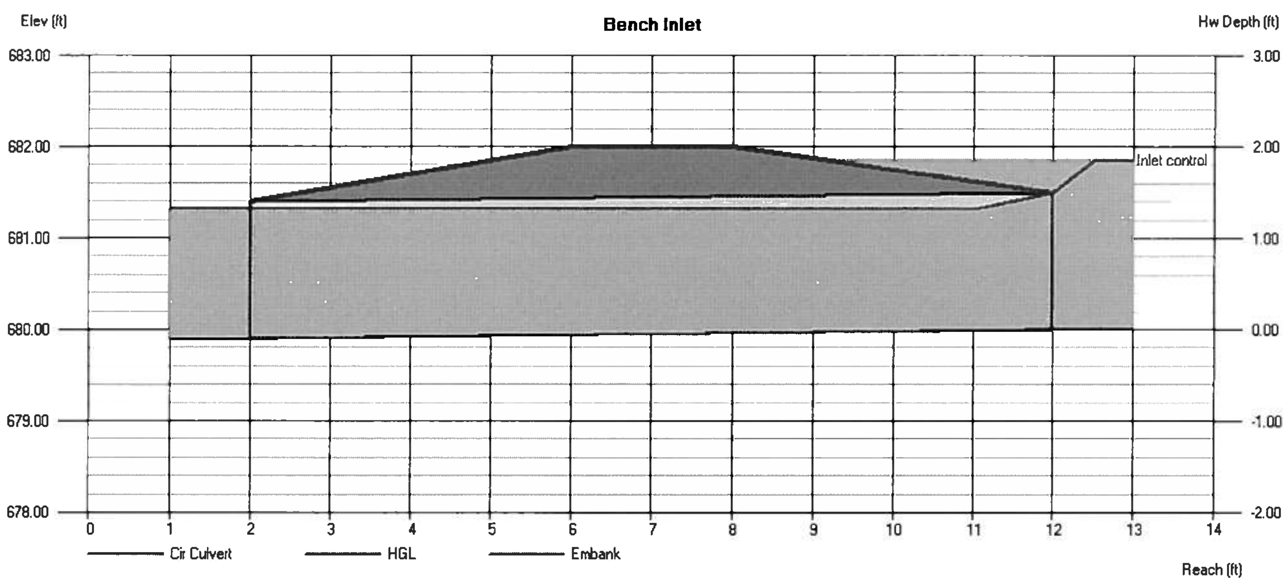
| | |
|---|---|
| Top Elevation (ft) | = 682.00 |
| Top Width (ft) | = 2.00 |
| Crest Width (ft) | = 0.00 |

**Calculations**

| | |
|---|---|
| Qmin (cfs) | = 8.94 |
| Qmax (cfs) | = 8.94 |
| Tailwater Elev (ft) | = 681.32 |

**Highlighted**

| | |
|---|---|
| Qtotal (cfs) | = 8.94 |
| Qpipe (cfs) | = 8.94 |
| Qovertop (cfs) | = 0.00 |
| Veloc Dn (ft/s) | = 5.17 |
| Veloc Up (ft/s) | = 5.41 |
| HGL Dn (ft) | = 681.32 |
| HGL Up (ft) | = 681.33 |
| Hw Elev (ft) | = 681.85 |
| Hw/D (ft) | = 1.24 |
| Flow Regime | = Inlet Control |



# Culvert Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. Monday, Aug 11 2008

## Culvert - C1

| | | |
|---|---|---|
| Invert Elev Dn (ft) | = | 689.13 |
| Pipe Length (ft) | = | 92.42 |
| Slope (%) | = | 1.21 |
| Invert Elev Up (ft) | = | 690.25 |
| Rise (in) | = | 24.0 |
| Shape | = | Cir |
| Span (in) | = | 24.0 |
| No. Barrels | = | 1 |
| n-Value | = | 0.012 |
| Inlet Edge | = | Projecting |
| Coeff. K,M,c,Y,k | = | 0.0045, 2, 0.0317, 0.69, 0.5 |

**Embankment**

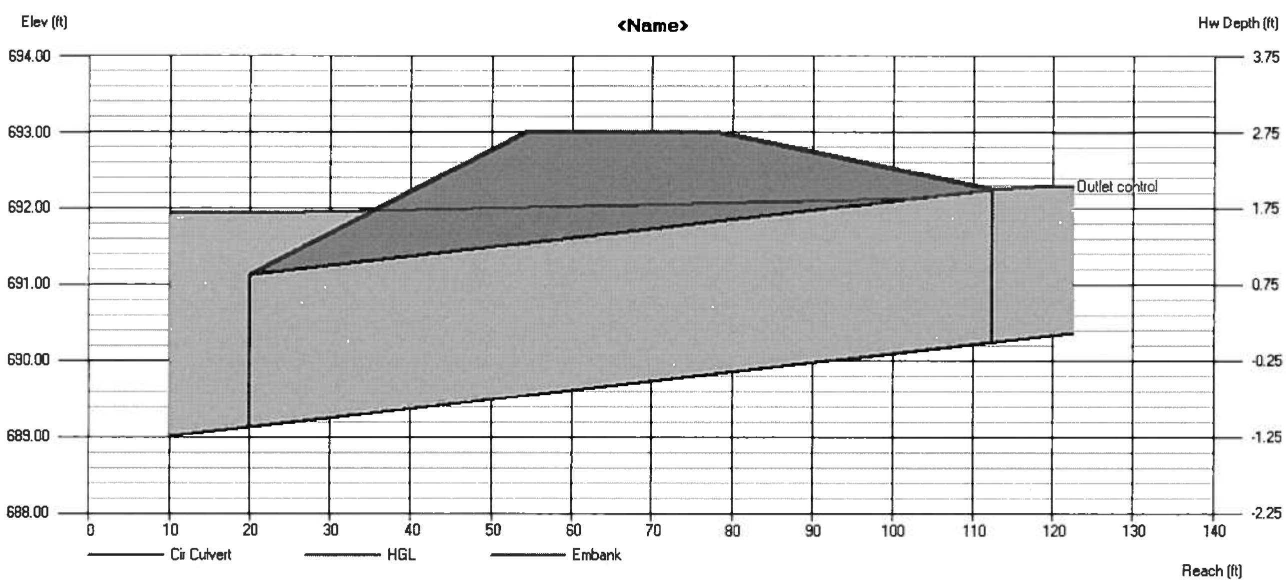
| | | |
|---|---|---|
| Top Elevation (ft) | = | 693.00 |
| Top Width (ft) | = | 24.00 |
| Crest Width (ft) | = | 0.00 |

**Calculations**

| | | |
|---|---|---|
| Qmin (cfs) | = | 12.77 |
| Qmax (cfs) | = | 12.77 |
| Tailwater Elev (ft) | = | 691.93 |

**Highlighted**

| | | |
|---|---|---|
| Qtotal (cfs) | = | 12.77 |
| Qpipe (cfs) | = | 12.77 |
| Qovertop (cfs) | = | 0.00 |
| Veloc Dn (ft/s) | = | 4.07 |
| Veloc Up (ft/s) | = | 4.14 |
| HGL Dn (ft) | = | 691.93 |
| HGL Up (ft) | = | 692.16 |
| Hw Elev (ft) | = | 692.29 |
| Hw/D (ft) | = | 1.02 |
| Flow Regime | = | Outlet Control |



# Culvert Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. — Monday, Aug 11 2008

## Culvert C2

| | | |
|---|---|---|
| Invert Elev Dn (ft) | = | 674.00 |
| Pipe Length (ft) | = | 79.61 |
| Slope (%) | = | 1.00 |
| Invert Elev Up (ft) | = | 674.80 |
| Rise (in) | = | 30.0 |
| Shape | = | Cir |
| Span (in) | = | 30.0 |
| No. Barrels | = | 2 |
| n-Value | = | 0.012 |
| Inlet Edge | = | Projecting |
| Coeff. K,M,c,Y,k | = | 0.0045, 2, 0.0317, 0.69, 0.5 |

**Embankment**

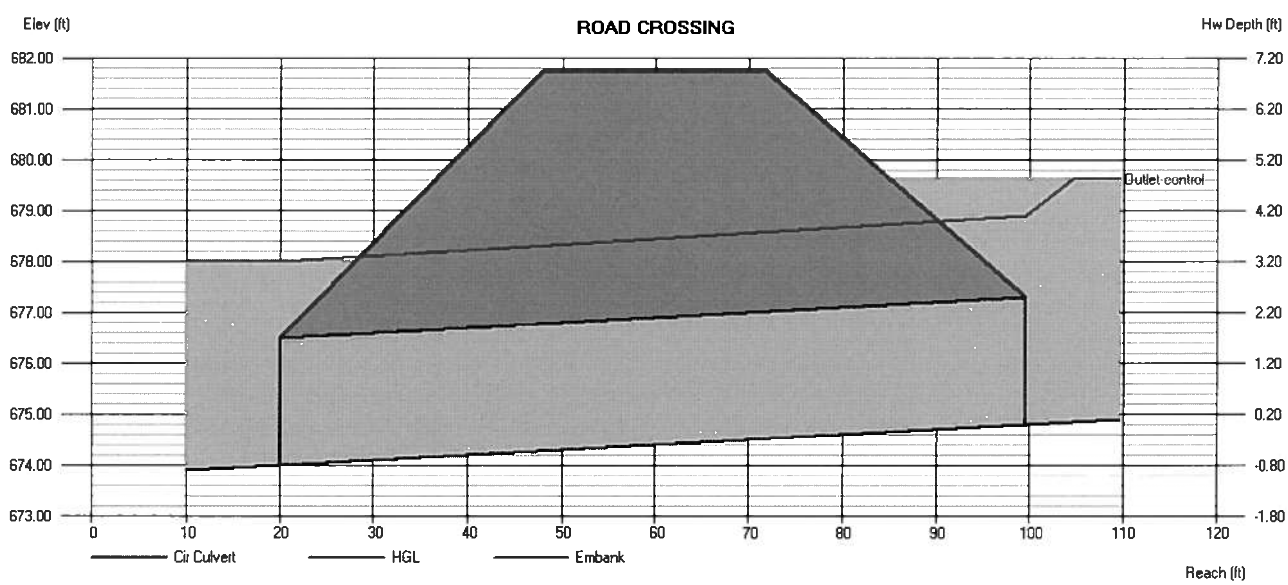
| | | |
|---|---|---|
| Top Elevation (ft) | = | 681.75 |
| Top Width (ft) | = | 24.00 |
| Crest Width (ft) | = | 4.00 |

**Calculations**

| | | |
|---|---|---|
| Qmin (cfs) | = | 94.52 |
| Qmax (cfs) | = | 94.52 |
| Tailwater Elev (ft) | = | 678 |

**Highlighted**

| | | |
|---|---|---|
| Qtotal (cfs) | = | 94.52 |
| Qpipe (cfs) | = | 94.52 |
| Qovertop (cfs) | = | 0.00 |
| Veloc Dn (ft/s) | = | 9.63 |
| Veloc Up (ft/s) | = | 9.63 |
| HGL Dn (ft) | = | 678.00 |
| HGL Up (ft) | = | 678.90 |
| Hw Elev (ft) | = | 679.62 |
| Hw/D (ft) | = | 1.93 |
| Flow Regime | = | Outlet Control |



Lake Norman C/DLF Closure
Proj. #: 135836
C. McDonald
8/11/08

Input Cells | Calculated Cells

## Faircloth Skimmer® Sizing Calculation (3 Day Drawdown)

| Basin ID | 10yr. Basin Volume ($ft^3$) | Skimmer Size (in) | Full Capacity ($ft^3$) | No. of Full Capacity Skimmers Needed | Orifice Calculation for single skimmers | | | Sizing of Remaining Skimmer | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Orifice Factor | Orifice Area | Orifice Radius (in) | Remaining | Skimmer Size (in) | Orifice Factor | Orifice Area ($in^2$) | Orifice Radius (in) |
| SB-2 | 136,299 | 6 | 155520 | 1 | 5442 | 25.05 | 2.8 | Single | Single | Single | Single | Single |

# Determining the Skimmer Size and the Required Orifice for the *Faircloth Skimmer*® Surface Drain

**November 2007**

***Important note:*** *The orifice sizing chart in the Pennsylvania Erosion Control Manual and reproduced in the North Carolina Design Manual **DOES NOT APPLY** to our skimmers. It will give the wrong size orifice and not specify which size skimmer is required. Please use the information below to choose the size skimmer required for the basin volume provided and determine the orifice size required for the drawdown time, typically 4-7 days in Pennsylvania and 3 days in North Carolina.*

The **size** of a Faircloth Skimmer®, for example a 4" skimmer, refers to the maximum diameter of the skimmer inlet. The inlet on each of the 8 sizes offered can be reduced to adjust the flow rate by cutting a hole or ***orifice*** in a plug using an adjustable cutter (both supplied).

Determining the skimmer size needed and the orifice for that skimmer required to drain the sediment basin's volume in the required time involves two steps: **First**, determining the size skimmer required based on the volume to be drained and the number of days to drain it; and **Second,** calculate the orifice size to adjust the flow rate and "customize" the skimmer for the basin's volume. *The second step is not always necessary* if the flow rate for the skimmer with the inlet wide open equals or is close to the flow rate required for the basin volume and the drawdown time.

Both the skimmer size and the required orifice radius for the skimmer should be shown for each basin on the erosion and sediment control plan. Make it clear that the dimension is either the radius or the diameter. It is also helpful to give the basin volume in case there are questions. During the skimmer installation the required orifice can be cut in the plastic plug using the supplied adjustable cutter and installed in the skimmer using the instructions provided.

The plan review and enforcement authority may require the calculations showing that the skimmer used can drain the basin in the required time.

## Determining the Skimmer Size

**Step 1**. Below are approximate **skimmer maximum flow capacities** based on typical draw down requirements, which can vary between States and jurisdictions and watersheds. If one 6" skimmer does not provide enough capacity, multiple skimmers can be used to drain the basin. For drawdown times not shown, multiply the 24-hour figure by the number of days required.

**Example:** A basin's volume is 29,600 cubic feet and it must be drained in 3 days. A 3" skimmer with the inlet wide open will work perfectly. (Actually, the chart below gives 29,322 cubic feet but this is well within the accuracy of the calculations and the basin's constructed volume.)
**Example:** A basin's volume is 39,000 cubic feet and it must be drained in 3 days. The 3" skimmer is too small; a 4" skimmer has enough capacity but it is too large, so the inlet will need

feet ÷ 4,803 = 8.12 square inches of orifice required. Calculate the orifice radius using Area = $\pi r^2$ and solving for r, $r = \sqrt{(8.12/3.14)}$ and r = 1.61". As a practical matter 1.6" is about as close as the cutter can be adjusted and the orifice cut..

**Factors** (in cubic feet of flow per square inch of opening through a **round** orifice with the head for that skimmer and for the drawdown times shown) for determining the **orifice radius** for a basin's volume to be drained. This quick method works because the orifice is centered and has a constant head (given above in Step 1).

| | | |
|---|---|---|
| **1½" skimmer:** | 960 to drain in **24 hours** | 3,840 to drain in **4 days** |
| | 1,920 to drain in **2 days** | 6,720 to drain in **7 days** |
| | 2,880 to drain in **3 days** | |
| **2" skimmer:** | 1,123 to drain in **24 hours** | 4,492 to drain in **4 days** |
| | 2,246 to drain in **2 days** | 7,861 to drain in **7 days** |
| | 3,369 to drain in **3 days** | |
| **2½" skimmer:** | 1,270 to drain in **24 hours** | 5,080 to drain in **4 days** |
| Revised 11-6-07 | 2,540 to drain in **2 days** | 8,890 to drain in **7 days** |
| | 3,810 to drain in **3 days** | |
| **3" skimmer:** | 1,382 to drain in **24 hours** | 5,528 to drain in **4 days** |
| | 2,765 to drain in **2 days** | 9,677 to drain in **7 days** |
| | 4,146 to drain in **3 days** | |
| **4" skimmer:** | 1,601 to drain in **24 hours** | 6,404 to drain in **4 days** |
| Revised 11-6-07 | 3,202 to drain in **2 days** | 11,207 to drain in **7 days** |
| | 4,803 to drain in **3 days** | |
| **5" skimmer:** | 1,642 to drain in **24 hours** | 6,568 to drain in **4 days** |
| | 3,283 to drain in **2 days** | 11,491 to drain in **7 days** |
| | 4,926 to drain in **3 days** | |
| **6" skimmer:** | 1,814 to drain in **24 hours** | 7,256 to drain in **4 days** |
| | 3,628 to drain in **2 days** | 12,701 to drain in **7 days** |
| | 5,442 to drain in **3 days** | |
| **8" skimmer:** | 1,987 to drain in **24 hours** | 7,948 to drain in **4 days** |
| | 3,974 to drain in **2 days** | 13,909 to drain in **7 days** |
| | 5,961 to drain in **3 days** | |

**J. W. Faircloth & Son, Inc.**
**Post Office Box 757**
**412-A Buttonwood Drive**
**Hillsborough, North Carolina 27278**
**Telephone (919) 732-1244 FAX (919) 732-1266**
**FairclothSkimmer.com jwfaircloth@embarqmail.com**

Orifice sizing Revised 2-2-01; 3-3-05; 2-1-07; 11-6-07

BROWN AND CALDWELL
Environmental Engineers & Consultants

Lake Norman C/DLF
Proj. #: 135836
C. McDonald
08/11/08

Input Cells | Calculated Cells

## Anti-Flotation Block Sizing Calculation

| Basin ID | Riser Diameter (ft) | Riser Bottom Elev. (ft) | Riser Crest (ft) | Riser Volume ($ft^3$) | Riser Displacement Weight (lbs) | Anti Flotation Block Dimensions (ft) | | | Block Volume ($ft^3$) | Block Displacement Weight (lbs) | Block Weight (lbs) | FS | Result |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Width 1 | Width 2 | Depth | | | | | |
| SB-2 | 2.0 | 673.0 | 678.0 | 15.7 | 980 | 3.0 | 3.0 | 2 | 18.00 | 1,123 | 2,700 | 1.3 | OK |

Lake Norman C8/11/2008 Landfill
Proj. #: 135836
C. McDonald
08/11/08

## Riprap Apron Outlet Protection Design (for minimum tailwater)

| Structure ID | 10-Year Storm Max. Flow ($Q_{10}$, cfs) | Outlet Pipe Diameter ($d_o$, ft) | Velocity (ft/s) | d50 Riprap Size* ($d_{50}$, in) | Maximum Riprap Size ($d_{max}$, in) | Apron Thickness (t, in) | Minimum Apron Length* ($L_a$, ft) | Width at Outlet ($W_U$, ft) | Width at End ($W_E$, ft) |
|---|---|---|---|---|---|---|---|---|---|
| **SB2OUT** | 4.00 | 1.25 | 7.25 | 4.0 | 6.0 | 9.0 | 10 | 4 | 11 |

# SB2 - Outlet

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.011 | |
| Channel Slope | 0.01540 | ft/ft |
| Diameter | 1.25 | ft |
| Discharge | 5.59 | ft³/s |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.69 | ft |
| Flow Area | 0.70 | ft² |
| Wetted Perimeter | 2.09 | ft |
| Top Width | 1.24 | ft |
| Critical Depth | 0.96 | ft |
| Percent Full | 55.2 | % |
| Critical Slope | 0.00614 | ft/ft |
| Velocity | 8.04 | ft/s |
| Velocity Head | 1.00 | ft |
| Specific Energy | 1.69 | ft |
| Froude Number | 1.89 | |
| Maximum Discharge | 10.19 | ft³/s |
| Discharge Full | 9.47 | ft³/s |
| Slope Full | 0.00536 | ft/ft |
| Flow Type | SuperCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

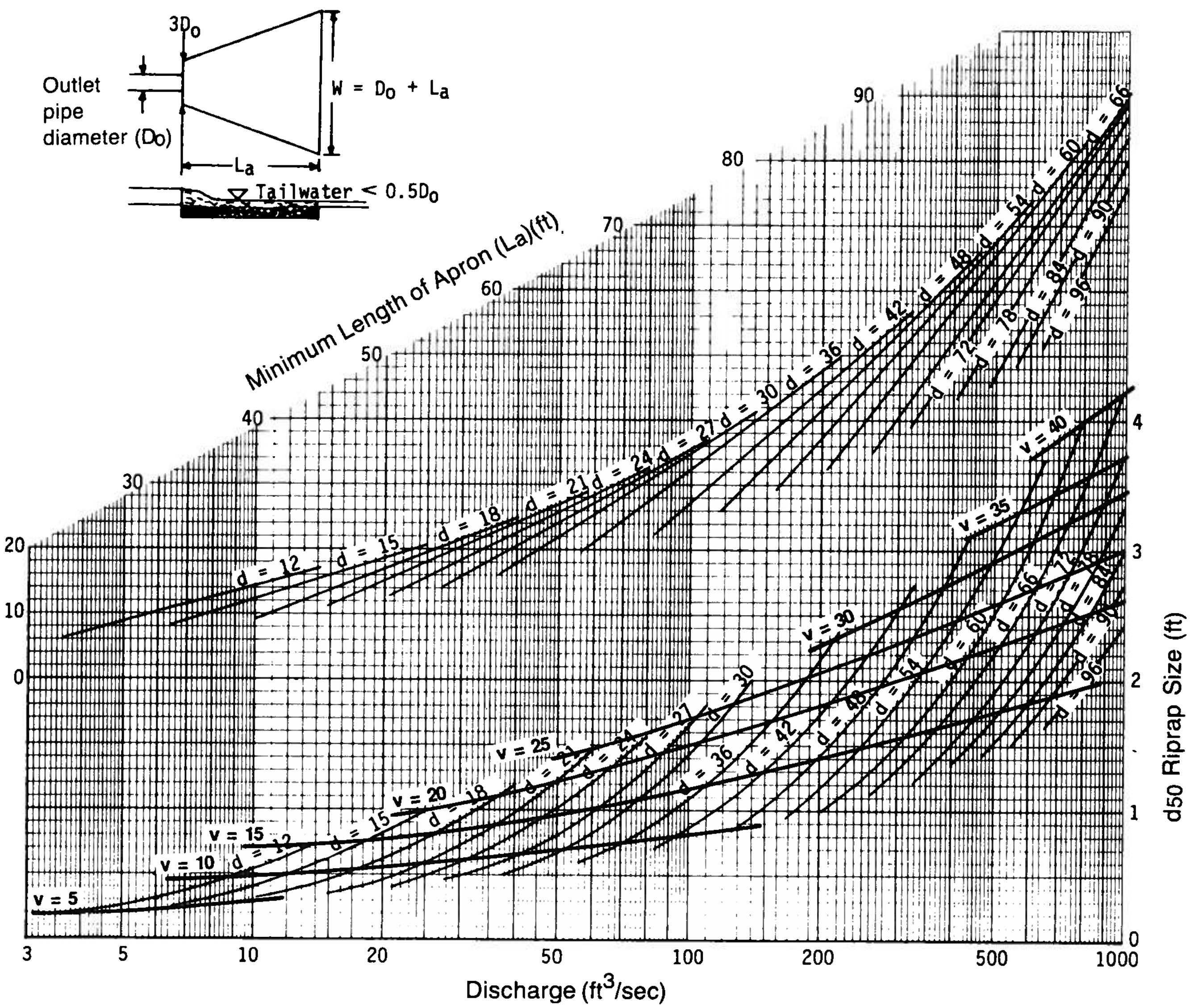
## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 55.25 | % |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |

# SB2 - Outlet

## GVF Output Data

| | | |
|---|---|---|
| Normal Depth | 0.69 | ft |
| Critical Depth | 0.96 | ft |
| Channel Slope | 0.01540 | ft/ft |
| Critical Slope | 0.00614 | ft/ft |




Curves may not be extrapolated.

**Figure 8.06a** Design of outlet protection protection from a round pipe flowing full, minimum tailwater condition ($T_w$ < 0.5 diameter).

# APPENDIX E: CLOSURE COST ESTIMATION SUMMARY

**CLOSURE CONSTRUCTION COST ESTIMATE**
**BFI - Lake Norman Landfill, Inc.**
**Lake Norman Construction and Demolition Landfill**
**Stanley, North Carolina**

| | | | | |
|---|---|---|---|---|
| Area Requiring Final Cover | 31.77 | acres | 1,383,901 | $ft^2$ |
| Total Property | 117 | acres | | |

| Cost Item Description | Quantity | Unit | Unit Cost | Reference | 2008 Cost Estimate |
|---|---|---|---|---|---|
| **1.0 ENGINEERING, TESTING AND ADMINISTRATION** | | | | | |
| 1.1 Topographic survey | 31.77 | Acre | $188 | 1 | $5,973 |
| 1.2 Boundary Survey for Affidavit | 117 | Acre | $52 | 2 | $6,084 |
| 1.3 Closure Design | 31.77 | Acre | $250 | 2 | $7,943 |
| 1.4 Development of Plans and Specifications | 31.77 | Acre | $700 | 2 | $22,239 |
| 1.5 Construction Quality Assurance | 31.77 | Acre | $3,575 | 2 | $113,578 |
| 1.6 Construction Administration | 80 | Hours | $102 | 2 | $8,160 |
| 1.7 Admin. Cost for Certification of Final Cover and Affidavit to the Public | 16 | Hours | $102 | 2 | $1,632 |
| **ENGINEERING, TESTING AND ADMINISTRATION TOTAL** | | | | | $165,608 |
| **2.0 CONSTRUCTION** | | | | | |
| **2.1 Final Cover System** | | | | | |
| 2.1.1 Mobilization | 1 | Each | $3,630 | 3 | $3,630 |
| 2.1.2 Barrier Soil Cap Placement (18 inches) | 76,883 | $y^3$ | $5.39 | 3 | $414,402 |
| 2.1.3 Erosion Layer Placement (18 inches) | 76,883 | $y^3$ | $5.39 | 3 | $414,402 |
| 2.1.4 Passive Gas Vents | 46 | Each | $2,175 | 2 | $100,050 |
| **2.2 Stormwater Management and Sediment & Erosion Control** | | | | | |
| 2.2.1 Seeding / Fertilizing / Mulching | 31.77 | Acre | $1,500 | 4 | $47,655 |
| 2.2.2 Erosion Control Matting | 10,434 | LF | $20 | 2 | $208,680 |
| 2.2.3 E & S and Stormwater Management Structures | 1 | LS | 80,000 | 2 | $80,000 |
| **CONSTRUCTION TOTAL** | | | | | $1,268,818 |
| **TOTAL CLOSURE COST** | | | | | $1,434,426 |

Reference:

1 - Bullseye Design Services, Inc. estimated 2008 costs.

2 - Brown and Caldwell estimated 2008 costs.

3 - Earnhardt Grading Contractor 2007 costs adjusted for inflation.

4 - Brown and Caldwell estimated costs and confirmed by Allied Waste site Environmental Manager.

**POST-CLOSURE COST ESTIMATE**
**BFI - Lake Norman Landfill, Inc.**
**Lake Norman Construction and Demolition Landfill**
**Stanley, North Carolina**

| | | | |
|---|---|---|---|
| Area Closed | 31.77 | acres | 1,383,901 $ft^2$ |
| Total Property | 117 | acres | |

| Cost Item Description | Quantity | Unit | Unit Cost | Reference | 2008 Cost Estimate for 30 Year Period |
|---|---|---|---|---|---|
| **1.0 MONITORING / OPERATIONS** | | | | | |
| 1.1 Site Inspections and Record Keeping (Annual) | 1 | LS | $1,300 | 1 | $39,000 |
| 1.2 Site Monitoring | | | | | |
| 1.2.1 Landfill Gas Quarterly Monitoring of 6 Probes | 24 | per year | $69 | 2 | $49,680 |
| 1.2.2 Groundwater Semi-Annual Monitoring of 4 Wells | 8 | per year | $438 | 3,4 | $105,120 |
| 1.2.3 Surface Water Semi-Annual Monitoring of 2 Locations | 4 | per year | $293 | 3,4 | $35,160 |
| 1.3 Final Cover Maintenance | | | | | |
| 1.3.1 Stormwater Management and E & S Control Systems | 3 | LS | $1,600 | 1 | $4,800 |
| 1.3.2 Revegegtation | 3 | acre/year | $1,300 | 5 | $117,000 |
| 1.3.3 Mowing | 1 | LS | $1,590 | 5 | $47,700 |
| 1.4 Access, Security and Signage | 1 | LS | $823 | 6 | $24,690 |
| 1.5 Corrective Measures (3 occurrences over 30 years) | | | | | |
| 1.5.1 Monitoring Well Installation | 1 | LS | $5,250 | 1 | $15,750 |
| 1.5.2 Engineering and Documentation of Repairs | 1 | LS | $3,150 | 1 | $9,450 |
| 1.5.3 Groundwater Sampling | 1 | LS | $1,050 | 1 | $3,150 |
| 1.5.4 Groundwater Assessment Report | 1 | LS | $3,150 | 1 | $9,450 |
| **MONITORING / OPERATIONS TOTAL** | | | | | $460,950 |
| **2.0 PROFESSIONAL FEES, MISCELLANEOUS** | | | | | |
| 2.1 Professional Services | 1 | LS | $575 | 1 | $17,250 |
| 2.2 Administration | 1 | LS | $1,525 | 1 | $45,750 |
| 2.3 Labor for Miscellaneous Repairs | 1 | LS | $1,225 | 1 | $36,750 |
| **PROFESSIONAL FEES, MISCELLANEOUS TOTAL** | | | | | $99,750 |
| **TOTAL 30 YEAR POST-CLOSURE COST** | | | | | $560,700 |

Reference:

1 - Brown and Caldwell estimated 2008 costs.

2 - SCS Field Services 2007 costs adjusted for inflation.

3 - Prism Labs 2007 costs adjusted for inflation.

4 - ASI Analytical Services 2007 costs adjusted for inflation.

5 - Coastal Landscaping 2007 costs adjusted for inflation.

6 - A-1 Fence Company 2007 costs adjusted for inflation.

309 East Morehead Street
Suite 160
Charlotte, NC 28202

Tel: (704) 358-7204
Fax: (704) 358-7205

May 30, 2008

BROWN AND CALDWELL

Mr. Mike Gurley
Environmental Manager
BFI CMS Landfill
5101 Morehead Road
Concord, North Carolina 28027 — 135430

Subject: Update of Financial Assurance
Lake Norman Landfill

Dear Mr. Gurley:

Please find enclosed the final Financial Assurance update documents for the Lake Norman Landfill.

We appreciate the opportunity to work with you on this project. If you have any questions, please contact us at 704-373-7117.

Very truly yours,

BROWN AND CALDWELL

Scott Baranowski

Scott Baranowski

SDB:dm
Enclosures

P:\135430 - Allied Lake Norman Financial Assurance\WP\Draft\L001 - Gurley - Financial Assurance_Cover letter_Lake Norman_final.doc

# BASIS FOR LAKE NORMAN LANDFILL
# ALLIED WASTE INDUSTRIES, INC.
# BASIS FOR FINANCIAL ASSURANCE UPDATE

1. Final Cover System: The total landfill area requiring final cover is 18.4 acres.

2. The inflation Factor is 1.029 based information posted on the NCDENR website. The inflation factor was used for some of the estimates as indicated in the attachment.

3. Tables contain notes that provide the source of cost estimates and unit costs. The topographic survey cost is based on an estimate from Bullseye Design Services, Inc., and earthwork construction unit costs are based on the Earnhardt Grading estimate. Quarterly monitoring of gas probes are based on an estimate from SCS Field Services, sampling costs are based on an estimate from Prism Labs, analytical and reporting estimates are based on estimates from ASI Analytical Services, Inc., mowing is based on an estimate from Coastal Landscaping, and access, security, and signs estimate is based on an estimate from A-1 Fence company and Brown and Caldwell assumed costs. The other estimates are from engineering design costs based on previous project history and estimates developed by Brown and Caldwell, 2008.

| Summary of Financial Assurance Cost 2008 | |
|---|---|
| **Closure** | **$439,096** |
| **Post Closure** | **$560,529** |
| **Total** | **$999,625** |

NORTH CAROLINA PROFESSIONAL SEAL 7775 ENGINEER JAMES H. LAUGHLIN, III

**Table 1**
**CLOSURE**
**Financial Assurance Cost Estimate**
**Allied Waste Industries, Inc.**
**Lake Norman Landfill**
**Stanley, NC**

Area Requiring Final cover 18.4 acres 801,504 $ft^2$ Total Footprint 31.3 Acres

| Cost Item Description | Quantity | Unit | Unit Cost | Source | Cost Estimate (3rd Party Estimates) | Inflation Factor | 2008 Total Cost |
|---|---|---|---|---|---|---|---|
| **1.0 ENGINEERING** | | | | | | | |
| 1.1 Topographic survey | 18.4 | AC | $188 | 1 | $3,459 | ---- | $3,459 |
| 1.2 Boundary Survey for Affidavit | 31.3 | AC | $52 | 2 | $1,628 | ---- | $1,628 |
| 1.3 Site Evaluation | 18.4 | AC | $102 | 2 | $1,877 | ---- | $1,877 |
| 1.4 Development of Plans | 90 | Hours | $102 | 2 | $9,180 | ---- | $9,180 |
| 1.5 Construction Administration | 40 | Hours | $82 | 2 | $3,280 | ---- | $3,280 |
| 1.6 Admin. Cost for Certification of Final Cover and Affidavit to the Public | 16 | Hours | $102 | 2 | $1,632 | ---- | $1,632 |
| 1.7 Project Management, Construction Observation and Testing | 18.4 | AC | $3,575 | 2 | $65,780 | ---- | $65,780 |
| **ENGINEERING TOTAL** | | | | | $86,836 | ---- | $86,836 |
| | | | | | | | |
| **2.0 CONSTRUCTION** | | | | | | | |
| 2.1 Final Cover System | | | | | | | |
| 2.1.1 Soil Placement and Processing | | | | | | | |
| 2.1.1a Mobilization | 1 | EACH | $3,630 | 3 | $3,630 | *1.029* | $3,735 |
| 2.1.1b Barrier soil cap (18 inches) | 44,528 | $y^3$ | $5.24 | 3 | $233,327 | *1.029* | $240,093 |
| 2.1.1c Erosion Layer Placement (6 inches) | 14,843 | $y^3$ | $5.24 | 3 | $77,776 | *1.029* | $80,031 |
| **2.2 Sediment / Erosion Control Structures** | | | | | | | |
| 2.2.2 Seeding / Fertilizing / Mulching | 18.4 | AC | $1,500 | 4 | $27,600 | *1.029* | $28,400 |
| **CONSTRUCTION TOTAL** | | | | | $342,332 | *1.029* | $352,260 |
| | | | | | | | |
| **TOTAL CLOSURE COST** | | | | | $429,168 | *1.029* | $439,095.53 |

[1] Estimate Bullseye Design Services, Inc. 1/2008
[2] Brown and Caldwell Assumed Costs 2008
[3] Earnhardt Grading Estimate for Lake Norman 2007
[4] Brown and Caldwell Assumed Costs and confirmed by Allied Waste site Environmental Manager

NORTH CAROLINA PROFESSIONAL SEAL 7775 ENGINEER JAMES H. LAUGHLIN, III

Table 2
POST-CLOSURE CARE
Financial Assurance Cost Estimate
Allied Waste Industries, Inc.
Lake Norman Landfill
Stanley, NC

Post Closure Care Period: 30 years
Corrective Action (over 30-year period): 3

| Cost Item Description | Quantity | Unit | Unit Cost | Annual Cost Estimate (3rd Party Estimates) | Note | Total Cost for 30 Yr. PC Period | Inflation Factor | 2008 Total Cost |
|---|---|---|---|---|---|---|---|---|
| **1.0 MONITORING/OPERATIONS** | | | | | | | | |
| **1.1 Site Inspection and Record Keeping (Annual)** | | | | | | | | |
| Yearly Inspections & Reporting | 1 | Lump Sum | $1,300 | $1,300 | 2 | $39,000 | ---- | $39,000 |
| **1.2 Site Monitoring (Sampling, Analytical, Reporting)** | | | | | | | | |
| 1.2.1 Landfill Gas | | | | | | | | |
| Quarterly Monitoring of 6 probes | 24 | Samples/yr | $67 | $1,608 | 5 | $48,240 | 1.029 | $49,639 |
| 1.2.2 Ground Water | | | | | | | | |
| Semi Annual Collection & Analysis of 4 Wells | 8 | Samples/yr | $425 | $3,400 | 6,7 | $102,000 | 1.029 | $104,958 |
| 1.2.3 Surface Water | | | | | | | | |
| Semi Annual Collection & Analysis of 2 Points | 4 | Samples/yr | $285 | $1,140 | 6,7 | $34,200 | 1.029 | $35,192 |
| **1.4 Cover Maintenance, Etc.** | | | | | | | | |
| 1.4.1 Sediment Basin/Silt Fence Maintenance (Total of 3 occurences over 30-year period) | 1 | Lump Sum | $1,600 | $1,600 | 2 | $4,800 | ---- | $4,800 |
| 1.4.2 Revegetation | 3 | Acre/yr | $1,300 | $3,900 | 2 | $117,000 | ---- | $117,000 |
| 1.4.3 Mowing | 1 | Lump Sum | $1,545 | $1,545 | 8 | $46,350 | 1.029 | $47,694 |
| 1.4.5 Access, Security, & Signs | 1 | Lump Sum | $800 | $800 | 9 | $24,000 | 1.029 | $24,696 |
| **1.5 Corrective Action Per Occurance (Total of 3 occurences over 30-year period)** | | | | | | | | |
| 1.5.1 Monitoring Well Installation | 1 | Lump Sum | $5,250 | $5,250 | 2 | $15,750 | ---- | $15,750 |
| 1.5.2 Engineering and Documentation of Repairs | 1 | Lump Sum | $3,150 | $3,150 | 2 | $9,450 | ---- | $9,450 |
| 1.5.3 Groundwater Sampling | 1 | Lump Sum | $1,050 | $1,050 | 2 | $3,150 | ---- | $3,150 |
| 1.5.4 Groundwater Assessment Report/Statistical Analysis | 1 | Lump Sum | $3,150 | $3,150 | 2 | $9,450 | ---- | $9,450 |
| **MONITORING/OPERATIONS SUBTOTAL** | | | | $27,893 | | $453,390 | 1.029 | $460,779 |

| Cost Item Description | Quantity | Unit | Unit Cost | Annual Cost Estimate (3rd Party Estimates) | Note | Total Cost for 30 Yr. PC Period | Inflation Factor | 2008 Total Cost |
|---|---|---|---|---|---|---|---|---|
| **2.0 PROFESSIONAL FEES, MISC.** | | | | | | | | |
| **2.1 Professional Licensed Engineer Services** | 1 | Lump Sum | $575 | $575 | 2 | $17,250 | ---- | $17,250 |
| **2.2 Administration** | 1 | Lump Sum | $1,525 | $1,525 | 2 | $45,750 | ---- | $45,750 |
| **2.3 Labor** | | | | | | | | |
| Miscellaneous Repairs | 1 | Lump Sum | $1,225 | $1,225 | 2 | $36,750 | ---- | $36,750 |
| **PROFESSIONAL FEES, MISC. SUBTOTAL** | | | | $3,325 | | $99,750 | ---- | $99,750.00 |
| **SUBTOTALS** | | | | $31,218 | | $553,140 | 1.029 | $560,529 |
| **30 YEAR POST CLOSURE CARE COST** | | | | | | | | $560,528.91 |

Notes:
[2] Brown and Caldwell Assumed Costs 2008
[5] Estimate from SCS Field Services 2007
[6] Estimate from Prism Labs 2007
[7] Estimate from ASI Analytical Services Inc. 2007
[8] Estimate from Coastal Landscaping 2007

[9] Estimate from A-1 Fence Company 11/2007 based on Brown and Caldwell estimate that 10% of fence will need repair each year. Total fence is 500 LF based on information provided by Allied Waste site Environmental Manager.

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# APPENDIX F: POST-CLOSURE INSPECTION CHECKLIST

# APPENDIX F

## POST-CLOSURE INSPECTION CHECKLIST

### 1. Site Security *(Inspect Monthly)*

| Action | Action Completed | Comments |
|---|---|---|
| Condition of fences, gates, locks, etc. | | |
| Evidence of vandalism (wells, vents, etc.) | | |
| Evidence of penetrations (poles, posts, stakes) | | |
| Evidence of human encroachment | | |
| General site condition | | |

### 2. Final Cover System *(Inspect Quarterly and After Large Storm Events)*

| Action | Action Completed | Comments |
|---|---|---|
| Final cover settlement | | |
| Erosion damage | | |
| Side slope downchute in operable condition | | |
| Grass condition | | |
| Removal of woody vegetation | | |
| Evidence of wildlife intrusion | | |

### 3. Landfill Gas Venting System *(Inspect Quarterly)*

| Action | Action Completed | Comments |
|---|---|---|
| Evidence of damage to wells or vents | | |
| Differential settlement or cover subsidence | | |
| Evidence of wildlife intrusion | | |
| Gas Vents: unusual conditions or excessive methane | | |

### 4. Site Stormwater Management and Erosion and Sediment Control Systems *(Inspect Monthly and After Large Storm Events)*

| Action | Action Completed | Comments |
|---|---|---|
| Culvert outfalls | | |
| Channels / Terraces | | |
| Sediment basins | | |