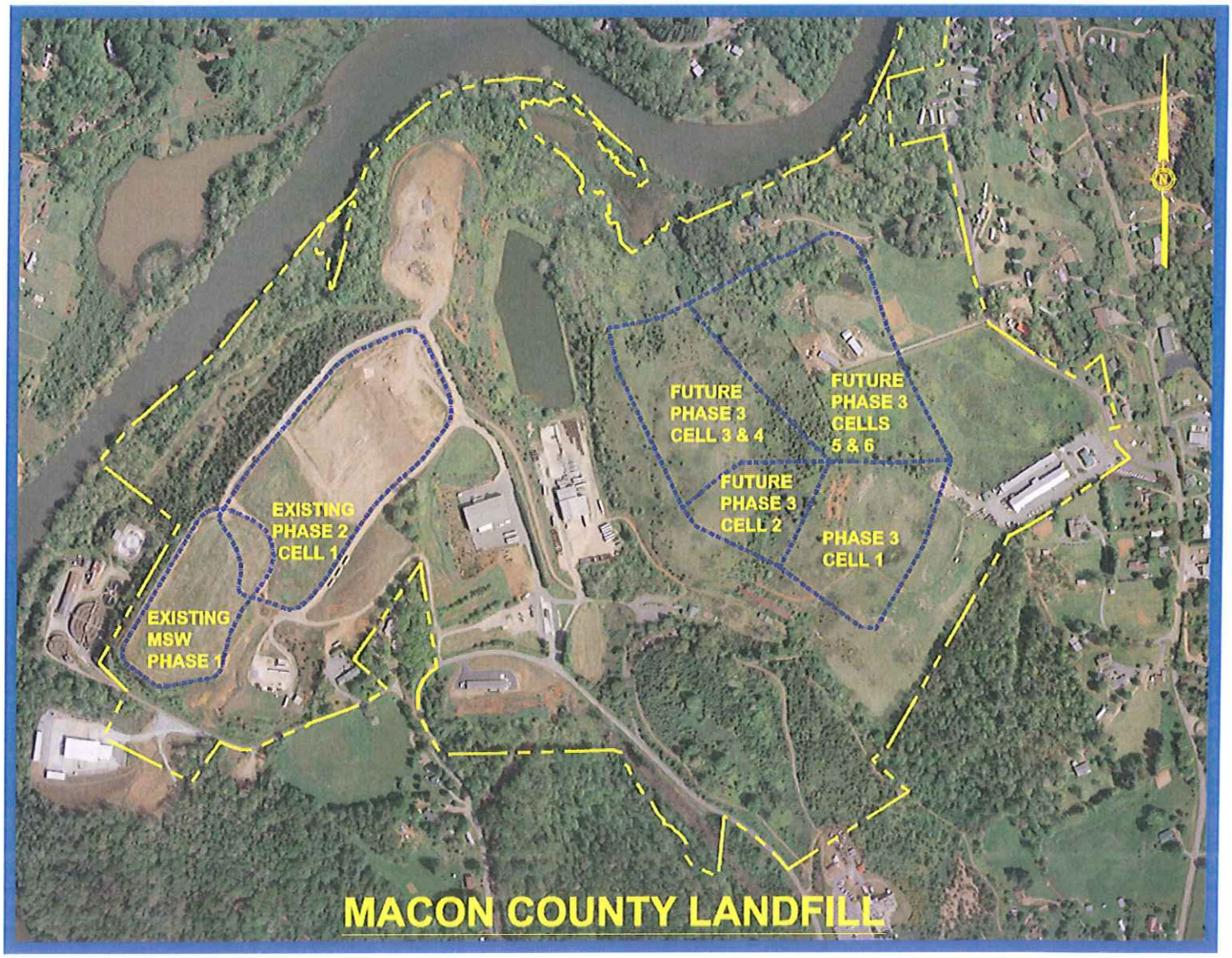
Permit No.	Date	DIN
57-03	June 10, 2015	24488

RECEIVED
June 5, 2015
Solid Waste Section
Asheville Regional Office

Macon County MSW Landfill
Macon County, North Carolina

Permit To Construct
MSW Phase 3 Cell 1



JUNE 2015

McGill ASSOCIATES
ENGINEERING·PLANNING·FINANCE
55 BROAD STREET ASHEVILLE, NC 28801 PH. (828) 252-0575 FIRM LICENSE # C-0459

PERMIT TO CONSTRUCT

MSW PHASE 3 CELL 1
MACON COUNTY MSW LANDFILL
PERMIT # 57-03

MACON COUNTY, NORTH CAROLINA

Submitted To:

North Carolina Department of
Environment and Natural Resources,
Division of Waste Management,
Solid Waste Section
2090 U.S. Hwy 70
Swannanoa, North Carolina 28778

June 4, 2015

Prepared By:

McGill Associates, P.A.
55 Broad Street
Asheville, North Carolina 28801
828-252-0575

MACON COUNTY MSW LANDFILL
MACON COUNTY, NORTH CAROLINA

PERMIT TO CONSTRUCT
MSW PHASE 3 CELL 1

June 4, 2015

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Section 10:	Design Hydrogeologic Report (Prepared by BLE and submitted under separate cover)
Section 11:	Water Quality Monitoring Plan (Prepared by BLE and submitted under separate cover)
Section 12:	Landfill Gas Monitoring Plan (Prepared by BLE and submitted under separate cover)
Section 13:	HELP Model Analysis
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Section 1: Project Correspondence

McGill ASSOCIATES

1984 2014 ENGINEERING & LANDSCAPE ARCHITECTURE

June 4, 2015

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

RE: Permit Renewal Existing Phase 2
Permit to Construct Phase 3 Cell 1
Macon County MSWLF – Permit # 57-03
Macon County, North Carolina

Dear Mr. Gaither:

On behalf of Macon County, McGill Associates is pleased to present this submittal for the Permit Renewal of the existing Municipal Solid Waste Landfill (MSWLF) Phase 2 and the Permit to Construct for proposed MSWLF Phase 3 Cell 1 at the Macon County MSWLF. Macon County is approaching the limits of their existing Phase 1\Phase 2 MSWLF, with the lifetime capacity projected to be reached in March of 2017, and the County would like to proceed with the development of MSWLF Phase 3 Cell 1, which received Site Study approval in 1997. As part of the Permit to Construct Phase 3 Cell 1, the County is planning a revision to the Facility Boundary to include a portion of two adjacent properties that were recently purchased by the County. The updated Facility Boundary Plat is included in the Drawings Section of the Permit to Construct documentation. The following sections are included in this submittal package:

Permit Renewal

- Sheet C-101, which illustrates the final cap grades for the existing MSWLF, the approximate fill sequence for the remaining 1.9 years of the existing cell, and the location of proposed passive methane gas vents.
- A copy of the annual capacity letter from McGill Associates to Macon County, based on the April 29, 2015 topographic survey of the existing MSWLF.
- The updated Operations Plan for the remaining lifetime of the existing MSWLF.

Permit to Construct

Section 1: Project Correspondence

55 Broad Street
Asheville, North Carolina 28801

P.O. Box 2259
Asheville, North Carolina 28802

ph: 828.252.0575
f: 828.252.2518

www.mcgillengineers.com

Section 2: Site Survey and Deeds of Property

Section 3: Facility Plan

Section 4: Engineering Plan

Section 5: Construction Quality Assurance Plan

Section 6: Operations Plan

Section 7: Closure and Post-Closure Plan

Section 8: Technical Specifications

Section 9: Erosion Control Plan (The Plan is being finalized and will be forwarded to the Solid Waste Section upon receipt of the land disturbing permit for the project)

Section 10: Design Hydrogeologic Report (Prepared by BLE and submitted under separate cover)

Section 11: Water Quality Monitoring Plan (Prepared by BLE and submitted under separate cover)

Section 12: Landfill Gas Monitoring Plan (Prepared by BLE and submitted under separate cover)

Section 13: HELP Model Analysis

Section 14: Landfill Leachate Production Records

Section 15: 404/401 Permits – Stream/Wetlands Impact

Section 16: Permit To Construct Drawings

Macon County and McGill Associates are working with BLE, Inc. to produce the Permit to Construct information. Under separate cover, BLE, Inc. will provide the following to the Solid Waste Section for review and approval:

1. Design Hydro Report
2. Water Quality Monitoring Plan
3. Landfill Gas Monitoring Plan

Per our recent discussion, BLE will submit the required electronic and hard copy of their portion of the submittal directly to the Solid Waste Section's hydrogeologist, Elizabeth Werner.

The County is in the process of obtaining an erosion control permit from the NCDENR – Land Quality Section for the construction and operation of MSWLF Phase 3 Cell 1 and a copy of that permit will be forwarded to your office upon receipt. The County will continue to discharge leachate collected at both the existing and proposed landfill cells at the adjacent Town of Franklin

Wastewater Treatment Facility. A formal agreement extending the current agreement between the Town and the County regarding the acceptance of leachate is being finalized and will be forwarded to your office upon receipt. There will be approximately 149 linear feet of stream impact and 0.08 acres of wetlands impact associated with the development of the access road to the proposed MSW Phase 3 area, and the County has worked with the U.S. Army Corps of Engineers and the NCDENR-Division of Water Resources to obtain the necessary 404/401 permits for this portion of the project. There will also be an additional 0.04 acres of wetlands impact in the vicinity of the Phase 3 Cell 1 area. The County is in the process of finalizing the 404/401 permits for the additional impact. A copy of those permits already obtained are included in Section 15 of the Permit to Construct documentation. The County will forward the 404/401 permits for the outstanding 0.04 acres of wetlands impact to the Solid Waste Section upon receipt.

A digital and hard copy of the enclosed information are included in this submittal. We understand that you will send an invoice directly to the County for the Permit Renewal/Permit to Construct processing fee. We look forward to working with you in order to obtain a Permit Renewal for existing MSW Phase 2 and a Permit to Construct MSW Phase 3 Cell 1 at the Macon County MSWLF. Please don't hesitate to contact us should you have any questions.

Sincerely,
McGILL ASSOCIATES, P.A.

Dave Pasko

DAVE PASKO
Senior Project Planner

Enclosures

cc: Chris Stahl, Macon County, w/ enc
Derek Roland, Macon County Manager, w/o enc
Elizabeth Werner, NCDENR-SWS, w/o enc
Mark Cathey, McGill Associates, w/enc
Scott Burwell, McGill Associates, w/enc
Adam Waldroup, McGill Associates, w/enc
Andy Alexander, BLE, Inc., w/o enc

X:\2013\13.00726 - Macon Cty\Permit to Construct\ AG 4june15 ltr.doc

Section 2: Site Survey and Deeds of Property

RECORDING DATE: 7-24-89
RECORDING TIME: 9:00 A.M.
BOOK: I-18
PAGE: 578

Milton Fouts etc.
Register of Deeds

BOOK I-18
PAGE 578

CNB
ASSESSOR
MACON CO.

Rec. $1,200.00

This instrument prepared by
R. S. Jones, Jr.
Jones, Key, Melvin & Patton, P.A.

NORTH CAROLINA
MACON COUNTY

WARRANTY DEED

THIS DEED, Made this the 21st day of July, 1989, by OSCAR J. LEDFORD and wife LOUISE B. LEDFORD of Franklin, Macon County, State of North Carolina, parties of the first part, and MACON COUNTY, a body politic and political subdivision of the State of North Carolina, party of the second part; whether one or more; the neuter gender shall be deemed to include the masculine and feminine and the singular number the plural, and vice versa;

WITNESSETH, That the said parties of the first part in consideration of Ten Dollars and other valuable consideration, the receipt of which is hereby acknowledged, has bargained and sold and by these presents does bargain, sell and convey unto said party of the second part and its successors and assigns, a certain tract or parcel of land in Franklin Township, Macon County, State of North Carolina, being more particularly described as follows:

BEGINNING at a 10-inch maple at the south shore line of Lake Emory, the same being the next to last and northeast corner of the Third Tract of land described in and conveyed by the deed from Dan T. Bryson and wife to Oscar Ledford and wife, dated March 8, 1955, recorded in Deed Book G-6 at page 148, Public Records of Macon County, North Carolina; thence with the east line of said tract, reversed, the following courses and distances: South 11 degrees 36 minutes East 113.25 feet to a 24-inch maple; thence South 33 degrees 49 minutes East 153.74 feet to a fence corner; thence North 82 degrees 28 minutes East 166.1 feet to an iron pipe at fence corner; thence South 39 degrees 55 minutes East 253.2 feet to a maple; thence South 30 degrees 37 minutes East 276.1 feet to a pipe at a fence corner; thence North 69 degrees 36 minutes East 803.3 feet to a pipe at the intersection of two roads; thence South 58 degrees 25 minutes East 217.95 feet to a pipe on the Northeast bank of the road; thence South 62 degrees 50 minutes East 212 feet to a pipe on the Northeast bank of the road; thence North 48 degrees 22 minutes East 149 feet to a pipe; thence South 14 degrees 39 minutes East 200.47 feet to a point in fence line; thence South 21 degrees 23 minutes East 255.63 feet to a point in center line of road; thence leaving road, runs South 52 degrees 54 minutes West 523.5 feet to a fence corner; thence South 26 degrees 57 minutes West 92.9 feet to a fence corner;

thence South 27 degrees 33 minutes West 1,044.9 feet to a fence corner; thence South 49 degrees 45 minutes West 81.5 feet to a pipe; thence South 62 degrees 01 minute East 644.9 feet to an iron bar, said iron bar replacing a fence post, the second and northernmost corner of the lands described in the deed from R. S. Jones, Jr., Administrator, to Oscar J. Ledford, et ux, dated May 13, 1976; thence with the east, south and southwest lines of said tract, the following courses and distances: Due South 55 feet to a fence post; South 41 degrees 15 minutes East 181.5 feet to a fence post; South 17 degrees 45 minutes East 196.5 feet to a fence post; South 26 degrees 15 minutes East 81.8 feet to a fence post; South 22 degrees 15 minutes East 189.7 feet to a fence post; South 04 degrees 30 minutes East 295.7 feet to a fence post; South 11 degrees 45 minutes West 97.7 feet to a fence post; South 50 degrees 15 minutes West 154.1 feet to a fence post and South 86 degrees 00 minutes West 196.7 feet to a point on the east edge of the right of way of State Road 1324; thence North 0 degrees 45 minutes West 85 feet to a 24-inch black gum; thence North 52 degrees 00 minutes West 250 feet to a point in the centerline of State Road 1324, the same being located South 58 degrees 29 minutes West 33 feet from a white oak stump; thence along and with the meanders of said State Road, the following courses and distances: North 51 degrees 29 minutes West 214.35 feet; North 48 degrees 21 minutes West 190.1 feet; North 31 degrees 27 minutes West 204.8 feet; North 21 degrees 27 minutes West 215.2 feet; North 33 degrees 43 minutes West 199.6 feet; North 50 degrees 18 minutes West 205 feet and North 60 degrees 02 minutes West 125.7 feet; thence leaving the road runs South 2 degrees 33 minutes West 261.3 feet to a fence corner; thence North 67 degrees 34 minutes West 128.91 feet to a locust stake at branch; thence with the branch, North 37 degrees 29 minutes West 595.39 feet to a locust stake at branch; thence South 86 degrees 04 minutes West 692.6 feet to a fence corner; thence South 84 degrees 30 minutes West 48.5 feet to a point in the center line of State Road No. 1324; thence with the centerline of the same, North 28 degrees 19 minutes West 247.2 feet and North 21 degrees 39 minutes East 164.5 feet to a point; thence leaving the road, runs North 9 degrees 54 minutes 52 seconds West 27.17 feet to a point on the northwest right of way of State Road 1324, the same being witnessed by an iron pipe located North 09 degrees 54 minutes 52 seconds West 42.93 feet distant; thence running with the north right of way line of said State Road 1324, the following courses and distances: North 62 degrees 41 minutes 35 seconds East 32.56 feet; North 70 degrees 56 minutes 49 seconds East 79.65 feet; North 76 degrees 14 minutes 23 seconds East 90.77 feet; North 83 degrees 01 minute 31 seconds East 63.13 feet; South 87 degrees 52 minutes 24 seconds East 71.77 feet and South 78 degrees 29 minutes 14 seconds East 65.70 feet to an iron stake; thence leaving said right of way, runs North 28 degrees 58 minutes 06 seconds West 814.14 feet to an iron stake; thence South 87 degrees 10 minutes 51 seconds West 100 feet to an iron stake, the northeast corner of the 2.34 acre tract of land described in the deed from Oscar J. Ledford and wife to James T. Ledford and wife, dated August 8, 1984, recorded in Deed Book W-15 at page 46, Public Records of Macon County, North Carolina; thence with the north line of the same, North 89 degrees 32 minutes 59 seconds West 261.79 feet to an iron stake, the same being located North 50 degrees 41 minutes 34 seconds West 132.07 feet from the northwest corner of the Jim Ledford house; thence leaving the line of said tract, runs South 09 degrees 34 minutes 55 seconds West 790.33 feet to an iron stake, the extreme westernmost corner of the 0.664 of an acre tract of land described in the deed from Oscar J. Ledford and wife to John Curtis McCall and wife, dated February 6, 1986, recorded in

Deed Book T-16 at page 308, Public Records of Macon County, North Carolina; thence with the west line of said tract, South 05 degrees 47 minutes 19 seconds West 764.79 feet to a twin poplar, the southernmost corner thereof; thence South 32 degrees 31 minutes West 378.58 feet to a 30-inch white oak, an old corner and being the fifth and southeast corner of the lands described in the deed from W. T. Joyner, et al, to Oscar J. Ledford, dated April 2, 1964, recorded in Deed Book C-7 at page 419, Public Records of Macon County, North Carolina; thence with a series of lines common to said tract, the following courses and distances: South 87 degrees 42 minutes West 132.3 feet to a pipe; thence North 18 degrees 43 minutes West crossing the branch, 208.5 feet to a pipe; thence South 33 degrees 18 minutes West 595 feet to a pipe; thence North 52 degrees 46 minutes West 200 feet to a pipe; thence South 77 degrees 24 minutes West 391 feet to an iron pipe on the contour line of Lake Emory; thence with the contour line of said Lake Emory in a general northerly and easterly direction 5,650 feet to the point of BEGINNING, and being all of the lands known as the Oscar Ledford Farm, and being described herein as shown by survey and plat, (unrecorded), made by Shope and Holden, Registered Land Surveyors, in April and May of 1971.

There is further conveyed hereby all that portion of the lands described in the deed from W. T. Joyner, et al, to Oscar J. Ledford as recorded in Deed Book C-7 at page 419, which is not encompassed within the foregoing metes and bounds description.

There is further conveyed hereby all the lands described in the deed from Tommy A. Mason and wife to Oscar J. Ledford and wife, dated July 27, 1982, and being described therein as follows:

"BEGINNING at a 24-inch black gum with old marks, the same being located at the site of a stake, the third corner of the lands described in the deed from J. A. Hurst and wife to Tommy A. Mason and wife, dated October 19, 1976, and recorded in Deed Book G-11 at page 256, Public Records of Macon County, North Carolina; runs thence with the second line of said tract, reversed, South 1 degree 00 minutes West 125 feet to a point in the centerline of State Road 1324; thence with the centerline of said State Road, the following courses and distances: North 28 degrees 30 minutes West 90 feet; North 38 degrees West 70 feet; North 43 degrees 30 minutes West 50 feet; North 49 degrees 30 minutes West 125 feet and North 51 degrees 30 minutes West 80 feet to a point, the same being witnessed by an iron pipe on the west side of said road, located due west; thence due east 40 feet to the spike of an old black oak corner; thence South 54 degrees 30 minutes East 302 feet to the point of BEGINNING and being all that portion of the lands described in the deed recorded in Book G-11 at page 256, which lies north and east of the centerline of State Road 1324, and being described herein as shown by unrecorded survey and plat made by J. Frank Shope, Registered Land Surveyor.

"This deed is made subject to the right of way of State Road No. 1324 and to easements for public utilities."

THERE IS EXCEPTED from the lands above described and there is not conveyed hereby all those portions thereof hereinafter identified:

FIRST EXCEPTION: That portion of the same lying within the contour lines of Lake Emory, together with the right to sog and render unfit for cultivation adjacent lands, as said lands

and rights are particularly described in the deeds from J. L. Barnard and wife to the Town of Franklin, as recorded in Deed Book J-4 at page 435, and 436, Public Records of Macon County, North Carolina.

SECOND EXCEPTION: That certain 3.83 acre tract of land described in and conveyed by the deed from Oscar J. Ledford, et ux, to the Town of Franklin, dated April 10, 1964, recorded in Deed Book C-7 at page 374, Public Records of Macon County, North Carolina.

THIRD EXCEPTION: All those certain tracts or parcels of land containing 0.14 acres and 5.55 acres, and being described in the deed from Oscar J. Ledford and wife to the Town of Franklin, dated December 30, 1983, recorded in Deed Book Z-15 at page 6, Public Records of Macon County, North Carolina.

This deed is further made subject to the rights granted the Town of Franklin to the use in common with Grantors, their heirs and assigns, of a 30-foot wide roadway as conveyed by the deed recorded in Book C-7 at page 374, above referenced.

This deed is further made subject to easements for existing public utilities and to the right of way of State Road 1324.

TO HAVE AND TO HOLD the aforesaid tract or parcel of land and all privileges and appurtenances thereunto belonging, or in anywise thereunto appertaining, unto the said party of the second part, and its successors and assigns, to their only use and behoof, in fee simple forever, subject to those exceptions, reservations and limitations following the description hereinabove set forth.

And the said party of the first part covenants with said party of the second part, his heirs, successors and assigns, that he is seized of said premises in fee, and has the right to convey the same in fee simple; that the same are free and clear from all liens and encumbrances and that he will warrant and defend the said title to the same against the lawful claims of all persons whomsoever, subject to those exceptions, reservations and limitations following the description hereinabove set forth.

IN TESTIMONY WHEREOF, the said party of the first part has hereunto set his hand and seal, the day and year first above written.

Oscar J. Ledford (SEAL)
Oscar J. Ledford

Louise B. Ledford (SEAL)
Louise B. Ledford

BOOK I-18
PAGE 578

NORTH CAROLINA
MACON COUNTY

I, Melissa D. Jones, a Notary Public of the aforesaid County and State, hereby certify that OSCAR J. LEDFORD and wife LOUISE B. LEDFORD personally appeared before me this day and acknowledged the due execution of the foregoing instrument for the purpose therein expressed.

WITNESS my hand and Notarial seal, this the 21st day of July, 1989.

Melissa D. Jones
Notary Public,
My Commission Expires 6-26-92

(NOTARIAL SEAL)

NORTH CAROLINA, MACON COUNTY

The foregoing or annexed certificate(s) of Melissa D. Jones a N.P. of Macon County, State of N.C.; and _____ a N.P. of _____ County, State of _____; attested by Ner (Seal) is certified to be correct. Presented for registration and recorded in this office in Book I-18 Page 578, this the 24 day of July, 1989 at 9:00 o'clock A.M.

Milton Toutscher
Register of Deeds
Macon County, North Carolina

BOOK I-18
PAGE 578

2008015541
MACON CO, NC FEE $17.00
PRESENTED & RECORDED:
06-01-2009 09:59:58 AM
TODD RABY
REGISTER OF DEEDS
BY: TODD RABY
REGISTER

BK: CRP B-33
PG: 1475-1476

Revenue $ -0-
THIS INSTRUMENT PREPARED BY
AND PLEASE RETURN TO:
LESLEY F. MOXLEY, a licensed
North Carolina Attorney.
5 WEST MAIN STREET
FRANKLIN, NORTH CAROLINA 28734

MACON COUNTY TAX COLLECTOR'S OFFICE 6-1-09 RA

PO

PIN: Portion of #01-34069

NORTH CAROLINA NON-WARRANTY DEED

THIS DEED, made and entered into this the 21st day of May, 2009, by and between **MACON COUNTY, a body politic and political subdivision of the State of North Carolina,** GRANTOR, and the **TOWN OF FRANKLIN, a municipal corporation in Macon County, North Carolina,** with its principal place of business being located at 70 West Main Street, Franklin, North Carolina, 28734, GRANTEE. (The designation Grantor and Grantee as used herein shall include said parties, their heirs, successors and assigns, and shall include the singular, plural, masculine, feminine, or neuter as required by the context.)

WITNESSETH: that the Grantor, for a valuable consideration paid by the Grantee, the receipt of which is hereby acknowledged, has and by these presents does grant, bargain, sell, and convey unto the Grantee in fee simple, all of that certain lot or parcel of land situated in the Town of Franklin, Franklin Township, Macon County, North Carolina, and more particularly described as follows:

BEING a portion of the lands described in and conveyed by that deed dated 21 July 1989 from Oscar J. Ledford and wife, Louise B. Ledford, to Macon County, as recorded in the Office of the Register of Deeds for Macon County, North Carolina, in Deed Book I-18 at page 578, and being more particularly described as follows:

BEING that 10.055 tract of land as shown on that plat survey dated 15 January 2008 by G. L. Sprinkle, Registered Land Surveyor, Drawing No. 5272, and revised on 2 March 2009, a copy of which said plat is recorded in the Office of the Register of Deeds for Macon County, North Carolina, on Plat Card #6253; to which said plat and record reference is hereby made.

THIS CONVEYANCE IS MADE TOGETHER WITH AND SUBJECT TO the easements set forth in the deed referred to hereinabove and as shown on the plat referred to hereinabove.

THIS CONVEYANCE IS MADE TOGETHER WITH AND SUBJECT TO an easement for the use of that approximate two acre tract south of Sierra Drive adjoining the northeastern portion of

the property described hereinabove. The easement shall be for and subject to the following conditions:

1. The County allows use of the property for grading activities, access road and storage yard.
2. No storage of hazardous material or solid waste material.
3. Only pole-barn type structures allowed.
4. Pre-approval by County of any structures prior to construction.
5. No bulk storage of liquid material.
6. The Town is responsible for acquiring all permits associated with construction.

TO HAVE AND TO HOLD the aforesaid lot or parcel of land and all privileges and appurtenances thereto belonging to the Grantee in fee simple.

The Grantor makes no warranty, express or implied, as to title to the property hereinabove described.

IN WITNESS WHEREOF, the Grantor has caused this deed to be signed in its name by its Chairman, attested by its Clerk to the Board of Commissioners and sealed with its official seal on the day and year first above written.

COUNTY OF MACON

By: _____
Ronnie Beale, Chairman
Board of Commissioners

ATTEST:

_____
C. Jack Horton, Clerk to the Board

NORTH CAROLINA
MACON COUNTY

I, Wilma J. Anderson, Notary Public for Macon County, North Carolina, certify that C. Jack Horton, personally came before me this day and acknowledged that he is the Clerk to the Board of Commissioners of Macon County and that by authority duly given and as the act of Macon County, the foregoing instrument was signed in its name by the Chairman of its Board of Commissioners, sealed with its seal and attested by him as the Clerk to the Board of Commissioners.

Witness my hand and official seal, this the 21st day of May, 2009.

(Official Seal)

Wilma J. Anderson NOTARY PUBLIC Macon County, NC

_____
Notary Public
My commission expires: 11-15-12

BK: CRP S-36
PG: 115-117
RECORDED:
04-14-2015
12:23:18 PM
BY: TODD RABY
REGISTER

2015001971
MACON COUNTY, NC
TODD RABY
REGISTER OF DEEDS

NC FEE $0.00
STATE OF NC
REAL ESTATE
EXTX $1600.00

EXCISE TAX: $1,600.00
PIN: 6595-48-3221
GRANTORS PRIMARY RESIDENCE: no RECORDING TIME, BOOK AND PAGE
****
Prepared by: Fred H. Moody, Jr., P.O. Box 670, Bryson City, NC 28713
TITLE TO THE WITHIN DESCRIBED LANDS ARE NOT CERTIFIED BY FRED H. MOODY, JR. UNLESS A WRITTEN TITLE OPINION IS RENDERED.
****

STATE OF NORTH CAROLINA

GENERAL WARRANTY DEED

COUNTY OF MACON

THIS DEED made this 14 day of April, 2015, by and between

CHARLES T. DALTON, a/k/a Terry Dalton and wife,
WENDY L. DALTON
605 Baird Cove Road
Franklin, NC 28734

MAPPING 34

MACON COUNTY 4/14/15 MP TAX COLLECTOR'S OFFICE

hereinafter referred to as Grantor, and

MACON COUNTY, a North Carolina County and Body Politic
Macon County Courthouse Annex Building
5 West Main Street
Franklin, NC 28734

hereinafter referred to as Grantee. The designation Grantor and Grantee as used herein shall include said parties, their heirs, successors, and assigns, and shall include singular, plural, masculine, feminine or neuter as required by context.

W I T N E S S E T H:

That the Grantor, for a valuable consideration paid by the Grantee, the receipt of which is hereby acknowledged, has and by these presents does grant, bargain, sell and convey unto the Grantee in fee simple, all that certain lot or parcel of land situated in Franklin Township, Macon County, North Carolina and more particularly described as follows:

Lying and being in the Franklin Township, Macon County, North Carolina and being that 8.41 acre, more or less, tract or parcel of land as shown on a map or plat entitled "Macon County Solid Waste" prepared by G. L. Sprinkle, PLS, and recorded in ~~Map Cabinet~~ ____, ~~at Slide~~ CARD # 8301, Office of the Register of Deeds for Macon County, North Carolina, to which said plat reference is hereby expressly made for a more complete and particular description of the land conveyed hereby.

Being that same tract or parcel of land described in a deed recorded in Book N-25, at page 1892, Macon County Registry.

TO HAVE AND TO HOLD the aforesaid lot or parcel of land and all privileges and appurtenances thereto belonging to the Grantee in fee simple.

And the Grantor covenants with the Grantee, that Grantor is seized of the premises in fee simple, has the right to convey the same in fee simple, that title is marketable and free and clear of all encumbrances, and that Grantor will warrant and defend the title against the lawful claims of all persons whomsoever except for the exceptions hereinafter stated.

Title to the property hereinabove described is subject to the following exceptions:

Easements in favor of Nantahala Power & Light Company recorded in Book A-9, page 213 and Book O-10, page 60, Macon County Registry; Right of way for Pannell Road, SR 1326.

IN WITNESS WHEREOF, the Grantors have hereunto set their hands and seals, the day and year first above written.

_____ (SEAL)
CHARLES T. DALTON

_____ (SEAL)
WENDY L. DALTON

STATE OF NORTH CAROLINA

COUNTY OF MACON

I, John F. Henning, Sr., a Notary Public of the County and State aforesaid, certify that CHARLES T. DALTON AND WENDY L. DALTON personally appeared before me this day and acknowledged the execution of the foregoing instrument.

Witness my hand and official stamp or seal, this 14th day of April, 2015.

My commission expires:
May 26, 2016

Notary Public

John F. Henning, Sr.
Print Notary Name

JOHN F. HENNING, SR
NOTARY
PUBLIC
MACON COUNTY, NC

BK: CRP S-36
PG: 141-142
RECORDED:
04-14-2015
03:28:22 PM
BY: TODD RABY
REGISTER

2015001981
MACON COUNTY, NC
TODD RABY
REGISTER OF DEEDS

NC FEE $0.00
STATE OF NC
REAL ESTATE
EXTX $1460.00

WARRANTY DEED

Delinquent taxes, if any, to be paid by the closing attorney to the county tax collector upon disbursement of the closing proceeds.

Revenue $1,460.00

This instrument prepared by: Joseph M. Collins, a licensed North Carolina attorney
Return To: COLLINS & HENSLEY, P.A.
217 Iotla Street
Franklin, North Carolina 28734

MACON COUNTY TAX COLLECTOR'S OFFICE 4/14/15 MP

Grantees' permanent mailing address: MACON COUNTY
5 West Main Street
Franklin, N.C. 28734

PIN # 6595-48-2707

STATE OF NORTH CAROLINA
COUNTY OF MACON

THIS DEED, made this the 14th day of April, 2015, by and between **DONALD V. BURLING and wife, FAYE E. FORTUNE,** Grantor, and **MACON COUNTY,** Grantee; whether one or more; the neuter gender shall be deemed to include the masculine and feminine and the singular number the plural, and vice versa;

WITNESSETH, That Grantor, in consideration of Ten Dollars and other valuable consideration, the receipt of which is hereby acknowledged, has bargained and sold, and by these presents does bargain, sell, and convey unto Grantee, and his heirs, successors, and assigns, a certain tract or parcel of land in Franklin Township, Macon County, North Carolina, being more particularly described as follows:

> BEING that certain 14.58 acre tract as shown on that certain survey prepared by Sprinkle Surveying P.A., G.L. Sprinkle, Professional Land Surveyor, dated 6 March 2015, entitled BOUNDARY SURVEY MACON COUNTY SOLID WASTE, drawing number #5857A, and being subsequently recorded on Plat Card # 8304, to which reference is hereby made for a more complete description.
>
> TOGETHER WITH AND SUBJECT TO those certain easements and rights of way as shown on the above referenced recorded plat and as is recorded in Deed Book M-24, Pages 1820-1822 , Macon County Land Registry.

Subject to easements for existing roadways and utility lines and facilities, to restrictions of record, and to applicable land use laws and ordinances.

The property hereinabove described was acquired by Grantors by instrument recorded in Deed Book M-24, Pages 1820-1822, Macon County Land Registry.

All or a portion of the property herein conveyed does not include the primary residence of a Grantor.

TO HAVE AND TO HOLD the aforesaid tract or parcel of land and all privileges and appurtenances thereunto belonging, or in anywise thereunto appertaining, unto the Grantee, and his heirs, successors and assigns, to their only use and behoof, in fee simple forever, subject to those exceptions, reservations, and limitations following the description hereinabove set forth.

And the Grantor covenants with Grantee, his heirs, successors and assigns, that he is seized of said premises in fee, and has the right to convey the same in fee simple; that the same are free and clear from all liens and encumbrances and that he will warrant and defend the said title to the same against the lawful claims of all persons whomsoever, subject to those exceptions, reservations, and limitations following the description hereinabove set forth.

IN TESTIMONY WHEREOF, Grantor has set his hand and seal, the day and year first above written.

_____(SEAL)
DONALD V. BURLING

Faye E. Fortune (SEAL)
FAYE E. FORTUNE

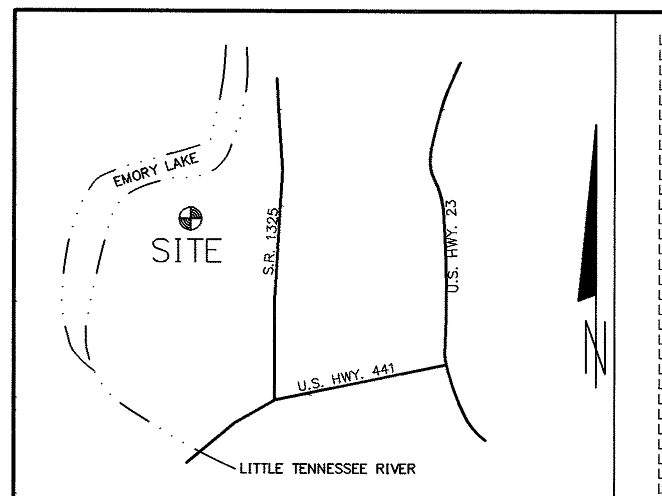
STATE OF NORTH CAROLINA
COUNTY OF MACON

I, a Notary Public of the County and State aforesaid, certify that DONALD V. BURLING and wife, FAYE E. FORTUNE personally appeared before me this day and acknowledged the due execution of the foregoing instrument. Witness my hand and official stamp or seal, this the 14th day of April, 2015.

(SEAL)

TANYA S. BLECKLEY NOTARY PUBLIC MACON COUNTY, NC

Notary Public
My Commission Expires: 6/5/16



VICINITY SKETCH (NO SCALE)

Line	Bearing	Distance
L1	S 7° 53' 41" E	113.71'
L2	N 50° 52' 33" E	148.97'
L3	S 18° 52' 27" E	114.11'
L4	S 75° 29' 45" W	41.71'
L5	S 25° 17' 29" E	80.35'
L6	S 45° 35' 22" E	72.54'
L7	S 54° 46' 35" W	152.37'
L8	S 62° 28' 06" W	109.41'
L9	INTENTIONALLY DELETED	
L10	S 50° 07' 11" W	88.14'
L11	S 57° 19' 50" W	22.04'
L12	N 56° 08' 34" W	36.71'
L13	N 55° 52' 02" W	43.85'
L14	N 59° 29' 42" W	53.73'
L15	N 61° 30' 25" W	22.06'
L16	N 64° 55' 43" W	128.85'
L17	N 34° 58' 27" W	49.90'
L18	N 0° 27' 03" E	14.08'
L19	N 9° 34' 47" E	36.05'
L20	N 31° 00' 17" W	23.20'
L21	N 42° 19' 22" W	35.84'
L22	N 63° 30' 55" W	16.02'
L23	N 32° 36' 44" W	20.12'
L24	N 69° 23' 48" W	42.15'
L25	N 6° 43' 23" E	14.91'
L26	N 44° 45' 26" W	39.33'
L27	N 28° 36' 05" W	54.16'
L28	N 50° 18' 45" W	23.29'
L29	N 37° 34' 01" W	44.99'
L30	N 32° 14' 35" W	93.74'
L31	N 23° 53' 44" W	23.75'
L32	N 45° 56' 49" W	23.43'
L33	N 16° 23' 25" W	49.43'
L34	N 79° 12' 33" W	24.05'
L35	N 15° 24' 21" W	4.01'
L36	S 88° 42' 19" W	12.00'
L37	S 87° 00' 33" W	48.49'
L38	N 32° 15' 00" W	40.26'
L39	N 31° 17' 50" W	62.65'
L40	N 26° 49' 05" W	64.00'
L41	N 19° 07' 58" W	59.49'
L42	N 0° 00' 20" E	72.09'
L43	N 24° 18' 54" E	50.99'
L44	N 40° 15' 31" E	44.78'
L45	N 60° 15' 55" E	33.83'
L46	N 7° 24' 19" W	32.43'
L47	N 8° 42' 41" W	46.32'
L48	N 2° 19' 53" W	38.99'
L49	S 35° 11' 27" W	63.11'
L50	S 35° 09' 02" W	104.51'
L51	S 66° 15' 00" W	19.93'
L52	S 60° 02' 32" W	49.82'
L53	S 62° 17' 26" W	53.99'
L54	S 67° 40' 23" W	73.58'
L55	S 70° 27' 27" W	52.81'
L56	S 70° 52' 24" W	75.97'
L57	S 70° 24' 16" W	46.03'
L58	S 35° 02' 24" W	10.70'
L59	S 68° 36' 00" W	86.22'
L60	S 66° 36' 20" W	61.39'
L61	S 65° 18' 25" W	103.23'
L62	S 79° 46' 00" W	30.87'
L63	N 83° 55' 30" W	29.55'
L64	N 71° 45' 55" W	48.13'
L65	N 66° 46' 50" W	45.98'
L66	S 35° 37' 13" W	23.24'
L67	S 35° 37' 13" W	90.01'
L68	N 50° 27' 44" W	146.21'
L69	N 50° 27' 04" W	53.99'
L70	S 79° 42' 46" W	55.69'
L71	N 10° 00' 12" E	107.71'
L72	N 4° 23' 12" E	94.41'
L73	N 4° 15' 37" E	269.72'
L74	S 88° 09' 17" W	16.63'
L75	N 26° 30' 47" E	72.82'
L76	N 11° 13' 42" E	82.89'
L77	N 10° 33' 32" E	144.72'
L78	S 40° 39' 17" W	53.39'
L79	S 11° 12' 07" W	96.21'
L80	S 8° 52' 17" W	97.13'
L81	S 33° 53' 57" W	52.36'
L82	S 19° 26' 17" W	89.54'
L83	N 4° 53' 52" E	164.03'
L84	N 6° 50' 47" E	206.49'
L85	N 14° 23' 52" E	122.44'
L86	S 63° 20' 05" E	315.95'
L87	S 65° 34' 38" E	99.54'
L88	S 66° 17' 45" E	131.10'
L89	N 30° 31' 28" E	21.15'
L90	N 45° 04' 01" W	170.39'
L91	N 52° 23' 42" W	2.21'
L92	N 36° 54' 30" E	39.23'
L93	N 43° 28' 42" E	106.59'
L94	N 35° 49' 53" E	34.38'
L95	N 47° 23' 17" E	50.54'
L96	N 52° 40' 28" E	36.57'
L97	N 48° 17' 48" E	92.89'
L98	N 48° 10' 02" E	44.63'
L99	N 49° 25' 28" E	64.03'
L100	N 41° 46' 17" E	113.28'
L101	N 36° 11' 16" E	80.16'
L102	N 39° 43' 40" E	81.13'
L103	N 37° 55' 53" E	86.71'
L104	N 43° 05' 18" E	80.46'
L105	N 38° 39' 14" E	92.54'
L106	N 38° 32' 27" E	79.58'
L107	N 40° 03' 27" E	96.68'
L108	N 42° 35' 19" E	39.51'
L109	N 83° 43' 25" E	7.44'
L110	S 1° 15' 05" E	7.97'
L111	S 27° 43' 59" W	15.18'
L112	S 23° 40' 51" W	19.30'
L113	S 16° 13' 45" W	21.12'
L114	S 11° 43' 18" W	39.49'
L115	S 6° 28' 46" W	17.23'
L116	S 23° 09' 55" E	14.92'
L117	N 89° 20' 18" E	12.47'
L118	N 80° 03' 25" E	17.59'
L119	N 68° 11' 38" E	11.35'
L120	S 82° 31' 36" E	9.51'
L121	S 18° 36' 54" E	10.57'
L122	S 4° 03' 38" W	26.80'
L123	S 16° 15' 30" W	14.36'
L124	S 6° 37' 51" W	10.24'
L125	S 4° 15' 14" E	43.71'
L126	S 5° 57' 10" E	14.59'
L127	S 24° 17' 27" E	14.55'
L128	S 3° 02' 28" W	19.38'
L129	S 47° 41' 27" E	9.88'
L130	N 34° 45' 54" E	16.74'
L131	N 9° 12' 46" E	25.11'
L132	N 20° 47' 31" E	50.26'
L133	N 13° 22' 54" E	85.99'
L134	N 17° 09' 24" E	37.75'
L135	N 3° 34' 51" E	49.72'
L136	N 11° 20' 23" E	23.45'
L137	N 20° 44' 50" E	48.75'
L138	N 14° 17' 58" E	38.56'
L139	N 1° 21' 15" W	10.07'
L140	N 81° 38' 52" W	7.11'
L141	S 56° 16' 10" W	10.61'
L142	S 43° 12' 20" W	12.28'
L143	S 53° 31' 18" W	26.80'
L144	S 59° 21' 53" W	14.48'
L145	S 46° 43' 49" W	25.03'
L146	S 42° 10' 36" W	23.94'
L147	S 60° 37' 58" W	17.07'
L148	N 76° 13' 29" W	9.00'
L149	N 4° 40' 24" E	7.59'
L150	N 51° 21' 33" E	38.73'
L151	N 45° 36' 32" E	37.60'
L152	N 44° 38' 15" E	55.54'
L153	N 40° 49' 43" E	26.71'
L154	N 34° 57' 56" E	46.82'
L155	N 17° 50' 19" E	48.64'
L156	N 18° 41' 02" E	62.03'
L157	N 36° 09' 46" E	27.91'
L158	N 42° 40' 43" E	65.36'

L159	N 49° 41' 29" E	37.33'
L160	N 40° 25' 44" E	46.29'
L161	N 49° 57' 39" E	70.91'
L162	N 50° 32' 42" E	92.32'
L163	N 59° 38' 19" E	47.82'
L164	N 65° 06' 34" E	56.86'
L165	N 72° 53' 36" E	87.62'
L166	N 83° 20' 40" E	20.75'
L167	N 61° 59' 05" E	22.55'
L168	N 70° 33' 35" E	25.00'
L169	N 80° 34' 43" E	43.62'
L170	N 85° 01' 14" E	24.64'
L171	S 89° 59' 52" E	26.23'
L172	N 86° 04' 10" E	18.25'
L173	N 80° 47' 25" E	17.30'
L174	N 69° 13' 55" E	17.45'
L175	S 84° 16' 51" E	25.33'
L176	S 84° 36' 02" E	75.15'
L177	S 80° 13' 06" E	26.71'
L178	S 77° 01' 20" E	19.47'
L179	S 73° 52' 18" E	24.65'
L180	S 61° 45' 35" E	41.67'
L181	S 53° 55' 17" E	33.48'
L182	S 50° 59' 47" E	27.92'
L183	S 47° 11' 36" E	27.44'
L184	S 42° 57' 34" E	40.73'
L185	S 45° 18' 37" E	30.82'
L186	S 43° 38' 42" E	46.86'
L187	S 42° 06' 01" E	49.59'
L188	S 48° 49' 41" E	31.46'
L189	S 46° 59' 26" E	45.35'
L190	S 53° 02' 06" E	50.08'
L191	S 45° 50' 28" E	19.90'
L192	S 63° 42' 31" E	15.93'
L193	S 48° 23' 17" E	26.02'
L194	S 45° 50' 32" E	12.03'
L195	S 35° 02' 04" E	6.87'
L196	S 22° 19' 18" E	24.32'
L197	S 16° 08' 36" E	29.44'
L198	S 17° 20' 15" E	19.10'
L199	S 19° 39' 38" E	13.60'
L200	S 34° 55' 24" W	3.49'
L201	S 61° 14' 57" W	19.25'
L202	S 36° 24' 07" W	13.00'
L203	S 73° 27' 27" W	3.53'
L204	N 86° 36' 10" W	11.69'
L205	N 72° 10' 05" W	4.78'
L206	N 56° 05' 36" W	6.82'
L207	N 47° 23' 25" W	7.56'
L208	N 27° 55' 32" W	3.58'
L209	N 2° 22' 25" W	4.30'
L210	N 26° 49' 12" E	3.22'
L211	N 52° 05' 15" E	6.14'
L212	N 37° 58' 04" E	2.28'
L213	N 30° 07' 21" W	17.65'
L214	N 37° 54' 31" W	6.25'
L215	N 54° 20' 25" W	6.12'
L216	N 73° 39' 07" W	3.91'
L217	N 85° 27' 58" W	12.38'
L218	N 83° 53' 59" W	5.65'
L219	N 66° 38' 55" W	4.63'
L220	N 52° 47' 48" W	5.02'
L221	N 41° 51' 37" W	31.37'
L222	N 53° 38' 08" W	18.50'
L223	N 40° 23' 41" W	3.91'
L224	N 8° 39' 48" W	4.00'
L225	N 15° 02' 15" E	4.55'
L226	N 37° 38' 36" E	4.25'
L227	N 31° 02' 50" E	3.88'
L228	N 7° 57' 29" E	3.16'
L229	N 51° 24' 56" W	9.49'
L230	S 85° 54' 56" W	11.27'
L231	N 84° 20' 40" W	4.46'
L232	N 48° 54' 09" W	3.72'
L233	N 16° 35' 52" W	3.73'
L234	N 3° 20' 53" E	5.31'
L235	N 3° 59' 19" W	4.54'
L236	N 29° 04' 21" W	13.29'
L237	N 71° 45' 25" W	7.64'
L238	N 79° 11' 26" W	7.48'
L239	N 89° 24' 43" W	8.09'
L240	N 72° 23' 32" W	6.68'
L241	N 37° 17' 31" W	6.44'
L242	N 10° 05' 28" W	5.90'
L243	N 17° 19' 17" W	8.04'
L244	N 61° 57' 23" W	10.00'
L245	N 20° 18' 01" W	6.42'
L246	N 8° 21' 08" W	11.92'
L247	N 4° 05' 45" W	27.72'
L248	N 19° 42' 04" W	7.10'
L249	N 0° 49' 31" W	5.69'
L250	N 36° 52' 12" E	11.55'
L251	N 20° 38' 43" E	6.08'
L252	N 32° 52' 16" W	6.38'
L253	N 62° 15' 52" W	9.04'
L254	N 51° 59' 10" W	44.61'
L255	N 51° 13' 15" W	24.76'
L256	N 68° 09' 23" W	24.22'
L257	N 29° 28' 59" W	7.47'
L258	N 46° 57' 09" W	10.27'
L259	N 64° 28' 13" W	12.25'
L260	N 51° 33' 10" W	17.38'
L261	N 44° 00' 13" W	13.42'
L262	N 53° 49' 23" W	30.05'
L263	N 67° 22' 39" W	9.65'
L264	S 73° 54' 56" W	23.53'
L265	S 69° 57' 54" W	7.46'
L266	S 87° 38' 48" W	12.06'
L267	S 49° 05' 06" W	4.91'
L268	S 9° 52' 00" W	5.78'
L269	S 13° 13' 56" W	5.06'
L270	S 59° 11' 24" W	3.77'
L271	N 89° 37' 32" W	4.44'
L272	N 66° 14' 18" W	24.73'
L273	N 64° 03' 51" W	11.89'
L274	S 87° 33' 07" W	15.80'
L275	N 54° 10' 34" W	11.87'
L276	N 83° 58' 19" W	5.66'
L277	S 73° 08' 14" W	6.88'
L278	S 6° 58' 49" W	4.07'
L279	S 15° 50' 06" E	6.27'
L280	S 22° 14' 56" W	2.19'
L281	S 52° 57' 54" W	2.08'
L282	S 81° 47' 04" W	2.56'
L283	N 75° 41' 43" W	14.59'
L284	N 79° 39' 21" W	10.85'
L285	N 89° 24' 07" W	9.10'
L286	N 74° 46' 58" W	4.90'
L287	S 18° 49' 23" E	7.00'
L288	S 1° 46' 14" E	3.24'
L289	S 7° 31' 20" W	7.59'
L290	S 5° 31' 27" E	7.71'
L291	S 13° 02' 36" E	14.99'
L292	S 26° 55' 27" W	11.84'
L293	S 21° 59' 01" W	9.70'
L294	S 36° 14' 55" W	7.67'
L295	S 22° 23' 20" W	5.32'
L296	S 2° 09' 15" E	5.00'
L297	S 37° 05' 43" E	10.38'
L298	S 18° 04' 55" E	13.14'
L299	S 43° 00' 20" E	23.47'
L300	S 36° 59' 04" E	25.10'
L301	S 60° 30' 02" E	33.98'
L302	S 52° 29' 40" E	23.74'
L303	S 53° 49' 34" E	30.62'
L304	S 59° 28' 53" E	32.08'
L305	S 56° 40' 17" E	31.84'
L306	S 56° 29' 22" E	21.51'
L307	S 50° 41' 11" E	11.62'
L308	S 43° 19' 57" E	14.48'
L309	S 39° 44' 10" E	33.96'
L310	S 38° 53' 17" E	24.77'
L311	S 43° 21' 19" E	31.21'
L312	S 40° 21' 50" E	8.45'
L313	S 8° 05' 37" E	24.13'
L314	S 0° 23' 42" W	10.30'
L315	S 14° 58' 17" W	6.91'
L316	S 40° 10' 39" W	5.15'
L317	S 63° 43' 26" W	6.21'
L318	S 38° 06' 20" W	2.49'

L319	S 16° 54' 09" E	5.70'
L320	S 27° 18' 44" E	11.97'
L321	S 39° 31' 31" E	4.68'
L322	S 60° 54' 01" E	3.33'
L323	S 73° 52' 18" E	7.79'
L324	N 67° 43' 27" E	17.32'
L325	N 75° 42' 21" E	14.76'
L326	S 81° 07' 30" E	8.59'
L327	S 71° 38' 14" E	11.78'
L328	S 62° 22' 58" E	6.23'
L329	S 82° 57' 13" E	2.80'
L330	N 49° 12' 13" E	7.90'
L331	N 67° 18' 23" E	3.65'
L332	S 78° 25' 42" E	4.08'
L333	S 65° 00' 15" E	7.41'
L334	S 43° 04' 55" E	13.82'
L335	S 33° 18' 38" E	7.83'
L336	S 19° 42' 13" E	4.56'
L337	S 0° 38' 34" E	5.26'
L338	S 24° 49' 51" E	31.21'
L339	S 18° 01' 11" E	5.24'
L340	S 2° 42' 20" W	6.08'
L341	S 10° 33' 33" W	13.95'
L342	S 44° 13' 01" E	4.76'
L343	S 24° 04' 50" E	1.72'
L344	S 19° 35' 46" W	9.30'
L345	N 1° 00' 06" W	4.40'
L346	N 33° 22' 59" W	4.35'
L347	N 53° 15' 17" W	7.72'
L348	S 85° 11' 47" W	9.85'
L349	S 64° 07' 18" W	10.78'
L350	S 23° 34' 00" E	6.76'
L351	N 70° 06' 57" E	3.51'
L352	S 86° 19' 21" E	7.25'
L353	S 66° 57' 54" E	3.08'
L354	S 18° 57' 05" E	9.37'
L355	S 27° 17' 15" E	16.60'
L356	S 7° 53' 42" E	13.45'
L357	S 75° 12' 29" E	7.76'
L358	N 77° 36' 00" E	5.26'
L359	N 73° 03' 01" E	7.52'
L360	S 85° 18' 07" E	7.41'
L361	S 68° 07' 15" E	4.52'
L362	S 49° 22' 33" E	4.63'
L363	S 26° 48' 06" E	4.98'
L364	S 11° 26' 12" E	16.66'
L365	S 11° 58' 35" E	31.53'
L366	S 1° 40' 26" E	13.97'
L367	S 13° 27' 12" E	6.15'
L368	S 27° 46' 07" E	6.02'
L369	S 33° 27' 46" E	11.88'
L370	S 47° 45' 23" E	33.98'
L371	S 45° 27' 06" E	14.71'
L372	S 66° 15' 10" E	6.76'
L373	N 73° 41' 18" E	3.52'
L374	N 46° 49' 53" E	6.81'
L375	N 72° 19' 06" E	8.78'
L376	S 86° 30' 33" E	13.34'
L377	N 70° 56' 59" E	7.33'
L378	N 47° 39' 23" E	8.82'
L379	N 22° 45' 25" E	14.65'
L380	N 33° 45' 49" E	10.37'
L381	N 49° 16' 32" E	3.59'
L382	N 68° 00' 08" E	12.41'
L383	N 38° 30' 27" E	9.81'
L384	N 31° 55' 41" E	12.64'
L385	N 38° 34' 59" E	9.92'
L386	N 63° 26' 11" E	16.42'
L387	N 16° 32' 39" E	13.30'
L388	N 34° 18' 56" E	4.07'
L389	N 52° 55' 57" E	4.87'
L390	N 69° 17' 03" E	5.59'
L391	N 82° 18' 53" E	5.17'
L392	S 80° 57' 36" E	4.37'
L393	S 72° 36' 18" E	6.99'
L394	N 86° 10' 41" E	6.29'
L395	N 75° 52' 15" E	4.49'
L396	N 16° 38' 44" E	6.74'
L397	N 23° 36' 44" E	13.26'
L398	N 31° 56' 57" E	17.09'
L399	N 44° 56' 54" E	5.50'
L400	N 63° 16' 25" E	3.65'
L401	N 88° 41' 40" E	8.16'
L402	N 81° 21' 27" E	4.71'
L403	N 57° 00' 24" E	4.79'
L404	N 38° 27' 31" E	6.94'
L405	N 50° 53' 23" E	0.34'
L406	N 73° 31' 14" E	5.96'
L407	S 82° 52' 45" E	12.26'
L408	S 65° 24' 48" E	9.26'
L409	S 56° 30' 18" E	9.00'
L410	S 62° 55' 07" E	9.79'
L411	S 73° 00' 09" E	5.67'
L412	S 7° 53' 41" E	18.00'
L413	S 35° 02' 24" W	19.79'
CEMETERY BOUNDARY		
L414	N 84° 27' 55" E	28.71'
L415	S 7° 08' 21" E	70.65'
L416	N 77° 51' 24" W	36.36'
L417	N 1° 44' 24" W	59.71'
POSSIBLE DEED OVERLAP BEARINGS		
L418	N 80° 04' 02" E	68.78'
L419	S 9° 55' 58" E	43.92'
L420	S 88° 42' 19" W	5.42'

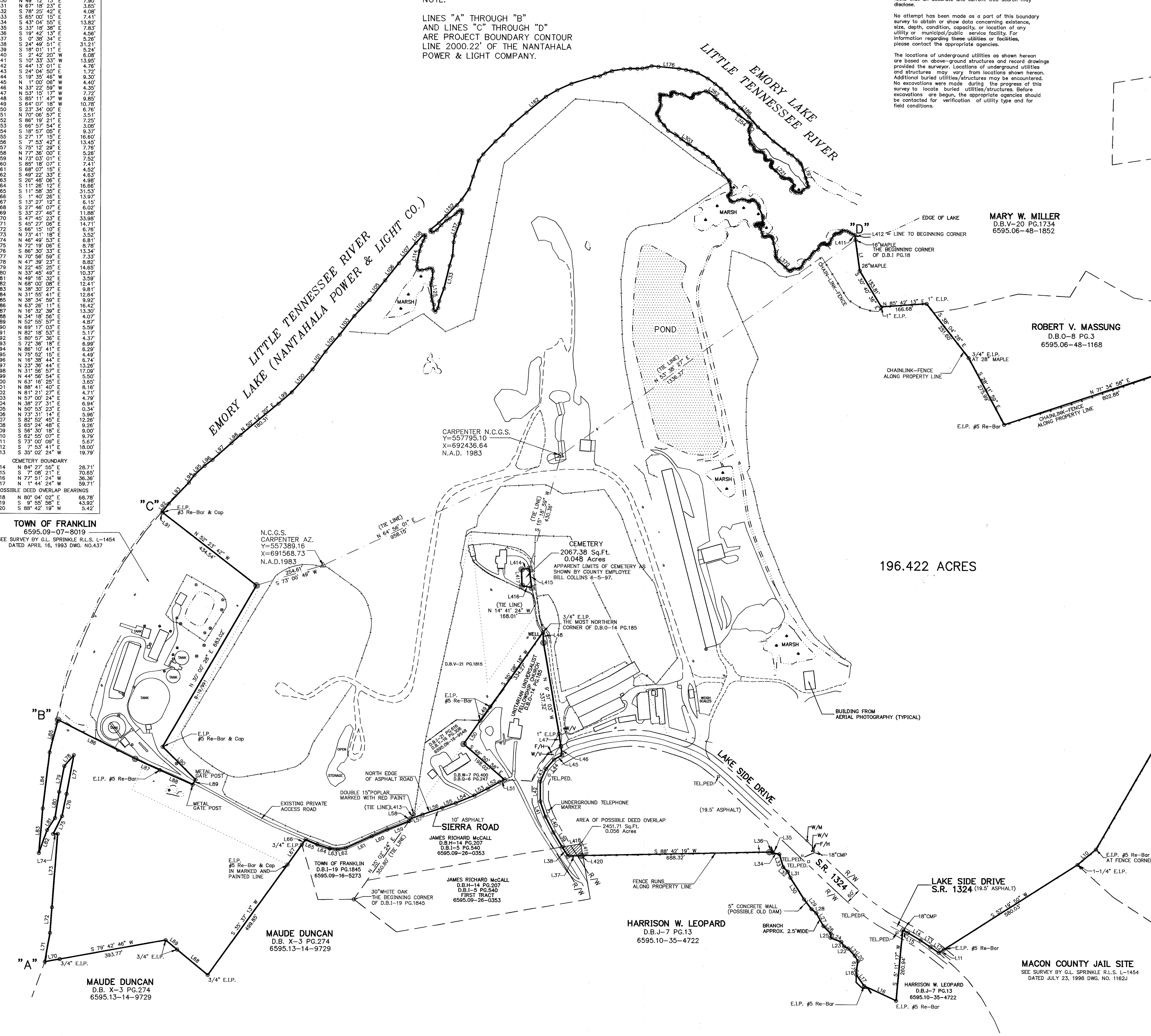
NOTE:

LINES "A" THROUGH "B" AND LINES "C" THROUGH "D" ARE PROJECT BOUNDARY CONTOUR LINE 2000.22' OF THE NANTAHALA POWER & LIGHT COMPANY.

Except as specifically stated or shown on this plat, this survey does not purport to reflect any of the following which may be applicable to the subject real estate: easements, other than possible easements that were visible at the time of making of this survey; zoning or other land use regulations, and any other facts that an accurate and current title search may disclose.

No attempt has been made as a part of this boundary survey to obtain or show data concerning existence, size, depth, condition, capacity, or location of any utility or municipal/public service facility. For information regarding these utilities or facilities, please contact the appropriate agencies.

The locations of underground utilities as shown hereon are based on above-ground structures and record drawings provided the surveyor. Locations of underground utilities and structures may vary from locations shown hereon. Additional buried utilities/structures may be encountered. No excavations were made during the progress of this survey to locate buried utilities/structures. Before excavations are begun, the appropriate agencies should be contacted for verification of utility type and for field conditions.



NOTES:

COORDINATES SHOWN ON THIS MAP ARE RELATIVE TO NCGS STATIONS "CARPENTER" & "CARPENTER AZ".

ALL ELEVATION ARE NGVD 1929 AND ARE RELATIVE TO NCGS STATION "CARPENTER"

DISTANCES SHOWN ON THIS PLAT ARE GRID LENGTHS. TO OBTAIN HORIZONTAL GROUND DISTANCES THEY MUST BE DIVIDED BY A COMBINED SCALE AND SEA LEVEL FACTOR OF 0.999778100.

PROPERTY IS SUBJECT TO RIGHTS-OF-WAY & EASEMENTS OF RECORD

REFERENCES:

SUBJECT PARCEL ID#6595.10-36-7772
D.B.I-18 P.G.578

A SURVEY BY G.L. SPRINKLE R.L.S. L-1454
DATED SEPTEMBER 20, 1991 DWG. NO.1162-LF

A SURVEY BY G.L. SPRINKLE R.L.S. L-1454
DATED APRIL 16, 1993 DWG. NO.437

A SURVEY BY G.L. SPRINKLE R.L.S. L-1454
DATED JULY 23, 1996 DWG. NO.1162J

ADDITIONAL REFERENCES AS SHOWN ON PLAT

FEATURES LEGEND:

- ....POINT NOT SET
- ....IRON PIPE OR PIN SET
- ....SPIKE OR NAIL SET
- E.I.P. = EXISTING IRON PIPE OR PIN
- —x—x— FENCE LINE
- L= LINE (SEE LINE TABLE)
- ....CONCRETE MONUMENT
- M.H.= MANHOLE
- U.P.= UTILITY POLE
- U.P.L.= UTILITY POLE (LIGHT)
- U.P.ELEC.= UTILITY POLE (ELECTRIC)
- U.P.TEL.= UTILITY POLE (TELEPHONE)
- U.P.E&T.= UTILITY POLE (ELECTRIC & TELEPHONE)
- TEL. PED.= TELEPHONE PEDESTAL
- E/T= ELECTRIC & TELEPHONE
- O/H= OVERHEAD
- U/G= UNDERGROUND
- F/H= FIRE HYDRANT
- W/M= WATER METER
- W/V= WATER VALVE
- RCP.= REINFORCED CONCRETE PIPE
- CMP.= CORRUGATED METAL PIPE
- R/W= RIGHT OF WAY

REVISIONS			FIELD PARTY CR BC	INITIAL DATE JUNE ,1997	JOB FILE No. 96020-D608
No	DATE	BY	DRAWN BY MES	DATE JULY 7, 1997	PRECISION 1:10000
1	7/11/97	WM	SCALE 1 IN = 200 FT		AREA BY D.M.D.
			LEASTSQUARES ADJUSTMENT		ADJ per ANGLE=1 SEC.
			DWG FILE: 96020B		SERVER
			RECORD REFERENCES: D.B.I-18 PG.578		
			PIN 6595.10-36-7772		

JOB No.
DATE:
SCALE:
REVISION:

NORTH CAROLINA
REGISTERED LAND SURVEYOR
SEAL L-2669
GERALD W. STEVENSON

DATE: JULY 11, 1997

THIS PLAT REPRESENTS AN ACTUAL FIELD SURVEY THAT MEETS OR EXCEEDS THE REQUIREMENTS FOR A CLASS "A" SURVEY IN ACCORDANCE WITH THE STANDARDS OF PRACTICE FOR LAND SURVEYING IN NORTH CAROLINA.

Gerald W. Stevenson

GERALD W. STEVENSON R.L.S.
N.C. NO. L-2669

BOUNDARY SURVEY OF THE

MACON COUNTY LANDFILL

FRANKLIN TOWNSHIP
MACON COUNTY N.C.

200 100 0 200 400 600
GRAPHIC SCALE

NATIONAL GEODETIC VERTICAL DATUM OF 1929
NORTH AMERICAN DATUM OF 1983

WEBB A. MORGAN & ASSOCIATES, P.A.
*** REGISTERED LAND SURVEYORS ***
96 CENTRAL AVENUE, ASHEVILLE, NORTH CAROLINA, 28801
PHONE:(704)252-1530
DRAWING FILE 96020B
JOB FILE NO.96020-D607

SHEET 1 OF 1

P:\1996\96020\96020B.dwg Fri Jul 11 08:07:38 1997 1"=300

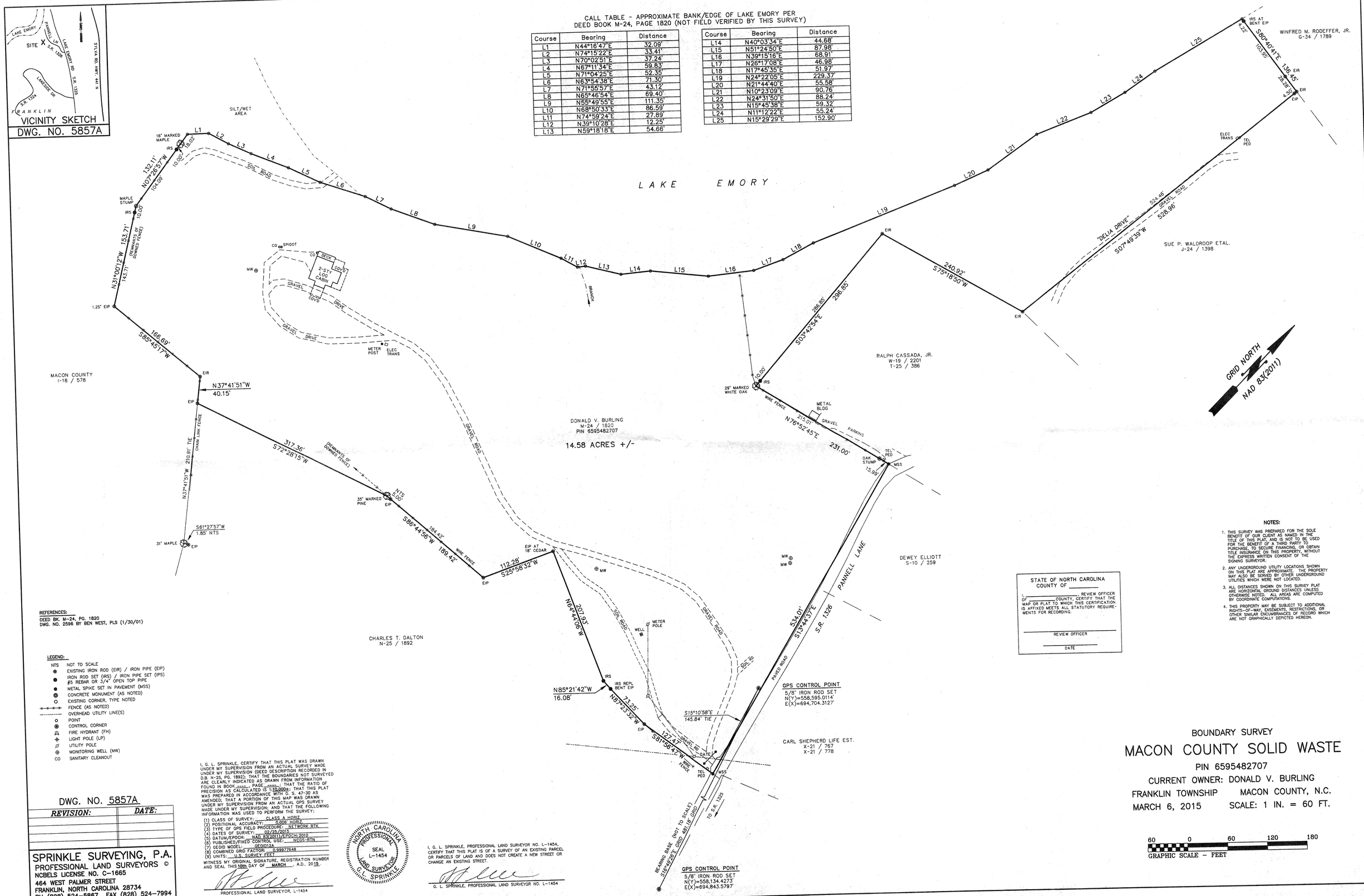
VICINITY SKETCH

DWG. NO. 5857A

CALL TABLE - APPROXIMATE BANK/EDGE OF LAKE EMORY PER DEED BOOK M-24, PAGE 1820 (NOT FIELD VERIFIED BY THIS SURVEY)

Course	Bearing	Distance
L1	N44°16'47"E	32.09'
L2	N74°15'22"E	33.41'
L3	N70°02'51"E	37.24'
L4	N67°11'34"E	59.83'
L5	N71°04'25"E	52.35'
L6	N63°54'38"E	71.30'
L7	N71°55'57"E	43.12'
L8	N65°46'54"E	69.40'
L9	N55°49'55"E	111.35'
L10	N68°50'33"E	86.59'
L11	N74°59'24"E	27.89'
L12	N39°10'28"E	12.25'
L13	N59°18'18"E	54.66'

Course	Bearing	Distance
L14	N40°03'34"E	44.68'
L15	N51°24'50"E	87.98'
L16	N39°15'16"E	68.91'
L17	N26°17'08"E	46.98'
L18	N17°45'35"E	51.97'
L19	N24°22'05"E	229.37'
L20	N21°44'40"E	55.58'
L21	N10°23'09"E	90.76'
L22	N24°31'50"E	88.24'
L23	N15°45'38"E	59.32'
L24	N11°12'22"E	55.24'
L25	N15°29'29"E	152.90'



REFERENCES:
DEED BK. M-24, PG. 1820
DWG. NO. 2596 BY BEN WEST, PLS (1/30/01)

LEGEND:

- NTS NOT TO SCALE
- EXISTING IRON ROD (EIR) / IRON PIPE (EIP)
- IRON ROD SET (IRS) / IRON PIPE SET (IPS) #5 REBAR OR 3/4" OPEN TOP PIPE
- METAL SPIKE SET IN PAVEMENT (MSS)
- CONCRETE MONUMENT (AS NOTED)
- EXISTING CORNER, TYPE NOTED
- FENCE (AS NOTED)
- OVERHEAD UTILITY LINE(S)
- POINT
- CONTROL CORNER
- FIRE HYDRANT (FH)
- LIGHT POLE (LP)
- UTILITY POLE
- MONITORING WELL (MW)
- CO SANITARY CLEANOUT

NOTES:

1. THIS SURVEY WAS PREPARED FOR THE SOLE BENEFIT OF OUR CLIENT AS NAMED IN THE TITLE OF THIS PLAT, AND IS NOT TO BE USED FOR THE BENEFIT OF A THIRD PARTY TO PURCHASE, TO SECURE FINANCING, OR OBTAIN TITLE INSURANCE ON THIS PROPERTY, WITHOUT THE EXPRESS WRITTEN CONSENT OF THE SIGNING SURVEYOR.
2. ANY UNDERGROUND UTILITY LOCATIONS SHOWN ON THIS PLAT ARE APPROXIMATE. THE PROPERTY MAY ALSO BE SERVED BY OTHER UNDERGROUND UTILITIES WHICH WERE NOT LOCATED.
3. ALL DISTANCES SHOWN ON THIS SURVEY PLAT ARE HORIZONTAL GROUND DISTANCES UNLESS OTHERWISE NOTED. ALL AREAS ARE COMPUTED BY COORDINATE COMPUTATIONS.
4. THIS PROPERTY MAY BE SUBJECT TO ADDITIONAL RIGHTS-OF-WAY, EASEMENTS, RESTRICTIONS, OR OTHER SIMILAR ENCUMBRANCES OF RECORD WHICH ARE NOT GRAPHICALLY DEPICTED HEREON.

STATE OF NORTH CAROLINA
COUNTY OF _____

I, _____, REVIEW OFFICER OF _____ COUNTY, CERTIFY THAT THE MAP OR PLAT TO WHICH THIS CERTIFICATION IS AFFIXED MEETS ALL STATUTORY REQUIREMENTS FOR RECORDING.

_____
REVIEW OFFICER

_____
DATE

I, G. L. SPRINKLE, CERTIFY THAT THIS PLAT WAS DRAWN UNDER MY SUPERVISION FROM AN ACTUAL SURVEY MADE UNDER MY SUPERVISION (DEED DESCRIPTION RECORDED IN D.B. M-25, PG. 1892); THAT THE BOUNDARIES NOT SURVEYED ARE CLEARLY INDICATED AS DRAWN FROM INFORMATION FOUND IN BOOK ____, PAGE ____; THAT THE RATIO OF PRECISION AS CALCULATED IS 1:10,000+; THAT THIS PLAT WAS PREPARED IN ACCORDANCE WITH G. S. 47-30 AS AMENDED; THAT A PORTION OF THIS MAP WAS DRAWN UNDER MY SUPERVISION FROM AN ACTUAL GPS SURVEY MADE UNDER MY SUPERVISION; AND THAT THE FOLLOWING INFORMATION WAS USED TO PERFORM THE SURVEY:

(1) CLASS OF SURVEY: CLASS A HORIZ.
(2) POSITIONAL ACCURACY: 0.006 HORIZ.
(3) TYPE OF GPS FIELD PROCEDURE: NETWORK RTK
(4) DATES OF SURVEY: 02/26/2015
(5) DATUM/EPOCH: NAD 83(2011)/EPOCH:2010
(6) PUBLISHED/FIXED CONTROL USE: NCGS-RTN
(7) GEOID MODEL: GEOID12A
(8) COMBINED GRID FACTOR: 0.99977648
(9) UNITS: U.S. SURVEY FEET

WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER AND SEAL THIS 10th DAY OF MARCH, A.D., 2015.

PROFESSIONAL LAND SURVEYOR, L-1454

NORTH CAROLINA PROFESSIONAL SEAL L-1454 LAND SURVEYOR G. L. SPRINKLE

I, G. L. SPRINKLE, PROFESSIONAL LAND SURVEYOR NO. L-1454, CERTIFY THAT THIS PLAT IS OF A SURVEY OF AN EXISTING PARCEL OR PARCELS OF LAND AND DOES NOT CREATE A NEW STREET OR CHANGE AN EXISTING STREET.

G. L. SPRINKLE, PROFESSIONAL LAND SURVEYOR NO. L-1454

DWG. NO. 5857A

REVISION:	DATE:

SPRINKLE SURVEYING, P.A.
PROFESSIONAL LAND SURVEYORS ©
NCBELS LICENSE NO. C-1665
464 WEST PALMER STREET
FRANKLIN, NORTH CAROLINA 28734
PH (828) 524-5867 FAX (828) 524-7994
WEBSITE: www.sprinklesurveying.com
SURVEY BY WCK PLAT BY BSB

BOUNDARY SURVEY

MACON COUNTY SOLID WASTE

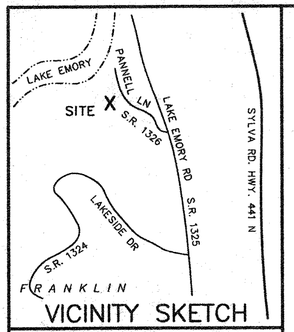
PIN 6595482707

CURRENT OWNER: DONALD V. BURLING

FRANKLIN TOWNSHIP MACON COUNTY, N.C.

MARCH 6, 2015 SCALE: 1 IN. = 60 FT.

60 0 60 120 180
GRAPHIC SCALE - FEET



VICINITY SKETCH

DWG. NO. 5857

NOTES:

1. THIS SURVEY WAS PREPARED FOR THE SOLE BENEFIT OF OUR CLIENT AS NAMED IN THE TITLE OF THIS PLAT, AND IS NOT TO BE USED FOR THE BENEFIT OF A THIRD PARTY TO PURCHASE, TO SECURE FINANCING, OR OBTAIN TITLE INSURANCE ON THIS PROPERTY, WITHOUT THE EXPRESS WRITTEN CONSENT OF THE SIGNING SURVEYOR.
2. ANY UNDERGROUND UTILITY LOCATIONS SHOWN ON THIS PLAT ARE APPROXIMATE. THE PROPERTY MAY ALSO BE SERVED BY OTHER UNDERGROUND UTILITIES WHICH WERE NOT LOCATED.
3. ALL DISTANCES SHOWN ON THIS SURVEY PLAT ARE HORIZONTAL GROUND DISTANCES UNLESS OTHERWISE NOTED. ALL AREAS ARE COMPUTED BY COORDINATE COMPUTATIONS.
4. THIS PROPERTY MAY BE SUBJECT TO ADDITIONAL RIGHTS-OF-WAY, EASEMENTS, RESTRICTIONS, OR OTHER SIMILAR ENCUMBRANCES OF RECORD WHICH ARE NOT GRAPHICALLY DEPICTED HEREON.

CALL TABLE - CENTERLINE OF S.R. 1326 (PANNELL LANE) BY DEED/PRIOR SURVEY

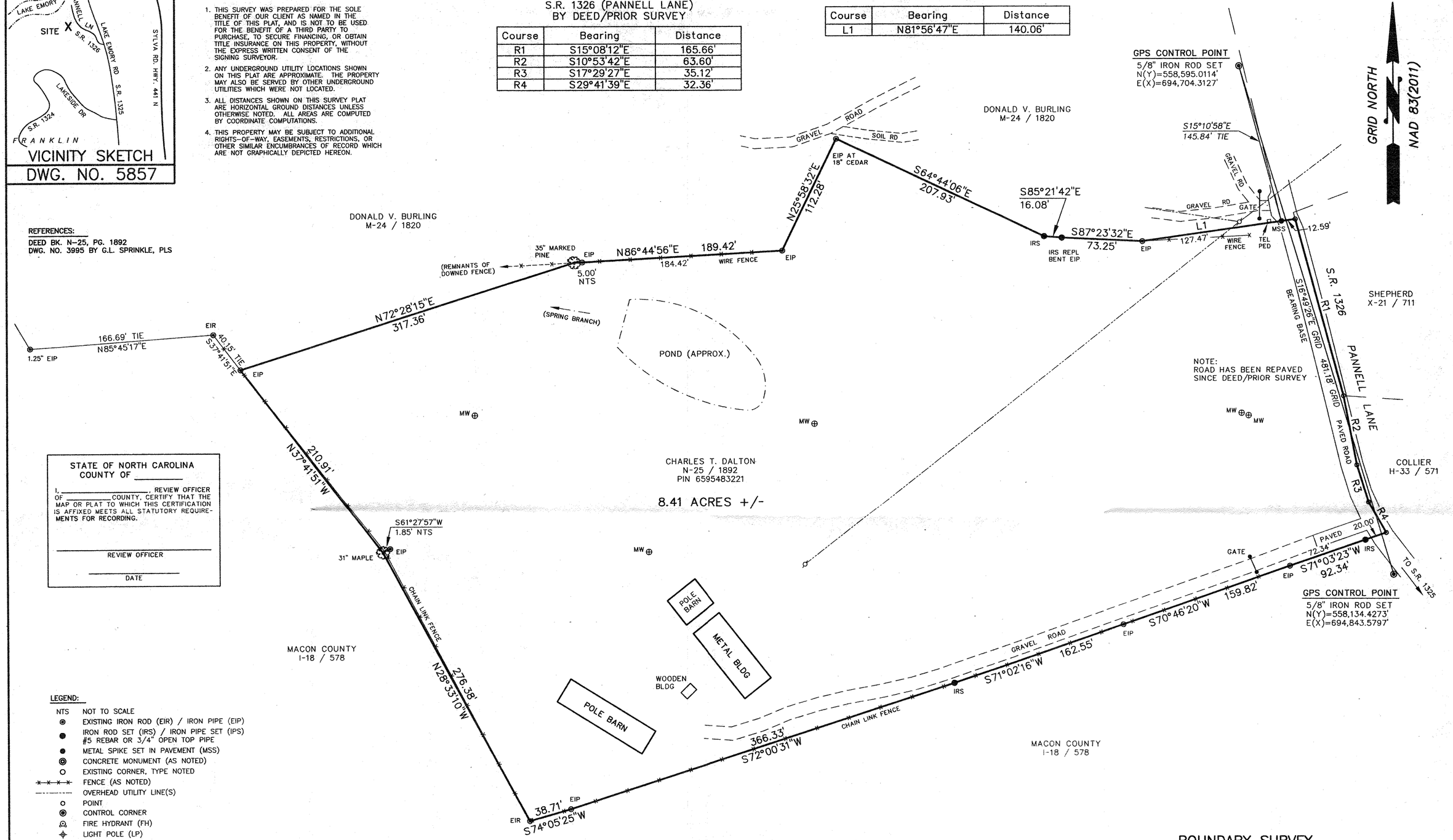
Course	Bearing	Distance
R1	S15°08'12"E	165.66'
R2	S10°53'42"E	63.60'
R3	S17°29'27"E	35.12'
R4	S29°41'39"E	32.36'

CALL TABLE

Course	Bearing	Distance
L1	N81°56'47"E	140.06'

REFERENCES:

DEED BK. N-25, PG. 1892
DWG. NO. 3995 BY G.L. SPRINKLE, PLS



STATE OF NORTH CAROLINA
COUNTY OF _____

I, _____, REVIEW OFFICER OF _____ COUNTY, CERTIFY THAT THE MAP OR PLAT TO WHICH THIS CERTIFICATION IS AFFIXED MEETS ALL STATUTORY REQUIREMENTS FOR RECORDING.

REVIEW OFFICER

DATE

LEGEND:

NTS	NOT TO SCALE
◉	EXISTING IRON ROD (EIR) / IRON PIPE (EIP)
●	IRON ROD SET (IRS) / IRON PIPE SET (IPS) #5 REBAR OR 3/4" OPEN TOP PIPE
●	METAL SPIKE SET IN PAVEMENT (MSS)
◎	CONCRETE MONUMENT (AS NOTED)
○	EXISTING CORNER, TYPE NOTED
-x-x-x-	FENCE (AS NOTED)
----------	OVERHEAD UTILITY LINE(S)
○	POINT
◉	CONTROL CORNER
	FIRE HYDRANT (FH)
	LIGHT POLE (LP)
	UTILITY POLE
⊕	MONITORING WELL (MW)

DWG. NO. 5857

REVISION:	DATE:

SPRINKLE SURVEYING, P.A.
PROFESSIONAL LAND SURVEYORS ©
NCBELS LICENSE NO. C-1665
464 WEST PALMER STREET
FRANKLIN, NORTH CAROLINA 28734
PH (828) 524-5867 FAX (828) 524-7994
WEBSITE: www.sprinklesurveying.com
SURVEY BY WCK PLAT BY BSB

I, G. L. SPRINKLE, PROFESSIONAL LAND SURVEYOR NO. L-1454, CERTIFY THAT THIS PLAT IS OF A SURVEY OF AN EXISTING PARCEL OR PARCELS OF LAND AND DOES NOT CREATE A NEW STREET OR CHANGE AN EXISTING STREET.

G. L. SPRINKLE, PROFESSIONAL LAND SURVEYOR NO. L-1454

NORTH CAROLINA PROFESSIONAL SEAL L-1454 LAND SURVEYOR G. L. SPRINKLE

I, G. L. SPRINKLE, CERTIFY THAT THIS PLAT WAS DRAWN UNDER MY SUPERVISION FROM AN ACTUAL SURVEY MADE UNDER MY SUPERVISION (DEED DESCRIPTION RECORDED IN D.B. N-25, PG. 1892); THAT THE BOUNDARIES NOT SURVEYED ARE CLEARLY INDICATED AS DRAWN FROM INFORMATION FOUND IN BOOK ----, PAGE ----; THAT THE RATIO OF PRECISION AS CALCULATED IS 1:10,000+; THAT THIS PLAT WAS PREPARED IN ACCORDANCE WITH G. S. 47-30 AS AMENDED; THAT A PORTION OF THIS MAP WAS DRAWN UNDER MY SUPERVISION FROM AN ACTUAL GPS SURVEY MADE UNDER MY SUPERVISION; AND THAT THE FOLLOWING INFORMATION WAS USED TO PERFORM THE SURVEY:

(1) CLASS OF SURVEY: CLASS A HORIZ.
(2) POSITIONAL ACCURACY: 0.006' HORIZ.
(3) TYPE OF GPS FIELD PROCEDURE: NETWORK RTK
(4) DATES OF SURVEY: 02/25/2015
(5) DATUM/EPOCH: NAD 83(2011)/EPOCH:2010
(6) PUBLISHED/FIXED CONTROL USE: NCGS-RTN
(7) GEOID MODEL: GEOID12A
(8) COMBINED GRID FACTOR: 0.99977648
(9) UNITS: U.S. SURVEY FEET

WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER AND SEAL THIS 9th DAY OF MARCH, A.D., 2015.

PROFESSIONAL LAND SURVEYOR, L-1454

BOUNDARY SURVEY

MACON COUNTY SOLID WASTE

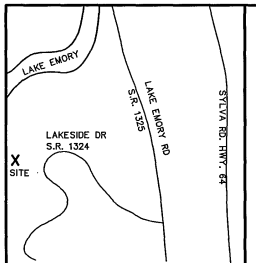
PIN 6595483221

CURRENT OWNER: CHARLES T. DALTON

FRANKLIN TOWNSHIP MACON COUNTY, N.C.

MARCH 6, 2015 SCALE: 1 IN. = 60 FT.

60 0 60 120 180
GRAPHIC SCALE - FEET



VICINITY SKETCH

DWG. NO. 5272

CARD 6253

NOTES:

1. THIS SURVEY WAS PREPARED FOR THE SOLE BENEFIT OF OUR CLIENT AS NAMED IN THE TITLE OF THIS PLAT, AND IS NOT TO BE USED FOR THE BENEFIT OF A THIRD PARTY TO PURCHASE, TO SECURE FINANCING, OR OBTAIN TITLE INSURANCE ON THIS PROPERTY, WITHOUT THE EXPRESS WRITTEN CONSENT OF THE SIGNING SURVEYOR.
2. ANY UNDERGROUND UTILITY LOCATIONS SHOWN ON THIS PLAT ARE APPROXIMATE. THE PROPERTY MAY ALSO BE SERVED BY OTHER UNDERGROUND UTILITIES WHICH WERE NOT LOCATED.
3. ALL DISTANCES SHOWN ON THIS SURVEY PLAT ARE HORIZONTAL GROUND DISTANCES UNLESS OTHERWISE NOTED. ALL AREAS ARE COMPUTED BY COORDINATE COMPUTATIONS.
4. THIS PROPERTY MAY BE SUBJECT TO ADDITIONAL RIGHTS-OF-WAY, EASEMENTS, RESTRICTIONS, OR OTHER SIMILAR ENCUMBRANCES OF RECORD WHICH ARE NOT GRAPHICALLY DEPICTED HEREON.

2008015540
MACON CO, NC FEE $21.00
PRESENTED & RECORDED
06-01-2009 09:59:57 AM
TODD RABY
REGISTER OF DEEDS
BY TODD RABY
REGISTER
BK: CARD 4
PG: 6253-6253

STATE OF NORTH CAROLINA
COUNTY OF MACON
I, ARTHUR R. PROVENCHER, REVIEW OFFICER OF MACON CO., CERTIFY THAT THE MAP OR PLAT TO WHICH THIS CERTIFICATION IS ATTACHED MEETS ALL STATUTORY REQUIREMENTS FOR RECORDING.
REVIEW OFFICER
DATE 6/1/09

REFERENCES:

OWNER: MACON COUNTY
DEED BK. C-7, PG. 419
PORTION OF PARCEL NO. 01-34069
DWG. NO. 350BA BY G.L. SPRINKLE, PLS

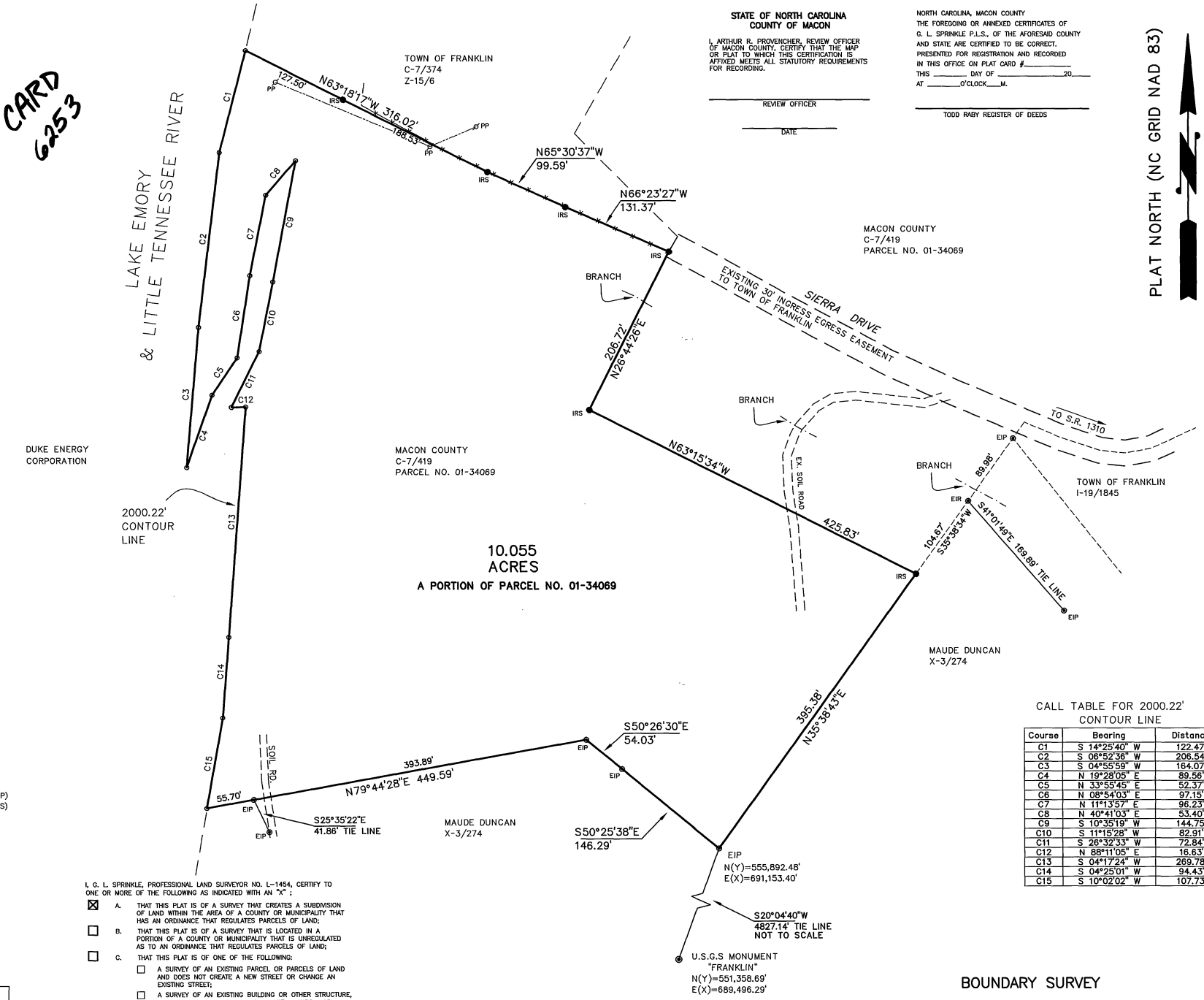
LEGEND:

- EXISTING IRON ROD (EIR) / IRON PIPE (EIP)
- IRON ROD SET (IRS) / IRON PIPE SET (IPS) #5 REBAR OR 3/4" OPEN TOP PIPE
- NAIL / SPIKE (AS NOTED)
- CONCRETE MONUMENT (AS NOTED)
- EXISTING CORNER, TYPE NOTED
- CHAIN LINK FENCE
- OVERHEAD UTILITY LINE(S)
- POINT
- CONTROL CORNER
- FIRE HYDRANT
- LIGHT POLE
- UTILITY POLE

DWG. NO. 5272

REVISION:	DATE:
REVISE BOUNDARY, ACREAGE & DEED REFS.	MARCH 2, 2009

SPRINKLE SURVEYING, P.A.
PROFESSIONAL LAND SURVEYORS ©
464 WEST PALMER STREET
FRANKLIN, NORTH CAROLINA 28734
TEL. 828-524-5867 & 828-349-0917
& 828-389-3048 FAX: 828-524-7994
SURVEY BY WCK PLAT BY BSB/BPL



STATE OF NORTH CAROLINA
COUNTY OF MACON
I, ARTHUR R. PROVENCHER, REVIEW OFFICER OF MACON COUNTY, CERTIFY THAT THE MAP OR PLAT TO WHICH THIS CERTIFICATION IS AFFIXED MEETS ALL STATUTORY REQUIREMENTS FOR RECORDING.
REVIEW OFFICER
DATE

NORTH CAROLINA, MACON COUNTY
THE FOREGOING OR ANNEXED CERTIFICATES OF G. L. SPRINKLE P.L.S., OF THE AFORESAID COUNTY AND STATE ARE CERTIFIED TO BE CORRECT. PRESENTED FOR REGISTRATION AND RECORDED IN THIS OFFICE ON PLAT CARD #_____
THIS _____ DAY OF _____ 20____
AT _____ O'CLOCK ____ M.
TODD RABY REGISTER OF DEEDS

PLAT NORTH (NC GRID NAD 83)

DWG. NO. 350BA BY G.L. SPRINKLE, PLS

CALL TABLE FOR 2000.22' CONTOUR LINE

Course	Bearing	Distance
C1	S 14°25'40" W	122.47'
C2	S 06°52'36" W	206.54'
C3	S 04°55'59" W	164.07'
C4	N 19°28'05" E	89.56'
C5	N 33°55'45" E	52.37'
C6	N 08°54'03" E	97.15'
C7	N 11°13'57" E	96.23'
C8	N 40°41'03" E	53.40'
C9	S 10°35'19" W	144.75'
C10	S 11°15'28" W	82.91'
C11	S 26°32'33" W	72.84'
C12	N 88°11'05" E	16.63'
C13	S 04°17'24" W	269.78'
C14	S 04°25'01" W	94.43'
C15	S 10°02'02" W	107.73'

I, G. L. SPRINKLE, PROFESSIONAL LAND SURVEYOR NO. L-1454, CERTIFY TO ONE OR MORE OF THE FOLLOWING AS INDICATED WITH AN "X" :

- ☒ A. THAT THIS PLAT IS OF A SURVEY THAT CREATES A SUBDIVISION OF LAND WITHIN THE AREA OF A COUNTY OR MUNICIPALITY THAT HAS AN ORDINANCE THAT REGULATES PARCELS OF LAND;
- ☐ B. THAT THIS PLAT IS OF A SURVEY THAT IS LOCATED IN A PORTION OF A COUNTY OR MUNICIPALITY THAT IS UNREGULATED AS TO AN ORDINANCE THAT REGULATES PARCELS OF LAND;
- ☐ C. THAT THIS PLAT IS OF ONE OF THE FOLLOWING:
  - ☐ A SURVEY OF AN EXISTING PARCEL OR PARCELS OF LAND AND DOES NOT CREATE A NEW STREET OR CHANGE AN EXISTING STREET;
  - ☐ A SURVEY OF AN EXISTING BUILDING OR OTHER STRUCTURE, OR NATURAL FEATURE, SUCH AS A WATERCOURSE; OR
  - ☐ A CONTROL SURVEY.
- ☐ D. THAT THIS PLAT IS OF A SURVEY OF ANOTHER CATEGORY, SUCH AS THE RECOMBINATION OF EXISTING PARCELS, A COURT-ORDERED SURVEY, OR OTHER EXCEPTION TO THE DEFINITION OF SUBDIVISION;
- ☐ E. THAT THE INFORMATION AVAILABLE TO THIS SURVEYOR IS SUCH THAT I AM UNABLE TO MAKE A DETERMINATION TO THE BEST OF MY PROFESSIONAL ABILITY AS TO THE PROVISIONS CONTAINED IN (A) THROUGH (D) ABOVE;
- ☐ F. THAT THIS PROPERTY IS/IS NOT WITHIN ANY FLOOD ZONE AS DELINEATED ON THE FLOOD HAZARD BOUNDARY MAP PREPARED BY THE U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT.

G. L. SPRINKLE, PROFESSIONAL LAND SURVEYOR NO. L-1454

I, G. L. SPRINKLE, CERTIFY THAT THIS MAP WAS DRAWN UNDER MY SUPERVISION FROM AN ACTUAL SURVEY MADE UNDER MY SUPERVISION; THAT THE RATIO OF PRECISION AS CALCULATED BY LATITUDES AND DEPARTURES IS 1/ 10,000+ ; THAT THE BOUNDARIES NOT SURVEYED ARE CLEARLY INDICATED AS DRAWN FROM INFORMATION FOUND IN DEED BK. ----, PAGE ----; THAT THIS PLAT WAS PREPARED IN ACCORDANCE WITH G. S. 47-30 AS AMENDED ✓, OR N. C. STANDARDS OF PRACTICE FOR LAND SURVEYING
WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER AND SEAL THIS 15th DAY OF JANUARY, A.D., 2008.

PROFESSIONAL LAND SURVEYOR, L-1454

NORTH CAROLINA PROFESSIONAL SEAL L-1454 LAND SURVEYOR G. L. SPRINKLE

BOUNDARY SURVEY

TOWN OF FRANKLIN

FRANKLIN TOWNSHIP MACON COUNTY, N.C.
JANUARY 15, 2008 SCALE: 1 IN. = 80 FT.

80 0 80 160 240
GRAPHIC SCALE - FEET

NO N.C.G.S. HORIZONTAL CONTROL MONUMENTS FOUND WITHIN 2000 FEET OF SITE

Section 3: Facility Plan

FACILITY PLAN

MACON COUNTY MSW LANDFILL
PERMIT TO CONSTRUCT
PHASE 3 CELL 1
MACON COUNTY, NORTH CAROLINA

MARK D. CATHEY, PE

McGill ASSOCIATES

Asheville, North Carolina

NORTH CAROLINA PROFESSIONAL SEAL 024993 ENGINEER MARK D. CATHEY

6-2-15

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13.00726

FACILITY PLAN
Macon County MSW Landfill

This Facility Plan has been prepared as required under Rule .1617 and in accordance with Rule .1619, of the North Carolina Solid Waste Management Rules (15A NCAC 13B).

The Macon County Municipal Solid Waste (MSW) Landfill, permit no. 57-03, is located approximately one mile north of Franklin, North Carolina on Lakeside Drive (S.R. 1324). The landfill facility is generally bordered by Lake Emory/Little Tennessee River to the North and the West, Pannell Road (S.R. 1326) to the North, Emory Lake Road (S.R. 1325) and U.S. 23/441 to the East, and the City of Franklin at Lakeside Drive to the South. The landfill entrance is off of Lakeside Drive. The landfill has been in operation since May 1992. Westinghouse Environmental performed the original Site Suitability Study dated January 1990. McGill Associates worked with the County in 1997 to expand the Site Suitability Study area to include existing MSW Phase 2 and proposed MSW Phase 3 Cell 1. Since the time of the last permit renewal in 2010, Macon County has purchased 2 additional tracts of land that adjoined the landfill property to the Northwest of proposed Phase 3 Cell 1, which will allow for the future expansion of additional Phase 3 cells. The County is in the process of completing the Site Study Expansion for the additional area, which will be required for Phase 3 cells beyond proposed Phase 3 Cell 1.

As part of the Permit to Construct MSW Phase 3 Cell 1, the County will expand the Facility Boundary as shown in the Permit to Construct drawings to include portions of the recently purchased properties. The revised Facility Boundary totals approximately 190 acres. There are approximately 7.5 additional acres of County-owned property extending beyond the proposed Facility Boundary. See the Permit to Construct Drawings, Sheet V-101 for a Plat of the proposed Facility Boundary.

The total facility waste area includes approximately 19.7 acres of existing waste area (Phase 1/Phase 2) and 7.6 acres for proposed MSW Phase 3 Cell 1. Future expansion into Phase 3 will include approximately 26.5 acres of additional landfill area, pending Site Study Approval.

1.0 Waste Stream

Macon County currently classifies their waste stream as residential or non-residential. Non-hazardous industrial sludge and sanitary sewage treatment sludge are currently accepted. The Macon County MSW Landfill prohibits regulated hazardous waste, and hazardous liquid wastes.

The service area for the Macon County MSW Landfill will include businesses and municipalities located within Macon County. Waste from other counties will not be accepted at the facility. The waste disposed at the Macon County MSW Landfill can be classified into two sectors, residential and non-residential. Past studies have shown that the residential waste compromises approximately 63% of the total waste stream while the non-residential waste compromises approximately 37% of the total waste stream. The

Macon County MSW Landfill receives wastewater sludge from the Town of Franklin Wastewater Treatment Facility.

The total waste disposed in existing MSW Phase 1/Phase 2 from May 1992 through April 30, 2015 was approximately 650,534.44 tons. It is estimated that the existing Phase 1/Phase 2 waste area can receive an additional 57,000 tons of waste prior to reaching final grades. To determine the projected waste disposal rate for proposed Phase 3 Cell 1, the County utilized the waste disposal tonnage for the 12-month period ending April 30, 2015, which was 29,974 tons, then added a 1.5% annual increase for the five-year permitting period. This equates to an average rate of approximately 31,663 tons per year over the next five years, or approximately 158,000 tons for the five-year permitting period.

The operating hours for the landfill are Monday through Friday 7:30 a.m. to 4:30 p.m. and 8:00 a.m. to 2:00 p.m. on Saturdays. The landfill is closed on Sunday, Christmas Day, Thanksgiving Day, and any Federal Holiday that is on Tuesday through Thursday.

Macon County currently operates a Waste Treatment and Processing Facility at the Macon County MSWLF at the former baler facility. The County hauls MSW waste from the waste processing facility to the active landfill cell. The County also has permitted a composting facility at the landfill; however, due to the lack of feedstock, does not conduct composting operations. A recycling center is also operated at the MSWLF to process and bale recyclable materials before shipment to vendors for final processing. The County operates a yard waste facility to process untreated wood waste from land clearing. The mulch produced from the yard waste facility is used as an Alternative Daily Cover for the MSW, and extra material is made available to the public. Construction and demolition waste is disposed in the MSWLF.

Macon County uses the following equipment to operate and maintain the Landfill: one compactor, one wheel loader, one track loader, two dozers, one skid steer, two flatbed trucks, and two dump trucks. This equipment should be sufficient for operating the landfill under its current waste stream.

2.0 Landfill Capacity and Soil Resources

The proposed Phase 3 Cell 1 landfill has approximately 450,000 cubic yards of net airspace available for the disposal of wastes, as measured from the top of the proposed stone drainage layer to the bottom of the proposed final or intermediate cap elevations shown on the Permit Drawings. Utilizing the projected average waste disposal rate of 31,663 tons/year and a 0.5 tons/cy waste compaction rate, Phase 3 Cell 1 has a theoretical lifetime capacity of approximately 7.1 years. However, due to the inefficiencies of operating a landfill cell to a sharp peak in the final cap grades as shown on the Permit to Construct Drawings, the County will work to bring Phase 3 Cell 2 online in approximately 5 years, so that a more cost efficient transition to the upper elevations of the Cell can be achieved with a minimal amount of temporary access road construction.

A change in either the waste disposal rate or the compaction rate will influence the actual lifespan of the Cell.

Based on operational experience at the existing Phase 1/Phase 2 waste area, the County anticipates the need to use cover soils at the rate of approximately 30% of the total airspace of the Phase 3 Cell 1 volume. This equates to the need for approximately 135,500 cy of soil for daily cover for the life of Phase 3 Cell 1. Construction of the base liner system will require approximately 18,500 cy of soil materials (assuming that 18 inches of soil is used along with a GCL). Additional soil requirements will include 12 inches of soil for an intermediate cap over the entire cell and 42 inches of soil for the final cap. Total intermediate cap soils = 12,500 cy. Total final cap soils = 43,500 cy. Total soil requirements for the life of Phase 3 Cell 1 is 210,000 cy. The County will stockpile approximately 600,000 cy of soil on site during the construction of MSW Phase 3 Cell 1, and will have access to additional soils available as Phase 3 Cell 2 is developed.

Macon County would like to conduct waste filling operations in an uphill direction, and therefore will begin waste filling at the southern margin of the site, adjacent to the sump area. However, the County will still maintain a stormwater pumping area on top of the stormwater cover above the leachate sump for as long as possible. Waste fill operations will continue up the hill on the eastern side of the cell. Waste fill operations for the five-year permitting period are shown on Sheets C-108 through C-112 of the Permit Drawings.

The following is a breakdown of the construction, airspace, and closure quantities.

Phase 3 Cell 1 Development, Operation, and Closure – 7.6 Acres:

<u>Airspace Summary:</u>
Airspace available for the disposal of waste,
as measured from the top of the stone drainage layer
to the bottom of either the intermediate or final cap grades
utilizing ACAD Civil 3D Software **450,000 cy**

<u>Lifetime Estimate:</u>
Estimated lifetime of cell based on
31,663 tons/yr and 0.5 tons/cy compaction: **7.1 years***
*note: estimate is to bottom of cap grades noted on Permit Drawings,
which are not feasible to obtain efficiently. Additional
landfill airspace will be required in approximately 5 years.

Soils Required:

Base liner construction – 18-inch clay liner:	18,500 cy
Cover soils at 30% of airspace volume (life of cell):	135,500 cy
Closure:	
12-inch intermediate cover:	12,500 cy
18-clay liner:	18,500 cy
24-inch vegetative layer:	25,000 cy
Total Soils for Life of Cell:	**210,000 cy**

Soils Available:

Soils stockpiled at the completion of Phase 3 Cell 1 base liner development:	**600,000 cy**

Future Phase 3 Development – ±26.5 Acres (Pending Site Study Approval)

Future Phase 3 Expansion will progress as existing landfill cells reach operational capacity, typically in approximately 5 years after coming online. Pending Site Study Approval, there is approximately an additional 26.5 acres beyond Phase 3 Cell 1 that could potentially be developed as landfill airspace. There are streams and wetlands on site and the County will work with the U.S. Army Corps of Engineers and the NCDENR – Division of Water Resources in order to obtain the proper permits for future stream/wetlands impacts. Additional Design Hydro investigation will be required as well. Future waste disposal rates will have a great impact on the strategies that the County employs in determining the size and timing for the development of any new landfill cell. Waste compaction rates in the future will impact the lifetime of any available airspace. The following is a summary of potential future landfill airspace, based on 3:1 final cap slopes:

Future Landfill Cells Summary

Landfill Area and Airspace

	Footprint	Available Airspace*
Phase 3 Cell 2:	3.9 Acres	500,000 cy
Phase 3 Cells 3 & 4 (built in one or two cells):	8.9 Acres	1,000,000 cy
Phase 3 Cells 5 & 6 (built in two or three cells):	13.7 Acres	1,650,000 cy
Total Landfill Area & Airspace beyond Phase 3 Cell 1:	26.5 Acres	3,150,000 cy

*approximate only, includes overlaying existing landfill cells

Lifetime Estimate

Lifetime estimate for Phase 3, all cells (including Cell 1), 3,600,000 cy of airspace available for the disposal of waste:

-Low assumption: 2.0% annual waste increase at 0.5 tons/cy compaction rate:	±40 years
-High assumption: 1.5% annual waste increase at 0.58 tons/cy compaction rate:	±60 years

Soils Estimate

Available soils after base liner development for all Phase 3 cells (including Cell 1)*:	1,300,000 cy
Total required soils for construction, operation, and closure for all Phase 3 cells (including Cell 1):	1,500,000 cy

*Significant additional onsite soils are available in buffer areas throughout the site beyond what has currently been graded that could easily make up the 200,000 cy soil deficit shown. The County will have 40-60 years to address this problem.

3.0 Environmental Control System

The major components of the Environmental Control System are a composite clay liner constructed of a 24-inch, low-permeability clay layer with a permeability not greater than 1 x 10^{-7} cm/sec, and overlain by a 60-mil HDPE liner OR an 18-inch, low-permeability clay layer with a permeability not greater than 1 x 10^{-5} cm/sec overlain with Geocomposite Clay Liner with a demonstrated permeability not greater than 1 x 10^{-9} cm/sec, and overlain by a 60-mil HDPE liner. Once a protective 16-ounce geotextile is placed on the HDPE liner, a two (2)-foot stone drainage layer including leachate collection pipes is placed on top of the composite liner system. The composite liner provides a redundant system for assuring that leachate is contained within the cell and does not affect local hydrogeology. The high permeability of the drainage layer assures quick and efficient removal of leachate from the cell floor to the sump areas at the southern margin of the cell, therefore further reducing leak potential. Once leachate reaches the sump area, it is pumped to the leachate surface impoundment through a dual-contained leachate force main. Leachate pumps located in the sump area are activated by head heights to assure that leachate head levels on the primary liner do not exceed 12-inches during normal operating conditions. The leachate sump will be double-lined with an additional 60-mil HDPE geomembrane overlain a second 60-mil HDPE geomembrane. Disposal of leachate from the leachate storage pond is discussed in the Engineering Plan.

4.0 Leachate Management

4.1 Design Concepts

The Phase 3 Cell 1 leachate collection system was designed to remove leachate from the lined waste area at a rate so as not to allow more than one (1) foot depth of leachate on the composite liner during normal operating conditions. This is achieved by using a high permeability drainage layer, appropriately spaced perforated leachate collection pipes, double lined leachate sump, and appropriately sized leachate pump stations.

4.2 Leachate Generation

The amount of leachate estimated to be generated by Phase 3 Cell 1 was analyzed using the HELP model and historical data from Phase 2 Cell 1. Phase 3 Cell 1 was analyzed for three different cross sections using the HELP model. The cross sections varied from the first, which analyzed the landfill in a worst case scenario of leachate production with the entire 7.6 acres active with 10 feet of compacted waste and 6 inches of daily cover, to the second, which analyzed the landfill midway through development with 40 feet of compacted waste and 12 inches of intermediate cover, to the third, which analyzed the landfill at closure with full depth of compacted waste, 12 inches of intermediate cover, 18 inches of low permeability clay, geomembrane, geocomposite, and 24” vegetative cover . The HELP model estimates that average monthly leachate production will reach 399,656 gallons/month during the worst case initial cross section.

4.3 Leachate Management System

The leachate collection system is shown on sheets C-104 and C-105 and is detailed on sheets C-501 through C-504 of the permit drawings. The collection system consists of a high permeability drainage layer, 8-inch HDPE leachate collector piping, and a leachate pump station within the sump area.

The leachate collection pipes were designed to handle the projected peak leachate flow demonstrated in the HELP Model. The highest leachate design flow was in cross section 1. The largest area draining into the 8" collector pipes was 5.0 acres. Applying the case 1 rate to the 5.0 acres produces a design flow of 6.0 gallons per minute (GPM). The leachate pipes are placed at a minimum slope of 3.0%. Full flow capacity for an eight-inch pipe at this slope is 1,032 GPM.

Leachate production will be handled by two pumps installed within the proposed sump area and connected to a 3" x 6" dual contained forcemain. The proposed forcemain will be installed from Phase 3 Cell 1 and connect to the existing 3" x 6" dual contained forcemain currently serving Phase 2 Cell 1. The connection will be made upstream of the existing air release valve by installing a pre-cast concrete manhole, with coating for dual containment, and check valves installed on both the proposed and existing forcemains. The HELP Model average monthly flow converts to 9 gallons per minute and a typical peaking factor of 3 was initially applied to yield a pump operation of 27 gallons per minute. However, it was calculated that a minimum of 45 gallons per minute would be required to provide a minimum velocity within the forcemain of 2 feet per second. Based on the system curve, it was determined that one EPG Series 8-4 pump would operate at 47 gallons per minute and 63 feet of total dynamic head. This condition of operation would only be valid if only one of the Phase 3 Cell 1 pumps was in operation. The effect of head losses and combined flows from the existing pumps serving Phase 2 Cell 1 was evaluated to confirm that all pumps would remain within an acceptable range of operation if all three were operating at the same time. It was determined that the proposed pump would operate at 41 gallons per minute, existing pump A would operate at 21 gallons per minute, and existing pump B would operate at 44 gallons per minute. All three pumps are the same EPG model and operate at an acceptable flow based on the pump curves and flow range. Next, the flow condition was calculated at 61.25 gallons per minute with a total dynamic head of 85 feet based on both pumps within the sump of Phase 3 Cell 1 operating at the same time. Based on average daily flows, one of the proposed pumps will run 4.7 hours to remove the leachate produced. The intent will be for the pumps to alternate in operation to help extend service life. Dual pumps also provide redundancy in the event that maintenance is required on one of the pumps. The proposed sump area will store approximately 7.44 days of leachate production at the average daily rate and will require approximately 1.44 days to completely drain the sump if full. Lastly, the existing leachate lagoon was evaluated for existing flows from Phase 2 Cell 1 and proposed flows from Phase 3 Cell 1. Assuming the leachate lagoon is completely empty with a volume of 770,000 gallons, the capacity would yield approximately 43.10 days of storage.

4.4 Contingency Plan

In the event of an extreme rainfall event, the HELP model projects a peak leachate production of 510,000 gallons per day and a maximum head on the liner of 9.563 inches. However, this peak event would only occur if the entire 7.6 acre landfill contained 10 feet of waste and 6 inches of daily cover. The available storage volume below the perimeter liner edge elevation of 2078, assuming porosity if 0.4 (actual value will be higher depending on the amount of waste that has been placed) is approximately 989,305 gallons. Even for the peak event for the worst case scenario cross section, the area below permanent liner edge would only at 51.5% full of leachate. In actuality, based on the conservative assumption of porosity and its effect on volume, multiple days of peak flow under normal operating conditions would be possible. The proposed pump's operating point of 47 gallons per minute allows for a peaking factor of 5.22 from average daily flow, therefore, it is highly unlikely for the landfill to produce more leachate than the pumps can transport to the leachate lagoon. In the event of extreme conditions, both pumps will provide 61 gallons per minute. Also, the leachate lagoon's capacity is greater than the peak daily leachate production.

Under average operating conditions, in the event that there was a temporary failure with any of the leachate removal and storage equipment, the geometry of the landfill would allow for the landfill to contain the leachate for approximately 2.5 months. However, the system should never be out of operation for more than a few hours, and then only under extreme circumstances. Due to the conservative design of the leachate removal and storage equipment and the geometry of the landfill, the possibility of leachate buildup overflowing the perimeter berm is very low.

Section 4: Engineering Plan

ENGINEERING PLAN

MACON COUNTY MSW LANDFILL
PERMIT TO CONSTRUCT
PHASE 3 CELL 1
MACON COUNTY, NORTH CAROLINA

MARK D. CATHEY, P.E.

McGill ASSOCIATES

Engineering • Planning • Finance
Asheville, North Carolina

May 2015

13.00726

ENGINEERING PLAN

Macon County MSWLF
Phase 3 Cell 1

1.0 Introduction

The Engineering Plan incorporates the plans and specifications relative to detailed design and performance of the Phase 3 Cell 1 Expansion at the Macon County MSWLF. This plan was developed in accordance with Section .1620 of the Solid Waste management Rules (15 NCAC 13B). Sections .1624 (Construction Requirements for MSWLF Facilities) and .1627 (Closure and Post-Closure Requirements for MSWLF Facilities) were also closely referenced during the development of this plan. This Engineering Plan discusses the engineering and design of the Phase 3 Cell 1 expansion. Phase 3 Cell 1 has an estimated life expectancy of five (5) years.

2.0 Engineering Report

2.1 Composite Base Liner and Leachate Collection System

The Phase 3 Cell 1 Expansion has the following: clay layer, HDPE liner and Leachate Collection System (LCS) design characteristics (from bottom to top):

- A minimum four (4)-foot vertical buffer between the average seasonal high water table and the post-settlement bottom of the composite liner,
- A minimum four (4)-foot vertical buffer between bedrock and the post-settlement bottom of the composite liner.
- A compacted select backfill layer (as needed).
- A two (2)-foot thick, compacted clay liner with a maximum permeability of 1.0×10^{-7} cm/sec., **or** an eighteen (18)-inch thick compacted clay liner with a maximum permeability of 1.0×10^{-5} cm/sec overlain with a geosynthetic clay liner (GCL) material with a demonstrated hydraulic conductivity of not more than 5×10^{-9} cm/sec under the anticipated confining pressure,
- A primary sixty (60)-mil, high density polyethylene (HDPE) geomembrane liner, smooth on the floor and textured on the slopes,
- A sixteen (16)-ounce geotextile cushion on the floor and side slopes, and
- A two (2)-foot thick leachate collection layer constructed of washed stone, and also including leachate collection and transfer piping constructed of HDPE.

2.2 Cap System

The Phase 3 Cell 1 Expansion will have the following cap system design characteristics (from bottom to top):

- A one (1)-foot thick layer of compacted intermediate cover directly on top of the waste,
- An eighteen (18)-inch thick compacted clay layer, with maximum permeability of 1.0×10^{-5} cm/sec
- A forty (40)-mil textured HDPE geomembrane,
- A double-sided, eight (8)-ounce geocomposite, and
- A twenty-four -inch (24") thick vegetative\erosion layer

2.3 Leachate Collection

The Phase 3 Cell 1 leachate collection lines consist of eight (8)-inch perforated HDPE main collector lines which run from the south portion of the cell at the sump to leachate clean-outs at the liner edges of the new cell. Eight (8) inch perforated HDPE lateral collectors will connect to the main lines. The main collection lines will be constructed with a minimum slope of 3.0%. The lateral collectors are spaced approximately 150 feet apart. See Sheet C-104 of the Permit Drawings for the layout of the leachate collection piping for Phase 3 Cell 1.

Phase 3 Cell 1 will be constructed with a leachate collection sump with two (2) leachate pumps, which will act as a duplex pumping station. The two (2) pumps will toggle run-times during normal operations, and will run concurrently during periods of high flow. The proposed sump area will be approximately ten (10)-foot by one hundred (100)-foot and will be recessed and will include a double-lined HDPE geomembrane.

The sumps will utilize two twenty-four (24)-inch perforated HDPE side slope riser pipes that will house the submersible leachate pumps. The submersible pumps will be lowered into the leachate collection sump through the side-slope riser by means of a steel cable and a rolling carriage. The side-slope riser rests on the 16-ounce geotextile cushion along the slope and lies between the sump and the top of the perimeter berm.

2.4 Leachate Generation

The amount of leachate that Phase 3 Cell 1 will generate was estimated by using the HELP Model analysis included in Section 14 of the Permit to Construct and by examining landfill records for Phase 2 Cell 1 for the past twelve years. See Section 15 of the Permit to Construct for landfill leachate records for the past six years. The HELP model analyzed three typical cross sections of landfill development during the lifetime of Phase 3 Cell 1. Each cross-section included all aspects of landfill construction, such as clay barrier soils, flexible membrane liners, gravel drainage layers and layers of compacted MSW wastes and cover soils. The cross sections varied from the first, which

analyzed the landfill in a worst case scenario of leachate production with the entire 7.6 acres active with 10 feet of compacted waste and 6 inches of daily cover, to the second, which analyzed the landfill midway through development with 40 feet of compacted waste and 12 inches of intermediate cover, to the third, which analyzed the landfill at closure with full depth of compacted waste, 12 inches of intermediate cover, 18 inches of low permeability clay, geomembrane, geocomposite, and 24" vegetative cover. The HELP model estimates that average monthly leachate production will reach 399,656 gallons/month during the worst case initial cross section. Utilizing the historical data from Phase 2 Cell 1, we determined that 2005 provided the best representation for a stage of landfill development where runoff would not reach periphery ditches and be treated as leachate, similar to the first cross section for the HELP Model. 2004 was not utilized due to the above average amount of rainfall experienced by Macon County. The monthly average for Phase 2 Cell was converted to a per acre amount to analyze an expected monthly average for the proposed 7.6 acre cell from an existing 14.0 acre cell. Based on historical data, the average monthly leachate production will reach 263,574. The HELP Model analysis is a conservative estimate of leachate production and will continue to be considered when designing improvements to the landfill leachate system; however, leachate production records will be utilized as well. The leachate collection system must be prepared to handle extreme events as well as function efficiently at average production levels.

2.5 Average Leachate Production Flows and Pumping

Utilizing the existing leachate production information from both the HELP Model and historical data included as Sections 14 and 15 of the Permit to Construct, and pro-rating those quantities over the 7.6-acre footprint of Phase 3 Cell 1, we chose to evaluate the HELP Model average monthly flow of 399,656 to provide a factor of safety and conservatism to the design. Detailed calculations and supporting documentation for the information provided in this section have been included as Appendix C – Leachate Calculations. Leachate production will be handled by two pumps installed within the proposed sump area and connected to a 3" x 6" dual contained forcemain. The proposed forcemain will be installed from Phase 3 Cell 1 and connect to the existing 3" x 6" dual contained forcemain currently serving Phase 2 Cell 1 (see Leaching Pumping System Diagram in Appendix C). The connection will be made upstream of the existing air release valve by installing a pre-cast concrete manhole, with coating for dual containment, and check valves installed on both the proposed and existing forcemains. The HELP Model average monthly flow converts to 9 gallons per minute and a typical peaking factor of 3 was initially applied to yield a pump operation of 27 gallons per minute. However, it was calculated that a minimum of 45 gallons per minute would be required to provide a minimum velocity within the forcemain of 2 feet per second. Based on the system curve, it was determined that one EPG Series 8-4 pump would operate at 47 gallons per minute and 63 feet of total dynamic head. This condition of operation would only be valid if only one of the Phase 3 Cell 1 pumps was in operation. The effect of head losses and combined flows from the existing pumps serving Phase 2 Cell 1 was evaluated to confirm that all pumps would remain within an acceptable range of

operation if all three were operating at the same time. It was determined that the proposed pump would operate at 41 gallons per minute, existing pump A would operate at 21 gallons per minute, and existing pump B would operate at 44 gallons per minute. All three pumps are the same EPG model and operate at an acceptable flow based on the pump curves and flow range. Next, the flow condition was calculated at 61.25 gallons per minute with a total dynamic head of 85 feet based on both pumps within the sump of Phase 3 Cell 1 operating at the same time. Based on average daily flows, one of the proposed pumps will run 4.7 hours to remove the leachate produced. The intent will be for the pumps to alternate in operation to help extend service life. Dual pumps also provide redundancy in the event that maintenance is required on one of the pumps. The proposed sump area will store approximately 7.44 days of leachate production at the average daily rate and will require approximately 1.44 days to completely drain the sump if full. Lastly, the existing leachate lagoon was evaluated for existing flows from Phase 2 Cell 1 and proposed flows from Phase 3 Cell 1. Assuming the leachate lagoon is completely empty with a volume of 770,000 gallons, the capacity would yield approximately 43.10 days of storage.

2.6 Contingency Plan for Peak Flow Conditions and Leachate System Disruption

In the event of an extreme rainfall event, the HELP model projects a peak leachate production of 510,000 gallons per day and a maximum head on the liner of 9.563 inches. However, this peak event would only occur if the entire 7.6 acre landfill contained 10 feet of waste and 6 inches of daily cover. The available storage volume below the perimeter liner edge elevation of 2078, assuming porosity if 0.4 (actual value will be higher depending on the amount of waste that has been placed) is approximately 989,305 gallons. Even for the peak event for the worst case scenario cross section, the area below permanent liner edge would only at 51.5% full of leachate. In actuality, based on the conservative assumption of porosity and its effect on volume, multiple days of peak flow under normal operating conditions would be possible. The proposed pump's operating point of 47 gallons per minute allows for a peaking factor of 5.22 from average daily flow, therefore, it is highly unlikely for the landfill to produce more leachate than the pumps can transport to the leachate lagoon. In the event of extreme conditions, both pumps will provide 61 gallons per minute. Also, the leachate lagoon's capacity is greater than the peak daily leachate production.

Under average operating conditions, in the event that there was a temporary failure with any of the leachate removal and storage equipment, the geometry of the landfill would allow for the landfill to contain the leachate for approximately 2.5 months. However, the system should never be out of operation for more than a few hours, and then only under extreme circumstances. Due to the conservative design of the leachate removal and storage equipment and the geometry of the landfill, the possibility of leachate buildup overflowing the perimeter berm is very low.
Section .1624 (2)(A)(ii) of the Solid Waste Management Rules states that "the geometry of the landfill shall be designed to control and contain the volume of the leachate generated by the 24-hour, 25-year storm." The input parameters of the HELP model

included maintaining a maximum head of one (1) foot on the geomembrane liner, and the additional calculations regarding peak daily flow assure that rule .1624 (2)(A)(ii) was met.

3.0 DESIGN SUMMARY

3.1 Analytical Methods Used for Design Evaluation

3.1.1 Liner Components.

Review of EPA literature, NCDENR regulations, and Geomembrane liner manufacturer data.

3.1.2 Leachate collection system

The leachate collection system is designed to handle leachate production flows as determined by evaluation of documented leachate generation rates and the HELP model. The pipe spacing is based upon Manning Equation analysis.

3.1.3 Leachate Production

Volumes – Documented leachate generation rates, and HELP Model
Storage Facilities - HELP Model during Phase 3 Cell 1

3.1.4 Gas Collection System

EPA design manual and assumption that gas well radius of influence = 100-125 feet.

3.2 Definition of Critical Conditions and Assumptions Made

Critical components

Phase 3 Cell 1 is a standalone cell and will connect to the future Phase 3 cells. The Phase 3 Cell 1 is designed in consideration of future expansion. A minimum separation of four (4) feet between the seasonal high water table and/or bedrock to the post-settlement bottom of the base liner system will be maintained.

- Maximize use of existing property
- Existing soils may require amendment to get 1.0 x 10^{-7} permeability, or off-site borrow sources may have to be utilized, or a GCL composite liner with 1.0 x 10^{-5} permeability compacted clay soils overlain with a GCL material with a demonstrated hydraulic conductivity of not more than 5 x 10^{-9} cm/sec under the anticipated confining pressure may be utilized.
- Constructed with washed stone leachate collection drainage layer to minimize potential of clogging
- Proposed base liner system and proposed final cap system in accordance with current regulations; although, a 3:1 final cap slope will be utilized.

3.3 Technical References Used

- EPA 530-R-93-017 "Solid waste disposal facility criteria, technical manual"
- NC Regulations (15A NCAC 13B)
- Federal Regulations
- HELP Model
- Geomembrane liner manufacturer literature
- "Subtitle D technical training manual"
- EPA/625/R-94/008 Seminar publication "Design, operation, and closure of municipal soil waste landfill"
- EPA/600/R-94/168a "Hydraulic evaluation of landfill performance (HELP) Model user's guide for version3"
- Bagchi, Amalendu. (1994). Design, Construction, and Monitoring of Landfills, John Wiley and Sons, Inc., New York, NY.

3.4 Location Restrictions

The Phase 3 Cell 1 expansion complies with all location restrictions given in Section .1622 of the Solid Waste Management Rules (15A NCAC 13B).

The closest public use airport to the Macon County MSWLF is the Macon County Airport, FAA Identifier 1A5, located at 1241 Airport Rd, Franklin, NC 28734. The Macon County Airport runway is located approximately 14,200 feet from the Proposed Phase 3 Cell 1 MSWLF. Rule 15A NCAC 13B .1622 (1) (c) requires the permittee of any existing MSWLF or lateral expansion to demonstrate that MSWLF unit does not pose a bird hazard to aircraft. The location of Proposed Phase 3 Cell 1 MSWLF is approximately 2,000 feet further from the Macon County Airport than the existing Phase 2 Cell 1 MSWLF. The Proposed Phase 3 Cell 1 MSWLF should not increase the risk of bird/aircraft collision due to its location being further from the Macon County Airport.

Rule 15A NCAC 13B .1622 (1) (b) requires the owners or operators proposing to site a new MSWLF unit or lateral expansion within a five-mile radius of any airport runway used by turbine-powered or piston-powered aircraft shall notify the affected airport and the Federal Aviation Administration prior to submitting a permit application to the Division. The letters to the Macon County Airport Authority and the Federal Aviation Administration are included in Appendix D.

3.4.2 Water Supply

Rule 15A NCAC 13B .1622 (9) Water Supply Watersheds. (a) A new MSWLF unit or lateral expansion shall not be located in the critical area of a water supply watershed or in the watershed for a stream segment classified as WS-I, in accordance with the rules codified at 15A NCAC 2B .0200 - "Classifications and Water Quality Standards Applicable To Surface Waters Of North Carolina." (b) Any new MSWLF unit or lateral expansion, which shall discharge leachate to surface waters at the landfill facility and must obtain a National Pollution Discharge Elimination System (NPDES) Permit from the Division of Environmental Management pursuant to Section 402 of the United States Clean Water Act, shall not be located within watersheds classified as WS-II or WS-III, in accordance with the rules codified at 15A NCAC 2B .0200 - "Classifications and Water Quality Standards Applicable To Surface Waters Of North Carolina."

A search of North Carolina Department of Environmental and Natural Resources (NCDENR) public water supply section databases was performed for the Proposed Phase 3 Cell 1 MSWLF expansion area. A review of this data does not indicate any public water supply wells within the 500-foot buffer of waste limits. The search results are included in Appendix E. The Proposed Phase 3 Cell 1 MSWLF is not located in the critical area of a water supply watershed or in the watershed for a stream segment classified as WS-1. Based on available information, there are no water intakes off the Little Tennessee River for consumable water.

3.4.3 Zoning

The County is in the process of acquiring the Town’s zoning approval for Phase 3 Cell 1 per NC general statute 130A-294 (b1) (4). A copy of the letter stating that the Town approves the zoning for the project will be submitted to the NCDENR-Solid Waste Section prior to the issuance of a Permit to Construct Phase 3 Cell 1.

3.4.4 Contamination Sources

The Macon County MSWLF is the only known potential source of contamination in the area, with the exception of agricultural activities in the area.

3.4.5 Historical Site

Rule 15A NCAC 13B .1622 (7) states that a new MSWLF unit or lateral expansion shall not damage or destroy an archaeological or historical property. The Department of Cultural Resources shall determine archeological or historical significance. To aid in making a determination as to whether the property is of archeological or historical significance, the Department of Cultural Resources may request the owner or operator to perform a site - specific survey which shall be included in the Site Study.

There are no mapped historic structures, buildings, or sites on the Phase 3 Cell 1 MSWLF expansion area. Information regarding the locations of historical sites was obtained from the North Carolina State Historic Preservation Office. Information regarding cultural resources was obtained from the North Carolina Department of Cultural Resources. A Phase I archeological survey will be included in the Site Suitability Study.

3.4.6 Floodplains

Rule 15A NCAC 13B .1622 (2) (a) states that new MSWLF units, existing MSWLF Units, and lateral expansions shall not be located in 100-year floodplains unless the owners or operators demonstrate that the unit will not restrict the flow of the 100-year flood, reduce the temporary water storage capacity of the floodplain, or result in washout of solid waste so as to pose a hazard to human health and the environment.

The outline of proposed landfill activity and the extent of the 100-year floodplain at the site is shown on sheet C-101. The floodplain delineation is based on the Flood Risk Information System data of 2015. The proposed landfill activity does not encroach on the 100-year floodplain. Thus, the landfill activity has no impact on the 100-year floodplain and satisfies the location restriction of 15A NCAC 13B .1622 (2) (a).

3.4.7 Wetlands and Streams

Rule 15A NCAC 13B .1622 (3) (a) states that new MSWLF units and lateral expansions shall not be located in wetlands, unless the owner or operator can make the following demonstrations to the Division: (i) Where applicable under Section 404 of the Clean Water Act or applicable State wetlands laws, the presumption that a practicable alternative to the proposed landfill facility is available which does not involve wetlands is clearly rebutted. (ii) The construction and operation of the MSWLF unit will not: (A) Cause or contribute to violations of any applicable State water quality standard; (B) Violate any applicable toxic effluent standard or prohibition under Section 307 of the Clean Water Act; (C) Jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of a critical habitat, protected under the Federal Endangered Species Act of 1973; and (D) Violate any requirement under the Marine Protection, Research, and Sanctuaries Act of 1972 for the protection of a marine sanctuary.

Wetlands areas and a stream are present in the vicinity of the Phase 3 Cell 1 development. See Sheet C-101 of the permit drawings for the location of the wetlands and stream. A jurisdictional delineation was performed by McGill Associates and a representative of the U.S. Army Corps of Engineers (USCOE) conducted a field verification of the delineation. There will be approximately 149 linear feet of stream impact and 0.08 acres of wetlands impact associated with the development of the access road to the proposed MSW Phase 3 area, and the County has worked with the U.S. Army Corps of Engineers and the NCDENR-Division of Water Resources to obtain the necessary 404/401 permits for this portion of the project. There will also be an additional 0.04 acres of wetlands impact in the vicinity of the Phase 3 Cell 1 area. The County is in the process of finalizing the 404/401 permits for the additional impact. A copy of those permits already obtained are included in Section 15 of the Permit to Construct documentation. The County will forward the 404/401 permits for the outstanding 0.04 acres of wetlands impact to the Solid Waste Section upon receipt. All of the following will be conformed to:

- Endangered Species Act of 1973
- Marine Protection, Research, and Sanctuaries Act of 1972
- Section 404 of the Clean Water Act

3.4.8 Seismic Design

See the Design Hydrogeologic Report prepared by Bunnell-Lammons, Inc.

3.4.9 Fault Areas

See the Design Hydrogeologic Report prepared by Bunnell-Lammons, Inc.

3.4.10 Unstable Areas

See the Design Hydrogeologic Report prepared by Bunnell-Lammons, Inc.

4.0 MATERIALS AND CONSTRUCTION PRACTICES

All materials and methods used for constructing the Phase 3 Cell 1 Expansion will meet the requirements set forth in Section .1624 of the Solid Waste Management Rules (15A NCAC 13B).

4.1 Subgrade

The landfill subgrade will be adequately free of organic materials and will consist of on-site soils or select fill material previously approved by the Division. The subgrade will be graded according to plans approved by the Division. The landfill operator may be required to notify the Division's hydrogeologist for inspection of the subgrade once excavation is complete. This notification would be indicated in the Permit to Construct.

Before construction of the liner system, the Project Engineer will visually inspect the subgrade. The Project Engineer will evaluate the integrity of the surface and document proper preparation and elevations according to plans approved by the Division. The subgrade will be proof-rolled using procedures specified by the technical specifications. The subgrade will be tested for moisture and density requirements at the minimum frequency given in the Division approved technical specifications and the Site Specific Construction Quality Assurance Plan.

4.2 Clay Liner and Geosyntheic Clay Liner (GCL)

The materials used to construct the compacted clay liner will consist of native on-site materials. The on-site materials may require bentonite admixture in order to meet the requirements of the technical specifications. If a bentonite admixture is required, the material will be mixed and stockpiled according to methods approved by the technical specifications and the Project Engineer. Off-site materials may be used to acquire materials capable of meeting the project technical specifications. Any material used to construct the clay liner portion of the base liner system shall meet all of the requirements of the project technical specifications.

The GCL will be installed beneath and in uniform contact with the geomembrane liner. The GCL will overlay a compacted clay liner, in accordance with the specifications. Any material used to construct the GCL portion of the base liner system shall meet all of the requirements of the project technical specifications and Section .1624 of the Solid Waste Rules.

Construction methods used for placement of the compacted clay liner or GCL will be in accordance with the project technical specifications.

4.3 Geomembrane Liner

The geomembrane material will have a demonstrated water vapor transmission rate less than or equal to 0.03 gm/M^2-day. The geomembrane will also have physical and chemical resistance to environmental exposure, waste placement, and leachate generation. The primary liner will be high density polyethylene with a minimum thickness of 60 mils.

The installation of the geomembrane will conform to manufacturer's recommendations and the project technical specifications. The liner edge will be installed and secured into an anchor trench at the Phase limits. Refer to Appendix B for anchor trench calculations.

4.4 Leachate Collection Pipes

Leachate collection piping will have a minimum nominal diameter of eight (8) inches for lateral and main collectors, and be made of high density polyethylene material. The pipe will provide adequate structural strength to support static and dynamic loads produced by materials and equipment used during construction and operation of the landfill. The pipe will also provide adequate structural strength to support static loads produced by the waste fill and components of the final cap. Refer to Appendix A for pipe stability calculations.

The leachate collection pipes will be installed according to the Sheet C-104 of the permit drawings for Phase 3 Cell 1. All piping will be constructed with cleanouts where physically possible for periodic cleaning and maintenance. The bedding material for the collection lines will be #5 washed aggregate with no more than five (5) percent by weight passing the #200 sieve. This aggregate will also be chemically compatible with leachate generated in the phase and shall meet all the requirements of the project technical specifications.

4.5 Drainage Layers

The aggregate used as the drainage layer in the phase will not be adversely affected by leachate produced in the phase and will promote lateral drainage of leachate. The drainage layer material shall meet all the requirements of the project technical specifications.

The drainage layer will be placed by methods given in the project technical specifications and the Site Specific Construction Quality Assurance Plan. The drainage layer material will be stable on the 3:1 side slopes of the phase. Please refer to the Design Hydrogeologic Report prepared by Bunnell-Lammons, Inc.

4.6 Filter Layers

Filter layers in the leachate collection system will prevent migration of fine soil particles from entering the aggregate drainage layer, while allowing water and gases to enter the drainage medium without clogging. Geosynthetic filters shall demonstrate adequate permeability and soil particle retention, while having chemical and physical resistance from waste placement, leachate, and any overlying material. Geosynthetic materials shall meet all of the requirements of the project technical specifications.

All filter layers will be installed according to the project technical specifications, construction drawings, and the Site Specific Construction Quality Assurance Plan. Geosynthetic filters will not be wrapped directly around leachate collection piping.

4.7 Erosion Control

The erosion control structures are designed and will be maintained to manage the run-off generated by the 24-hour, 25-year storm event and will conform to the requirements of the Sedimentation Pollution Control Law (15A NCAC 4). An erosion and sedimentation control permit from NCDENR-Land Quality Section is pending. A copy of the approved erosion control plan will be forwarded to the Solid Waste Section prior to the issuance of a Permit to Construct for Phase 3 Cell 1. Erosion control measures for Phase 3 are shown on Sheets C-106 and C-107 of the Permit to Construct plans.

5.0 DESIGN HYDROGEOLOGIC REPORT

The Design Hydrogeologic Report for Phase 3 Cell 1 was prepared by BLE, Inc. A copy of this report was included with the design package submitted to the Solid Waste Section under separate cover.

6.0 ENGINEERING DRAWINGS

6.1 Existing Conditions

Sheet C-101 of the design drawings shows existing site topography, borings, piezometers, existing and proposed ground water monitoring wells, existing and proposed gas probes, existing roads, existing buildings, existing MSW Phases 1 and 2, existing landfill facilities, the proposed revised Facility Boundary, and the proposed location of the Phase 3 Cell 1 Expansion.

6.2 Grading Plans

The grading plans identify the proposed limits of excavation, clay liner elevations, and drainage layer elevations. Sheet C-102 shows the subgrade elevation when a GCL is utilized along with one and one-half (1 1/2)-feet of compacted clay. The subgrade elevations associated with two (2) feet of compacted clay at 1×10^{-7} are six (6)-inches below those elevations shown on Sheet C-102. Sheet C-103 of the permit drawings shows the top of clay liner or top of GCL elevations. Sheet C-104 shows the top elevation of the drainage layer. Cap grades are shown on Sheet C-106 of the plans.

6.3 Base Liner System

The grades for the top of the Phase 3 Cell 1 clay liner or GCL are shown on Sheet C-103. As shown on the drawings, the minimum floor slope within the Phase 3 Cell 1 Expansion is approximately 4 percent. The minimum post-settlement slope of the base liner system is greater than three (3) percent. The anchor configuration and details of the base liner system are shown on the detail sheets C-501-C-504.

6.4 Leachate Collection System

The leachate collection system for Phase 3 Cell 1 is shown on Sheet C-104 and C-105 of the permit drawings. The drainage layer washed stone for the leachate collection system is placed directly on the geotextile cushion and primary geomembrane. The cleanouts and sump locations are also identified on the drawings. The top elevation of the stone drainage layer is shown on Sheet C-104. Details for the leachate collection system, including sump details, cleanout details, and piping details are shown on the detail Sheets C-501-C-504. The proposed leachate system force main is shown on Sheets C-104 and C-105.

6.5 Stormwater Segregation System

Phase 3 Cell 1 will be covered by a synthetic stormwater control liner that lies on top of the drainage layer. (Refer to Sheet C-104). This stormwater control liner will allow stormwater runoff to collect in the lower end of the phase. Stormwater runoff will then be pumped over the perimeter embankment and discharged into the storm drainage system leading to sediment basin #2. Additionally, a stormwater control berm will be installed in the floor of Cell 1 and will discharge stormwater runoff directly to a perimeter ditch near the Southwest corner of the cell. Prior to entering an inactive area of landfill, the stormwater control liner will be partially removed. The overlying synthetic cover will be pulled back in stages, therefore keeping even active areas exposed to a minimum amount of rainwater. As the active working face increases in elevation, berms will be used to direct stormwater runoff to periphery ditches. See Sheets C-501 for a detail of the temporary stormwater control berm.

6.6 Cap System

Sheet C-106 of the permit drawings shows proposed intermediate cover and permanent cap grades of the proposed Phase 3 Cell 1 Expansion. Intermediate cover will be placed of the western and northern portion of the Cell. As adjacent phases are developed, the temporary slopes will increase to the ultimate build-out of the phase. The final cap will include a one (1) foot thick compacted intermediate cover, a twenty-four (24)-inch thick clay layer, a forty (40) mil textured HDPE geomembrane, a double-sided eight (8)-ounce geocomposite, and an eighteen (18)-inch thick vegetative\erosion layer. The slope of the final cap will be 3:1. BLE Inc. included an analysis of the slope stability for a 3:1 final cap, the results of which are included in the Design Hydrogeological Report. Details of the cap system are shown on Sheets C-501 – C-504 of the permit drawings.

Macon County is not required by Solid Waste or air permitting rules to install an active gas collection system and will therefore show a passive venting system at this time. The passive vents will be constructed prior to construction of the final cap at the locations shown on Sheet C-106 and in accordance with the detail on Sheet C-502.

6.7 Erosion Control

An erosion control plan submittal for the construction of Phase 3 Cell 1is in the process of being finalized. The erosion control plan is designed for the construction and operation of Phase 3 Cell 1 as well as the construction and operation of future Phase 3 Cell 2. There are six (6) sediment basins proposed for Phase 3 Cell 1 that will be utilized to control sedimentation during construction and operation of the cells. Storm water runoff will be directed to these basins prior to release to nearby streams. In all cases, ditches, piping, and sediment basins were sized to accommodate the greatest flow that will be encountered throughout the lifetime of the landfill phase. Often, the greatest flow will be seen as the landfill reaches its capacity when the slopes are steepest, many years into the future. A copy of the erosion control permit associated with the development of Phase 3 Cell 1 will be forwarded to the Solid Waste Section upon receipt. The Macon Count MSWLF is being operated under a general stormwater permit that issued in November of 2012.

The erosion and sedimentation control law is performance based and although existing erosion control permits and measures are in-place, it is still the responsibility of the contractor and landfill operator to ensure that the erosion control systems are functioning properly. Existing and proposed erosion/sedimentation control structures include sediment basins, storm drains, temporary slope drains, check dams, and diversion ditches. Sediment basins will be checked after periods of significant runoff. Sediment will be removed from the basin to its original dimension when sediment accumulates to one half of the design depth. The sedimentation basins, embankments, ditches, inlets and outlets will also be inspected for erosion damage. All necessary repairs will be made immediately. Any trash or debris within the riser pipes will be removed. Storm drain outlets and diversion ditches will be inspected for damage after each runoff event. Rip rap will be placed in ditches and at pipe outlets to prevent erosion and wash outs. Provisions for a vegetative ground cover sufficient to control erosion must be

accomplished within fifteen days upon completion of any phase of grading. Embankment slopes shall be periodically inspected for erosion. The embankment slopes shall be mowed at a frequency sufficient to maintain a good stand of vegetation. The slopes shall be mowed once in any one (1) year period. The embankment slopes shall be refertilized in the second year unless vegetation growth is fully adequate. Any damaged areas will be reseeded, fertilized, and mulched immediately. Seeding, fertilizing and mulching shall be in accordance with the North Carolina Erosion and Sedimentation Control Guidelines.

The erosion control plan for the construction of Phase 3 Cell 1 is included on Sheet C-107 of the permit drawings.

6.8 Vertical Separation Requirements

Cross sections of Phase 3 Cell 1 are shown on Sheets C-113 and C-114 of the permit drawings. These drawings illustrate the base liner thickness, the depth of waste, the cap system thickness, and the existing ground elevation, the potentiometric surface, and bedrock elevations. Cross sections of the subsurface conditions, created from boring data at the site, are shown in the Phase 3 Cell 1 Design Hydrogeologic Report prepared by BLE, Inc. The report also contains an average seasonal high water contour map, a bedrock contour map, and a potentiometric surface map. The minimum separation between the **bottom** of the proposed post-settlement clay liner and the water table in Phase 3 Cell 1 is approximately 4.0 feet at one location, located at boring BLE 18R, near the location of the sump. The minimum separation between the **bottom** of the proposed post-settlement clay liner and bedrock is approximately 5.3 feet, located at boring BLE 10. The vertical separation increases up to the high point at the eastern edge of the new cell. The estimated subgrade settlement is shown in the BLE Design Hydrogeologic Report. Differential settlement was looked at to evaluate the potential for one area of the landfill to subside greater than adjacent areas. The projected settlement is negligible and will not cause significant differential settling along leachate lines that could interrupt the flow of leachate to the sump area.

APPENDIX A

Pipe Stability Calculations

Pipe Stability Calculations

Max Landfill Elevation	2176
Clay Grade Elevation	2082
Maximum Overburden Depth	94

Overburden Description (Landfill Fully developed)	
Layer Description	Unit Weight (psf)
Drainage Layer Stone	130
Compacted Waste	55
Compacted Soil Material	110

Overburden Pressure

Layer Descrition	Depth (ft)	Overburden Pressure (psf)	Overburden Pressure (psi)
Drainage Layer	2	260	1.8
Compacted Waste	94	5170	35.9
Compacted Soil	4	440	3.1

Check for Wall Crushing

$$S_a = \frac{(SDR - 1)}{2} P_t$$

P_t	40.8	psi
SDR	17	
S_a	326.1	psi
Assume Compressive yield strength of HDPE =	1500	psi
Factor of Safety	4.6	

Check for Wall Buckling

$$P_{cd} = 0.8 \sqrt{(E' \times P_c)}$$

$$P_c = \frac{2.32\,(E')}{(SDR)^3} = 14.17$$

P_{cd} Must be greater than P_t to resist against wall buckling.
Assume E' = 30,000 psi (crushed stone compacted) for Pcd
AssumeE' = 3,000 psi (soil modulus) for Pc
Time dependent modulus of elasticity @ 150 psi tensile stress = 30,000psi (Ref. pf. 36 of DriscoPipe design Manual)

P_t	40.8	psi
P_c	14.17	
P_{cd}	164.9	psi

165 psi > 53.8 psi, therefore, there is resistance to wall buckling

Factor of Safety = 164.9 psi/40.8 psi	4.0	

Ring Deflection

Allowable ring deflection: $\Delta Y/D = (0.25)E(SDR)$

ΔY	0.28	inches
ΔY/D	4.25%	

Vertical Soil Strain E=Pt/E'

E	0.0136

ΔY = vertical deflection (in.)
D = Pipe O.D. (in.)
E = tangential strain in surface of pipe ring due to reflection, .
SDR = Standard dimension ratio, D/t
t = pipe wall thickness
For 6" SDR 17, D = 6.625", t= 0.39"
E' = Soil modulus, psi (3,000 psi)
E = Vertical soil strain
P_t = total vertical soil pressure =40.8 psi

Allowable ring deflection > vertical soil strain

ΔY/D	0.0425	>	E	0.0136
Factor of Safety	3.1	Pipe Meets Requirements		

APPENDIX B

HDPE Liner Anchor Trench Calculations

McGill ASSOCIATES
ENGINEERING • PLANNING • FINANCE
McGill Associates, P.A. P.O. Box 2259, Asheville, NC 28802
55 Broad Street, Asheville, NC 28801 828-252-0575 Fax 828-252-2518

PROJECT: Macon County MSW Landfill Phase 3 Cell 1
PROJECT NO.: 13.0072
DESCRIPTION: Anchor Trench Calculations
CALCULATED BY: SLB CHECKED BY:
DATE: 6/4/15 SHEET NO. OF

$T_{allow} = 130\ lbs/in\ \left(\frac{12\ in}{ft}\right) = 1{,}560\ lb/ft$

$F_{Ro} = \sigma_n \tan\delta_R (L_{Ro})$

$F_{Ro} = 2ft(120\ lb/ft^3)\tan(0)(3') = 0$

$F_{Lo} = \sigma_n \tan\delta_L (L_{Ro})$

$F_{Lo} = 2ft(120\ lb/ft^3)\tan(17)(3') = 220\ lb/ft$

$F_{LT} = T_{allow} \sin\beta \tan\delta_L$

$F_{LT} = 1{,}560\ lb/ft \sin(18.4)\tan(17) = 151\ lb/ft$

$P_A = (0.5\gamma_{AT} d_{AT} + \sigma_n) K_A d_{AT}$

$P_A = (0.5(120\ lb/ft^3)(3ft) + 2ft(120\ lb/ft^3)) \tan^2(45 - \frac{30}{2})(3ft)$

$P_A = 240\ lb/ft$

$P_P = (0.5(120\ lb/ft)(3ft) + 2ft(120\ lb/ft)) \tan^2(45 + \frac{30}{2})(3ft)$

$P_P = 2160\ lb/ft$

$T_{allow}\cos\beta = F_{Ro} + F_{Lo} + F_{LT} - P_A + P_P$

$1560\ lb/ft \cos(18.4) = 1480\ lb/ft$

$220\ lb/ft + 151\ lb/ft - 240\ lb/ft + 2160\ lb/ft = 2{,}160\ lb/ft$

$FS = \frac{2{,}160\ lb/ft}{1{,}480\ lb/ft} = 1.45$ ok

APPENDIX C

Leachate Calculations

2005 LEACHATE VOLUMES
MACON COUNTY PHASE 2 (14 ACRES)

MONTH	TOTAL GALLONS
JANUARY	350,110
FEBRUARY	329,080
MARCH	423,546
APRIL	321,042
MAY	503,177
JUNE	439,781
JULY	862,974
AUGUST	500,447
SEPTEMBER	651,429
OCTOBER	465,290
NOVEMBER	416,238
DECEMBER	563,253

YEAR TOTAL **5,826,367**

AVERAGE LEACHATE PRODUCTION (GAL/MONTH/ACRE) **34,681**

AVERAGE LEACHATE PRODUCTION (GAL/MIN/ACRE) **0.79**

PHASE 3 CELL 1 (7.6 ACRES)	HISTORICAL DATA	HELP MODEL
LEACHATE PRODUCTION (GAL/MONTH)	263,574	399,656
LEACHATE PRODUCTION (GAL/MIN)	6.02	9.12

CONDITION 1 - PHASE 3 CELL 1 SINGLE PUMP

AVERAGE LEACHATE PRODUCTION PER DAY (GAL)	13,140
PUMP OPERATING POINT (GPM)	47
PUMP RUN TIME PER DAY (HOURS)	4.659574

CONDITION 2 - PHASE 3 CELL 1 SINGLE PUMP RUNNING SIMULTANEOUSLY WITH PHASE 2 CELL 1 PUMPS

AVERAGE LEACHATE PRODUCTION PER DAY (GAL)	13,140
PUMP OPERATING POINT (GPM)	41
PUMP RUN TIME PER DAY (HOURS)	5.34

SUMP SUMMARY

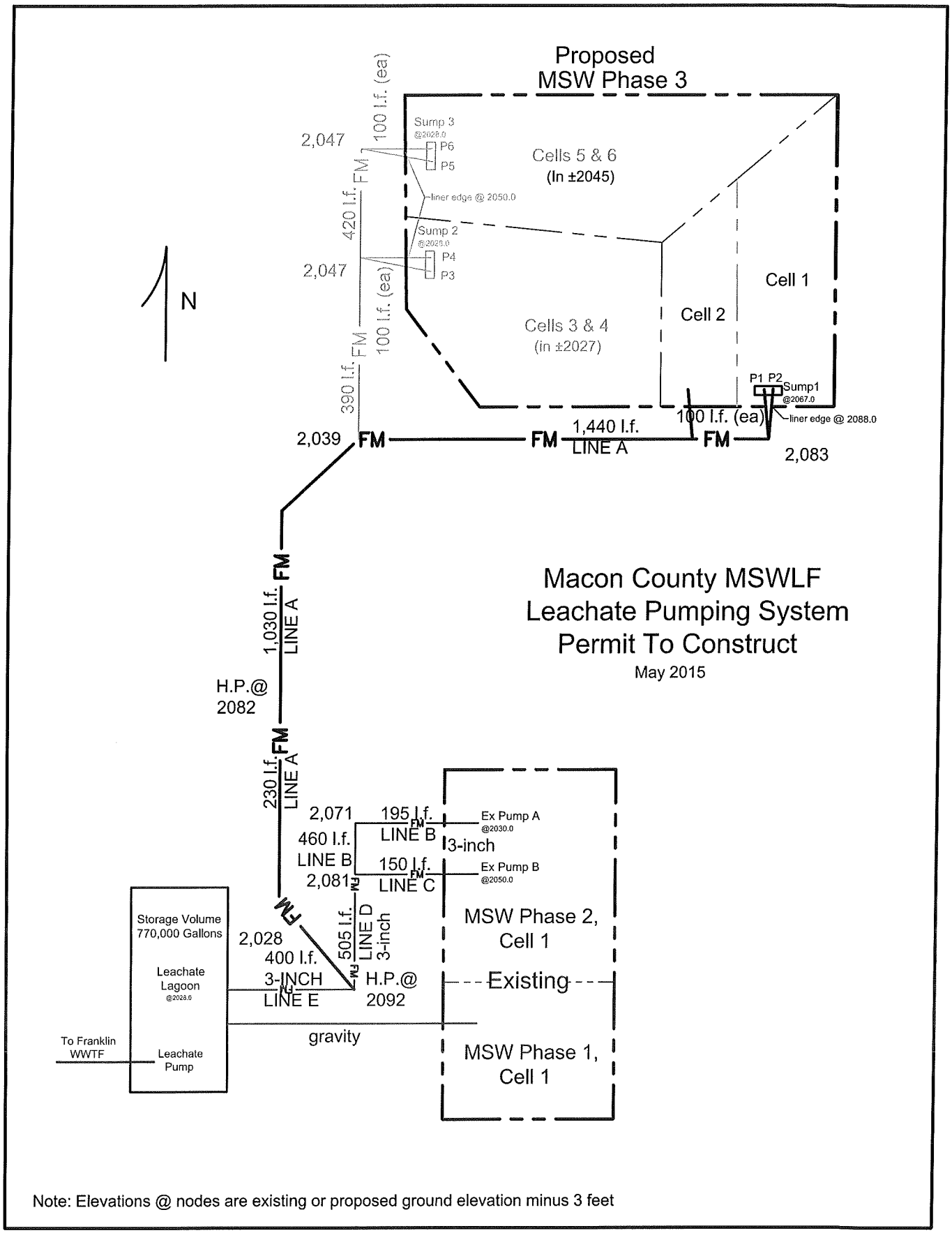
STONE POROSITY (VOL/VOL)	0.4
SUMP EXCAVATED VOLUME (GAL)	244,319
SUMP ACTUAL VOLUME	97,728
DAYS OF LEACHATE STORAGE	7.44
TIME TO DRAIN SUMP - CONDITION 1 (DAYS)	1.44
TIME TO DRAIN SUMP - CONDITION 2 (DAYS)	1.66

CONTINGENCY PLAN SUMMARY

STONE/WASTE POROSITY (VOL/VOL)	0.4
EXCAVATED VOLUME BELOW PERM. LINER EDGE (GAL)	2,473,262
ACTUAL VOLUME BELOW PERM. LINER EDGE (GAL)	989,305
PEAK DAILY VOLUME FROM HELP MODEL	510,884
TIME TO DRAIN PEAK DAILY VOLUME - CONDITION 1 (DAYS)	7.55
STORAGE CAPACITY WITH AVERAGE FLOW (MONTHS)	2.48

LEACHATE LAGOON SUMMARY

LAGOON VOLUME (GAL)	770,000
AVERAGE GALLONS PER DAY - PHASE 2 CELL 1, 2014 DATA	4,727
AVERAGE GALLONS PER DAY - PHASE 3 CELL 1	13,140
STORAGE CAPACITY (DAYS)	43.10



Note: Elevations @ nodes are existing or proposed ground elevation minus 3 feet

Single Forcemain Cell 1			
L, Force Main Length (ft)	4165	Pump Off Elev. (ft)	2068
D, Force Main Diameter (in)	3	High Point Elev. (ft)	2092
Design ADF, Average Daily Flow (gpm)	9	PF, Peaking Factor	5
Q, Peak Flow (gpm)	45.00	C, Friction Coefficient	120

Note: Hazen Williams Friction Coefficient Maximum per NC Design Criteria, DIP (Initial Service 125, End of Service 100), PVC (Initial Service 140, End of Service 120), HDPE (Initial Service 140, End of Service 120). For Force Mains with multiple pipe materials use a weighted average friction coefficient.

TDH = Head static + Head friction + Head minor

The friction loss in the force main can be represented as:

$$\text{Head friction} = 10.57\ Q^{1.85}\ L\ /\ (C^{1.85}\ D^{4.87})$$

Friction Headloss (ft)	10.57 * Q (45.00gpm)^1.85 * L (4165 ft) / (C (120)^1.85 * D (3 inches)^4.87)	**34.05**
Static Head (ft)	High Point Elev. (2092 ft) - Pump Off Elev. (2068 ft)	**24**

The minor losses due to valves and fittings can be represented as:

$$\text{Head L} = K\ V^2/2g$$

The following valves and fittings, and associated K values, are included in the flow path of the piping system with one pump running:

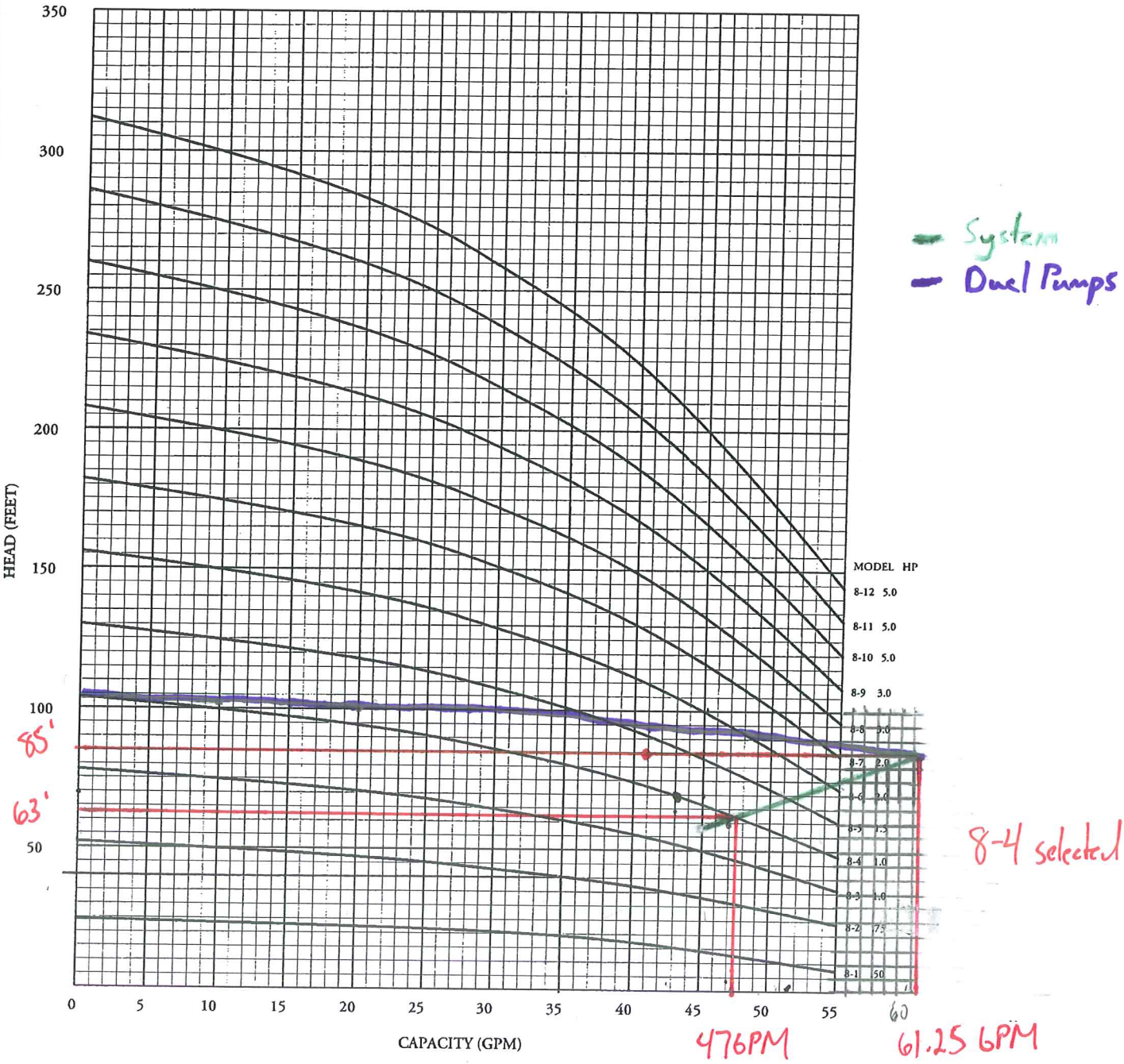
Minor Losses			
	Quantity	K value	K * Quantity
90 degree bends	3	0.8	2.4
45 degree bends	5	0.4	2
Gate valves	0	0.2	0
Plug valves	0	0.2	0
Check Valves	1	2.5	2.5
Tee (flow through run)	0	0.6	0
Tee (flow through branch)	2	1.8	3.6
Exit	1	1	1
		Total K	**11.5**

Flow Velocity through Force Main (fps)	Q (45.0gpm) / Area of 3 inch Force Main	**2.04**
Total Minor Headloss: (ft)	Total K (11.5) * V (2.04)^2 / 2 g	**0.75**
Total Dynamic Head: (ft)	Friction Head (34.0 ft)+Static Head(24 ft)+ Minor Headloss (0.7ft)	**58.79**
Pump Operating Point:	**45 gpm @ 58.79 ft TDH**	
Estimated Horse Power:		1.5

SERIES 8 SurePump™

Flow Range 20-50 GPM

60 Hz



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McGill ASSOCIATES
ENGINEERING • PLANNING • FINANCE
McGill Associates, P.A. P.O. Box 2259, Asheville, NC 28802
55 Broad Street, Asheville, NC 28801 828-252-0575 Fax 828-252-2518

PROJECT: Macon County MSWLF Phase 3 Cell 1
PROJECT NO.: B.00726
DESCRIPTION: Leachate Pumping System
CALCULATED BY: SB CHECKED BY:
DATE: 5/20/15 SHEET NO. OF

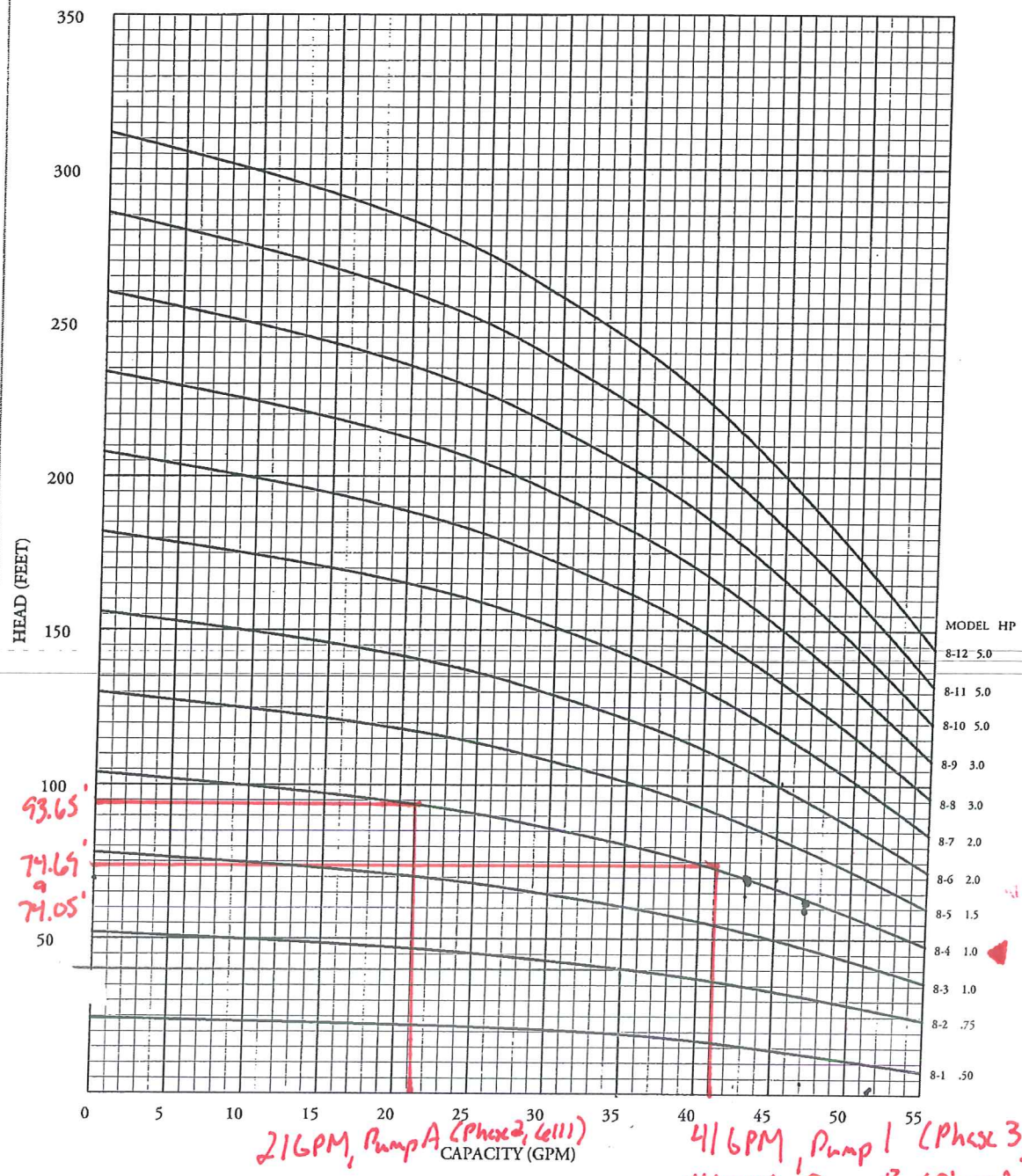
Check for Pumping Flows with Pumps Running Simultaneously at Phase 3 Cell 1 and Phase 2 Cell 1

Pump 1	Existing Pump A	Existing Pump B
1.) Assume 29 GPM	Assume 17 GPM	Assume 43 GPM
Line A - 37.6'	Line A - 0'	Line A - 0'
Line B - 0'	Line B - 52'	Line B - 0'
Line C - 0'	Line C - 0'	Line C - 32.81'
Line D - 0'	Line D - 19.6'	Line D - 19.6'
Line E - 14.47'	Line E - 14.47'	Line E - 14.47'
Total 52.07'	Total 86.07'	Total 66.88'
53 GPM From Pump Curve	29 GPM From Pump Curve	45 GPM from Pump Curve
2.) Assume 41 GPM	Assume 23 GPM	Assume 44 GPM
Line A - 50.53'	Line A - 0'	Line A - 0'
Line B - 0'	Line B - 52.77'	Line B - 0'
Line C - 0'	Line C - 0'	Line C - 32.89'
Line D - 0'	Line D - 21.27'	Line D - 21.27'
Line E - 20.81'	Line E - 20.81'	Line E - 20.81'
Total 71.34'	Total 94.85	Total 74.97
42 GPM From Pump Curve	19 GPM From Pump Curve	40 GPM From Pump Curve
3.) Assume 42 GPM	Assume 21 GPM	Assume 44 GPM
Line A - 54.24'	Line A - 0'	Line A - 0'
Line B - 0'	Line B - 52.49'	Line B - 0'
Line C - 0'	Line C - 0	Line C - 32.89'
Line D - 0'	Line D - 20.71	Line D - 20.71'
Line E - 20.45'	Line E - 20.45	Line E - 20.45'
Total 74.69'	Total 93.65'	Total 74.05
41 GPM From Pump Curve	21 GPM From Pump Curve	41 GPM From Pump Curve

SERIES 8 SurePump™

Flow Range 20-50 GPM

60 Hz



DATA SUBJECT TO CHANGE WITHOUT NOTICE

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Line Segment A Pump 1			
L, Force Main Length (ft)	3765	Pump Off Elev. (ft)	2068
D, Force Main Diameter (in)	3	High Point Elev. (ft)	2092
Design ADF, Average Daily Flow (gpm)	9	PF, Peaking Factor	5
Q, Peak Flow (gpm)	44.00	C, Friction Coefficient	120

Note: Hazen Williams Friction Coefficient Maximum per NC Design Criteria, DIP (Initial Service 125, End of Service 100), PVC (Initial Service 140, End of Service 120), HDPE (Initial Service 140, End of Service 120). For Force Mains with multiple pipe materials use a weighted average friction coefficient.

TDH = Head static + Head friction + Head minor

The friction loss in the force main can be represented as:

$$\text{Head friction} = 10.57\ Q^{1.85}\ L\ /\ (C^{1.85}\ D^{4.87})$$

Friction Headloss (ft)	10.57 * Q (44.00gpm)^1.85 * L (3765 ft) / (C (120)^1.85 * D (3 inches)^4.87)	**29.52**
Static Head (ft)	High Point Elev. (2092 ft) - Pump Off Elev. (2068 ft)	**24**

The minor losses due to valves and fittings can be represented as:

$$\text{Head L} = K\ V^2/2g$$

The following valves and fittings, and associated K values, are included in the flow path of the piping system with one pump running:

Minor Losses			
	Quantity	K value	K * Quantity
90 degree bends	3	0.8	2.4
45 degree bends	5	0.4	2
Gate valves	0	0.2	0
Plug valves	0	0.2	0
Check Valves	1	2.5	2.5
Tee (flow through run)	0	0.6	0
Tee (flow through branch)	2	1.8	3.6
Exit	1	1	1
	Total K		**11.5**

Flow Velocity through Force Main (fps)	Q (44.0gpm) / Area of 3 inch Force Main	**2.00**
Total Minor Headloss: (ft)	Total K (11.5) * V (2.00)^2 / 2 g	**0.71**
Total Dynamic Head: (ft)	Friction Head (29.5 ft)+Static Head(24 ft)+ Minor Headloss (0.7ft)	**54.24**
Pump Operating Point:	**44 gpm @ 54.24 ft TDH**	
Estimated Horse Power:		1.3

Line Segment B Ex Pump A			
L, Force Main Length (ft)	665	Pump Off Elev. (ft)	2030
D, Force Main Diameter (in)	3	High Point Elev. (ft)	2081
Design ADF, Average Daily Flow (gpm)	9	PF, Peaking Factor	2
Q, Peak Flow (gpm)	21.00	C, Friction Coefficient	120

Note: Hazen Williams Friction Coefficient Maximum per NC Design Criteria, DIP (Initial Service 125, End of Service 100), PVC (Initial Service 140, End of Service 120), HDPE (Initial Service 140, End of Service 120). For Force Mains with multiple pipe materials use a weighted average friction coefficient.

TDH = Head static + Head friction + Head minor

The friction loss in the force main can be represented as:

$$\text{Head friction} = 10.57\ Q^{1.85}\ L\ /\ (C^{1.85}\ D^{4.87})$$

Friction Headloss (ft)	10.57 * Q (21.00gpm)^1.85 * L (665 ft) / (C (120)^1.85 * D (3 inches)^4.87)	**1.33**
Static Head (ft)	High Point Elev. (2081 ft) - Pump Off Elev. (2030 ft)	**51**

The minor losses due to valves and fittings can be represented as:

$$\text{Head L} = K\ V^2/2g$$

The following valves and fittings, and associated K values, are included in the flow path of the piping system with one pump running:

Minor Losses			
	Quantity	K value	K * Quantity
90 degree bends	3	0.8	2.4
45 degree bends	5	0.4	2
Gate valves	0	0.2	0
Plug valves	0	0.2	0
Check Valves	1	2.5	2.5
Tee (flow through run)	0	0.6	0
Tee (flow through branch)	2	1.8	3.6
Exit	1	1	1
		Total K	**11.5**

Flow Velocity through Force Main (fps)	Q (21.0gpm) / Area of 3 inch Force Main	**0.95**
Total Minor Headloss: (ft)	Total K (11.5) * V (.95)^2 / 2 g	**0.16**
Total Dynamic Head: (ft)	Friction Head (1.3 ft)+Static Head(51 ft)+ Minor Headloss (0.2ft)	**52.49**
Pump Operating Point:	**21 gpm @ 52.49 ft TDH**	
Estimated Horse Power:		0.6

Line Segment C Ex Pump B			
L, Force Main Length (ft)	150	Pump Off Elev. (ft)	2050
D, Force Main Diameter (in)	3	High Point Elev. (ft)	2081
Design ADF, Average Daily Flow (gpm)	9	PF, Peaking Factor	5
Q, Peak Flow (gpm)	44.00	C, Friction Coefficient	120

Note: Hazen Williams Friction Coefficient Maximum per NC Design Criteria, DIP (Initial Service 125, End of Service 100), PVC (Initial Service 140, End of Service 120), HDPE (Initial Service 140, End of Service 120). For Force Mains with multiple pipe materials use a weighted average friction coefficient.

TDH = Head static + Head friction + Head minor

The friction loss in the force main can be represented as:

$$\text{Head friction} = 10.57\ Q^{1.85}\ L\ /\ (C^{1.85}\ D^{4.87})$$

Friction Headloss (ft)	10.57 * Q (44.00gpm)^1.85 * L (150 ft) / (C (120)^1.85 * D (3 inches)^4.87)	**1.18**
Static Head (ft)	High Point Elev. (2081 ft) - Pump Off Elev. (2050 ft)	**31**

The minor losses due to valves and fittings can be represented as:

$$\text{Head } L = K\ V^2/2g$$

The following valves and fittings, and associated K values, are included in the flow path of the piping system with one pump running:

Minor Losses			
	Quantity	K value	K * Quantity
90 degree bends	3	0.8	2.4
45 degree bends	5	0.4	2
Gate valves	0	0.2	0
Plug valves	0	0.2	0
Check Valves	1	2.5	2.5
Tee (flow through run)	0	0.6	0
Tee (flow through branch)	2	1.8	3.6
Exit	1	1	1
	Total K		**11.5**

Flow Velocity through Force Main (fps)	Q (44.0gpm) / Area of 3 inch Force Main	**2.00**
Total Minor Headloss: (ft)	Total K (11.5) * V (2.00)^2 / 2 g	**0.71**
Total Dynamic Head: (ft)	Friction Head (1.2 ft)+Static Head(31 ft)+ Minor Headloss (0.7ft)	**32.89**
Pump Operating Point:	**44 gpm @ 32.89 ft TDH**	
Estimated Horse Power:		0.8

Line Segment D Exp Pump A and Ex Pump B			
L, Force Main Length (ft)	505	Pump Off Elev. (ft)	2081
D, Force Main Diameter (in)	3	High Point Elev. (ft)	2092
Design ADF, Average Daily Flow (gpm)	9	PF, Peaking Factor	7
Q, Peak Flow (gpm)	65.00	C, Friction Coefficient	120

Note: Hazen Williams Friction Coefficient Maximum per NC Design Criteria, DIP (Initial Service 125, End of Service 100), PVC (Initial Service 140, End of Service 120), HDPE (Initial Service 140, End of Service 120). For Force Mains with multiple pipe materials use a weighted average friction coefficient.

TDH = Head static + Head friction + Head minor

The friction loss in the force main can be represented as:

$$\text{Head friction} = 10.57\ Q^{1.85}\ L\ /\ (C^{1.85}\ D^{4.87})$$

Friction Headloss (ft)	10.57 * Q (65.00gpm)^1.85 * L (505 ft) / (C (120)^1.85 * D (3 inches)^4.87)	**8.15**
Static Head (ft)	High Point Elev. (2092 ft) - Pump Off Elev. (2081 ft)	**11**

The minor losses due to valves and fittings can be represented as:

$$\text{Head } L = K\ V^2/2g$$

The following valves and fittings, and associated K values, are included in the flow path of the piping system with one pump running:

Minor Losses			
	Quantity	K value	K * Quantity
90 degree bends	3	0.8	2.4
45 degree bends	5	0.4	2
Gate valves	0	0.2	0
Plug valves	0	0.2	0
Check Valves	1	2.5	2.5
Tee (flow through run)	0	0.6	0
Tee (flow through branch)	2	1.8	3.6
Exit	1	1	1
		Total K	**11.5**

Flow Velocity through Force Main (fps)	Q (65.0gpm) / Area of 3 inch Force Main	**2.95**
Total Minor Headloss: (ft)	Total K (11.5) * V (2.95)^2 / 2 g	**1.56**
Total Dynamic Head: (ft)	Friction Head (8.2 ft)+Static Head(11 ft)+ Minor Headloss (1.6ft)	**20.71**
Pump Operating Point:	**65 gpm @ 20.71 ft TDH**	
Estimated Horse Power:		0.8

Line Segment E Pump 1, Ex Pump A, Ex Pump B			
L, Force Main Length (ft)	400	Pump Off Elev. (ft)	2092
D, Force Main Diameter (in)	3	High Point Elev. (ft)	2092
Design ADF, Average Daily Flow (gpm)	9	PF, Peaking Factor	12
Q, Peak Flow (gpm)	107.00	C, Friction Coefficient	120

Note: Hazen Williams Friction Coefficient Maximum per NC Design Criteria, DIP (Initial Service 125, End of Service 100), PVC (Initial Service 140, End of Service 120), HDPE (Initial Service 140, End of Service 120). For Force Mains with multiple pipe materials use a weighted average friction coefficient.

TDH = Head static + Head friction + Head minor

The friction loss in the force main can be represented as:

$$\text{Head friction} = 10.57\ Q^{1.85}\ L\ /\ (C^{1.85}\ D^{4.87})$$

Friction Headloss (ft)	10.57 * Q (107.00gpm)^1.85 * L (400 ft) / (C (120)^1.85 * D (3 inches)^4.87)	**16.23**
Static Head (ft)	High Point Elev. (2092 ft) - Pump Off Elev. (2092 ft)	**0**

The minor losses due to valves and fittings can be represented as:

$$\text{Head L} = K\ V^2/2g$$

The following valves and fittings, and associated K values, are included in the flow path of the piping system with one pump running:

Minor Losses			
	Quantity	K value	K * Quantity
90 degree bends	3	0.8	2.4
45 degree bends	5	0.4	2
Gate valves	0	0.2	0
Plug valves	0	0.2	0
Check Valves	1	2.5	2.5
Tee (flow through run)	0	0.6	0
Tee (flow through branch)	2	1.8	3.6
Exit	1	1	1
	Total K		**11.5**

Flow Velocity through Force Main (fps)	Q (107.0gpm) / Area of 3 inch Force Main	**4.86**
Total Minor Headloss: (ft)	Total K (11.5) * V (4.86)^2 / 2 g	**4.22**
Total Dynamic Head: (ft)	Friction Head (16.2 ft)+Static Head(0 ft)+ Minor Headloss (4.2ft)	**20.45**
Pump Operating Point:	**107 gpm @ 20.45 ft TDH**	
Estimated Horse Power:		1.2

APPENDIX D

Letters to FAA and Macon County Airport

McGill
ASSOCIATES

June 2, 2015

Mr. Neil Hoppe
Macon County Airport Authority
1241 Airport Road
Franklin, NC 28734

RE: Notification of
Phase 3 Cell 1
MSW Landfill Expansion
Macon County MSW Landfill

Dear Mr. Hoppe:

On behalf of Macon County, we are notifying you that the Proposed Macon County Phase 3 Cell 1 MSW Landfill expansion is located approximately 14,000 feet south west of the Macon County Airport. Per rule 15a NCAC 13b.1622 (1) (b) of the North Carolina Solid Waste Management Rules, owners of a new landfill unit must notify all airport runways within a five mile radius of the landfill site. The Macon County Municipal Solid Waste Landfill has been in operation since May 1992; however, this notification pertains to the proposed expansion.

Please call should you have any questions.

Sincerely,

McGILL ASSOCIATES, P.A.

Mark D. Cathey

Mark Cathey, P.E.
Senior Project Manager

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55 Broad Street
Asheville, North Carolina 28801

P.O. Box 2259
Asheville, North Carolina 28802

ph: 828.252.0575
f: 828.252.2518

www.mcgillengineers.com

McGill
ASSOCIATES

June 2, 2015

Mrs. Anna Cohen, Regional Program Manager
Federal Aviation Administration
P.O. Box 20636
Atlanta, Georgia 30320

RE: Notification of
Phase 3 Cell 1
MSW Landfill Expansion
Macon County MSW Landfill

Dear Mrs. Cohen:

On behalf of Macon County, we are notifying you that the Proposed Macon County Phase 3 Cell 1 MSW Landfill expansion is located approximately 14,000 feet south west of the Macon County Airport 1A5 runway. The Macon County MSW Landfill Property Line is located approximately 12,000 feet from the Macon County Airport 1A5 Property Line. Per rule 15a NCAC 13b.1622 (1) (b) of the North Carolina Solid Waste Management Rules, owners of a new landfill unit must notify all airport runways within a five mile radius of the landfill site. A 7460-1 form, Notice of Proposed Construction or Alteration, has been submitted per Title 14 Code of Federal Regulations Part 77 to begin an Obstruction Evaluation/Airport Airspace Analysis (OE/AAA). The corresponding FAA assigned Aeronautical Study Number is 2015-ASO-8479-OE. The Macon County Municipal Solid Waste Landfill has been in operation since May 1992; however, this notification pertains to the proposed expansion. The Macon County Airport 1A5 is owned by the Macon County Airport Authority and managed by Mr. Neil Hoppe. A similar notification has been sent to the airport.

Please call should you have any questions.

Sincerely,

McGILL ASSOCIATES, P.A.

Mark D. Cathey

Mark Cathey, P.E.
Senior Project Manager

X:\2013\13.00726\Letters\RC22May15-FAA Notification.docx

55 Broad Street
Asheville, North Carolina 28801

P.O. Box 2259
Asheville, North Carolina 28802

ph: 828.252.0575
f: 828.252.2518

www.mcgillengineers.com

APPENDIX E

Public Water Supply Search Results

Macon County Alternate Site Analysis. Water Resources Evaluation. 2-mile Radius. Raw Water Intakes; Well Systems.

Site A: MSW Landfill: Macon County: MCPID#'s: 6595371587; 6595260611; 6595273034; 6595272249; 6595483221; 6595482707

PWSID#	PWS Name	System Type	MCPID#	MC Property Owner	Notes
0157108	Riverbend Estates	Community	6596216011; 6596216048	Riverbend Water System INC	System has converted to a purchased water system; wells abandoned.
0157108	Riverbend Estates	Community	6596312733	Riverbend Water System INC	System has converted to a purchased water system; wells abandoned.
0157113	Swiss Colony POA	Community	6586809506	Swiss Colony Property Owners Assoc	
0157004	Windy Gap Baptist Church	Transient, Non-Community	6585576349	Windy Gap Baptist Church	
0157564	Franklin Ford	Transient Non-Community	6596711848	BCH of Franklin LLC	
0157413	Ridgecrest Baptist Church	Transient Non-Community	6596947249	C Raymond Thomas, Life Estate	
0157478	Mi Mountain Campground	Transient Non-Community	7506130279	Gregory D. Hoover	
1057008	The Gardens at Cat Creek Wells #1,#2	Community	7505226603; 7505226495	Cat Creek Properties LLC	System installed for subdivision that was never built, system never activated.
0157121	Holly View Subdivision	Community	7505088829	Hollyview Road and Water Assoc.	
0157475	Watauga Baptist Church	Transient, Non-Community	7506470225	Watauga Baptist Church	
0157527	Happy Valley Campground	Transient, Non-Community	7504068846	Dennis K McDowell	
0157515	Macon County Airport	Transient, Non-Community	6576948822	Macon County Airport Authority	Outside of 10,000-foot Buffer Requirement
0157420	Iotla Elementary School	Non-Transient, Non-Communit	6586361626	Macon County	
0157544	Rose Creek Mine and Campground	Transient, Non-Community	6587500102	Victoria E Velasco	
0157521	Iotla Baptist Church	Transient, Non-Community	6586074932	Iotla Baptist Church of Franklin, INC	

Source Information: Contact with Buddy Melton, NCDENR, PWS Section: Database from portal website - North Carolina Source Water Assessment Program; Google Earth Layer for Spill Response Unit

Section 5: Construction Quality Assurance Plan

SITE SPECIFIC CONSTRUCTION QUALITY ASSURANCE PLAN

MACON COUNTY MSW LANDFILL
PERMIT TO CONSTRUCT
PHASE 3 CELL 1
MACON COUNTY, NORTH CAROLINA

MARK D. CATHEY, P.E.

McGill ASSOCIATES

Engineering • Planning • Finance
Asheville, North Carolina

May 2015

13.00726

SITE SPECIFIC CONSTRUCTION QUALITY ASSURANCE PLAN

Macon County MSW Landfill
Macon County, North Carolina
Phase 3 Cell 1

This Construction Quality Assurance Plan has been prepared as required under Rule .1617 and in accordance with Rule .1621.

1.0 INTRODUCTION

1.1 Project Background

The Macon County MSW Landfill Site is the current MSW landfill for Macon County. The current project involves the construction of a 7.6-acre expansion referred to as Phase 3 Cell 1. Phase 3 Cell 1 will be constructed to provide approximately 5 years of landfill airspace for the County. Phase 3 Cell 2 will be constructed and brought on line as Phase 3 Cell 1 nears operational capacity. Macon County began receiving wastes in 1993 Phase 1 Cell 1. The current active waste area, Phase 2 Cell 2, began operation in 1999. This project is a standalone MSW Cell. The Phase 3 Cell 1 Project will consist of structural fill to achieve the desired gradients followed by a compacted, low-permeability clay liner layer, a low-permeability geocomposite clay liner, a 60-mil high density polyethylene (HDPE) geomembrane liner, and an aggregate drainage layer. The Macon County Landfill site is located in Macon County at 1448 Lakeside Drive (S.R. 1324).

1.2 Project Scope

The purpose of this Site Specific Construction Quality Assurance Plan (SSCQAP) is to provide guidance to McGill Associates and sub-contractor personnel on required documentation activities during the construction of the engineered Phase expansion. This guidance is intended to ensure that construction meets the requirements of Macon County and the Project Construction Quality Assurance (CQA) Plan and project drawings and specifications.

The overall goals of the SSCQAP are to ensure that proper construction techniques and procedures are used to verify that the materials and installation techniques used meet Project CQA Plan and project drawings and specifications. Additionally, the program will identify and define problems that may occur during construction and ensure that these problems are corrected before the construction is complete. At completion of work, the program will culminate in a certification report, which documents that, the clay liner and the geosynthetic liners have been constructed in substantial compliance with this SSCQAP and project drawings and specifications. The primary emphasis of the

SSCQAP is careful documentation during the preparation and placement of the clay and the geosynthetic liner.

1.2.1 Scope of Services

The Scope of Services provided by CQA Consulting Firm for the construction of engineered base is as follows:

1. Pre-Construction materials evaluation (structural fill, clay liner, geosynthetics).
2. Structural Fill observation, testing, documentation, and verification of construction procedures.
3. Clay liner or geosynthetic clay liner (GCL) observation, testing, documentation, and verification of construction procedures.
4. Geosynthetic observation, testing, documentation, and verification of construction procedures.
5. Provide CQA Report and CQA Certification that Phase 3 Cell 1 was constructed in accordance with this SSCQAP.

1.2.2 Construction Schedule

Construction of Phase 3 Cell 1 shall be completed within 270 consecutive calendar days.

Description
Preconstruction Meeting
Structural Fill Subgrade Installation
Primary Clay Liner or Geosysnthetic Clay Liner Installation
Primary Geomembrane Liner Installation
Primary Geotextile Cushion Installation
Installation of Leachate Collection System
Installation of Washed Stone Drainage Layer
Submit CQA Report and CQA Certification

2.0 Parties Involved

2.1 Macon County

Contact: Mr. Chris Stahl, (828) 349-2100
Title: Macon County Solid Waste Director

2.2 McGill Associates, P.A.

Contact: Mark D. Cathey, P.E. (828) 252-0575
Title: Project Engineer

2.3 General Contractor

Contact: Unknown

Title:

2.3.1 Surveyor

Contact: Unknown

Title:

2.3.2 Geosynthetic Manufacturer

Contact: Unknown

Title:

2.3.3 Geosynthetic Installer

Contact: Unknown

2.4 Construction Quality Assurance Consulting Firm

Contact: Unknown
Title:

2.4.1 CQA Certifying Engineer

Name: Unknown

Title:

CQA Resident Engineer

Name: Unknown

Title:

Geosynthetic Testing Laboratory

Contact: Unknown

Title:

2.4.4 Soils Laboratory (permeability testing)

Contact: Unknown

Title:

3.0 Preconstruction Meeting

A Preconstruction meeting will be held prior to the beginning of construction. The following people shall be present: Owner representative, Solid Waste Director, County Engineer, Project Engineer, Design Engineer, Certifying CQA Engineer/CQA Project Manager, Resident CQA Engineer, General Contractor, Geosynthetics Installer, and all other subcontractors.

The following items will be discussed at a minimum:

Any questions about the SSCQAP will be addressed and any modifications that result will be documented. Any modifications to the approved SSCQAP must be approved by the North Carolina Department of Environment, Health, and Natural Resources, Division of Waste Management, Solid Waste Section (NCDENR Solid Waste Section).

- Special permits and state and/or federal regulations.
- Responsibilities, expectations, and roles of each party.
- Lines of authority and proper lines of communication.
- Procedures for documenting and reporting information.
- Distribution and storage of documents and reports.
- Protocol for testing and geosynthetic sample management.

- Protocol for handling construction deficiencies.
- Protocol for repairs and re-testing.
- Conduct site walk through:

  Discuss work plans
  Inspect material handling and storage locations
  Review office facilities (copy machine, mailing, etc.)

- Review detailed time schedule for all operations.
- Review work area security, check-in procedure, and safety protocol.
- Establish procedures for material processing.
- Review site health and safety requirements.

The Preconstruction Meeting will be documented by McGill Associates and a copy of the meeting minutes will be distributed to all parties who attend.

4.0 Definitions

4.1 Construction Quality Assurance

A planned and systematic application of all means and actions designed to provide adequate confidence that items or services meet design and specifications requirements and will perform satisfactorily in service. In the context of the geosynthetic liner system, construction quality assurance refers to means and actions employed by the CQA Resident Engineer, CQA Senior Lead Technician, and the CQA Monitors to ensure conformity of the liner system installation with guidelines set forth in the SSCQAP, construction plans, and construction specifications.

4.2 Construction Quality Control

Those actions which provide a means to measure and regulate the characteristics of an item or services to design, and specifications requirements. In the context of the geosynthetic liner system installation, quality control refers to those actions taken by the Geosynthetic Contractor/Manufacturer to ensure that the product and the workmanship

meets the requirements set forth in the SSCQAP, construction plans, and construction specifications.

4.3 Design Engineer

The individual or firm responsible for the preparation of this SSCQAP, construction drawings, and construction specifications.

4.4 Project Engineer

The individual or firm responsible for the implementation of this SSCQAP, construction drawings, and construction specifications.

4.5 General Contractor

The firm responsible for the complete construction of the soil and geosynthetic components of the landfill as specified in this SSCQAP and as shown on the construction drawings and construction specifications.

4.6 Construction Quality Assurance Consultant

The firm responsible for observing, testing and documenting activities related to construction quality assurance during the installation of the leak detection layer, clay liner, geomembrane liner, and the leachate collection system. The CQA Certifying Engineer is responsible for issuing a summary certification and documentation report bearing his/her Professional Engineering Seal. The CQA Resident Engineer is responsible for the management of on-site CQA personnel and providing the Project Engineer and Owner with a daily report of the construction activities.

5.0 DOCUMENTATION PROCEDURES

5.1 Standard Reporting Procedures

The CQA Technicians shall issue a daily report of construction activities. These reports shall include, as a minimum, the following information:

An identifying sheet number for cross-referencing and documentation control.

Date, project name, location and other identification.

1. Weather conditions.

2. Problems encountered and resolutions.

3. Descriptions and locations of ongoing construction.

4. Equipment and personnel in each work area, including subcontractors.

5. Descriptions and specific locations of areas or units of work being tested and/or observed and documented (identified by coordinates or seam/panel numbers).

6. Locations where samples were taken.

7. A summary of test results, failures, and re-tests.

5.2 Monitors of geosynthetic installation shall perform and/or provide the following information and services:

a. Material delivery (time, date, and physical condition of material)
b. Unloading and on-site storage and transport
c. Sampling for conformance testing
d. Deployment operations (roll #, panel #, approved QA\QC cert, thickness, overlap, defects, etc.)
e. Seam preparation (proper overlap and cleanliness)
f. Seaming operations (seaming method, seam#, welding technician, welding apparatus #, welder settings, ambient temperature, chronological order of seams welded, seam length, etc.)
g. Conditions of panel before and after placement
h. Locate and document all defects in the geosynthetic material.
i. Repairs (location, method, technician, date, etc.)
j. Trial seams (monitor preparation and testing)
k. Nondestructive testing (visual observation and documentation)
l. Sampling for destructive seam testing (locating test location)
m. Final walkovers (confirm defect repairs)

5.3 Applicable Forms

As a minimum, the CQA monitors will utilize the following forms for the project:

1. Daily Field Report
2. Weekly Progress Report
3. Nuclear Density Testing
4. Drive Cylinder Test Report
5. Soil Testing Tracking Log
6. Certificate of Acceptance of Soil Subgrade

7. Geosynthetic Materials Inventory Checklist
8. Weather Log
9. Trial Weld Form
10. Panel Deployment
11. Panel Seaming
12. Nondestructive Seam Testing
13. Destructive Sample Test Log
14. Geosynthetic Defect Log
15. Geosynthetic Repair Log
16. Construction Site Safety Form
17. Construction Photo Log
18. Certificate of Completion

5.4 Problem/Deficiency Identification and Corrective Action Report

The CQA Monitor is required to inform the General Contractor and/or the Geosynthetic Contractor, or their representatives, in a timely manner, of any difference between the interpretation of the SSCQAP, the construction plans and construction specifications by the contractor versus the CQA Monitor's interpretation. In addition, any actual or suspect work deficiencies shall be brought to the Project Engineer's and Owner's attention.

A special meeting shall be held when and if a problem or deficiency is present. At a minimum, the meeting shall be attended by the General Contractor, the Owner, the Project Engineer, the CQA Resident Engineer, and the CQA Monitor. If the problem involves a possible design modification, the Design Engineer shall be notified. The purpose of the meeting is to define and resolve the problem or work deficiency as follows:

1. Define and discuss the problem or deficiency
2. Review alternative solutions
3. Implement an action plan to resolve the problem or deficiency

The CQA Resident Engineer or his representative will document all proceedings.

Any changes and/or modifications to the SSCQAP must be approved by the Owner, Design Engineer, Project Engineer, CQA Certifying Engineer, and the NCDENR Solid Waste Section.

5.5 Plan Modifications

Design and/or specification changes shall be made only with written approval of the Owner, the Design Engineer and the Project Engineer. Substantial design changes shall also require approval from the NCDENR Solid Waste Section.

5.6 Scope Change

The CQA Resident Engineer shall notify the Project Engineer whenever additional engineering services are requested by Owner that exceed the original scope of services.

5.7 Photographic Documentation

Photographs taken to document observations, problems, and/or deficiencies, or work in progress will include identification of the date, location, direction of view, and time period. Photographs will be filed in chronological order in a permanent protective file by the CQA team. One set of prints shall be turned over to both the Owner and Project Engineer at the conclusion of the project.

The permanent file will also contain a comprehensive index of each photo, which the CQA Monitor is responsible for preparing and maintaining. This index will include the following information:

1. Date of photograph
2. Provide a location and scale where photographed, including information regarding the orientation of the photograph itself for proper viewing
3. Subject description
4. Photo file number

The following is a list of minimum photographs to be taken during cell construction:

1. Subgrade/subbase proof rolling
2. Geosynthetic conformance sampling
3. Geomembrane deployment
4. Fusion welding devices
5. Extrusion welding devices
6. Air testing
7. Vacuum box testing
8. Seaming
9. Destructive sample location and removal
10. Trial welds
11. Tensiometer testing

12. Geotextile deployment
13. On-site lab soil testing
14. Drainage Layer Construction
15. Progress photographs
16. Design modifications
17. Construction deficiencies
18. Completed construction

5.8 Final Construction Documentation Report

During placement of the drainage layer and stormwater control liner, the CQA Resident Engineer shall prepare a final certification-documentation report covering the installation and testing of the clay and geosynthetic lining system. This report shall certify that the clay or GCL system and geosynthetic liner system has been constructed in substantial accordance with this SSCQAP, the construction drawings, and the construction specifications. A Draft Copy of this report shall be issued to the Project Engineer following completion of the lining system. The final report shall be issued to the Project Engineer following completion of the drainage layer. For this project, two (2) copies of the draft version, five (5) copies of the final version of the report, and a digital copy of the final version of the report, complete with all attachments shall be issued.

5.9 Format of CQA Report

As a minimum, the certification report will contain the following items for discussion in the narrative portion of the report. The proposed table of contents is:

5.9.1 Table of Contents

<u>Section</u>

1.0 Summary of Information

1.1 Narrative
1.2 Reference Information

2.0 Soil Preconstruction Data (embankment and clay liner)

2.1 Proctors
2.2 Soil Density/Moisture
2.3 Soil Classification

3.0 Subgrade Field Data

3.01 Moisture Content

3.02 Field Density Testing

3.1 Clay Liner or GCL Field Data

3.21 Moisture Content
3.22 Field Density Testing
3.23 Permeability Testing

4.0 Soil Laboratory Data

4.1 Construction Proctors
4.2 Soil Classification
4.3 Permeability

5.0 Geosynthetic Quality Control

5.1 Manufacturer's Q.C.
5.2 Installer Resumes
5.3 Material Conformance Testing

6.0 Geosynthetic Liner Field Data

6.1 Weather Log
6.2 Trial Welds
6.3 Panel Placement
6.4 Panel Seaming
6.5 Non-Destruct Test
6.6 Destruct Test
6.7 Repair Log
6.8 Installed Quantities
6.9 Defect Location Map

7.0 Protective/Drainage Layer Data

7.1 Preconstruction testing

7.2 Field and laboratory testing

7.2.1 Sieve analysis
7.2.2 Permeability testing

8.0 Project Meeting Minutes

9.0 Construction Photographs

10.0 Pertinent Information

5.9.2 List of Drawings

As a minimum, the certification will include in an appendix the following proposed list of drawings:

- Geomembrane Panel Layout
- Defect Location Map
- Map giving elevation of subgrade, clay or GCL liner, and drainage layer at a maximum frequency of every fifty (50) feet and a maximum frequency of every fifty (50) feet along grade breaks.

5.10 Site Surveying Requirements

The CQA Resident Engineer shall coordinate all survey activities with the surveyor, provided by the Contractor. Survey services will be required for initial site layout, final grade verification, and primary geomembrane as-built survey. All grade surveying shall be conducted on a maximum 50-foot grid and a maximum 50-foot frequency along grade breaks. The certification surveys will be as directed by the CQA Resident Engineer and shall include the following items:

- Panel placement and seaming locations
- Location of destructive testing samples
- Location of all significant repairs
- Topographic survey of base grades
- Topographic survey of top of clay or GCL liner
- Topographic survey of top of drainage layer

6.0 LANDFILL CONSTRUCTION-EARTHWORK

6.1 Subgrade/ Structural Fill Preparation

6.1.1 Subgrade

Subgrade preparation shall be performed by the General Contractor and in accordance with the construction drawings and construction specifications.

The General Contractor shall be responsible for preparing the subgrade prior to placement of the base liner system and is responsible for constructing the subgrade in accordance with the technical specifications.

Before beginning placement of the Compacted Clay Liner:

1. The Resident CQA Engineer shall document that a licensed land surveyor has verified that all grades and elevations are consistent with the NCDENR Solid Waste Section approved engineering plans.

2. The Resident CQA Engineer shall document that he/she has visually inspected the subgrade surface to evaluate its suitability and that the subgrade meets the criteria specified in the project specifications.

3. The prepared subgrade shall be proof-rolled using a smooth-drum roller (minimum 20 tons) making a minimum of two (2) passes in each direction or other procedures and equipment approved by the Project Engineer.

4. The Resident CQA Engineer shall document that the subgrade has been tested for conformance to the construction specifications at the following minimum frequencies:

Construction Testing SUBGRADE TESTING FREQUENCIES		
TEST	ASTM METHOD	QUANTITY
Field Density	D6938, D1556, D2937	1/5,000 YD^3
Field Moisture	D2216, D6938, D4643	1/5,000 YD^3

6.1.2 Structural Fill

Structural fill shall be the soil placed to achieve the design subgrade contours. The subgrade will be tested for field density and field moisture content at a minimum frequency of one (1) test per 5,000 cubic yards placed. Testing will also consist of visual observation and documentation of proof-rolling with a smooth-drum roller (minimum 20 tons) with at least two (2) passes in each direction or by other procedures and equipment approved by the Project Engineer. If a nuclear gauge is used as the primary means of construction testing, the instrument shall be calibrated properly and test data shall be verified using alternate test methods such as drive cylinders. An alternate test method shall be used at least once for every hundred tests performed with the nuclear gauge. The alternate test method should be performed in the same area as an instrument reading in order to allow accurate comparison of the data resulting from the two tests.

Preconstruction Qualification Structural Fill

Test	ASTM Method	Quantity
Natural Moisture Content	D2216	1/5,000 YD^3
Laboratory Compaction	D698	1/5,000 YD^3

Construction Testing STRUCTURAL FILL TESTING FREQUENCIES		
TEST	ASTM METHOD	QUANTITY
Field Density	D6938, D1556, D2937	1/5,000 YD^3
Field Moisture	D2216, D6938, D4643	1/5,000 YD^3

6.2 Select Backfill Placement and Testing

Select backfill will be utilized on a limited basis in berms near the liner edge and at anchor trenches. This material will have the same preconstruction and testing requirements as the subgrade, with the exception that the preconstruction and construction testing will have to be performed to show conformance with the Maximum Particle Size requirements. The testing requirements are as follows:

Preconstruction Qualification		
Test	**ASTM Method**	**Quantity**
Natural Moisture Content	D2216	1/5,000 YD^3
Laboratory Compaction	D698	1/5,000 YD^3
Grain Size Analysis	D422	1/5,000 YD^3
*** Preconstruction test samples shall be taken from the borrow source and or clay stockpiled prior to construction.**		
Construction Testing		
Test	**ASTM Method**	**Quantity**
Field Density	D6938, D1556, D2937	1/5,000 YD^3
Field Moisture	D2216, D6938, D4643	1/5,000 YD^3

Grain Size Analysis	D422	1/5,000 YD^3

6.3 Compacted Clay Liner Material

The Compacted Clay Liner shall consist of low-permeability soils placed on the prepared subgrade.

Table 1 - QA Testing Frequencies and Criteria for Compacted Clay Liner Layer

Preconstruction Qualification		
Test	**ASTM Method**	**Quantity**
Natural Moisture Content	D2216	1/1,000 YD^3 or Change in Material
Grain Size Analysis	D422 or D1140	1/5,000 YD^3 or Change in Material
Classification	D2487	1/5,000 YD^3 or Change in Material
Atterberg Limits	D4318	1/5,000 YD^3 or Change in Material
Laboratory Compaction	D698 - Standard	1/5,000 YD^3 or Change in Material
Permeability **	D5084	1/10,000 YD^3 or Change in Material Three per Moisture-Density Curve

*** Preconstruction test samples shall be taken from the borrow source and or clay stockpiled prior to construction.**

****** The Moisture-Density Curve shall show the region in which the required maximum permeability is met. A minimum of three (3) permeability tests (ASTM D5084) shall be performed per curve to establish the zone of acceptable moistures and densities at which the required maximum permeability may be achieved. If the Contractor elects to run multiple curves to enlarge the zone of acceptance, all curves must be submitted.

Construction Testing		
Test	**ASTM Method**	**Quantity**
Field Density	D6938, D1556, D2937	1/10,000 FT^2/Lift
Field Moisture	D2216, D6938, D4643	1/10,000 FT^2/Lift
Classification	D2487	1 per acre per lift
Permeability	Extracted per D1587 Tested Per D5084	1/40,000 FT^2/Lift
Atterberg Limits	D4318	1/5,000 YD^3
Grain Size	D422 or D1140	1/5,000 YD^3
Maximum particle Size		3- inch diameter (lower 18 inches) 1/4-inch diameter (top 6 inches)
Soil Layer Thickness	Observation, Field Measurement	Continuous Observation, Minimum of Five (5) per Lift

If a nuclear gauge is used as the primary method for construction testing of the clay liner, the test data shall be verified by alternate test methods at least once for every 10 tests performed.

Any modifications made to these testing frequencies will require prior approval from the NCDENR Solid Waste Section.

Clay liner material generally consists of cohesive soils with low hydraulic conductivity used as barriers in lining systems. Soils used in clay liners shall consist of clean, select material free of debris, excessive coarse particles or other deleterious matter. Soils with a visibly identifiable organic content, or soils classified according to the Unified Soil Classification System as organic silt or organic clay (OL, OH) shall not be used.

Any tests resulting in the penetration of the compacted clay liner shall be repaired by backfilling the test area with a hand-tamped 50/50 bentonite/clay mixture.

6.4 Clay Liners

Prior to the construction of a clay liner, soil evaluation tests shall be performed to confirm the adequacy of clay liner materials procured from each on-site or off-site source area. All tests shall be performed in a geotechnical laboratory. The General Contractor shall submit the results of source evaluation tests to the Project Engineer. Previous testing and evaluations of the soil sources may also be used to evaluate the soil material. The material shall be accepted or rejected by the Project Engineer according to these results. The acceptance and rejection criteria for the clay liner material will be verified by the construction of a test pad in accordance with the construction specifications

6.4.1 Quality Assurance Testing

Permeability tests shall be performed at a confining pressure of 25 psi +/- 1 psi and with a gradient in accordance with ASTM method D5084. Samples taken from each location shall be compared to the approved moisture-density-permeability relation. Test frequencies for construction testing are given in Table 1 of Section 6.3. The Resident CQA Engineer shall certify that the clay liner was constructed using the same methods and acceptance criteria consistent with test pad construction and tested according to the NCDENR Solid Waste Section approved plans.

6.4.2 Test Pad Construction

The test pad shall be constructed in accordance with the technical specifications. The results of the test pad testing shall be in accordance with Table 1 in Section 6.3 and the previously approved moisture-density-permeability relationship established from preconstruction testing. Field moisture and density tests and laboratory permeability tests will be performed by the Resident CQA Engineer for each lift placed on the test

pads to verify the construction method, equipment, and material to achieve the maximum required permeability for the clay liner. If the contractor chooses to construct the test pads within the cell, all lifts of the test pads must pass to enable them to remain as part of the clay liner. The Contractor shall allow sufficient time for construction and testing of the test pad prior to placement of the Compacted Clay Liner.

6.4.3 Clay Liner Placement

The clay liner shall be placed in accordance with Section 02300 of the technical specifications.

6.4.4 Clay liner Acceptance

The Resident CQA Engineer must approve the condition of the clay liner prior to the geosynthetic installer deploying the geomembrane.

The soil components of the lining system will be approved by the Resident CQA Engineer when:

1. The installation of the soil components is finished.

2. Verification of the adequacy of the constructed components, including repairs, if any, is completed in accordance with this SSCQAP and the technical specifications.

All documentation of installation is completed.

The depth and grade of the clay liner has been verified by a licensed surveyor and has been approved by the project engineer.

3. The appropriate frequency of permeability tests have been performed and the results have been approved by the Certifying CQA Engineer.

4. The Soil QA Monitors shall certify that installation of the soil components has proceeded in accordance with this SSCQAP and the Technical Specifications.

6.5 Granular Drainage and Protective Layer

The Granular Drainage and Protective Layer will be the twenty-four (24) inch layer of material placed directly over the liner system to provide protection for the liner system as well as a drainage conduit for leachate drainage. The testing requirements are as follows:

Testing Frequencies and Criteria for Granular Drainage and Protective Layer

Preconstruction Qualification		
Test	**ASTM Method**	**Quantity**
Moisture Content	D2216	1 per source***
Grain Size	D422 or D1140	1 per source***
Classification	D2487	1 per source
Calcium Carbonate	D4373	1 per source
Permeability	D2434	1 per source
***In addition to quarry certificate		
Construction Testing		
Test	**ASTM Method**	**Quantity**
Grain Size	D422	1/1,500 YD^3
Permeability	D2434	1/6,000 YD^3

6.6.2 Placement

Placement of the granular drainage layer shall be performed by a low ground pressure dozer and/or off-road dump truck not in direct contact with the geomembrane. A minimum depth of 2 feet of drainage layer material must be maintained at all times during placement activities when vehicles other than the low ground pressure dozer are needed. High traffic areas, such as access roads constructed to transport material into the landfill, should have a minimum depth of three (3) feet.

The drainage layer shall be placed in the coolest part of the day when possible in order to reduce the potential for wrinkles forming in the geomembrane. See Sections 1.4.2 and 1.1.5 of Appendix B for information on evaluating and repairing wrinkles in the geomembrane.

The Resident CQA Engineer will observe placement activities. The General Contractor is to provide laborers ahead of drainage material placement to assist in minimizing

wrinkle formation of the geomembrane. Temperature variations may impact the Contractor's ability to place this material.

6.6.3 Depth Verification

CQA Monitor(s) will randomly verify granular drainage layer depth utilizing test pits or survey means. A Surveyor licensed in the State of North Carolina will survey the top of the drainage layer to certify proper depth was achieved. The General Contractor may use depth markers (i.e., painted tubes, flags, traffic cones, etc.) during placement to provide depth control and minimize possible damage to geomembrane. Depth markers shall be removed as the drainage layer is completed. Depth markers shall not be constructed of a material that could potentially puncture the geomembrane and shall be approved by the Project Engineer.

7.0 LANDFILL CONSTRUCTION-GEOMEMBRANE

7.1 Geomembrane Liner

The geosynthetic components of the lining system will be approved by the Resident CQA Engineer when:

The installation of the geosynthetic components has been completed in accordance with this SSCQAP and the Technical Specifications.

Verification of the adequacy of all seams including associated testing and repairs, if any, is completed in accordance with this SSCQAP and the Technical Specifications.

1. All documentation of installation is completed.

2. The Geosynthetic CQA Monitor(s) are able to recommend acceptance.

7.2 Geomembrane Quality Control

The Geosynthetic Contractor/Manufacturer will provide geosynthetic quality control in accordance with Appendix A.

7.3 Geomembrane Quality Assurance

7.3.1 Conformance Sampling

Conformance testing will be done on-site as material arrives and is inventoried. Conformance sampling procedures will be in accordance with Appendix A.

7.4 Geomembrane Seaming

Field seaming will be done in accordance with Appendix B.

7.4.1. Double Tracked Fusion Welding

All seaming performed shall utilize the double-tracked fusion process when possible. Detailing and repairs do not require double tracked fusion welding.

7.4.2 Extrusion Welding

Extrusion welding shall only be used when double-tracked fusion welding is not possible. The extrusion process will be utilized for repair or detail work, attaching temporary rain flaps, capping a failed seam, or completion of other appurtenances that cannot be performed with fusion welding.

7.5 Geomembrane/Seam Repairs

All repairs to the geomembrane or seams shall be done utilizing the extrusion welding process. All repair work shall be conducted in accordance with Appendix B.

7.6 Geotextile Quality Control

The Geosynthetic Contractor/Manufacturer shall provide quality control information in accordance with Appendix C.

7.7 Geotextile Quality Assurance

Conformance sampling will be performed on-site as material arrives and is inventoried. All conformance sampling will be in accordance with Appendix C.

8.0 LEACHATE COLLECTION PIPING

8.1 Definition and Applicability

Leachate Collection Piping pertains to the High Density Polyethylene Pipe (HDPE) pipe utilized in the collection and transmission of leachate and/or other contaminated liquids generated as a byproduct of the disposal of MSW.

8.2 Quality Control Documentation

Prior to the shipment of any HDPE pipe, the Manufacturer shall provide the Resident CQA Engineer with the following information:

1. A specification for the HDPE pipe that includes all properties contained in the Project Technical Specifications measured using the appropriate test methods.

2. At a minimum, results shall be given for the following:

Property	Test Method	Frequency
Relative Density	ASTM D1505	Per Shipment
Melt Index	ASTM D1238	Per Shipment
Carbon Black Content	ASTM D3350	Per Shipment
Tensile Strength at Yield	ASTM D638, Type IV	Per Shipment
Elastic Modulus	ASTM D638	Per Shipment

The Manufacturer shall identify all HDPE pipe products with the following:

Manufacturers Name
Product Identification
Size
SDR Rating

The Resident CQA Engineer shall review these documents and shall report any discrepancies with the above requirements to the Project Engineer. The Resident CQA Engineer shall verify that:

Property values submitted by the Manufacturer meet the required Project Technical Specifications.

Measurements of properties by the Manufacturer are properly documented and that the test methods used are acceptable.

HDPE pipe products are appropriately labeled.

Appendix A

1.0 Geomembranes

1.1 Description and Applicability

Geomembranes are low permeability geosynthetic barriers used in lining systems. This Section is applicable to smooth and textured high density polyethylene (HDPE) geomembranes. This Section may need to be modified when using other geomembranes.

1.2 Manufacturing Plant Inspection

The Owner or other appropriate representative may conduct an inspection of the Manufacturer's plant. In addition, the Project Engineer, or his designated representative, may visit the manufacturing plant for a project-specific inspection if deemed necessary. If possible, the project-specific inspection shall be prior to or during the manufacturing of the geomembrane rolls for that particular project. The purpose of the plant inspection is to review the manufacturing process and quality control procedures.

The manufacturing plant inspection shall include:

Verification that properties guaranteed by the manufacturer are met and meet all the project specifications.

Verification that the measurement of properties by the Manufacturer is properly documented and test methods used are acceptable.

Spot inspection of the rolls and verification that they are free of imperfections or any sign of contamination by foreign matter.

Review of handling, storage, and transportation procedures, and verification that these procedures will not damage the geomembrane.

Verification that roll packages have a label indicating the name of the manufacturer, type of geomembrane, thickness, roll number, and roll dimensions.

Verification that extrusion rods and/or beads are produced from the same base resin type as the geomembrane.

A report describing the inspection shall be retained by the Owner and by the Project Engineer for project-specific inspections.

1.3 Quality Control Documentation

Prior to the shipment of any geomembrane, the Manufacturer shall provide the Resident CQA Engineer with the following information:

1. The origin (supplier's name and production plant) and identification (brand name and number) of the resin used to manufacture the geomembrane.

2. Copies of dated quality control certificates issued by the resin supplier.

3. Results of tests conducted by the Manufacturer to verify that the resin used to manufacture the geomembrane meets the project specifications.

4. A statement indicating that the amount of reclaimed polymer added to the resin during manufacturing was done with appropriate cleanliness.

5. A list of the materials that comprise the geomembrane, expressed in the following categories as percent by weight: polyethylene, carbon black, other additives.

6. A specification for the geomembrane that includes all properties contained in the project specifications measured using the appropriate test methods.

7. Written certification that minimum values given in the specification are guaranteed by the Manufacturer.

8. Quality control certificates, signed by a responsible party employed by the Manufacturer. Each quality control certificate shall include roll identification numbers, testing procedures, and results of quality control tests. At a minimum, results shall be given for the following:

Property	Test Method	Frequency
Thickness	ASTM D-5199 (Smooth) ASTM D-5994 (Textured)	Each Roll
Relative Density	ASTM D-1505	Every 5th roll
Tensile Properties	ASTM D6693 Type IV	Every 5th roll
Tear Resistance	ASTM D1004 Die C	Every 5th roll
Puncture Resistance	ASTM D-4833	Every 5th roll
Carbon Black Content	ASTM D-1603	Every 5th Roll
Carbon Black Dispersion	ASTM D-5596	Every 5th Roll

The Manufacturer shall identify all rolls of geomembranes with the following:

Manufacturer's name
Product identification
Thickness
Roll number
Roll dimensions

The Resident CQA Engineer shall review these documents and shall report any discrepancies with the above requirements to the Project Engineer. The Resident CQA Engineer shall verify that:

Property values certified by the Manufacturer meet all of its guaranteed specifications.

Measurements of properties by the Manufacturer are properly documented and that the test methods used are acceptable.

Quality control certificates have been provided at the specified frequency for all rolls, and that each certificate identifies the rolls related to it.

Rolls are appropriately labeled.

Certified minimum properties meet the project specifications.

1.4 Conformance Testing

1.4.1 Sampling Procedures

Upon delivery of the rolls of the geomembrane, the Resident CQA Engineer shall ensure that conformance test samples are obtained for the geomembrane. The geomembrane rolls to be sampled shall be selected by the Resident CQA Engineer. Samples shall be taken across the entire width of the roll judged by the Resident CQA Engineer not to be damaged. Unless otherwise specified, samples shall be 3 ft (1 m) long by the roll width. The Resident CQA Engineer shall mark the machine direction on the samples with an arrow.

A lot shall be defined as a group of consecutively numbered rolls from the same manufacturing line. Alternatively, a lot may be designated by the Certifying CQA Engineer based on a review of all roll information including quality control documentation and manufacturing records.

If the Project Engineer desires, the Resident CQA Engineer can perform the conformance test sampling at the manufacturing plant. This may be advantageous in expediting the installation process for very large projects.

Unless otherwise specified in the project specifications, samples shall be taken at a rate of one per lot and not less than one per 100,000 ft^2 (10,000 m^2) of geomembrane. These samples shall be forwarded to the Resident CQA Engineer for testing.

1.4.2 Conformance Tests

The following conformance tests shall be conducted:

Relative Density (ASTM D-1505)
Carbon black content (ASTM D-1603)
Carbon black dispersion (ASTM D-5596)
Thickness – Smooth (ASTM D-5199)
Thickness - Textured (ASTM D-5994)
Tensile properties (ASTM D-6693, Type IV)

Other conformance tests may be required by the project specifications.

1.4.3 Test Results

All conformance test results shall be reviewed and accepted or rejected by the Certifying CQA Engineer prior to the deployment of the geomembrane. The Certifying CQA Engineer shall examine all results from laboratory conformance testing and shall report any non-conformance to the Project Engineer. The Certifying CQA Engineer shall be responsible for checking that all test results meet or exceed the property values listed in the project specifications.

If a test result is in nonconformance, all material from the lot represented by the failing test shall be considered out-of-specification and rejected. Alternatively, at the option of the Project Engineer, additional conformance test samples may be taken to “bracket” the portion of the lot not meeting the project specification. This procedure is valid only when all rolls in the lot are consecutively produced and numbered from one manufacturing line. To isolate the out-of-specification material, additional samples must be taken from rolls that have roll numbers immediately adjacent to the roll that was sampled and failed. If both additional tests pass, the roll that represents the initial failed test and the roll manufactured immediately after that roll (next large roll number) shall be rejected. If one or both of the additional tests fail, then the entire lot shall be rejected or the procedure repeated with two additional tests that bracket a greater number of rolls within the lot.

1.5 Geomembrane Specifications

1.5.1 Materials

The geomembrane materials used for construction shall be in strict accordance with the technical specifications.

1.5.2 Construction

The geomembrane liner shall be installed as soon as practical after completion and approval of the compacted clay liner or portion thereof. The top of the compacted clay liner will be surveyed to ensure adequate thickness of clay material and proper grades toward the collection sump area have been achieved. The geomembrane is to cover the bottom of the secure cell and the side slopes in accordance with the Contract Drawings.

Areas to receive liner installation should be relatively smooth and even, free of ruts, voids, etc., to the extent required by the Engineer. This shall be accomplished by final dressing of the compacted liner with smooth drum rollers. No vehicles are permitted on final dressed surfaces unless authorized by the Engineer.

An anchor trench (as illustrated on the Contract Drawings) will be required to secure the geomembrane. No loose soil will be allowed to underlie the geomembrane in the anchor trenches. The time schedule for excavation and backfilling of the anchor trenches is to be approved by the Engineer so that desiccation of trench soils does not occur prior to backfilling.

Before the geomembrane installation begins, the Resident CQA Engineer shall verify that:

1) A State of North Carolina licensed Professional Land Surveyor has verified all lines and grades of the compacted clay liner.

2) A qualified and licensed Professional Engineer has verified that the clay liner surface meets the criteria specified in the project specifications.

3) The clay liner surface to be lined has been rolled, compacted, or hand-worked so as to be free of irregularities, protrusions, loose soil, and abrupt changes in grade.

4) The surface of the clay liner does not contain stones, which may be damaging to the geomembrane.

5) There is no area excessively softened by high water content.

6) There is no area where the clay liner surface contains desiccation cracks, which may damage the geomembrane.

7) The clay liner has sufficient thickness and that all permeability tests have not exceeded the specified maximum permeability.

8) The geomembrane to be deployed has an absolute minimum thickness of 60 mils and passing conformance samples at the frequencies specified in Section 1.4.1 of this Appendix B and be documented .

The Installer shall certify in writing that the surface on which the geomembrane will be installed is acceptable. A certificate of acceptance shall be given by the Installer to the Resident CQA Engineer prior to commencement of geomembrane deployment in the area under consideration. The Certifying CQA Engineer shall be given a copy of this certificate by the Resident CQA Engineer.

After the underlying soil has been accepted by the Installer, it is the Installer's responsibility to indicate to the General Contractor any change in the underlying soil condition that may require repair work. The General Contractor will consult with the Resident CQA Engineer regarding the need for repairs. If the Resident CQA Engineer concurs with the Installer, the General Contractor shall ensure that the underlying soil is repaired.

At any time before or during the geomembrane installation, the Resident CQA Engineer shall indicate to the General Contractor any locations which may not be adequately prepared for the geomembrane.

The Resident CQA Engineer shall verify that the **anchor trench** is constructed in accordance with the following:

1) The anchor trench has been constructed according to the project plans and specifications.

2) If the anchor trench is excavated in a clay material susceptible to desiccation, the amount of trench open at any time is minimized. The Resident CQA Engineer shall inform the Contractor and Project Engineer of any signs of significant desiccation associated with the anchor trench construction.

3) Rounded corners are provided in the trench so as to avoid sharp bends in the geomembrane.

4) Excessive amounts of loose soil are not allowed to underlie the geomembrane in the anchor trench.

5) The anchor trench is adequately drained to prevent ponding or softening of the adjacent soils while the trench is open.

6) The anchor trench is backfilled and compacted as outlined in the project specifications.

Care shall be taken when backfilling the trenches to prevent any damage to the geosynthetic components. The Resident CQA Engineer shall observe the backfilling operation and advise the Contractor and Project Engineer of any problems. Any problems shall be documented by the Resident CQA Engineer in his daily report.

Appendix B

1.0 Field Seaming

1.1.1 Seam Layout

Before installation begins, the Installer shall provide the Resident CQA Engineer and the Project Engineer with a panel layout drawing. This drawing shall present all the proposed seams of the lining system at the facility. The Project Engineer and the Resident CQA Engineer shall review the panel layout drawing and verify that it is consistent with the technical specifications and the Division approved plans. No panels may be seamed until written approval of the panel layout drawing has been provided by the Project Engineer. In addition, panels not specifically shown on the panel layout drawing may not be used without the Project Engineer's prior approval.

In general, seams should be oriented parallel to the line of maximum slope, thus, oriented along, not across, the slope. In corners and odd-shaped geometric locations, the number of seams should be minimized. No horizontal seam should be less than 10 ft (3.0m) from the toe or crest of the slope, or areas of potential stress concentrations, unless otherwise authorized by the Project Manager.

A seam numbering system compatible with the panel numbering system shall be used by the Resident CQA Engineer and the CQA monitors.

1.1.2 Accepted Seaming Methods

Approved processes for field seaming are fusion welding and extrusion welding. Proposed alternate processes shall be documented and submitted by the Installer to the Project Engineer for approval. Only apparatuses that have been specifically approved by make and model shall be used. The Contractor shall submit all documentation regarding seaming methods to be used to the Resident CQA Engineer for review.

1.1.2.1 Fusion Process

The CQA monitor shall log ambient temperature, seaming apparatus, and geomembrane surface temperatures at appropriate intervals and report any noncompliances to the Resident CQA Engineer.

The Resident CQA Engineer shall verify that:

The Installer maintains on-site the number of spare operable seaming apparatuses agreed upon at the pre-construction meeting.

Equipment used for seaming is not likely to damage the geomembrane.

The electric generator is placed on a smooth base such that no damage occurs to the geomembrane.

A smooth insulating plate or fabric is placed beneath the hot welding apparatus after usage such that no damage occurs to the geomembrane.

1. A movable protective layer is used as required by the Installer directly below each overlap of geomembrane that is to be seamed to prevent buildup of moisture between the sheets and to prevent debris from collecting around the pressure rollers.

2. In general, the geomembrane panels are aligned to have an overlap of 4 to 6 in (100 mm to 150 mm) for fusion welding. In any event, the final overlap shall be sufficient to allow peel tests to be performed on the seam.

3. No solvent or adhesive is used.

4. The geomembrane is protected from damage in heavy traffic areas.

1.1.2.2 Extrusion Process

The CQA monitor shall log ambient temperature, seaming apparatus, and geomembrane surface temperatures at appropriate intervals and report any noncompliances to the Resident CQA Engineer.

The Resident CQA Engineer shall verify that:

The Installer maintains on-site the number of spare operable seaming apparatuses agreed upon at the pre-construction meeting.

Equipment used for seaming is not likely to damage the geomembrane.

Prior to beginning a seam, the extruder is purged until all heat-degraded extrudate has been removed from the extruder barrel.

Clean and dry welding rods or extrudate pellets are used.

The electric generator is placed on a smooth base such that no damage occurs to the geomembrane.

Grinding is completed no more than one hour prior to seaming.

A smooth insulating plate or fabric is placed beneath the hot welding apparatus after usage such that no damage occurs.

The geomembrane is protected from damage in heavy traffic areas.

Exposed grinding marks adjacent to an extrusion weld shall be minimized. In no instance shall exposed grinding marks extend more than 1/8 in (6 mm) from the finished seamed area.

In general, the geomembrane panels are aligned to have a nominal overlap of 3 in (75 mm) for extrusion welding. In any event, the final overlap shall be sufficient to allow peel tests to be performed on the seam.

No solvent or adhesive is used.

The procedure used to temporarily bond adjacent panels together does not damage the geomembrane; in particular, the temperature of hot air at the nozzle of any temporary welding apparatus is controlled such that the geomembrane is not damaged

1.1.3 Seam Preparation

The CQA monitors shall verify that prior to seaming, the seam area is clean and free of moisture, dust, dirt, debris or foreign material of any kind. If seam overlap grinding is required, the CQA monitors must ensure that the process is completed according to the Manufacturer's instruction within one hour of the seaming operation, and in a way that does not damage the geomembrane. The CQA monitors shall also verify that seams are aligned with the fewest number of wrinkles and "fishmouths".

1.1.4 Test Seams

Trial seams shall be made on fragment pieces of geomembrane liner to verify that conditions are adequate for production seaming. Trial seams shall be performed in accordance with Section 02620 of the technical specifications.

1.1.5 General Seaming Procedures

During general seaming, the CQA monitors shall ensure the following:

Fishmouths or wrinkles at the seam overlaps shall be cut along the ridge of the wrinkle in order to achieve a flat overlap. The cut fishmouths or wrinkles shall be seamed and any portion where the overlap is inadequate shall then be patched with an oval or round patch of the same geomembrane extending a minimum of 6 in (150 mm) beyond the cut in all directions.

If seaming operations are carried out at night, adequate illumination shall be provided.

Seaming shall extend to the outside edge of panels placed in the anchor trench.

All cross seam tees should be extrusion welded to a minimum distance of 4 in (100 mm) on each side of the tee.

No field seaming shall take place without the Master Seamer being present.

A firm substrate may be required to be provided by using a flat board, a conveyor belt, or similar hard surface directly under the seam overlap to achieve proper support.

The Resident CQA Engineer shall verify that the above seaming procedures or any other procedures agreed upon and indicated in the Preconstruction Meeting or construction progress meetings are followed, and shall inform the Project Engineer of any nonconformance.

1.1.6 Seaming Weather Conditions

1.1.6.1 Cold Weather Conditions

To ensure a quality installation, if seaming is conducted when the ambient temperature is below 40°F (5°C), the following conditions shall be met:

Geomembrane surface temperatures shall be determined by the Resident CQA Engineer at intervals of at least once per 100 feet (30 m) of seam length to determine if preheating is required. For extrusion welding, preheating is required if the surface temperature of the geomembrane is below 41°F (5°C).

1. For fusion welding, preheating may be waived by the Project Engineer based on a recommendation from the Resident CQA Engineer, if the Installer demonstrates to their satisfaction that welds of equivalent quality may be obtained without preheating at the expected temperature of installation.

2. If preheating is required, the CQA monitors shall observe all areas of geomembrane that have been preheated by a hot air device prior to seaming, to ensure that they have not been overheated.

3. Care shall be taken to confirm that the surface temperatures are not lowered below the minimum surface temperatures specified for welding due to winds or other adverse conditions. It may be necessary to provide wind protection for the seam area.

4. All preheating devices shall be approved prior to use by the Resident CQA Engineer.

Additional destructive tests shall be taken at an interval between 250 feet and 500 feet 75 to 150 m) of seam length, at the discretion of the Resident CQA Engineer.

Sheet grinding may be performed before preheating, if applicable.

Test seams shall be conducted under the same ambient temperature and preheating conditions as the production seams. Under cold weather conditions, additional trial seams shall be conducted if the ambient temperature drops by more than 10°F from the initial trial seam test conditions. Such new seams shall be constructed upon completion of seams in progress during temperature drop.

1.1.6.2 Warm Weather Conditions

At ambient temperatures above 104°F, no seaming of the geomembrane shall be permitted unless the Installer can demonstrate to the satisfaction of the Resident CQA Engineer that geomembrane seam quality is not compromised. Test seams shall be conducted under the same ambient temperature conditions as the production seams. At the option of the Resident CQA Engineer, additional destructive tests may be required for any suspect areas.

1.2 Nondestructive Seam Testing

1.2.1 Concept

The Installer shall nondestructively test all field seams over their full length using an air pressure test (for double fusion seams only, a vacuum test or other approved method. Air pressure testing and vacuum testing are described elsewhere respectively. The purpose of nondestructive tests is to check the continuity of seams. It does not provide quantity information on seam strength. Nondestructive testing shall be carried out as the seaming work progresses, not at the completion of all field seaming.

For all seams, the CQA monitors shall:

Observe nondestructive testing procedures.

Record location, data, test unit number, name of tester, and outcome of all testing.

Inform the Installer and Resident CQA Engineer of any required repairs.

Any seams that cannot be nondestructively tested shall be cap-stripped. The cap-stripping operations shall be observed by the Resident CQA Engineer and Installer for uniformity and completeness.

1.2.2 Air Pressure Testing

Air pressure testing is applicable to double fusion welding which produces a double seam with an enclosed space.

The Equipment for air pressure testing shall consist of the following:

An air pump (manual or motor driven), equipped with pressure gauge and capable of generating and sustaining a pressure between 25 and 30 psi (160 and 200 kPa) and mounted on a cushion to protect the geomembrane.

A rubber hose with fittings and connections.

A sharp hollow needle, or other pressure feed device, approved by the Resident CQA Engineer.

The following procedures shall be followed:

Seal both ends of the seam to be tested.

Insert needle or other approved pressure feed device into the air channel created by the fusion weld.

Insert a protective cushion between the air pump and the geomembrane.

Pressurize the air channel to a pressure of approximately 30 psi (200 Kpa). Close valve, allow 2 minutes for pressure to stabilize, and sustain pressure for at least 5 minutes. Pressure loss over the 5-minute period should not exceed 3psi.

If loss of pressure exceeds the maximum permissible pressure differential as outlined in the project specifications or does not stabilize, locate fault area and repair in accordance with Section 1.4.3.

Cut opposite end of tested seam area once testing is complete to verify continuity of the air channel. If air does not escape, locate blockage and retest unpressurized area.

Remove needle or other approved pressure feed device and grind and weld or patch the hole in the geomembrane.

1.2.3 Vacuum Testing

Vacuum testing is applicable to extrusion welding.

The equipment shall consist of the following:

A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, a porthole or valve assembly, and a vacuum gauge.

A pump assembly equipped with a pressure controller and pipe connections.

A rubber pressure/vacuum hose with fittings and connections.

A soapy solution. (CQA monitors shall ensure solution makes bubbles when air is passed through.)

A bucket and wide paint brush, or other means of applying the soapy solution.

The following procedures shall be followed:

Wet a strip of geomembrane approximately 12 in X 48 in (0.3 m X 1.2 m) with the soapy solution.

Place the box over the wetted area.

Close the bleed valve and open the vacuum valve.

Ensure that a leak-tight seal is created.

Energize the vacuum pump and reduce the applied pressure to approximately 5 psi (10 in of Hg/35kPa) gauge.

For a minimum of 10 seconds, apply vacuum with the box placed and maintaining a seal, examine the geomembrane through the viewing window for the presence of soap bubbles.

If no bubble appears after 10 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum 3 in (75 mm) overlap, and repeat the process.

All areas where soap bubbles appear shall be marked and repaired in accordance with Section 1.4.3.

1.2.4 Test Failure Procedures

The Installer shall complete any required repairs in accordance with Section 1.4.3. For repairs, the CQA monitor shall:

Observe the repair and testing of the repair.

Mark on the geomembrane that the repair has been made.

Document the repair procedures and test results.

1.3 Destructive Seam Testing

1.3.1 Concept

The purpose of destructive tests is to evaluate seam strength. Destructive seam tests shall be performed at selected locations. Seam strength testing shall be done as the seaming work progresses, not at the completion of all field seaming.

1.3.2 Location and Frequency

The Resident CQA Engineer shall select where seam samples will be cut out for laboratory testing. The frequency and locations shall be established as follows:

A minimum frequency of one test location per 500 feet (150 m) of seam length performed by each welding machine. This frequency is to be determined as an average taken throughout the entire facility.

Test locations shall be determined during seaming at the discretion of the Resident CQA Engineer or the Project Engineer. Special consideration shall be given to locations where the potential for imperfect welding, such as overheating, contamination, and offset welds exists.

1.3.3 Sampling Procedures

Samples shall be cut by the Installer at locations chosen by the Resident CQA Engineer as the seaming progresses so that laboratory test results are available before the geomembrane is covered by another material. The Resident CQA Engineer shall:

Observe sample cutting.

1. Assign a number to each sample, and mark it accordingly.

2. Record sample location on layout drawing.

3. Record reason for taking the sample at this location (e.g., statistical routine, suspicious feature of the geomembrane).

All holes in the geomembrane resulting from destructive seam sampling shall be repaired in accordance with repair procedures described in Section 1.4.3 immediately following receipt of successful test results. The continuity of the new seams in the repaired area shall be tested according to Section 1.2.3. All holes in the geomembrane shall be temporarily patched or repaired in accordance with Section 1.4.3 before the end of each work day in order to protect the clay liner from inclement weather.

1.3.4 Sampling Procedure

Destructive sampling shall be performed in accordance with Section 02620 of the technical specifications.

1.3.5 Field Testing

Destructive field testing shall be performed in accordance with Section 02620 of the technical specifications.

1.3.6 Destructive Test Failure

Destructive test failures shall be handled in accordance with Section 02620 of the technical specifications.

1.4 Defects and Repairs

1.4.1 Identification

All seams and non-seam areas of the geomembrane shall be examined by the CQA monitors for identification of defects, holes, blisters, undispersed raw materials, large wrinkles and any sign of contamination by foreign matter. The geomembrane surface shall be cleaned by the Installer prior to examination if the CQA monitor determines that the amount of dust or mud inhibits examination.

1.4.2 Evaluation

Each suspect location both in seam and non-seam areas shall be nondestructively tested using the methods described in Section 1.2. Each location which fails the nondestructive testing shall be marked by the CQA monitor and repaired by the Installer. Work shall not proceed with any materials that will cover locations that have been repaired until successful nondestructive and/or laboratory tests are obtained.

When seaming of the geomembrane is completed, and prior to placing overlying materials, the Resident CQA Engineer shall indicate to the General Contractor any large wrinkles that should be cut and reseamed by the Installer. The number of wrinkles to be repaired should be kept to an absolute minimum. Therefore, wrinkles should be located during the coldest part of the installation period, while keeping in mind the forecasted

weather to which the undercover geomembrane may be exposed. Wrinkles are considered to be large when the geomembrane can be folded over onto itself which is generally a wrinkle that extends 12 in (0.3 m) from the subgrade. Seams produced while repairing wrinkles shall be nondestructively tested.

When placing overlying material on the geomembrane, every effort must be made to minimize wrinkle development. If possible, cover should be placed during the coolest weather. In addition, small wrinkles should be isolated and covered as quickly as possible to prevent their growth. The placement of cover materials shall be observed by McGill Associates or a CQA monitor to ensure that wrinkle formation is minimized and that, in all cases, the geomembrane is not folded over on itself.

1.4.3 Repair Procedures

Any portion of the geomembrane exhibiting a flaw, or failing a destructive or nondestructive test, shall be repaired. Several procedures exist for the repair of these areas. The final decision as to the appropriate repair procedure shall be determined by the Project Engineer and the Resident CQA Engineer.

1. The repair procedures available include:

    a. Patching, used to repair holes, tears, undispersed raw materials, and contamination by foreign matter.

    b. Spot welding used to repair pinholes, or other minor, localized flaws.

    c. Capping, used to repair large lengths of failed seams.

    d. Extrusion welding the flap, used to repair areas of inadequate fusion seams which have an exposed edge. Repairs of this type shall be approved by Resident CQA Engineer and shall not exceed 100 ft (30 m) in total length.

    e. Removing bad seam and replacing with a strip of new material welded into place.

2. For any repair method, the following provisions shall be satisfied:

    a. Surfaces of the geomembrane which are to be repaired using extrusion methods shall be ground no more than one hour prior to the repair.

    b. All surfaces shall be clean and dry at the time of the repair.

c. All seaming equipment used in repairing procedures shall meet the requirements of this SSCQAP.

d. Patches or caps shall extend at least 6 in (150 mm) beyond the edge of the defect, and all corners of patches shall be rounded with a radius of approximately 3 in (75 mm).

1.4.4 Repair Verification

The CQA monitors shall observe all nondestructive testing of repairs and shall record the number of each repair, date and test outcome. Each repair shall be nondestructively tested using the method described in Section 1.2 as appropriate. Repairs that pass the nondestructive test shall be taken as an indication of an adequate repair. Repairs more than 500 ft (50 m) long require destructive test sampling. Failed tests require that the repair shall be redone and re-tested until a passing test results.

1.5 Geomembrane Protection

The quality assurance procedures indicated in this Section are intended only to assure that the installation of adjacent materials does not damage the geomembrane. The quality assurance of the adjacent materials themselves are covered in separate Sections of this manual.

1.5.1 Soils

1. Placement of gravel on the geomembrane shall not proceed at an ambient temperature below 32 degrees F (0 degrees C) nor above 104 degrees F (40 degrees C) unless otherwise specified.

2. Placement of gravel on the geomembrane should be done during the coolest part of the day to minimize the development of wrinkles in the geomembrane.

3. Equipment used for placing gravel shall not be driven directly on the geomembrane.

4. A minimum thickness of 24 inches of gravel shall be maintained between the geotextile cushion and the top of the drainage layer Off-road trucks shall have a minimum thickness of 3 feet between them and the geomembrane/geotextile cushion.

5. In any areas traversed by heavy construction, any vehicles other than low ground pressure vehicles approved by the Project Engineer, the gravel layer shall have a minimum thickness of 3 ft (09 m). This requirement may be waived if provisions are made to protect the geomembrane through an engineered design approved by

the Project Engineer. Drivers shall proceed with caution when traveling on the overlying gravel and prevent spinning of tires or sharp turns.

6. Leachate collection pipes shall not be crossed with construction equipment without the full two (2) feet of stone in place. In areas where off-road trucks must repeatedly cross the leachate piping, a temporary stone road shall be build to bridge over the pipe and maintain a minimum thickness of three (3) feet.

7. Care shall be taken to avoid creating wrinkles in the geomembrane during placement of the gravel layer.

1.5.2 Sumps and Appurtenances

The sumps shall be constructed in accordance with the technical specifications and the Resident CQA Engineer shall certify the following:

1. Installation of the geomembrane, sumps, equipment, and appurtenant areas has been performed properly, and connections of geomembrane to sumps and appurtenances have been made according to project specifications.

2. Extreme care is taken while welding around appurtenances since nondestructive testing will be difficult in these areas.

3. The geomembrane has not been visibly damaged while making connections to sumps and appurtenances.

4. The Resident CQA Engineer or his representative shall be present at all times when the Installer is welding geomembrane to appurtenant structures.

The Resident CQA Engineer shall inform the Project Engineer in writing if the above conditions are not fulfilled.

Appendix C

1.0 Geotextiles

1.1 Definition and Applicability

Geotextiles are used in protection and filtering applications in lining systems. This Section does not describe procedures for other applications such as erosion control or reinforcement. This Section is applicable to nonwoven geotextiles made of polyester of polypropylene and not applicable to nonwoven geotextiles made of other materials or woven geotextiles.

1.2 Manufacturing Plant Inspection

The Owner or an appropriate representative may conduct a periodic inspection of the Manufacturer's plant. In addition, the Project Engineer or his designated representative may visit the manufacturing plant for a project-specific inspection if deemed necessary. If possible, the project-specific inspection shall be prior to or during the manufacturing of the geotextile rolls for that particular project. The purpose of the plant inspections is to review the manufacturing process and quality control procedures.

The manufacturing plant inspection shall include:

1. Verification that properties of the geotextile guaranteed by the Manufacturer are met and meet the project specifications.

2. Verification that the measurement of properties by the manufacturer is properly documented and test methods used are acceptable.

3. Inspection of the rolls and verification that they are free of imperfections or any sign of contamination by foreign matter.

4. Review of packaging, handling, storage, and transportation procedures and verification that these procedures will not damage the geotextile.

5. Verification that roll packages have a label indicating the name of the manufacturer, type of geotextile, roll number and roll dimensions.

6. Verification that the geotextiles are inspected continuously for the presence of needles using a metal detector.

A report describing the inspection will be retained by the Owner for periodic inspections and by the Project Engineer for project-specific inspections.

1.3 Quality Control Documentation

Prior to the shipment of any geotextile, the Manufacturer shall provide the Resident CQA Engineer with the following information:

1. Results of tests conducted by the Manufacturer to verify that the material used to manufacture the geotextile meets the project specifications.

2. A specification for the geotextile that includes all properties contained in the Project Technical Specifications were measured using the appropriate test methods.

3. Written certification that minimum values given in the Project Technical Specifications are guaranteed by the Manufacturer.

4. Quality control certificates, signed by a responsible party employed by the Manufacturer. Each quality control certificate shall include roll identification numbers, testing procedures, and the results of quality control tests. At a minimum, results shall be given for the following:

Property	**Test Method**	**Frequency**
Mass per Unit Area	ASTM D-5261	Each Roll
Grab Tensile Strength	ASTM D-4632	Every 5th Roll
Grab Tensile Elongation	ASTM D-4632	Every 5th Roll
Puncture (pin) Strength	ASTM D-4833	Every 5th Roll
Apparent Opening Size (AOS)	ASTM D-4751	Every 5th Roll

The Manufacturer shall identify all rolls of geotextiles with the following:

Manufacturer's name
Product identification
Thickness
Roll number
Roll dimensions

The Resident CQA Engineer shall review these documents and shall report any discrepancies with the above requirements to the Project Engineer. The Resident CQA Engineer shall verify that:

Property values certified by the Manufacturer meet all of its guaranteed specifications.

Measurements of properties by the Manufacturer are properly documented and that the test methods used are acceptable.

Quality control certificates have been provided at the specified frequency for all rolls, and that each certificate identifies the rolls related to it.

Rolls are appropriately labeled.

Certified minimum properties meet the project specifications.

1.4 Conformance Testing

1.4.1 Sampling Procedures

Upon delivery of the rolls of geotextiles, the Resident CQA Engineer shall ensure that conformance test samples are obtained for the geotextile. The rolls to be sampled shall be selected by the Resident CQA Engineer. Samples shall be taken from any portion of a roll that has not been damaged. Unless otherwise specified, samples shall be 3 ft (1 m) long by the roll width. The Resident CQA Engineer shall mark the machine direction on the samples with an arrow. All lots of material and the particular test sample that represents each lot should be defined before the samples are taken.

A lot shall be defined as a group of consecutively numbered rolls from the same manufacturing line. Alternatively, a lot may be designated by the Certifying CQA Engineer based on a review of all roll information including quality control documentation and manufacturing records.

Unless otherwise specified in the project specifications, samples shall be taken at a rate of one per lot, not to be less than one per 100,000 ft^2 of geotextile. These samples shall then be forwarded to the Geosynthetic laboratory for testing to ensure conformance with the project specifications.

1.4.2 Conformance Tests

The following conformance tests shall be conducted;

Mass per Unit Area (ASTM D5261)
Grab Tensile Strength (ASTM D4632)
Grab Tensile Elongation (ASTM D4632)
Puncture Strength (ASTM D4833)
Apparent Opening Size (ASTN D4751)

1.4.3 Test Results

All conformance test results shall be reviewed and accepted or rejected by the Certifying CQA Engineer prior to the deployment of the geotextile. The Certifying CQA Engineer shall examine all results from laboratory conformance testing and shall report any non-conformance to the Project Engineer. The Certifying CQA Engineer shall be responsible for checking that all test results meet or exceed the property values listed in the project specifications.

If a test result is in nonconformance, all material from the lot represented by the failing test shall be considered out-of-specification and rejected. Alternatively, at the option of the Project Engineer, additional conformance test samples may be taken to "bracket" the portion of the lot not meeting the project specification. This procedure is valid only when all rolls in the lot are consecutively produced and numbered from one manufacturing line. To isolate the out-of-specification material, additional samples must be taken from rolls that have roll numbers immediately adjacent to the roll that was sampled and failed. If both additional tests pass, the roll that represents the initial failed test and the roll manufactured immediately after that roll (next large roll number) shall be rejected. If one or both of the additional tests fail, then the entire lot shall be rejected or the procedure repeated with two additional tests that bracket a greater number of rolls within the lot.

2.0 Geocomposites

2.1 Definition and Applicability

Geocomposites are geosynthetic nets with geotextile heat bonded to the surface. The geocomposite can be single-sided or double-sided depending on the application. They are used as a drainage medium in lining systems, where the properties of the geotextile can either serve as a filter media from clogging the geonet or increase stability of the lining system. This Section is applicable to geocomposites where the geonet portion is made of high density polyethylene (HDPE), including "foamed" HDPE products but is not applicable to geocomposites where the geonet is made of other polymers.

2.2 Manufacturing Plant Inspection

The Owner or appropriate representative may conduct a periodic inspection of the Manufacturer's plant. In addition, the Project Engineer, or his designated representative may visit the manufacturing plant for a project-specific inspection if deemed necessary. If possible, the project-specific inspection shall be prior to or during the manufacturing of the geocomposite rolls for that particular project. The purpose of the inspection is to review the manufacturing process and quality control procedures.

The manufacturing plant inspection shall include:

Verification that properties guaranteed by the Manufacturer are met and meet all project specifications.

1. Verification that properties guaranteed by the Manufacturer are met and meet all Project Technical Specifications.

2. Verification that the measurement of properties by the Manufacturer is properly documented and test methods used are acceptable.

3. Spot inspection of the rolls and verification that they are free of imperfections or any sign of contamination by foreign matter.

4. Review of packaging, handling, storage, and transportation procedures and verification that these procedures will not damage the geocomposite.

5. Verification that the geotextiles are inspected continuously for the presence of needles using a metal detector.

6. Verifications that roll packages have a label indicating the name of the manufacturer, type of geocomposite, roll number and roll dimensions.

A report describing the inspection will be retained by the Owner for periodic inspections and by the Project Engineer for project-specific inspections.

2.3 Production

The geocomposite shall be manufactured by heat bonding the geotextile to the HDPE drainage net on one or both sides. No burn through geotextiles shall be permitted. No glue or adhesive shall be permitted.

The geonet portion of the geocomposite shall be manufactured by extruding two sets of strands to form a three (3) dimensional structure to provide planar water flow.

2.4 Quality Control Documentation

Prior to the shipment of any geocomposite, the Manufacturer shall provide the Resident CQA Engineer with the following information:

1. The origin (supplier's name and production plant) and identification (brand name and number) of the resin used for geonet.

2. Copies of dated quality control certificates issued by the geonet resin supplier.

3. Results of tests conducted by the Manufacturer to verify that the resin used to manufacture the geonet meets the Project Technical Specifications.

4. A statement indicating that the amount of any reclaimed polymer added to the resin during manufacturing was done with appropriate cleanliness.

5. A list of the materials that comprise the geonet, expressed in the following categories as a percent by weight: polyethylene, carbon black, other additives.

6. Results of tests conducted by the Manufacturer to verify that the material used to manufacture the geotextile meets the Project Technical Specifications.

7. A specification for the geocomposite that includes all properties contained in the Project Technical Specifications measured using the appropriate test methods.

8. Written certification that minimum values given in the Project Technical Specification are guaranteed by the Manufacturer.

9. Quality control certificates, signed by a responsible party employed by the Manufacturer. Each quality control certificate shall include roll identification numbers, testing procedures, and results of quality control tests. At a minimum, results shall be given for the following:

GEONET COMPONENT		
Property	**Test Method**	**Frequency**
Density	ASTM D1505 or ASTM D792, Method B	Every 5th Roll
Thickness	ASTM D5199	Each Roll
Carbon Black Content	ASTM D1603	Every 5th Roll
Peak Tensile Strength	ASTM D5035	Every 5th Roll
Transmissivity (MARV)	ASTM D4716	Every 5th Roll
GEOTEXTILE COMPONENT		
Property	**Test Method**	**Frequency**
Mass per Unit Area	ASTM D5261	Each Roll
Grab Tensile Strength	ASTM D4632	Every 5th Roll
Grab Tensile Elongation	ASTM D4632	Every 5th Roll
Puncture Strength	ASTM D4833	Every 5th Roll
Permittivity (min. avg.)	ASTM D4491	Every 5th Roll
Apparent Opening Size (AOS)	ASTM D4751	Every 5th Roll
UV Stability, % Retained (500 hr.)	ASTM D4355	Every 5th Roll
GEOCOMPOSITE		

Property	Test Method	Frequency
Ply Adhesion	ASTM D7005	Every 5th Roll
Transmissivity (MARV)	ASTM D4716	Every 5th Roll

The manufacturer shall identify all rolls of geocomposite with the following:

Manufacturers Name
Product Identification
Roll Number
Roll Dimensions

The Resident CQA Engineer shall review these documents and shall report any discrepancies with the above requirements to the Project Engineer. The Resident CQA Engineer shall verify that:

Property values certified by the Manufacturer meet all of its guaranteed specifications.

Measurements of properties by the Manufacturer are properly documented and that the test methods used are acceptable.

Quality control certificates have been provided at the specified frequency for all rolls, and that each certificate identifies the rolls related to it.

Rolls are appropriately labeled.

Certified minimum properties meet the project specifications.

2.5 Conformance Testing

2.5.1 Sampling Procedures

Upon delivery of the rolls of geocomposite, the Resident CQA Engineer shall ensure that conformance test samples are obtained for the geocomposite. The rolls to be sampled shall be selected by the Resident CQA Engineer. Samples shall be taken from any portion of a roll that has not been damaged. Unless otherwise specified, samples shall be 3 ft. (2 m) long by the roll width. The Resident CQA Engineer shall mark the machine direction on the samples with an arrow.

A lot shall be defined as a group of consecutively numbered rolls from the same manufacturing line. Alternatively, a lot may be designed by the Certifying CQA Engineer based on a review of all roll information including quality control documentation and manufacturing records.

Unless otherwise specified in the project specifications, samples shall be taken at a rate of one per lot, not to be less than one per 100,000 ft^2 of geocomposite. These samples shall then be forwarded to the Geosynthetic laboratory for testing to ensure conformance to the project specifications.

2.5.2 Conformance Tests

The following conformance tests shall be conducted;

Ply Adhesion (ASTM D7005)
Transmissivity (ASTM D4716)

2.5.3 Test Results

All conformance test results shall be reviewed and accepted or rejected by the Certifying CQA Engineer prior to the deployment of the geocomposite. The Certifying CQA Engineer shall examine all results from laboratory conformance testing and shall report any non-conformance to the Project Engineer. The Certifying CQA Engineer shall be responsible for checking that all test results meet or exceed the property values listed in the project specifications.

If a test result is in nonconformance, all material from the lot represented by the failing test shall be considered out-of-specification and rejected. Alternatively, at the option of the Project Engineer, additional conformance test samples may be taken to "bracket" the portion of the lot not meeting the project specification. This procedure is valid only when all rolls in the lot are consecutively produced and numbered from one manufacturing line. To isolate the out-of-specification material, additional samples must be taken from rolls that have roll numbers immediately adjacent to the roll that was sampled and failed. If both additional tests pass, the roll that represents the initial failed test and the roll manufactured immediately after that roll (next large roll number) shall be rejected. If one or both of the additional tests fail, then the entire lot shall be rejected or the procedure repeated with two additional tests that bracket a greater number of rolls within the lot.

Section 6: Operations Plan

OPERATIONS PLAN

MACON COUNTY MSW LANDFILL
PERMIT TO CONSTRUCT
PHASE 3 CELL 1
MACON COUNTY, NORTH CAROLINA

MARK D. CATHEY, P.E.

McGill ASSOCIATES

Engineering • Planning • Finance
Asheville, North Carolina

NORTH CAROLINA PROFESSIONAL SEAL 024993 ENGINEER MARK D. CATHEY

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OPERATIONS PLAN
Macon County MSW Landfill

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OPERATIONS PLAN
Macon County MSW Landfill

Introduction

Macon County currently manages the operation of a single active MSW cell - Phase 2 Cell 1 - at the Macon County Municipal Solid Waste Landfill (MSWLF) Facility. Phase 2 Cell 1 began receiving waste in February 1999 and is expected to reach capacity in the spring of 2017, at which time, the County will begin to utilize proposed Phase 3 Cell 1. The proposed Phase 3 Cell 1 area received Site Study Approval in 1997 at the same time as the existing Phase 2 Cell 1 area. Phase 3 Cell 1 is a standalone landfill unit. The County has recently purchased adjoining property and will expand the Facility Boundary as part of the Permit to Construct Phase 3 Cell 1. Existing MSWLF facilities that will remain in operation include a landfill office, scales and scalehouse, Waste Treatment and Processing Facility, equipment storage building, leachate collection system, yard waste facility and a recycling processing center. Proposed MSW Phase 3 Cell 1 is expected to provide five (5) years of additional landfill airspace. The location of MSW Phase 3 Cell 1 along with the proposed Facility Boundary is shown on Sheet C-101 of the Permit to Construct drawings. Appendix 7 includes the waste and volume projections for the five (5)-year permitting period for MSW Phase 3 Cell 1.

The Macon County Municipal Solid Waste Landfill is owned and operated by Macon County, North Carolina. Operation and maintenance of the landfill is under the supervision of the Macon Solid Waste Director, Mr. Chris Stahl.

This Operations Plan has been prepared as required under Rule .1617 and in accordance with Rule .1625 of the North Carolina Solid Waste Management Rules (15A NCAC 13B). Macon County shall maintain and operate the Macon County MSW Landfill in accordance with the following requirements.

1.0 Waste Acceptance and Disposal Requirements

The Macon County Municipal Solid Waste Landfill will only accept municipal solid waste, construction and demolition waste, and non-hazardous industrial waste generated in Macon County, and the Town of Highlands. Macon County will notify the Division of Waste Management, Solid Waste Section within 24 hours of any attempts to dispose of non-permitted waste.

1.1 Prohibited Wastes

The following wastes are prohibited from disposal at the landfill:

- Hazardous waste as defined within 15A NCAC 13A, including hazardous waste from conditionally exempt small quantity generators.

- Polychlorinated biphenyls (PCB) waste as defined in 40 CFR 761.

- Liquid wastes unless they are managed in accordance with Rule .1626(9).

- Wastes prohibited by Statute GS 130A-309.10 of the North Carolina Solid Waste Management Rules. These wastes include:

    - Used oil,
    - Yard trash,
    - White goods,
    - Antifreeze (ethylene glycol),
    - Lead-acid batteries,
    - Aluminum cans,
    - Whole scrap tires.
    - Motor oil filters,
    - Recyclable plastic bottles (excluding motor oil bottles),
    - Wooden pallets.
    - Electronics

- Wastes prohibited by Macon County Solid Waste Ordinance passed on July 2, 1996. Theses wastes include:

    - Burning or smoldering materials, or any other materials that would create a fire hazard,
    - Cardboard,
    - Radioactive Waste,
    - Wet sludges that cannot pass the paint filter test,
    - Aluminum cans,
    - Metal drums of 50 gallons or more capacity unless drain holes are provided to prevent containers from holding liquid or unless filled with identifiable solid waste which is otherwise acceptable,
    - Automobiles, truck or other motor vehicle bodies, large pieces of metal such as manufactured homes or farm equipment,
    - Ash unless approved by the Solid Waste Director,
    - Regulated medical waste,
    - Wood waste greater than 6 inches in diameter at the butt end and greater than 4 feet in length, and
    - Friable Asbestos.

1.2 Hazardous Wastes

Hazardous waste may be gases, liquid, solids or sludges that are listed or exhibit the characteristics described in 40 CFR Part 261.

PCB wastes are defined in 40 CFR 761. They may be liquids or non-liquids (sludges or solids). PCB wastes do not include small capacitors found in white goods (e.g., washers, dryers, refrigerators) or other consumer electrical products (e.g., radio and television units).

1.3 Liquid Wastes

Bulk or non-containerized liquid waste may not be placed in Macon County Municipal Solid Waste Landfill cell unless:

1. The waste is household waste other than septic waste.
2. The waste is leachate or gas condensate derived from the cell itself.

Containers holding liquid waste may not be placed in the Macon County Municipal Solid Waste Landfill unless:

1. The container is a small container similar in size to that normally found in household waste.
2. The container is designed to hold liquids for use other than storage.
3. The waste is household waste.

Note: Liquid Waste means any waste material that is determined to contain "free liquids" as defined by Method 9095 (Paint Filter Liquids Test), as described in "Test Methods for Evaluating Solid Wastes, Physical/Chemical methods" (EPA Pub. No. SW-846).

1.4 White Goods

The Macon County Municipal Solid Waste Landfill does accept white goods, which are taken to a white goods pad that is located behind the Recycling Processing Center. All appliances containing chlorofluorocarbon (CFC) refrigerants are segregated from the other scrap metals. Freon (type 12 for refrigeration units and type R22 for air conditioning units) is removed by certified staff (State Board of Refrigeration Examiners certification number NC-820-3177) using model CR-600 refrigerant extraction pumps. The Freon is collected into 50-pound storage tanks and then transferred to a 250-pound storage tank located inside the Recycling Facility. The Freon is shipped to a certified Freon recycler for final processing when the 250-pound tank is full. Once a white good unit is empty, it is marked, logged into the Freon records book and transferred to the scrap metal pile located on the same concrete pad behind the refrigeration units. Any refrigerators with locking doors will have the door removed immediately.

Non-freon containing white goods are placed into the scrap metal area on the white goods pad for removal by a contractor. Freon and non-freon items are stored separately on the pad prior to Freon removal.

1.5 Car Wash Sediment

The Macon County Municipal Solid Waste Landfill does not accept car wash sediment unless a TCLP test on metals has been performed at the potential customer's expense and the test is negative. Any waste accepted must not contain any free liquids and must pass the paint filter test as well.

1.6 Mercury Containing Products

Mercury containing devices are accepted as Universal Wastes from residents and commercial entities at the Materials Recovery Facility (MRF) located at the MSW Landfill. These devices include intact mercury thermostat switches, and mercury containing lamps. These devices will be packaged and stored according to the Universal Waste regulations, and will be sent to qualified Universal Waste handlers for processing and recycling. A detailed plan for management of Mercury containing devices can be found in Appendix 8.

1.7 Automobile Fuel Tanks

Steel automobile gasoline tanks are accepted at the Macon County MSW Facility as long as they do not contain any explosive vapors or any free liquids and they have been perforated or rendered incapable of retaining liquids. Terne-coated gasoline tanks cannot be landfilled due to the tanks exhibiting TCLP leachability for lead well in excess of 5.0 ppm, which is the EPA hazardous threshold.

1.8 Asbestos

All waste containing asbestos shall be managed in accordance with 40 CFR 61. Only non-friable asbestos is accepted at the Macon County Municipal Solid Waste Landfill. A small sample of the asbestos must be brought to the Landfill for inspection prior to bringing the full load to the landfill. The Solid Waste Director or a NCDENR representative will verify if the asbestos is acceptable for disposal in the Macon County Municipal Solid Waste Landfill. Asbestos is considered non-friable if it cannot be crushed into a powder form or into multiple smaller pieces when squeezed in a fist. Non-friable asbestos will only be accepted between 8:00 am and 3:00 pm, Monday through Friday. The asbestos must be double-bagged in heavy duty trash bags. Prior to sealing the bags, the asbestos must be sprayed with water to discourage creation of airborne particles in the event that the bags rip or become opened. Asbestos waste should be brought to the landfill separately from any other waste. Upon entry to the landfill, the generator/hauler will inform the scalehouse attendant of the nature of the waste. The scalehouse attendant will direct the customer to a landfill operator at the Waste

Treatment and Processing Facility, not to the landfill. One of the Waste Treatment and Processing Facility or landfill operators will escort the customer to a determined disposal location and stay with the customer until the waste is deposited. The landfill operator will excavate a hole in the working face for placement of the asbestos waste materials. The operator will then immediately cover the waste with additional loose waste at the toe of the working face to cover the bags. Asbestos waste will not be placed with a compactor or bulldozer.

1.9 Food, Animal, & Regulated Medical Waste

No hazardous, liquid, or regulated medical waste shall be accepted or disposed of in the Landfill. Spoiled foods, animal carcasses, abattoir waste, hatchery waste, and other animal waste delivered to the disposal site shall be covered immediately. These wastes will be placed at the toe of the working face and shall be covered immediately.

1.10 Wastewater Sludge

Wastewater sludges may be disposed of in the landfill. Sludges disposed in the landfill must pass the paint filter test and must be designated non-hazardous with the Toxicity Characteristic Leaching Procedure (TCLP) test.

1.11 Electronic Waste Recycling

Macon County accepts a full range of electronics from residents at the Macon County MSWLF. Electronic waste to be collected and recycled includes, but is not limited to; computer equipment, televisions, hard drives, scanners, fax machines, copiers, and other miscellaneous electronic equipment. Electronics are brought into the Waste Treatment and Processing Facility where they are prepared by County staff for shipping. The County contracts with an approved vendor that has e-steward or R2 certification to remove the collected electronic waste back to their facility for recycling and/or further disposal. Once the electronic waste is collected, the vendor will send the County a statement that provides the tonnage of material disposed, broken down by computer equipment, televisions, and other electronic material.

2.0 Random Waste Inspections

Macon County has a program in place for detecting and preventing the disposal of hazardous and banned wastes by conducting a random inspection program. The frequency of random inspections shall be based on the type and quantity of wastes received daily, and the accuracy and confidence desired in conclusions drawn from inspection observations. Currently, the random inspection rate represents approximately 5–10% of the average daily waste load. At a minimum, inspected loads will always represent at least 1% of the waste stream. Inspections will be performed at the Waste Treatment and Processing Facility. If these inspections indicate that unauthorized wastes are being brought to the Macon County Municipal Solid Waste Landfill site, then the random inspection program should be modified to increase the frequency of inspections.

Inspection priority also will be given to haulers with unknown service areas, to loads brought to the facility in vehicles not typically used for disposal of municipal solid waste, and to loads transported by previous would-be offenders. For wastes of unidentifiable nature, the inspector should question the transporter about the source/composition of the materials. The program will include the following:

Landfill personnel will conduct random inspections of incoming loads. The frequency of the random inspections will be based on the type and quantity of waste, but not less than 1% of the waste stream. Inspections will occur at the Waste Treatment and Processing Facility. The driver will be directed to dump his/her load on the tipping floor of the Facility off to the side of the regular waste stream. The load will be carefully spread using the bucket of a rubber-tired loader. Landfill personnel who have been adequately trained to identify hazardous and banned waste will then inspect the load. Any unacceptable wastes are removed from the load and taken to the proper disposal area. If hazardous or unknown wastes are discovered, the waste is secured away from the operating area at an isolated location of the tipping floor. The waste generator/hauler would then be questioned on the source and nature of the waste and the Solid Waste Director notified immediately. If the nature of the waste presents an acute or immediate hazard to personal safety, the Emergency Management Services will be contacted. NCDENR will be notified of the situation by telephone within 24 hours and in writing within 15 days of the occurrence. The written notice will take the form of a Special Waste Handling Occurrence Report, which is located at the Solid Waste Administration Building.

2.1 Waste Inspection Records and Notices

A record will be kept of each inspection that is performed. These records will be included and maintained in the operating record of the landfill. A copy of the waste inspection record and a procedure of the random waste screening process are attached as Appendix 3.

Signs shall be placed in clear view of each incoming waste transporter, which shall include the following notice:

> NOTICE: RANDOM WASTE SCREENING IS PRACTICED HERE. WE RESERVE THE RIGHT TO INSPECT ANY LOAD OR PORTION OF A LOAD ARRIVING AT OUR FACILITY. WE WILL REJECT ALL: HAZARDOUS WASTES, PCBs, LIQUIDS AND ANY UNACCEPTABLE WASTE AS DETERMINED BY OUR MANAGEMENT. YOUR PARTICIPATION IN THIS PROGRAM IS NOT OPTIONAL!

2.2 Training of Facility Personnel

Landfill Operators and Transfer Station Operators shall become certified and maintain their Continuing Education Units (CEU's) through training courses offered by SWANA. Documentation of training will be placed in the operating record for the facility. There are at least four (4) certified Landfill Operators employed at the Macon County MSW Landfill in addition to the Solid Waste Director, who currently has a Manager of Landfill Operations and a MSW Systems Management Certification. At no time will non-certified employees staff the landfill without a certified operator present.

Macon County, with the assistance of J&B Disposal, operates eleven (11) staffed convenience centers throughout rural parts of the County. Personnel at the convenience centers are trained to identify hazardous, liquid, and special wastes. If any banned or hazardous wastes are identified by center personnel, they will instruct the individual attempting to dispose of the waste to remove it and require the individual to dispose of the waste in a hazardous facility or direct them to the landfill for proper disposal. Macon County will provide at least annual training to all landfill personnel in regard to recognizing hazardous and liquid waste.

2.3 Contingency Plan

A Contingency Plan for handling prohibited wastes is included as part of the training plan. The Contingency Plan is described in the Waste Screening and Special Waste Handling Occurrence Procedures included in Appendix 3. The plan involves the identification of the waste by inspection. If the load has been determined to be of a hazardous nature, the landfill will not accept the waste and require that hauler remove the waste from the facility. The hauler will then be required to find a facility suitable for accepting the hazardous waste.

3.0 Waste Treatment and Processing Facility

3.1 Overview

Macon County utilizes the Waste Treatment and Processing Facility to receive incoming waste at the Macon County MSWLF. The Waste Treatment and Processing Facility consists of a pre-engineered metal building with a concrete tipping floor and concrete push wall. Incoming waste collection vehicles will deposit municipal solid waste (MSW) and construction & demolition wastes directly onto the concrete tipping floor of the Facility. Once the wastes have been dumped onto the tipping floor, it will be inspected for illegal and banned wastes, hazardous wastes, and/or other wastes requiring special handling. Illegal and hazardous wastes will be diverted from the waste stream and disposed of properly in a hazardous waste landfill. Once the wastes have been inspected for unacceptable materials, a loader will spread the remaining wastes over the tipping floor so that recyclable materials can be removed from the waste stream. Cardboard and scrap metal will be the principle materials targeted for recovery, along with clean wood and pallets, rigid plastics, #1 and #2 plastics, and electronics. Other recyclable wastes will only be recovered if they arrive in bulk form and/or are easily separable from the waste stream. The remaining wastes will be pushed to the rear of the Facility via a rubber tired loader. The waste will be collected along the push-wall that runs parallel to a 48-ft. walking floor trailer. The loader will pick up the waste along the push-wall and deposit it into the walking floor trailer. A road tractor will then carry the waste in the trailer to the landfill for disposal. It is anticipated that 1-3 loads will be taken to the landfill daily. The cycle time for off-loading the trailer is approximately 15 minutes. Wastes will be collected at the toe of the push-wall while the trailer is away from the facility. At the end of each operating day, all wastes will be removed from the tipping floor and partial trailer loads will be stored overnight in the walking floor trailer within the Treatment and Processing Facility.

Normal working hours for the Waste Treatment and Processing Facility are 7:30 a.m. to 4:30 p.m., Monday through Friday and 8:00 am to 2:00 pm on Saturdays. Note that should unexpectedly heavy volumes occur, Facility personnel would continue to load MSW wastes after the regularly scheduled hours. The Facility is closed on Sunday and the following holidays: Thanksgiving Day, Christmas Day and any federal holiday which falls on Tuesday through Thursday.

3.2 Personnel

The Facility is owned and operated by Macon County. The operation is staffed at all times that waste is being received in the Waste Treatment and Processing Facility. These employees are properly trained in safety procedures and the inspection of incoming wastes. Training materials published by the Solid Waste Association of North America (SWANA) are utilized for initial training of on-site personnel and for continuing education. The Waste Treatment and Processing Facility employees also direct and coordinate the movement of collection vehicles into and out of the Facility

3.3 Characterization of Waste Stream

The waste received at the Waste Treatment and Processing Facility will have the same characterization as the waste accepted by the MSW landfill. Certain waste types will bypass the Facility and be taken directly to the landfill for disposal. These materials include such wastes as asbestos wastes, sludges, non-regulated medical wastes, and potentially any other wastes that are difficult to process and/or contain no recoverable materials.

3.4 Inspection of Wastes

Properly trained employees control access to the Waste Treatment and Processing Facility. As the contents of the collection vehicles are emptied onto the tipping floor, an employee will conduct periodic visual inspections of the waste materials as outlined in the Waste Screening and Special Waste Handling Occurrence Procedure found in Appendix 3. If unacceptable waste is found, the driver of the vehicle will be instructed to terminate dumping and the unacceptable waste will be reloaded onto the vehicle for removal from the site. Examples of unacceptable wastes include large containers of liquid waste, sludges, drums that have not been emptied and crushed prior to delivery, and containers either smoking or emitting noxious vapors. If any hauler using the Facility develops a pattern of deceptive waste identification in order to circumvent proper regulation, the Asheville regional office of NCDENR will be notified within 24 hours of attempted disposal and informed as to the type of material and the hauler so that follow-up investigations can be conducted, if necessary.

If hazardous waste is identified during vehicle dumping, Facility personnel will immediately notify the driver and if necessary, contact NCDENR and the Hazardous Materials Emergency Response Team for the region, RRT6. The appropriate information concerning the waste will be provided to those officials and the recommended steps will be taken until properly trained handlers of hazardous waste arrive on-site.

Infectious or medical waste haulers are advised that the Facility does not accept such wastes and that the hauler will have to transport the infectious wastes to an approved facility for disposal.

Should a “hot load” occur in a vehicle using the Facility, the attendant will not permit the load to be unloaded. No asbestos or animal wastes will be accepted at the Treatment and Processing Facility.

The above limitations on the types of wastes that will be accepted do not circumvent the incidental wastes that may be found in the residential waste stream that is expected at the facility.

3.5 Traffic Control

Site personnel control access to the Waste Treatment and Processing Facility. As vehicles arrive at the Facility, site personnel will direct the driver to position the vehicle at the correct unloading location once there is sufficient room to maneuver on the concrete floor. When the contents of the vehicle are emptied, the driver is instructed to move the vehicle away from the tipping floor and exit the Facility. Directional signs located at the facility will aid traffic control.

During times when several vehicles are at the Facility at the same time, haulers are instructed to wait within the staging area located outside the entrance to the building. The tipping area will allow up to four (4) trucks to dump simultaneously.

3.6 Housekeeping, Litter, and Vector Control

Incoming wastes will be transported to the Facility in covered or enclosed vehicles. Throughout the day and at the end of each working day, facility personnel will police the building and surrounding site for litter. Collected litter is placed in containers for proper disposal. A yard hydrant is available to wash down the concrete tipping floor and adjacent equipment areas when needed. The equipment used for pushing trash on the tipping floor also has a bucket equipped with a squeegee. The wash water flows into drains located throughout the tipping floor. A metal grate covers the drain to blocks large debris that might clog the drains. The metal grates are raked periodically and the collected trash is placed into containers for proper disposal. The drain is connected to a six (6)-inch sewer line that also services the office, breakroom, and restrooms. The sewer line drains to a duplex pump station outside the Facility. This pump station pumps through a two (2)-inch force main to a 10-inch force main that runs between the East Franklin Pump Station and the Franklin Wastewater Treatment Plant. The pump station has an excess volume capacity of 200 gallons and a pumping capacity of 20 gpm. The pump station is equipped with automatic controls and high-water alarm. Final disposal of the leachate is at the Franklin Wastewater Treatment Plant. The Town of Franklin operates this wastewater treatment plant. See Appendix 1 for a letter from the Town of Franklin, which states that the Town of Franklin Wastewater Treatment Plant will accept an average flow of 875 gallons per day from the former Baling Facility (now the Waste Treatment and Processing Facility) at the Franklin Landfill.

Odors are controlled by prompt unloading and transfer of all delivered wastes at the Facility, which has seven (7) roll-up doors to allow adequate access to all areas of the building to ease operations, maintenance, and cleaning. The doors allow adequate fresh air exchange when opened, which aid in odor control. The building is also equipped with ventilation fans for operation during cold weather.

The daily removal of solid waste in conjunction with daily housekeeping procedures effectively controls the development of vector related problems. The tipping floor is constructed of concrete, which is a relatively impervious, cleanable material. Floor and equipment wash-downs at the Facility also reduce both odor and vector problems. As

described previously, wash water is diverted to the duplex pump station located outside the building. Licensed exterminators are also available to visit the Facility as needed.

3.7 Waste Treatment and Processing Facility Bypass Procedures

Wastes from commercial haulers and convenience centers are disposed directly at the working face of the landfill, unless large quantities of recoverable materials are identified. Smaller loads utilize the Waste Treatment and Processing Facility. Unregulated wastes from hospitals and retirement facilities, animal wastes, and asbestos wastes are disposed directly at the working face of the landfill. Asbestos wastes require special handling as outlined in Section 1.8.

In the event that wastes cannot be processed through the Waste Treatment and Processing Facility due to equipment failure, the Facility may be bypassed. If the Facility is anticipated to be out of operation for only a short period, wastes will be stockpiled on the tipping floor. The tipping floor at the Facility can comfortably accommodate approximately 150 tons of wastes. If the Facility is anticipated to be out of operation for more than 2 or 3 hours, the Facility will be bypassed. The waste would then be taken directly to the MSW landfill by the collection trucks. All rules that apply to traditional landfilling practices will be followed. Inspections will be performed in the landfill adjacent to the working face and materials will be separated as required. The MSW will then be compacted and sufficiently covered. In all cases, wastes will not be allowed to remain on the tipping floor of the Facility overnight.

3.8 Dust and Fire Control

Since collection and transfer vehicles travel at low speeds on paved roads, dust generation to the Facility is not a problem. The road from the Facility to the MSW Landfill is gravel so the County periodically wets the road to contain dust. Furthermore, periodic washdown of the tipping floor and equipment will also prevent excessive build-up of dirt and dust at the facility.

Hand-held fire extinguishers and two fire hoses located inside the building provide fire control. Fire protection will be provided by the local fire department, which is aware of the fire control needs for the Facility. In the event that a fire occurs, the local authorities will be notified immediately if help is needed. The telephone numbers of local fire, police, ambulance and hospital facilities are posted in and around the Facility at all times. Should a fire occur at the Facility, the NCDENR will be notified within 24 hours and written notification will be submitted within 15 days.

3.9 Wastewater Collection

Wastewater flow at the Facility consists of wash-down water and liquids escaping the deposited wastes. These sources of wastewater are directed into six drains located throughout the Facility floor. The metal roof covering the Facility minimizes the generation of wastewater. The drains empty into the duplex pumping station located

outside of the building. The wastewater that accumulates in the pump station is pumped to the Franklin Wastewater Treatment Plant. Refer to Appendix 1 for a letter from the Town of Franklin, accepting flow from the former Baling Facility (now Waste Treatment and Processing Facility).

3.10 Stormwater Management and Erosion Control

Areas adjacent to the Facility are graded away from the building. Gutters and downspouts are positioned on the building to divert discharge of stormwater to diversion ditches and stormdrains. The Macon County Landfill operates under a stormwater discharge permit issued by the NCDENR-Division of Water Quality, permit number: NCG120083, which requires regular monitoring of stormwater discharge locations.

3.11 Zoning

Since the Waste Treatment and Processing facility is located on the Macon County Landfill property, zoning approved for the current solid waste management facilities allows for the Waste Treatment and Processing Facility. Refer to Appendix 4 for a letter from the county where zoning for the Macon County Landfill property is given.

3.12 Facility Inspections

Regular maintenance inspections of the Facility are conducted at least annually. The inspections are conducted by site personnel who are familiar with the buildings and equipment at the site, as well as operations of the Facility. No records of inspections are kept. Observations include the following:

1. Building, foundation, and push walls
2. Ventilation system
3. Fire equipment
4. Electrical systems
5. Floor drains and yard hydrant
6. Leachate pump station

If the Waste Treatment and Processing Facility personnel note any unsatisfactory conditions, the concerns will be reported to the Macon County Solid Waste Director. If a threat to safety or to the environment is identified, immediate action will be taken to correct the situation. If necessary, operations at the Facility will be suspended temporarily until the proper authority can be contacted.

4.0 Waste Placement & Cover Material Requirements

Macon County would like to conduct waste filling operations in an uphill direction, and therefore will begin waste filling at the southern margin of the site, adjacent to the sump area. However, the County will still maintain a stormwater pumping area on top of the stormwater cover above the leachate sump for as long as possible. In addition to pumping stormwater from the low point of the cell, a stormwater control berm will be installed and will divert runoff to the low point of the liner edge near the southwest corner of Phase 3 Cell 1. Waste fill operations will continue up the hill on the eastern side of the cell. Waste fill operations for the five-year permitting period are shown on Sheets C-108 through C-112 of the Permit to Construct Drawings.

Waste placement will continue in a phased manner until the final grades are reached. The initial 6 – 10 foot depth of waste in each subcell shall be carefully screened for objects that could be pushed through the composite liner. A compactor shall not be used on this initial lift of waste to reduce the potential for impacting the geomembrane. The initial lift of waste will be compacted only by the equipment used to place the waste. Following placement of the initial lift, the solid waste will be placed and compacted as densely as possible using compactors and dozers. Waste placement will be in lifts not to exceed 10 feet. In order to increase compaction, waste should be placed from the downgradient to upgradient direction when possible. The working face shall be maintained in as small an area as possible to increase compaction and to reduce the amount of daily cover required. All windblown material resulting from daily waste placement will be recovered and returned to the cell for disposal at the end of each workday.

4.1 Daily Cover

Macon County shall cover the disposed solid waste with six (6) inches of earthen material at the end of each operating day, or at more frequent intervals if necessary, to control disease vectors, fires, odors, blowing litter, and scavenging.

4.2 Alternative Daily Cover

As an alternative to the six inches of earthen material, Macon County may use an alternative daily cover (ADC) that has been approved by the Solid Waste Division. The County will abandon the use of the 4 mm thick polyethylene film as an ADC in conjunction with the removal of the baling process from the landfill operation. Two types of ADC have been approved by the NCDENR-Solid Waste Division for use at the landfill. Macon County has obtained the approval of a 48ft x 50ft landfill tarp as an ADC. The tarp will be spread over the sloped working face of the landfill at the end of each day. The second method of approved ADC is the use of 3-inches of ground pallets and wood waste in conjunction with 3-inches of native soil instead of the 6-inches of earthen material. Correspondence pertaining to both of the approved ADC's is included in Appendix 6.

Each day at closing, the ADC tarp is walked onto the landfill face. The sides of the tarp will be weighted with soil as needed to prevent the tarp from being blown off of the landfill face by high winds. The size of the working face will be maintained so that the tarp completely covers all wastes not otherwise covered with at least six inches of earthen material or approved ADC. On rare occasions, such as the beginning or end of a landfill lift, it may be necessary to maintain a larger working face. Under such circumstances, a second tarp will be taken to the landfill for additional temporary coverage. The second tarp will be placed so that a maximum overlapping of the tarps is maintained. Care is taken to make sure that no vehicle traffic or landfill equipment is allowed to pass over the cover, which could result in shearing or tearing of the cover. The spare tarp will be stored at the Waste Treatment and Processing Facility.

The second type of approved ADC consists of a 6-inch thick lift consisting of a 50/50 mixture of native soil and ground pallets and yard waste. The ground wood waste and soil are mixed in the buffer area prior to transport to the landfill and spread as cover at the end of the day. The mixed material will be used on internal slopes and working faces.

The ADC's will be placed to meet or exceed the performance criteria of an ADC as outlined in Rule .1626 2 (b) by providing control of disease vectors, fires, odors, blowing litter, and scavenging.

Macon County shall cover all waste areas that will be inactive for more than twelve (12) months and have not reached final elevations with a minimum of one foot of intermediate cover. Any area inactive for more than ninety (90) days will be hydro-seeded to prevent erosion of the cover layer.

4.3 Disease & Vector Control

Macon County will control the spread of disease vectors by maintaining daily cover requirements and picking up windblown trash at the end of each day.

5.0 Explosive Gases Control

Refer to the Landfill Gas Monitoring Plan prepared by Bunnell-Lammons Engineering, Inc. for Phases 1, 2, and 3 (Cell1) dated May 28, 2015. The plan was prepared in accordance with North Carolina Rules for Solid Waste Management, 15A NCAC 13B Rule .1624(4).

6.0 Air Quality

6.1 Clean Air Act

The Macon County MSW Landfill is not required to have an air quality permit as promulgated by the U.S. EPA Administrator pursuant to Section 110 of the Clean Air Act, as amended. The Macon County Landfill would be required to obtain a Title V operating permit at the point in time that the Macon County MSW Landfill reaches an on-site volume of more than 2.5 million Megagrams of waste. The Phase 1/Phase 2 area contains approximately 0.59 million Megagrams of waste (as of April 29, 2015) and will accommodate a total of approximately 0.64 million Megagrams of waste at full capacity. MSW Phase 3 Cell 1 has the capacity of approximately 0.20 million Megagrams, which will bring the total disposed waste at the Macon County MSWLF to 0.84 million Megagrams at the end of the Phase 3 Cell 1 five-year permitting period.

6.2 Open Burning

No open burning of solid waste shall be allowed at the landfill, except for the infrequent burning of land clearing debris generated on site or debris from emergency clean-up operations. The Division of Solid Waste must approve any such infrequent burning.

6.3 Hot Loads

If a hot load of waste is delivered to the landfill, the driver shall not be allowed to dump the load. If a hot load must be dumped, it will be dumped on an inactive portion of the landfill near the working face so that liquids in the waste or liquids used to extinguish the fire are confined in the landfill. The waste may be smothered with clean dirt, or the local fire department may be called for assistance. Once the load has been extinguished and the cause determined, the load will be taken to the working face for disposal.

If a load of “hot” waste is unknowingly discharged in the Landfill, it will immediately be watered or smothered with dirt until extinguished by landfill personnel if possible and the local fire department called if needed. The Waste Treatment and Processing Facility is equipped with a two-inch hose bib at the side of the tipping floor. Hoses will remain connected to the hose bib to allow quick access. Fire hydrants are located just outside the Waste Treatment and Processing Facility.

Equipment and a stockpile of soil shall also be maintained in close proximity to the Landfill for controlling accidental fires. The local fire department has been contacted and informed of the potential fire hazards at the Landfill. Arrangements have been made with the fire department to provide access to the landfill site. The fire department has also been provided with operational information of the facility in case of emergency.

6.4 Fire Notification Requirements

Macon County shall provide verbal notification to the Solid Waste Division within 24 hours of a fire at the Landfill and written notice within 15 days. The Fire Occurrence Notification Form is included in Appendix 3.

7.0 Access and Safety Requirements

A fence currently encloses the site with access controlled by means of gates. A security check station and weigh scales is located at the landfill entrance to evaluate waste stream and proper disposal. An attendant will be on duty at the site at all times while it is open for public use to insure compliance with operational requirements. Access roads to the site shall be of all weather construction and maintained in good condition.

7.1 Dust Control

Dust generated due to landfill activities will be controlled. Dust will be controlled through the application of water by truck or other approved dust control products, if necessary. Removal of mud and dirt from the roads will also be a part of the dust control measures. Additionally, final cover will be vegetated as soon as practical in order to minimize the blowing of dust on-site.

7.2 Signage

Signs providing information on disposal procedures, the hours that the site is open for public use, the permit number, stating that no hazardous or un-permitted waste can be received without written permission, stating that no liquid waste can be received for disposal, and other pertinent information will be posted at the site entrance. Traffic signs and markers shall be provided as necessary to promote an orderly traffic pattern to and from the discharge area and maintain efficient operating conditions.

7.3 Scavenging

Scavenging of solid waste is prohibited unless approved by the owner or operator and the removal is not performed on the working face.

7.4 Barrels and Drums

Barrels and drums shall not be disposed of unless they are empty and perforated sufficiently to ensure that no hazardous or liquid waste is contained therein. The only exception is drums that contain non-friable asbestos.

8.0 Erosion and Sedimentation Control Requirements

Existing and proposed erosion/sedimentation control structures include sediment basins, storm drains, temporary slope drains, check dams, and diversion ditches. Existing and proposed erosion/sedimentation control structures include sediment basins, storm drains, temporary slope drains, check dams, and diversion ditches. The County will install at least 6 new sediment/skimmer basins as part of the development of Phase 3 Cell 1. An erosion control plan submittal to the NCDENR-Land Quality Section for the work associated with the construction of Phase 3 Cell 1 is pending. The County will provide a copy of the Erosion Control Permit to the Solid Waste Section upon receipt. The Erosion Control Plan will be designed to restrain the sedimentation associated with the construction and operation of Phase 3 Cell 1 and the construction and operation of Phase 3 Cell 2. The Plan will address the construction of access roads and stockpile/borrow areas for approximately 10 years of landfill operations.

Sedimentation basins will be checked after periods of significant runoff. Sediment will be removed from the basin to its original dimension when sediment accumulates to one half of the design depth. The sedimentation basins, embankments, ditches, inlets and outlets will also be inspected for erosion damage. All necessary repairs will be made immediately. Any trash or debris within the riser pipes will be removed. The Macon County Landfill operates under a storm water permit issued for the NCDENR-Division of Water Resources, permit number: NCG120083.

Storm drain outlets and diversion ditches will be inspected for damage after each runoff event. Rip rap will be placed in ditches and at pipe outlets to prevent erosion and wash outs. Provisions for a vegetative ground cover sufficient to control erosion must be accomplished within fourteen (14) working days upon completion of any phase of MSWLF development.

Embankment slopes shall be periodically inspected for erosion. The embankment slopes shall be mowed at a frequency sufficient to maintain a good stand of vegetation. The slopes shall be mowed a minimum of twice per one (1) year period. The embankment slopes shall be refertilized in the second year unless vegetation growth is fully adequate. Any damaged areas will be reseeded, fertilized, and mulched immediately. Seeding, fertilizing and mulching shall be in accordance with the North Carolina Erosion and Sedimentation Control Guidelines.

9.0 Drainage Control and Water Protection Requirements

9.1 Surface Water Diversion

Surface water from outside the operational area will be diverted from the waste area by the use of perimeter ditches. The perimeter ditches direct surface water to the sedimentation basins.

9.2 Storm Water Cover

The active waste area will be filled and graded so that no surface water will pond near or on waste and that no waste will be disposed of in ponded water. Initially for Phase 3 Cells 1, a stormwater diversion berm will be installed to divert water to the low point in the liner edge near the southwest corner of the Cell.

Leachate will be collected within the active waste area on top of the HDPE liner. Leachate will the pumped with side slope riser pumps through a dual-contained force main to a leachate holding pond, located adjacent to the landfill on the property of the Town of Franklin Wastewater Treatment Plant.

9.3 Discharge of Pollutants

There shall be no discharge of pollutants from the landfill into waters of the U.S., including wetlands, that violates any requirements of the Clean Water Act, including, but not limited to, the National Pollutant Discharge Elimination Systems (NPDES) requirements, pursuant to Section 402.

There shall be no discharge of a nonpoint source of pollution into waters of the U.S., including wetlands, that violates any requirement of area-wide or State-wide water quality management plan that has been approved under Section 208 or 219 of the Clean Water Act, as amended.

10.0 Recordkeeping Requirements

Landfill personnel shall record and retain the following information in an operating record at the landfill, or at an alternate location that has been approved by the Division.

- Inspection of leachate management system,
- Inspection records and waste determination records,
- Training received by landfill personnel,
- Waste amounts received by weight, which includes source of generation,
- Gas monitoring results and any necessary remediation plans,
- Any demonstration, certification, finding, monitoring, testing, or other analytical data required by sections .1630 to .1637 of the Rules (15A NCAC 13B),
- Any monitoring, testing, or analytical data as required by Rule .1627 (15A NCAC 13B),
- Any cost estimates and financial assurance documentation required by Rule .1628 (15A NCAC 13B), and
- Yearly Landfill Capacity and Volume Calculations

This information will be readily available for inspection by the Division of Waste Management-Solid Waste Section. A copy of this Operation Plan will remain at the facility at all times.

11.0 Leachate Management Plan

11.1 LCRS System Maintenance

Landfill personnel shall maintain records of all inspections, cleaning, and repairs made on the leachate collection system.

11.2 Leachate Testing

The leachate quality will be sampled on a semi-annual basis. Leachate will be analyzed for Appendix 1 constituents as well as BOD, COD, phosphate, nitrate, sulfate, pH, and Specific Conductance.

11.3 Pump Requirements

The average flow that will reach the sump for Phase 3 Cell 1 is estimated to be 9.0 gallons per minute (GPM). A peaking factor of 5.22 was applied to the average flow for a pump station design flow of 47 GPM for a single pump operation. Both pumps will pump a combined flow of 61.25 GPM. In the condition where the existing pumps from Phase 2 Cell 1 and one proposed pump from Phase 3 Cell 1 are in operation, it was determined that the proposed pump would operate at 41 gallons per minute, existing pump A would operate at 21 gallons per minute, and existing pump B would operate at 44 gallons per minute. All three pumps are the same EPG model and operate at an acceptable flow based on the pump curves and flow range. See the Phase 3 Cell 1 Engineering Plan Appendix C for design calculations and system layout.

11.4 Leachate Disposal

The leachate will be pumped to the adjacent Town of Franklin Wastewater Treatment Plant. There is an agreement between the Landfill and the Town that the WWTP accept leachate from the landfill and the landfill receive sludge from the WWTP. A letter approving disposal of leachate at the plant is included in Appendix 5. A copy of the Macon County Landfill Pretreatment Permit is also included in Appendix 7.

11.5 LCRS System Inspection

The landfill operator is responsible for periodic inspection and maintenance of the LCRS. Landfill personnel will perform monthly inspections of the leachate collection system equipment, specifically the pumping stations. A copy of the inspection form has been attached as Appendix 2. The pump stations will be inspected for proper operation and run-time hours will be documented. If the monthly inspection reveals any equipment deficiency, remedial measures will be taken immediately to correct the problem. An incident report will be completed that includes details of the incident and any corrective measures required. If an incident report is required, a copy of the report shall be attached to the inspection form where the deficiency was identified.

11.6 Leachate Records

Comprehensive records of the amount of leachate generated will be maintained at the Town of Franklin Wastewater Treatment Plant, which is located adjacent to the Landfill facility. Leachate generation will be determined from the hours of pump operation and pump rates. An annual summary of leachate generation will be maintained in the operating record.

11.7 LCRS Contingency

In the event that there is a temporary failure with any of the leachate removal and storage equipment, the geometry of the landfill will allow for the landfill to contain the leachate for a period of several months. Action will be taken to remedy any malfunction within 2 days. Due to the conservative design of the leachate removal and storage equipment and the geometry of the landfill, the possibility of leachate overflowing the perimeter berm is virtually impossible.

In the event that extreme levels of particular constituents are found to be present in the leachate during sampling, or extremely excessive leachate production occurs, the Solid Waste Division and the Town of Franklin Wastewater Treatment Plant will be notified. Additional pre-treatment methods will be utilized if problems are encountered with leachate quality.

12.0 Composting Operation

12.1 Overview

The Composting Operation has been dormant since 2004 due to the lack of a feedstock; however, if a feedstock should become available, the County may resume Composting Operations. The County will notify the NCDENR-Solid Waste Section upon reinstatement of the Composting Operation and apply for an updated permit.

13.0 Yard Waste Treatment and Processing Operation

13.1 Overview

The Yard Waste Treatment and Processing Operation at the Macon County Municipal Solid Waste Facility generate mulch for use as an alternate daily cover for the Landfill. Incoming waste collection vehicles will deposit yard waste at the unloading area. The hauler will unload the yard waste in a manner to keep the unloading area free of debris. A contractor will grind the yard waste to produce mulch.

13.2 Personnel

The facility is owned and operated by Macon County. The employees are properly trained in safety procedures and the inspection of incoming wastes. Training materials published by the Solid Waste Association of North America (SWANA) are utilized for initial training of on-site personnel and for continuing education.

13.3 Characterization of Waste Stream

The waste received by the Yard Waste Operation will include untreated, unpainted pallets and wood, leaves and land clearing debris consisting entirely of weedy material such as roots, brush, saplings and stumps. If municipal solid waste is mixed with yard waste, the hauler will need to dispose of the MSW at the Waste Treatment and Processing Facility before unloading the yard waste. The following items are not accepted at the Yard Waste Operation: treated or painted lumber wastes, household waste, cardboard, any non-recyclable material or any non-yard waste materials.

13.4 Procedures

Vehicles containing yard waste will be weighed on the scales upon entry to and from the Landfill. The hauler will be directed to the Yard Waste Management Area. If there is Municipal Solid Waste or other material mixed with the yard waste, the hauler will be directed to the Waste Treatment and Processing Facility to unload the MSW before the yard waste. The hauler will proceed to the Yard Waste Management Area along the gravel drive along the northeast side of the adjacent MSW landfill. The unloading area is of sufficient size to allow two or three vehicles to unload simultaneously. The hauler will unload the yard waste in such a manner as to keep the unloading area free of debris. Larger loads that may come in by dump truck will be unloaded as far from the access roadway as possible. As necessary, the County staff will use a bulldozer and loader to push the waste into stockpiles. The stockpiles will be configured so that stormwater runoff flows in a laminar fashion across the graded and grassed slopes to prevent erosion and point source runoff. The yard waste pile will be maintained so that air can freely flow through the pile in order to keep the internal temperature below 110-degrees Fahrenheit (F). A qualified contractor will grind the yard waste to make mulch. The primary use of the mulch will be an approved alternative daily cover for the Municipal

Solid Waste and in the composting process. Mulch will be hauled to the Municipal Solid Waste Landfill and the Composting Pad using a dump truck.

13.5 Traffic Control

The Scale personnel will direct vehicles that contain yard waste to the Yard Waste Management Area. The unloading area is adequately sized to allow two to three vehicles to unload simultaneously. The hauler will empty their load themselves onto the stockpiles.

14.0 Recycling Operation

14.1 Overview

Macon County operates a Recycling Processing Center at the Landfill facility. The Recycling Center accepts materials dropped off at the facility as well as processes incoming recycling waste from the eleven collection sites located throughout Macon County. The recyclable material is baled and shipped to corresponding recycling companies.

14.2 Personnel

The Recycling Processing Center is owned and operated by Macon County. The employees are properly trained in safety procedures and the inspection of incoming wastes.

14.3 Characterization of Waste Stream

The waste received by the Recycling Processing Center will include the following items:

- Newspaper,
- Cardboard
- Mixed Paper
- Aluminum Cans,
- Steel Cans,
- Clear, Brown and Green Glass,
- #1 Plastic (PETE), and
- #2 Plastic (HDPE),
- Mixed rigid plastics,
- White Goods and scrap metal,
- Used clothing.

Additional materials recovered by the County:

- Batteries,
- Anti-freeze,
- Oil,
- Oil filters,
- Used Cooking Oil
- Carpet and padding
- Mercury lamps and switches
- Electronics

Appendix 1

Correspondence from Town of Franklin Wastewater Treatment Facility Approving Wastewater from (former) Baling Facility (now Waste Treatment and Processing Facility)

Town of Franklin
70 West Main Street
Franklin, North Carolina 28734
(704) 524-2516

February 20, 1997

Mr. A. Preston Howard, P.E.
North Carolina Department of Environment, Health and
Natural Resources
Post Office Box 29535
Raleigh, North Carolina 27626-0535

Dear Mr. Howard:

The Town of Franklin will accept the wastewater (875 gpd) from the proposed Macon County Solid Waste Baling Facility for treatment at the Town of Franklin Wastewater Treatment Plant.

Sincerely,

David E. Henson
Mayor

Appendix 2

Leachate Collection System Inspection Report

LEACHATE SYSTEM INSPECTION REPORT

DATE:_____ TIME:_____AM/PM NAME:_____

Phase 1 Cell I

Gravity System through landfill dike to leachate pond.

- Are manholes free of debris: ☐ Yes ☐ No
- Is there any leachate standing in the manhole: ☐ Yes ☐ No
- Is there indication of a leachate spill along main: ☐ Yes ☐ No

Phase 2 Cell I

Pump system with two pumping stations and force main that becomes gravity and empties into leachate pond.

Leachate Pump Station; Upper:

- Is pump station operational: ☐ Yes ☐ No
- Are control panels working properly: ☐ Yes ☐ No
- Is there indication of leachate spill along main: ☐ Yes ☐ No
- Current water depth in well: _____ inches
- Pump runtime meter: _____ hours

Leachate Pump Station; Lower:

- Is pump station operational: ☐ Yes ☐ No
- Are control panels working properly: ☐ Yes ☐ No
- Is there indication of leachate spill along main: ☐ Yes ☐ No
- Current water depth in well: _____ inches
- Pump runtime meter: _____ hours

Phase 3 Cell I

Pump system with two pumping stations and force main that connects to existing forcemain from Phase 2 Cell 1.

Leachate Pump Station; 1:

- Is pump station operational: ☐ Yes ☐ No
- Are control panels working properly: ☐ Yes ☐ No
- Is there indication of leachate spill along main: ☐ Yes ☐ No
- Current water depth in well: _____ inches
- Pump runtime meter: _____ hours

Leachate Pump Station; 2:

- Is pump station operational: ☐ Yes ☐ No
- Are control panels working properly: ☐ Yes ☐ No
- Is there indication of leachate spill along main: ☐ Yes ☐ No
- Current water depth in well: _____ inches
- Pump runtime meter: _____ hours

Leachate Pond:

Leachate from landfill empties into pond. Treated by aeration and pumped to head works of Wastewater Treatment Plant.

- Is leachate flowing into pond: ☐ Yes ☐ No
- Is foot-valve clean: ☐ Yes ☐ No
- Are Aeration Pumps operational: ☐ Yes ☐ No
- Is control panel for aeration pumps operational: ☐ Yes ☐ No
- Is leachate pump #1 functioning properly: ☐ Yes ☐ No
- Is leachate pump #2 functioning properly: ☐ Yes ☐ No
- Are pump controls functioning properly: ☐ Yes ☐ No
- Is flow meter/totalizer functioning properly: ☐ Yes ☐ No
- What is the depth of leachate in pond: _____feet
- Inquire from WWTP Operators as to any noticed changes in leachate flow, volume or characteristics that cannot be explained by change in weather (i.e. heavy rain event). Note changes below on incident report:

LEACHATE SYSTEM INCIDENT REPORT

If YES was answered to any of the previous questions or if a breakdown has occurred in the leachate management system, an incident report must be completed. On the report, list the nature of the problem and steps taken to correct the problem. If the breakdown resulted in a leachate spill outside of the landfill liner perimeter, notify the Solid Waste Director and report to DENR immediately.

Incident Report:

Nature of Incident:

Corrective Action Taken:

Appendix 3

Waste Screening and Special Waste Handling Occurrence procedure

WASTE SCREENING AND SPECIAL WASTE HANDLING OCCURRENCE PROCEDURES

Waste Screening Program

Macon County has established the following program for screening and detecting hazardous and banned wastes, and preventing such wastes from disposal in the Macon County Municipal Solid Waste (MSW) Landfill.

Convenience Centers:
Convenience Center employees are trained to recognize and refuse banned wastes from disposal at the drop-off centers. Signs are posted at the centers to inform the public as to waste types not accepted at the centers.

Scale House:
All loads entering the landfill must cross the scales at the entrance to the landfill. Scale house attendants are trained to recognize potential hazardous or banned wastes, and question generators/haulers as to the nature of the wastes. Scale house attendants refuse banned wastes from disposal. Customers hauling questionable wastes are directed to the tipping floor of the Waste Treatment and Processing Facility where the Solid Waste Director or Landfill Operator will inspect the waste and determine proper disposal of the waste.

Waste Treatment and Processing Facility/Landfill:
The Solid Waste Operations personnel conduct regular random load inspection of waste entering the Waste Treatment and Processing Facility. Currently, inspections are conducted on approximately 5-10% of the waste stream. At a minimum, inspected loads will always represent 1% of the waste stream. Operators receive yearly training from SWANA On-site Waste Screening and Healthy and Safety Training Courses. These courses teach operators to recognize potentially hazardous wastes by container markings and waste characteristics such as noxious odor. Completed inspection reports are kept at the baling facility until being filed at the Solid Waste Administration Building. The records are updated monthly. Most banned wastes are non-hazardous and common in nature; such as tires, metal, lead-acid batteries, etc., and are simply removed from the waste stream and taken to the proper disposal area. Banned wastes that are brought in by individuals are refused and the generator/hauler is instructed as to proper disposal of the waste. If a waste of suspected hazardous or unknown nature is found, procedures for a Special Waste Handling Occurrence are followed.

Random Load Inspection Procedures:

- Driver is directed to dump load on the tipping floor of the bale facility off to the side of the regular waste stream.
- The load is spread using the bucket of a rubber-tired loader.
- The load is then inspected by landfill personnel to search for hazardous/banned wastes.
- Any unacceptable wastes found are removed from the load and taken to the proper disposal area. If hazardous or unknown wastes are discovered, procedures for a Special Waste Handling Occurrence are followed.

- Remaining, acceptable wastes are then incorporated back into the waste stream for disposal.

<u>Special Waste Handling Occurrence Procedures</u>:

If a known hazardous waste or waste of unknown nature that exhibits potentially hazardous characteristics is discovered, the following steps should be taken:

1. **Secure the waste**. Move waste away from the operating area to an isolated section of the tipping floor. If necessary, construct a dam around the suspected waste using absorbent material or socks. Remove public and personnel from contact with the waste. Depending on the nature of the hazard, this would include: at minimum, placing cones or other restrictive barrier around waste; and up to, complete evacuation of public and personnel from the bale facility and a safe perimeter around the facility. In the event of a closing of the Waste Treatment and Processing Facility, waste would be directed to the landfill.
2. **Identify waste generator/hauler**. Hold and question generator/hauler of the waste as to the source and nature of the waste.
3. **Notify Solid Waste Director Immediately**.
4. **Contact Emergency Management Services.** If the nature of the waste presents an acute or immediate hazard to personal safety, contact EMS by dialing 911. EMS may also contact the Regional Hazardous Waste Management Team located in Asheville, North Carolina.
5. **Notify NCDENR**. Notify NCDENR by telephone of the situation within 24 hours of the occurrence. NCDENR should also be notified in writing of the occurrence within 15 days. This notice will be sent by completion of a Special Waste Handling Occurrence Report. Blank forms are located at the Solid Waste Administration Building.
6. **Properly dispose of waste**. Follow up, and include in the report, on final status of the waste. Either, the waste was identified and acceptable for burial in the landfill or the waste was handled by contractor or other agent to remove the waste for proper disposal at acceptable waste handling facility.

Special Waste Handling Occurrence Notification

NC DENR Division of Waste Management
Solid Waste Section

The Solid Waste Rules require verbal notification within 24 hours and submission of a written notification within 15 days of the occurrence requiring special handling of waste at the landfill. The completion of this form shall satisfy that requirement. *(If additional space is needed, use the back of this form.)*

NAME OF FACILITY: _____ PERMIT #: _____

DATE AND TIME OF OCCURRENCE: _____/_____/_____@ _____:_____ AM/PM (circle one)

HOW WAS THE WASTE REPORTED AND BY WHOM _____

LIST ACTIONS TAKEN _____

WHAT WAS THE SOURCE OF THE WASTE _____

DESCRIBE THE AREA AND TYPE AND AMOUNT OF WASTE INVOLVED _____

CURRENT STATUS OF WASTE _____

DESCRIBE PLAN OF ACTIONS TO PREVENT FUTURE INCIDENTS _____

NAME _____ TITLE _____ DATE _____

THIS SECTION TO BE COMPLETED BY SOLID WASTE SECTION REGIONAL STAFF

DATE RECEIVED _____

List any factors not listed that might have contributed to the occurrence or that might prevent future occurances:

FOLLOW-UP REQUIRED:
[] NO [] PHONE CALL [] SUBMITTAL [] MEETING [] RETURN VISIT BY: _____ (DATE)

ACTIONS TAKEN OR REQUIRED:

FIRE OCCURRENCE NOTIFICATION

NC DENR Division of Waste Management
Solid Waste Section

The Solid Waste Rules [15A NCAC 13B, Section 1626(5)(d) and Section .0505(10)(c)] require verbal notification within 24 hours and submission of a written notification within 15 days of the occurrence of a fire at a landfill unit. The completion of this form shall satisfy that requirement. *(If additional space is needed, use back of this form)*

NAME OF FACILITY: _____ PERMIT # _____

DATE AND TIME OF FIRE _____/____/____ @ ____:____ AM / PM (circle one)

HOW WAS THE FIRE REPORTED AND BY WHOM _____

LIST ACTIONS TAKEN _____

WHAT WAS THE CAUSE OF THE FIRE _____

DESCRIBE AREA AND TYPE AND AMOUNT OF WASTE INVOLVED _____

WHAT COULD HAVE BEEN DONE TO PREVENT THIS FIRE _____

CURRENT STATUS OF FIRE _____

DESCRIBE PLAN OF ACTIONS TO PREVENT FUTURE INCIDENTS: _____

NAME _____ TITLE _____ DATE _____

THIS SECTION TO BE COMPLETED BY SOLID WASTE SECTION REGIONAL STAFF

DATE RECEIVED _____

List any factors not listed that might have contributed to the fire or that might prevent occurrence of future fires:

FOLLOW-UP REQUIRED:

☐ NO ☐ PHONE CALL ☐ SUBMITTAL ☐ MEETING ☐ RETURN VISIT BY: _____ (DATE)

ACTIONS TAKEN OR REQUIRED:

Appendix 4

Letter from Zoning Committee

Town of Franklin
70 West Main Street
Franklin, North Carolina 28734
(704) 524-2516

December 19, 1989

Mr. Jack Horton
Macon County Manager
5 West Main Street
Franklin, NC 28734

Dear Mr. Horton,

As you are aware the Board of Aldermen of the Town of Franklin, at the regular meeting on December 4, 1989 passed an ordinance setting forth an Extraterritorial Jurisdiction area around the perimiter of the Town and to also establish the zoning as it appeared on the planning maps at that time.

This action was taken by the authority granted in G.S. 160A-360, Article 19 and G.S. 160A-381,382,383,384,385,386,387,388,389 and 390.

The area in which the proposed Macon County Landfill will be sited is now zoned residential, but the Board adopted amendments to the existing Zoning Ordinance that will permit landfills that are approved by the State of North Carolina in the residential zone. A copy of the amended zoning ordinance will be made available to you as soon as we receive it from the printers.

I hope this answers the questions you had, but if you have others please let me know.

Sincerely,

Jim Williamson

Jim Williamson
Town Administrator

JW/ss

Appendix 5

Correspondence from Town of Franklin Wastewater Treatment Facility Approving Leachate Acceptance and Pretreatment Permit

TOWN OF FRANKLIN
hereafter in this permit referred to as the Control Authority

DISCHARGE PERMIT

Industrial User Pretreatment Permit (IUP)
To Discharge Wastewater Under the
Industrial Pretreatment Program

0002
IUP Number

In compliance with the provisions of North Carolina General Statute 143-215.1, any applicable federal categorical pretreatment regulations, all other lawful standards and regulations promulgated and adopted by the North Carolina Environmental Management Commission, and the Control Authority Sewer Use Ordinance. The following Industry, hereafter referred to by name or as the permittee:

Industry name, permittee: **MACON COUNTY**
Facility Located at Street Address **1448 LAKE SIDE DRIVE**
City **FRANKLIN**
State, Zip **NORTH CAROLINA, 28734**

is hereby authorized to discharge wastewater from the facility located at the above listed address into the sanitary sewer collection system and the wastewater treatment facility of the Control Authority listed below:

IUP Control Authority WWTP name: **TOWN OF FRANKLIN WWTP**
NPDES Number: **NC0021547**
WWTP Address: **70 WEST MAIN STREET**
City, State, Zip **FRANKLIN, NC 28734**

in accordance with effluent limitations, monitoring requirements, and all other conditions set forth in Parts I, II, and III of this Industrial User Pretreatment Permit (IUP).

Effective date, this permit and the authorization to discharge shall become effective at midnight on this date:. **November 15, 2005**
Expiration date, this permit and the authorization to discharge shall expire at midnight on this date:. **July 31, 2010**

Wayne Price
Mr. Wayne Price

11-14-05
Date

IUP, PART I,
Industrial User (IU) Specific Conditions

IUP, PART I, OUTLINE:

A.) IUP Basic Information
B.) IUP Modification History
C.) Authorization Statement
D.) Description of Discharges
E.) Schematic and Monitoring Locations
F.) Effluent Limits & Monitoring Requirements
G.) Definitions and Limit Page(s) notes

A. IUP Basic Information:

Receiving POTW name : **TOWN OF FRANKLIN WWTP**	POTW NPDES # : **NC0021547**
IUP Name : **MACON COUNTY LANDFILL**	IUP Number : **0002**
IUP Effective date : **February 29, 2004**	Pipe Numbers, list all regulated pipes: **1**
IUP Expiration date : **July 15, 2005**	IUP 40 CFR # (if applicable), or N/A: **N/A**

B. IUP Modification History:

Date Modified	Reason for & Description of modifications.
October 31, 1997	Original permit issuance
May 1, 1998	Modified limits and monitoring frequency.
July 31, 2001	Permit renewal with no modifications.
February 29, 2004	Identified separate monitoring frequencies for Permittee and Control Authority
July 31, 2005	Permit renewal, modified limits for Chromium and Nickel.
November 15, 2005	Permit revisions, Modified TTO Monitoring, Updated sampling point diagram

IUP, PART I,
Industrial User (IU) Specific Conditions

C.) Authorization Statement:

1.) The Permittee is hereby authorized to discharge wastewater in accordance with the effluent limitations, monitoring requirements, and all other conditions set forth in this Industrial User Pretreatment Permit (IUP) into the sewer collection system and wastewater treatment facility of the Control Authority.

2.) The Permittee is hereby authorized to continue operation of and discharge wastewater from the following treatment or pretreatment facilities. These facilities must correspond to the treatment units listed on both the application and inspection forms.

IU Treatment Units	
AERATION	Three floating aerators in 480,000 gallon leachate collection lagoon.
CHEMICAL ADDITION and FLOCULATION	Facility has the capability to introduce chemicals for pH adjustment and polymer to aid in flocculation if needed. System is not currently in operation and is not expected to be operated. Components include 1-800 gallon tank, 1-1,100 gallon tank, and a flocculation tank.

3.) The Permittee is hereby authorized to, if required by the Control Authority and after receiving Authorization to Construct (A to C) from the Control Authority, construct and operate additional pretreatment units as needed to meet final effluent limitations.

D.) Description of IUP Discharge(s):

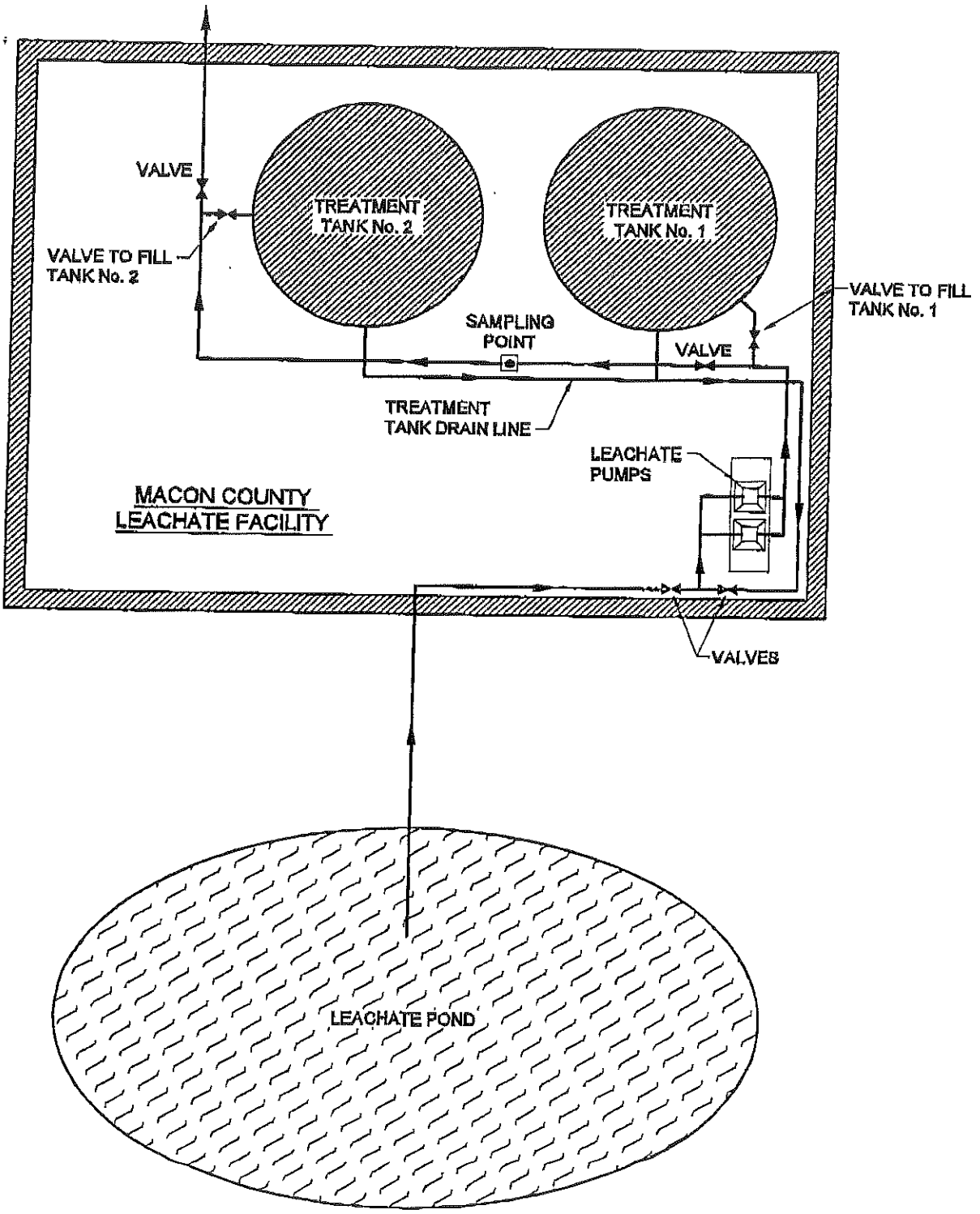
1. Describe the discharge(s) from all regulated pipes.

Pipe # **001**, Description of Discharge: LANDFILL LEACHATE ONLY.

E.) Schematic and Monitoring Locations:

The facility schematic is show on the attached location map. The discharge shall be monitored prior to discharge to the WWTP.

MACON COUNTY LANDFILL SAMPLING POINT DIAGRAM
TOWN OF FRANKLIN PRETREATMENT PROGRAM
MACON COUNTY, NORTH CAROLINA



IUP, PART I,
Industrial User (IU) Specific Conditions

F.) Effluent limits and Monitoring Requirements:

Effective November 15, 2005 and lasting to July 31, 2010 the permittee is authorized to discharge from pipe 001. Parameters not limited in this permit shall be discharged in accordance with the Town of Franklin Sewer Use Ordinance. This discharge shall be limited and monitored as specified below:

PARAMETER	DAILY MAXIMUM	SAMPLE TYPE	MONITORING FREQUENCY	
			Permittee	Control Authority
FLOW	0.040 MGD	Meter*	Each sample	Each Sample
BOD	1,000 mg/l	Composite	Quarterly	2/Year
TSS	500 mg/l	Composite	Quarterly	2/Year
CADMIUM	0.02 mg/l	Composite	Quarterly	2/Year
CHROMIUM	0.10 mg/l	Composite	Quarterly	2/Year
COPPER	0.50 mg/l	Composite	Quarterly	2/Year
CYANIDE	0.05 mg/l	Grab	Quarterly	2/Year
LEAD	0.03 mg/l	Composite	Quarterly	2/Year
MERCURY	0.03 mg/l	Composite	Quarterly	2/Year
NICKEL	0.50 mg/l	Composite	Quarterly	2/Year
SILVER	0.15 mg/l	Composite	Quarterly	2/Year
ZINC	0.30 mg/l	Composite	Quarterly	2/Year
OIL & GREASE	100 mg/l	Grab	Quarterly	2/Year
TTO		Composite/Grab	At each Permit Renewal	At each Permit Renewal
pH	5 - 12	Grab	Quarterly	2/Year
TEMPERATURE	40° C	Grab	Quarterly	2/Year

All samples shall be taken at the location designated in IUP, Part I, E. Schematic and Monitoring Locations, taken from Pipe No. 001.

*Discharge Flow Meter shall be read and recorded at the beginning and end of each sample period.

IUP, PART I,
Industrial User (IU) Specific Conditions

G.) Definitions and Limit Page(s) notes:

In addition to the definitions in the Control Authority Sewer Use Ordinance the following definitions apply:

1. Composite Sample:

Unless defined differently below, a composite sample for the monitoring requirements of this IUP, is defined as the automatic or manual collection of one grab sample of constant volume, not less than 100 ml, collected every hour during the entire discharge period on the sampling day. Sampling day shall be a typical production, and discharge day.

2. Composite Sample, alternative definition:

A composite sample for the monitoring requirements of this IUP is the same as described above unless specifically defined below as the automatic or manual collection of constant volume and constant time grab samples collected and composited according to the following criteria:

specific volume of each grab sample =	N/A	milliliters
specific time interval between samples =	N/A	hours
total duration of sample collection period =	N/A	hours
total number of grab samples to be composited =	N/A	samples

3. Daily Monitoring Frequency

Daily Monitoring Frequency as specified in this IUP shall mean each working day.

4. Grab Sample

Grab sample for the monitoring requirements of this IUP, is defined as a single "dip and take" sample collected at a representative point in the discharge stream.

5. Instantaneous measurement

An Instantaneous measurement for the monitoring requirements of this IUP is defined as a single reading, observation, or measurement.

PART II
General Conditions
Industrial User Pretreatment Permit (IUP)

Outline of PART II,

1. Representative Sampling
2. Reporting
3. Test Procedures
4. Additional Monitoring by Permittee
5. Monitoring By Control Authority
6. Duty to comply
7. Duty to Mitigate
8. Facilities Operation, Bypass
9. Removed substances
10. Upset Conditions
11. Right of Entry
12. Availability of Records
13. Duty to provide information
14. Signatory Requirements
15. Toxic Pollutants
16. Civil and Criminal Liability
17. Federal and/or State Laws
18. Penalties
19. Need to Halt or Reduce
20. Transferability
21. Property Rights
22. Severability
23. Modification, Revocation, Termination
24. Reapplication
25. Dilution Prohibition
26. Reports of Changed Conditions
27. Construction of pretreatment facilities
28. Reopener
29. Categorical Reopener
30. General Prohibitive Standards
31. Reports of Potential Problems
32. Total Toxic Organics (TTO) Definition
33. Flow Measurement Requirements

1. Representative Sampling

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge. All samples shall be taken at the monitoring points specified in this permit and, unless otherwise specified, before the effluent joins or is diluted by any other wastestream, body of water, or substance. Monitoring points shall not be changed without notification to, and approval by, the permit issuing authority.

2. Reporting

a.) Monitoring results obtained by the permittee shall be reported on forms specified by the Control Authority, postmarked no later than the twentieth day of the month following the month in which the samples were taken. If no discharge occurs during a reporting period (herein defined as each calendar month) in which a sampling event was to have occurred, a form with the phrase "no discharge" shall be submitted. Copies of these and all other reports required herein shall be submitted to the Control Authority.

b.) If the sampling performed by the permittee indicates a violation, the permittee shall notify the Control Authority within 24 hours of becoming aware of the violation. The permittee shall also repeat the sampling and analysis and submit the results of the repeat analysis to the Control Authority within 30 days after becoming aware of the violation.

3. Test Procedures

Test procedures for the analysis of pollutants shall be performed in accordance with the techniques prescribed in 40 CFR part 136 and amendments thereto unless specified otherwise in the monitoring conditions of this permit.

4. Additional Monitoring by Permittee

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be submitted to the Control Authority. The Control Authority may require more frequent monitoring or the monitoring of other pollutants not required in this permit by written notification.

PART II
General Conditions
Industrial User Pretreatment Permit (IUP)

5. Monitoring by Control Authority

The control authority may collect samples for analysis as deemed appropriate. All samples collected and properly analized by the permittee and/or the control authority may be used as the basis of compliance with this permit and other applicable regulations.

6. Duty to Comply

The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Control Authority Sewer Use Ordinance and is grounds for possible enforcement action.

7. Duty to Mitigate - Prevention of Adverse Impact

The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health, the POTW, the waters receiving the POTW's discharge, or the environment.

8. Facilities Operation, Bypass

The permittee shall at all times maintain in good working order and operate as efficiently as possible, all control facilities or systems installed or used by the permittee to achieve compliance with the terms and conditions of this permit. Bypass of treatment facilities is prohibited except when approved in advance by the Control Authority. Bypass approval shall be given only when such bypass is in compliance with 40 CFR 403.17.

9. Removed Substances

Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in a manner such as to prevent any pollutants from such materials from entering the sewer system. The permittee is responsible for assuring its compliance with any requirements regarding the generation, treatment, storage, and/or disposal of "Hazardous waste" as defined under the Federal Resource Conservation and Recovery Act.

10. Upset Conditions

An "upset" means an exceptional incident in which there is an unintentional and temporary noncompliance with the effluent limitations of this permit because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed or inadequate treatment facilities, lack of preventative maintenance, or careless or improper operations.

An upset may constitute an affirmative defense for action brought for the noncompliance. The permittee has the burden of proof to provide evidence and demonstrate that none of the factors specifically listed above were responsible for the noncompliance.

11. Right of Entry

The permittee shall allow the staff of the State of North Carolina Department of Environment, Health, and Natural Resources, Division of Environmental Management, the Regional Administrator of the Environmental Protection Agency, the Control Authority, and/or their authorized representatives, upon the presentation of credentials:

1. To enter upon the permittee's premises where a real or potential discharge is located or in which records are required to be kept under the terms and conditions of this permit; and
2. At reasonable times to have access to and copy records required to be kept under the terms and conditions of this permit; to inspect any monitoring equipment or monitoring method required in this permit; and to sample any discharge of pollutants.

PART II
General Conditions
Industrial User Pretreatment Permit (IUP)

12. Availability of Records and Reports

The permittee shall retain records of all monitoring information, including all calibration and maintenance records as well as copies of reports and information used to complete the application for this permit for at least three years. All records that pertain to matters that are subject to any type of enforcement action shall be retained and preserved by the permittee until all enforcement activities have concluded and all periods of limitation with respect to any and all appeals have expired.

Except for data determined to be confidential under the Sewer Use Ordinance, all reports prepared in accordance with terms of this permit shall be available for public inspection at the Control Authority. As required by the Sewer Use Ordinance, effluent data shall not be considered confidential.

13. Duty to Provide Information

The permittee shall furnish to the Director of Public Works or his/her designees, within a reasonable time, any information which the Director, his/her designee, or the Division of Environmental Management may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The permittee shall also furnish, upon request, copies of records required to be kept by this permit.

14. Signatory Requirements

All reports or information submitted pursuant to the requirements of this permit must be signed and certified by a ranking official or duly authorized agent of the permittee.

15. Toxic Pollutants

If a toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 307(a) of the Federal Clean Water Act for a toxic pollutant which is present in the discharge and such standard or prohibition is more stringent than any limitation for such pollutant in this permit, this permit may be revised or modified in accordance with the toxic effluent standard or prohibition and the permittee so notified.

16. Civil and Criminal Liability

Nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

17. Federal and/or State Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable Federal and/or State law or regulation.

18. Penalties

The Sewer Use Ordinance of the Control Authority provides that any person who violates a permit condition is subject to a civil penalty not to exceed $10,000 dollars per day of such violation.

Under state law, (NCGS 143-215.6B), under certain circumstances it is a crime to violate terms, conditions, or requirements of pretreatment permits. It is a crime to knowingly make any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance. These crimes are enforced at the prosecutorial discretion of the local District Attorney.

19. Need to Halt or Reduce not a Defense

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity to maintain compliance with the conditions of the permit.

PART II
General Conditions
Industrial User Pretreatment Permit (IUP)

20. Transferability

This permit shall not be reassigned or transferred or sold to a new owner, new user, different premises, or a new or changed operation without approval of the Town.

21. Property Rights

This permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations.

22. Severability

The provisions of this permit are severable and, if any provision of this permit or the application of any provision of this permit to any circumstance is held invalid, the application of such provision to other circumstances and the remainder of this permit shall not be affected thereby.

23. Permit Modification, Revocation, Termination

This permit may be modified, revoked and reissued or terminated with cause in accordance to the requirements of the Control Authority Sewer Use Ordinance and North Carolina General Statute or implementing regulations.

24. Re-Application for Permit Renewal

The permittee is responsible for filing an application for reissuance of this permit at least 180 days prior to its expiration date.

25. Dilution Prohibition

The permittee shall not increase the use of potable or process water or in any other way attempt to dilute the discharge as a partial or complete substitute for adequate treatment to achieve compliance with the limitations contained in this permit.

26. Reports of Changed conditions

The permittee shall give notice to the Control Authority of any planned significant changes to the permittee's operations or system which might alter the nature, quality, or volume of its wastewater at least 180 days before the change.

27. Construction

No construction of pretreatment facilities or additions thereto shall be begun until Final Plans and Specifications have been submitted to the Control Authority and written approval and an Authorization to Construct (A to C) have been issued.

28. Reopener

The permittee shall be modified or, alternatively, revoked and reissued to comply with any applicable effluent standard or limitation for the control of any pollutant shown to contribute to toxicity of the WWTP effluent or any pollutant that is otherwise limited by the POTW discharge permit. The permit as modified or reissued under this paragraph may also contain any other requirements of State or Federal pretreatment regulations then applicable.

PART II
General Conditions
Industrial User Pretreatment Permit (IUP)

29. Categorical Reopener

This permit shall be modified, or alternatively, revoked and reissued, to comply with any applicable effluent standard or limitation issued or approved under Sections 302(b)(2)(C) and (D), 304(b)(2), and 307(a)(2) of the Clean Water Act, if the effluent standard or limitation so issued or approved:

1.) contains different conditions or is otherwise more stringent than any effluent limitation in this permit; or
2.) controls any pollutant not limited in this permit.

The permit as modified or reissued under this paragraph shall also contain any other requirements of the Act then applicable.

30. General Prohibitive Standards

The permittee shall comply with the general prohibitive discharge standards in 40 CFR 403.5 (a) and (b) of the Federal pretreatment regulations.

31. Reports of Potential Problems

The permittee shall notify by telephone the Control Authority immediately of all discharges that could cause problems to the POTW including any slug loadings as defined by 40 CFR 403.5(b). If the permittee experiences such a discharge, they shall inform the Control Authority immediately upon the first awareness of the commencement of the discharge. Notification shall include location of the discharge, type of waste, concentration and volume if known and corrective actions taken by the permittee. A written follow-up report thereof shall be filed by the permittee within five (5) days, unless waived by the Control Authority.

32. Total Toxic Organics (TTO) Definition

"TTO", or Total Toxic Organics, is the sum of the concentrations of the toxic organic compounds tested for by methods EPA 608, EPA 624, EPA 625 that are found in the permittee's process discharge at a concentration greater than 0.01 mg/l.

33. Flow Measurement Requirements

The permittee shall maintain appropriate discharge flow measurement devices and methods consistent with approved scientific practices to ensure the accuracy and reliability of measurements of the volume of monitored discharges. Devices installed shall be a continuous recording flow meter capable of measuring flows with a maximum deviation of less than 10% from true discharge rates throughout the range of expected discharge volumes. The devices shall be installed, calibrated, and maintained to ensure accuracy. The meter shall be calibrated once per year. Modifications to the flow metering equipment shall be approved by the Control Authority prior to installation. If a required flow measurement device fails, the Control Authority shall be notified within 24 hours

Appendix 6

Correspondence regarding approved methods of Alternate Daily Cover

Macon County Department of Solid Waste Management
109 Sierra Drive, Franklin, North Carolina 28734, Ph.:(828)349-2100, Fax:(828)349-2185

October 9, 2006

Mr. James Coffey, Regional Engineer
NCDENR
Division of Solid Waste Management
Asheville Regional Office
2090 US Highway 70
Swannanoa, North Carolina 28778

Re: Request for Demonstration and Approval of Alternate Daily Cover
Macon County MSW Landfill; Permit # 57-03

Dear Mr. Coffey:

The Macon County Department of Solid Waste Management (Department) is formally requesting the use of an Alternate Daily Cover (ADC) at the Macon County MSW Landfill. The Department proposes a 90-180 day demonstration period, during which Field Specialists with the Solid Waste Section will be able to verify the ADC's effectiveness in meeting the requirements of Rule .1626(2)(a).

The proposed ADC will consist of a Landfill Tarp system. The tarp will be approximately 50'x50' in size, and 6.5-8.5 oz/sq ft. The tarp is constructed of a woven polypropylene that is puncture, tear and U.V. resistant. Actual material specifications will be available for inspection at the time of implementation of the tarp system.

Macon County has recently abandoned our Bale Facility, and waste is being diverted directly to the landfill working face. In conjunction with the direct fill, Macon County has purchased a Terex 110,000 pound Compactor. Currently, we have approved as an ADC a 2 mil polyethylene film designed to drape over the vertical face of the bale fill. Under the direct fill method currently employed, the open or working face is at a 4:1 to 5:1 slope, rendering the film ineffective as an ADC. The tarp, therefore, would replace the film as an ADC, and would be utilized in much the same manner as the film.

As we have already made the above changes, we would like to begin the demonstration period for approval of the ADC as soon as possible. The tarp will be put into use once we receive permission to proceed with the demonstration. An amended operating plan detailing the tarping system operational procedures will be submitted to your office upon successful completion of the demonstration period and final approval of the tarp as an ADC. Use of the tarp will follow the general operations listed below, and will be designed to ensure protection of public and environmental health and all requirements of Rule .1626(2)(a).

Operations Plan: ADC; Polypropylene Tarp.

By the end of each day of operations, the horizontal or lateral expansion of the working face will be covered with at least six (6) inches of earthen material, or an earthen material and ground LCID mixture; as approved. The working face will be maintained at a minimum of a 4:1 slope and compacted to reach maximum waste density possible to minimize the size of the working face; preserve

Macon County Department of Solid Waste Management
109 Sierra Drive, Franklin, North Carolina 28734, Ph.:(828)349-2100, Fax:(828)349-2185

landfill space; and deter wind-blown litter. At the end of each operating day, a 50'x50', 8.5 oz/sq ft tarp will be pulled over the slope of the working face. The tarp will cover all exposed portions of the working face, and the corners and sides of the tarp will be weighted with dirt and/or small stones to prevent the wind from exposing any waste. At the beginning of the next operating day, the tarp will be walked off of the working face and stored in an adjacent area to the working face.

Thank you for your time and consideration of this request. Please contact me at your convenience should you need any additional information or have any additional requirements of this department with regards to the request. I look forward to your response.

Sincerely,

Michael Chris Stahl
Director of Solid Waste Management, Macon County

CC: Sam Greenwood, County Manager
Mark Cathey; Jeff Bishop, McGill & Associates
Jim Patterson, Waste Specialist, NC DENR

PACTEC

P.O. Box 8069 Clinton, LA 70722 (800) 272-2832 Fax (225) 683-8711 www.pactecinc.com

6 oz. Coated Woven Polypropylene

Properties	Test Method	Value
Coating		1.5 Mil, one side
Weight		7.5 oz/yd² coated
Thickness		20 Mil
Color		White
Warp Grab	ASTM D 5034-90	370 lbs
Weft Grab	ASTM D 5034-90	380 lbs
Warp Tear	ASTM D 2261-83	170 lbs
Weft Tear	ASTM D 2261-83	160 lbs
Mullen Burst	ASTM D 3786-87	800 psi
Puncture	ASTM D 4833	106 lbs
Accelerated UV Weathering	ASTM G53	>70% @ 1200 hrs

This product is manufactured for the sole purpose described in this spec sheet. The buyer or user of this product is solely responsible for determining whether this product is suitable for any intended use and for its proper installation and use.

NCDENR

North Carolina Department of Environment and Natural Resources

Dexter R. Matthews, Director | Division of Waste Management, Solid Waste Section | Michael F. Easley, Governor, William G. Ross Jr., Secretary

October 20, 2006

Mr. Chris Stahl, Director
Macon County Solid Waste Management
109 Sierra Drive
Franklin, NC 28734

Re: Alternate Daily Cover Demonstration Authorization Letter,
Macon County Municipal Solid Waste Landfill, Permit Number 57-03

Dear Mr. Stahl:

This letter is in response to your request for approval to demonstrate the capability of an alternate daily cover (ADC) at the referenced landfill. This Authorization Letter conditionally approves the Demonstration Project as described in your letter dated October 6, 2006, for a period of nine (9) months. This period of time provides the operator with six (6) months of time to perform the Demonstration Project, and three (3) months to compile and submit the certified Demonstration Report to the Solid Waste Section for review.

After six (6) months of using the conditionally approved ADC, the facility operator may then either:

(1) provide a written report demonstrating the feasibility and request approval for the use of the ADC material on a full-time basis, or

(2) cease use of the ADC material, properly dispose of any remaining ADC material, and provide a written report detailing the findings of the use of the material during the approval period and what actions were taken to dispose of the material.

If the operator decides to request approval for the use of the ADC material on a full-time basis, a Demonstration Report and revised facility Operation Plan that incorporates the ADC operation, both certified by a professional engineer licensed in North Carolina, shall be submitted to the Solid Waste Section for review and approval.

The certified Demonstration Report would include documentation addressing the performance and effectiveness of the material, the number of times the ADC material was used, the quantities of the ADC material, and other supportive information, including photographs.

Following satisfactory demonstration of the ADC material and application, the Solid Waste Section would issue a modified permit for the facility that includes the ADC operation.

2090 US Highway 70, Swannanoa, North Carolina. 28778
Phone: 828-296-4500 \ FAX: 828-299-7043 \ Internet http://wastenotnc.org
An Equal Opportunity / Affirmative Action Employer – Printed on Recycled Paper

If you have any questions, please call me, phone number 828-296-4703 or Jim Patterson, phone number 828-296-4700 at the Asheville Regional Office.

Sincerely,

James C. Coffey Digitally signed by James C. Coffey
DN: CN = James C. Coffey, C = US
Date: 2006.10.20 07:50:17 -04'00'

James C. Coffey
Asheville Regional Engineer
Solid Waste Section

cc. Jim Patterson

Appendix 7

Airspace Volume Calculations – Five-Year Permitting Period

Appendix 7
Airspace Volume Calculations – Five-Year Permitting Period

Notes:
1) Five-Year permitting period runs from 2017 through 2021.
2) Assume a 1% annual increase in waste growth for 2016, 1.5% for 2017 through 2021.
3) Assume compaction rate of 0.5 tons/cy

Waste Trends

May 1, 2014 through April 30, 2015 waste tonnage: 29,974 tons.
Waste tonnage projected for 2016 (@1.0% annual increase: 30,274
Total waste tonnage projected (@1.5% annual increase) through
end of five-year permitting period: 158,318 tons

Airspace Summary

Airspace available for the disposal of waste,
as measured from the top of the stone drainage layer
to the bottom of either the intermediate or final cap grades
utilizing ACAD Civil 3D Software **450,000 cy**

Lifetime Estimate

Estimated lifetime of cell based on
31,663 tons/yr and 0.5 tons/cy compaction: **7.1 years***
*note: estimate is to bottom of cap grades noted on Permit Drawings,
which are not feasible to obtain efficiently. Additional
landfill airspace will be required in approximately 5 years.

Appendix 8

Management of Universal Wastes:
Mercury Containing Lamps and Devices

Appendix 8: Mercury Containing Products

1.General Conditions:

a) The Macon County Solid Waste Department will accept waste Mercury Containing Devices (MCD) and Lamps Containing Mercury (LCM) from residents and commercial entities. MCD's and LCM's will be accepted at the Materials Recovery Facility (MRF), located at the MSW Landfill facility at 1448 Lakeside Drive, Franklin, North Carolina during normal operating hours (Monday through Friday from 7:30am until 4:30pm, and Saturday 8:00am until 2:00pm). An Operator on staff will oversee and assist the receiving of MCD's and LCM's to insure that wastes are intact (not broken or leaking); insure proper storage in a storage box or container; and provide a count of items received for the purposes of inventory tracking and invoicing, if applicable.
b) Universal Waste Storage: A section of the tipping floor in the MRF is being used as a Universal Waste Handling Area. This area is secured by a fenced enclosure with locking doors. The area will be signified by a sign located on the door. Appropriate containers will be located in the secured area for the temporary storage of the wastes. A label will be placed on each container once the first waste has been placed in the container. The label will detail the following information: Notification that the container holds a Universal Waste (-Mercury Containing Equipment; or – Used Lamps), and the date the first waste was placed in the container.
c) Training and Emergency Response: Landfill staff will be trained in the proper handling and storage procedures associated with management of LCM's and MCD's as well as spill containment and decontamination procedures. Additionally, materials for cleaning up a mercury spill and a sign detailing cleanup procedures will be provided in the storage area.
d) Universal Waste Recycling: LCM's and MCD's will be shipped to or collected by a company authorized to manage and recycle these materials. A further description of these companies is listed below.

2.Management of Mercury Containing Devices (MCD):

a) Acceptance: Waste MCD's are defined as thermostat switches which contain an ampule of mercury as a functioning part of the device. The devices must be received with the ampule intact so that mercury is not released into the environment. MCD's will be accepted at no charge at the Materials Recovery Facility (MRF), located at the MSW Landfill facility at 1448 Lakeside Drive, Franklin, North Carolina during normal operating hours.

b) Packaging and Storage: MCD's will only be stored in the designated Universal Waste Handling Area at the MRF. The devices will be placed into a sealed bag and then into a plastic recycling bin provided by the vendor. A label will be placed on the container once the first MCD is placed in the container. The label will contain information identifying that the container holds a Universal Waste – Mercury Containing Device, and the date of the first device being placed in the container. The bins will remain closed at

all times that devices are not being added to the bin. Storage of the bins will be limited to one-year or until the bin is full; whichever occurs first.

c) Recycling Vendor: The Macon County Solid Waste Department is partnered with the Thermostat Recycling Corporation (TRC) for the recycling of waste thermostats containing Mercury. Bins are shipped from TRC to the Solid Waste Department. Once full, the Solid Waste Department will contact TRC to make arrangements for the pick-up of the bins.

d) Emergency Response and Cleanup: In the event a mercury containing thermostat is broken at the facility, the following procedures will be followed. An operator will put on latex gloves and put any pieces in a sealable bag. Any remnants will be collected in a dustpan by use of a squeegee and placed in the bag. Any visible liquid mercury will be collected by placing duct tape over the area. The tape will then be added to the bag. Finally, a wet scrubbing towel will be used to wipe down the area as well at the dustpan, squeegee, and the wipe will be placed in the bag. The bag and its contents will then be placed in container with sealing lid, and the date will be noted on the container. The container will be transferred to Southeast Recycling Technologies within ninety (90) days.

3. Management of Lamps Containing Mercury (LCM):

a) Acceptance: Unbroken waste LCM's will be accepted at the Materials Recovery Facility (MRF), located at the MSW Landfill facility at 1448 Lakeside Drive, Franklin, North Carolina during normal operating hours. Residential quantities of lamps will be accepted at no charge at the facility. Commercial conditionally-exempt small quantity lamps will be accepted for a fee to cover the costs of recycling, materials and handling. Broken bulbs are not accepted. Broken lamps from residential generators will be placed in the landfill as household exempted wastes. Commercial quantities of broken bulbs are hazardous waste. They will be rejected from delivery and must be taken to a hazardous waste handling facility.

b) Packaging and Storage: LCM's will only be stored in the designated Universal Waste Handling Area at the MRF. Waste lamps will be placed into suitable containers or packages that are structurally sound, adequate to prevent breakage, and compatible with the contents of the lamps. The containers will be kept closed unless actively being filled with waste lamps. Upon the first lamp being placed in a container, a label will be applied signifying that the container holds Universal Waste Lamps, and the date. Filled containers will be transferred to a locked storage trailer just outside of the MRF in order to keep the handling area from becoming overly cluttered and to further reduce the potential of breaking the lamps during operations. The lamps will be stored until sufficient quantities are amassed to contact the vendor for collection, or before the oldest containers have been stored for one year; whichever occurs first.

c) Recycling Vendor: Macon County has partnered with Southeast Recycling Technologies as an approved vendor under the State Convenience Contract 926B for the

recycling of LCM's. Macon County may wish to contract with other vendors for this service, but will only select vendors that are approved under the State Contract.

d) Emergency Response and Cleanup: In the event a mercury containing lamp(s) is(are) broken at the facility, the following procedures will be followed. An operator will put on latex gloves and put the pieces of the lamp into a sealable bag. Smaller pieces and any powder from the lamp will be collected in a dustpan with a squeegee and also placed in the bag. Finally, the operator will use a moistened scrubbing towel to wipe down any residual waste and the squeegee and dustpan. The towel will then be placed in the bag along with the latex gloves. The bag will be sealed and placed, along with its contents into a container with a sealing lid. The date will be recorded on the container, and the container will be forwarded to the universal waste lamp recycler within ninety (90) days.

Macon County Solid Waste
Universal Waste Log

Date	Waste Type and Quantity					Generator	
	Fl. Lamp 4'	Fl. Lamp 8'	CFL	Other	Thermostat	Commercial	Residential

As part of the Macon County Solid Waste program to accept Universal Waste Mercury Containing Lamps and Devices; this sign will be posted on the secured enclosure delineating the waste handling area:

Universal Waste Handling Area

Macon County is a small quantity universal waste handler. Please ask for assistance. **DO NOT** disturb this area if you are not part of staff trained in proper handling of universal waste bulbs.

STAFF: Each Container must be labeled with the following information

UNIVERSAL WASTE LAMPS/DEVICES
Macon County Solid Waste
Accumulation Start Date

CONTAINER MUST BE CLOSED AT ALL TIMES WHEN NOT ACTIVELY FILLING CONTAINER

DO NOT STORE NEW AND USED BULBS IN THE SAME CONTAINER

DO NOT PLACE LAMPS IN CONTAINERS THAT ARE TAPED OR BOUND TOGETHER

ALWAYS FOLLOW EMERGENCY RESPONSE PROCEDURES IN THE EVENT OF BULB BREAKAGE

Section 7: Closure and Post-Closure Plan

CLOSURE and POST CLOSURE PLAN

MACON COUNTY MSW LANDFILL
PERMIT TO CONSTRUCT
PHASE 3 CELL 1
MACON COUNTY, NORTH CAROLINA

MARK D. CATHEY, P.E.

McGill ASSOCIATES

Engineering • Planning • Finance
Asheville, North Carolina

NORTH CAROLINA PROFESSIONAL SEAL 024993 ENGINEER MARK D. CATHEY

6-2-15

May 2015

13.00726

CLOSURE AND POST-CLOSURE PLAN

Macon County MSW Landfill

Phase 3 Cell 1

The final cap system for the Phase 3 Cell 1 Expansion at the Macon County MSW Landfill will be constructed in a progressive manner. As substantial areas of the landfill are brought to final grade, the cap system will be constructed in order to minimize infiltration of stormwater and to reduce leachate production. The Phase 3 Cell 1 Expansion, which covers a total area of approximately 7.6 acres, is estimated to reach capacity in 2022.

1.0 CAP DESCRIPTION AND CONSTRUCTION

A detail of the final cap is shown on Sheet C-501 of the permit drawings. The cross-section will consist of a one-foot layer of compacted on-site soils (intermediate cover), a compacted clay liner with a minimum thickness of 18 inches and a maximum permeability of 1.0 $x10^{-5}$ cm/sec, a 40-mil HDPE textured geomembrane, a double-sided geocomposite drainage layer, and a vegetative supportive layer with a minimum thickness of 24 inches.

1.1 Cap Foundation (intermediate cover)

The cap foundation cover (intermediate cover) is designed to minimize infiltration of stormwater into the landfill prior to placement of the barrier cap, and to provide a sound working platform over the municipal solid waste. The compacted intermediate cover will extend over the entire waste area and consist of compacted soil with a minimum thickness of 12 inches.

1.2 Clay Liner

The composite cap system consists of an 18-inch thick compacted clay layer and an overlying textured geomembrane. The clay liner is the first portion of the composite cap system. The function of the clay liner is to minimize surface water infiltration into the underlying waste cell. The clay liner must be constructed of clay soil with a minimum thickness of 18 inches and a maximum permeability of 1.0 $x10^{-5}$ cm/sec. The clay soil may consist of on-site soils, off-site soils, or a combination of the two. The soil may require the addition of bentonite to meet the permeability requirements. The design of the landfill cap provides for a minimum number of penetrations through the low permeable barrier cap. The only anticipated penetrations will be for leachate collection piping cleanouts and methane gas system wells.

1.2a - Construction Requirements

Construction methods for the compacted clay liner shall be based upon the type and quality of the borrow source and shall be verified in the field by constructing test pad(s). The CQA engineer shall ensure that the compacted clay liner installation conforms to the Design Study approved by the Division of Solid Waste (Division), including the following minimum requirements:

1. A test pad shall be constructed prior to beginning installation of the compacted clay liner and at any time when there is a significant change in soil material properties. The location, equipment,

liner thickness, and subgrade slope and conditions shall be representative of full-scale construction. Acceptance and rejection criteria shall be based on results from the tests as specified in Section **1.2b**. For each lift, a minimum of three (3) locations shall be established for testing moisture content and density, and collecting a composite sample for recompacted lab permeability. In addition, at least one shelby tube sample, or another in-situ test approved by the Division, shall be collected or performed for each lift of the test pad constructed. These samples will be used for performing lab permeability tests.

2. Soil conditioning, placement, and compaction shall be maintained within the range identified in the moisture-density-permeability relation developed in accordance with Section **1.2b**.

3. The final compacted thickness of each lift shall be a maximum of six inches.

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

5. The final lift shall be adequately protected from environmental degradation.

1.2b - Construction Quality Assurance Requirements

clay liner - The project engineer shall ensure that the clay liner installation conforms to the Division approved Site Specific Construction Quality Assurance Plan. All (CQA) requirements for the clay liner installed as part of the landfill cap system will be the same requirements that the clay liner installed as part of the composite base liner system. The only difference is as follows:

- The clay liner portion of the cap system is required to have a permeability not greater than 1.0 x 10^{-5} cm/sec and must have a minimum thickness of 18 inches. The clay liner portion of the composite base liner is required to have a permeability not greater than 1.0 x 10^{-7} cm/sec and a minimum thickness of 24 inches, or a geosynthetic composite liner (GCL) system consisting of a minimum 18 inches of compacted soil with a permeability not greater than 1.0 x 10^{-5} overlain with a GCL material with a demonstrated hydraulic conductivity of not more than 5 x 10^{-9} cm/sec under the anticipated confining pressure.

1.3 Geomembrane Liner

The geomembrane liner is the second portion of the composite cap system. The geomembrane liner shall have a demonstrated vapor transmission rate of not more than 0.03 gm/m^2-day. The liner material and any seaming materials shall have chemical and physical resistance not adversely affected by environmental exposure, waste placement and leachate generation. The type of geomembrane used for constructing the composite cap system shall be in accordance with this section and approved by the Division.

- **i.** High density polyethylene (HDPE) geomembrane liners shall have a minimum thickness of 40 mils.
- **ii.** The minimum thickness of any geomembrane approved by the Division shall be greater than 30 mils.

geonet drainage layer - A double-sided, eight (8)-ounce geocomposite will be placed on top of the 40-mil textured geomembrane. The materials used for the geonet drainage layer shall comply with the following:

- **i.** The chemical properties of the drainage layer materials shall not be adversely affected by waste placement or leachate generated by the landfill.
- **ii.** The physical and hydraulic properties of the drainage layer materials shall promote lateral drainage of leachate through a zone of relatively high permeability or transmissivity under the predicted loads imposed by overlying materials.

1.3a - Construction Requirements

The project engineer shall ensure that the geomembrane installation conforms to the requirements of the manufacturer's recommendations and the Division approved plans including the following:

- **i.** The surface of the supporting soil upon which the geomembrane will be installed shall be reasonably free of stones, organic matter, protrusions, loose soil, and any abrupt changes in grade that could damage the geomembrane;
- **ii.** Field seaming preparation and methods, general orientation criteria, and restrictive weather conditions approved by the Division;
- **iii.** Approved Anchor trench design;
- **iv.** Critical tensile forces and slope stability;
- **v.** Protection from environmental damage; and
- **vi.** Physical protection from the materials installed directly above the geomembrane.

geonet drainage layer - The construction of the geonet drainage layer shall conform to the following:

- **i.** The drainage layer materials shall be placed according to the Division approved plans and in a manner that prevents equipment from working directly on the geomembrane.

ii. The drainage layer materials shall be stable when placed on the slopes specified on the construction plans.

1.3b - Construction Quality Assurance Requirements

geomembrane liner - The project engineer shall ensure that the geomembrane installation conforms to the requirements of the manufacturer's recommendations and the Division approved Site Specific Construction Quality Assurance Plan.

geonet drainage layer - The project engineer shall ensure that the geonet installation conforms to the requirements of the manufacturer's recommendations and the Division approved Site Specific Construction Quality Assurance Plan.

1.4 Methane Gas Removal System

The proposed methane gas collection system for Phase 3 Cell 1 has been shown on the final cap grades drawing in the permit drawings. The proposed system will be consist of passive gas vents, installed as shown in the detail for the passive gas vent on Sheet C-502 of the permit drawings.

An HDPE boot will be placed at the area where the passive gas vent penetrates the geomembrane to retard surface water infiltration into the waste layers. A bentonite/soil mixture will also be placed and compacted around the gas vents where the vents penetrate the clay liner.

The Construction Quality Assurance representative will observe and photo document the installation of each passive gas vent installed in the final cap of the landfill.

1.5 Final Cover

The final cover will be a total of 24-inches thick. The soil cover will be suitable to provide support for a vegetative cover and protect the low-permeability barrier.

1.5a - Materials Required

A grass cover is proposed for the Landfill to provide the required cover while minimizing cap maintenance. The surface will be prepared by fertilizing and placing seed in accordance with the North Carolina Erosion and Sediment Control Standards. The lower 12 inches of the final cover will be constructed of native soils. Although the material will not be required to have a specific classification or permeability, it should be a cohesive soil. The upper 6 inches of the final cover should be suitable for supporting vegetative growth. The materials used for the top portion of the final cover shall meet the following criteria:

i. Uppermost soil

Natural, friable, loamy soil, typical of local soil which produces heavy vegetative growth; free from subsoil, weeds, sods, stiff clay, stones larger than 1 inch, toxic substances, litter, or other foreign material harmful to plant growth; having a pH between 6.0 and 7.0.

GRADING ANALYSIS

Sieve	Minimum Percent Passing
2 inch	100
No. 4	90
No. 10	80

Topsoil shall contain sand, silt, and clay as required by AASHTO M146.

	Minimum Percent	Maximum Percent
Sand	20	75
Silt	10	60
Clay	5	30

ii. <u>Fertilizer and/or Compost</u>:

The uppermost soil material shall be tested prior to spreading to determine the amount of fertilizer and/or compost material that should be added to achieve optimum growth potential of the required vegetative cover.

The quality of fertilizer and/or compost and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Fertilizer Law and regulations adopted by the North Carolina Board of Agriculture.

Fertilizer and/or compost shall be 10-10-10 grade. Upon written approval of the Engineer a different grade of fertilizer may be used, provided the rate of application is adjusted to provide the same amounts of plant food.

During handling and storing, the fertilizer shall be cared for in such a manner that it will be protected against hardening, caking, or loss of plant food values. Any hardened or caked fertilizer shall be pulverized to its original conditions before being used.

i. <u>Lime</u>:

The uppermost soil material shall be tested prior to spreading to determine the amount of lime that should be added to achieve optimum growth potential of the required vegetative cover.
The quality of lime and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Lime Law and regulations adopted by the North Carolina Board of Agriculture.

During the handling and storing, the lime shall be cared for in such a manner that it will be protected against hardening and caking. Any hardened or caked lime shall be pulverized to its original condition before being used.

Lime shall be agriculture grade ground dolumitic limestone. It shall contain not less than 85% of the calcium and magnesium carbonates and shall be of such fineness that at least 90% will pass a No. 10 sieve and at least 50% will pass a No. 100 sieve.

iv. <u>Seed</u>:

The quality of seed and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Seed Law and regulations adopted by the North Carolina Board of Agriculture.

Seed shall have been approved by the North Carolina Department of Agriculture or any agency approved by the Engineer before being sown, and no seed will be accepted with a date of test more than nine (9) months prior to the date of sowing. Such testing however, will not relieve the Contractor from responsibility for furnishing and sowing seed that meets these specifications at the time of sowing. When a low percentage of germination causes the quality of the seed to fall below the minimum pure live seed specified, the Contractor may elect, subject to the approval of the Engineer, to increase the rate of seeding sufficiently to obtain the minimum pure live seed contents specified, provided that such an increase in seeding does not cause the quantity of noxious weed seed per square yard to exceed the quantity that would be allowable at the regular rate of seed.

During handling and storing, the seed shall be cared for in such a manner that it will be protected from damage by heat, moisture, rodents, or other causes.

Seed shall be entirely free from bulblets or seed of Johnson Grass, Nutgrass, Sandbur, Wild Onion, Wild Garlic, and Bermuda Grass. The specifications for restricted noxious weed seed refers to the number per pound, singly or collectively, of Blessed Thistle, Wild Radish, Canada Thistle, Corncockle, Field Bindwee, Quackgrass, Dodders, Dock, Horsenettle, Bracted Plantain, Buckhorn or Wild Mustard; but in no case shall the number of Blessed Thistle or Wild Radish exceed 27 seeds of each per pound. No tolerance on weed seed will be allowed.

v. <u>Mulch</u>:

Straw mulch shall be threshed straw of oats, rye or wheat free from matured seed of obnoxious weeds or other species which would grow and be detrimental to the specified grass.

1.5b - Construction Requirements

Uppermost soil shall be placed according to the following requirements:

i. Use equipment and methods to prevent damage to other components of the final cap system such as the clay liner, 40-mil textured geomembrane, and gas collection piping.

ii. The uppermost soil shall be spread by utilizing small equipment with a relatively low ground pressure. This will reduce the potential of the underlying layers of the final cap being damaged. Prior to placing topsoil, shape the underlying soil layer to graded lines and cross sections to provide for 6 inches of compacted topsoil. Clear the underlying soil layer of materials larger than 2" in diameter.

iii. After alignment of the underlying soil, loosen and till to a depth of 6 inches by disking, harrowing, rototilling, or other approved methods to assure that the topsoil layer properly adheres to the underlying soil layer.

iv. After the condition of the underlying soil layer has been approved by the on-site CQA personnel, place and spread topsoil to achieve required depth after compaction; rake and remove materials larger than 2 inches. Compact with approved roller equipment, grade to finished tolerances, and prepare the seedbed in accordance with the approved Phase 3 Cell 1 Technical Specifications

Seed, fertilizer and lime shall be applied according to the following:

Seed shall be applied by means of a hydro-seeder or other approved methods. The rates of application of seed, fertilizer and limestone shall be as stated below, unless pre-construction testing is contrary to these rates and can be documented.

All rates are in pounds per acre:

Fertilizer and/or compost - 1000 lbs. per acre
Lime - 4,000 lbs. per acre
KY-31 Fescue - 100 lbs. per acre
Straw mulch – 60 to 80 bales

For summer seeding the following shall be added:

- German Millet - 10 lbs. per acre
- Sudangrass – 15 lbs. per acre

For winter seeding the following shall be added:

- Rye grain – 15 lbs. per acre

For steep slopes the following shall be added:

- Sericea Lespedeza – 40 lbs. per acre

Equipment to be used for the application, covering or compaction of limestone, fertilizer, compost, and seed shall have been approved by the Engineer before being used on the project. Approval may be revoked at any time if equipment is not maintained in satisfactory working condition, or if the equipment operation damages the seed. Limestone, fertilizer, compost, and seed shall be applied within 24 hours after completion of seedbed preparation unless otherwise permitted by the Engineer, but no limestone, fertilizer, or compost shall be distributed and no seed shall be sown when the Engineer determines that weather and soil conditions are unfavorable for such operations.

Limestone may be applied as a part of the seedbed preparation, provided it is immediately worked into the soil. If not so applied, limestone and fertilizer shall be distributed uniformly over the prepared seedbed at the specific rate of application and then harrowed, raked, or otherwise thoroughly worked or mixed into the seedbed.

Seed shall be distributed uniformly over the seedbed at the required rate of application, and immediately harrowed, dragged, raked, or otherwise worked so as to cover the seed with a layer of soil. The depth of covering shall be as directed by the Engineer. If two kinds of seed are to be used which require different depths of covering, they shall be sown separately.

When a hydraulic seeder is used for application of seed and fertilizer, the seed shall not remain in water containing fertilizer for more than 30 minutes prior to application unless otherwise permitted by the Engineer.

Immediately after seed has been properly covered the seedbed shall be compacted in the manner and degree approved by the Engineer.

<u>Mulch shall be applied according to the following</u>:

It shall be spread uniformly at the rate give above and in a continuous blanket over the areas specified.

Before mulch is applied on cut or fill slopes which are 3:1 or flatter, and ditch slopes, the Contractor shall remove and dispose of all exposed stones in excess of 2 inches in diameter and all roots or other debris which will prevent proper contact of the mulch with the soil.

Mulch shall be applied within 24 hours after the completion of the seeding unless otherwise permitted by the Engineer. Care shall be exercised to prevent displacement of soil or seed or other damage to the seeded area during the mulching operations.

Mulch shall be uniformly spread by hand or by approved mechanical spreaders or blowers that will provide an acceptable application. An acceptable application will be that which will allow some sunlight to penetrate and air to circulate but also partially shade the ground, reduce erosion, and conserve soil moisture.

Mulch shall be held in place by applying a sufficient amount of approved binding material to assure that the mulch is properly held in place. The rate and method of application of binding material shall meet the approval of the Engineer. Where the binding material is not applied directly with the mulch, it shall be applied immediately following the mulch operation.

The Contractor shall take sufficient precautions to prevent mulch from entering drainage structures through displacement by wind, water, or other causes and shall promptly remove any blockage to drainage facilities that may occur.

1.4c - Construction Quality Assurance Requirements

Macon County will ensure that the materials described above are utilized for the final cover and that their placement is done in accordance with the above detailed Construction Requirements. The project engineer will ensure that the materials and methods described above are utilized to construct the final cover system, and that all requirements of the Site Specific Construction Quality Assurance Plan are met.

2.0 ON-SITE WASTE INVENTORY

At closure, the amount of waste on site is estimated to be:

Existing Phases 1 & 2	- 702,000 tons
Proposed Phase 3 Cell 1	- 162,000 tons
Total	864,000 tons

3.0 CLOSURE SCHEDULE

3.1 Notification of Division of Solid Waste

Prior to beginning closure of the Macon County MSW Landfill, the Macon County will notify the Division of Solid Waste of the intent to close the landfill.

Probable Date of Closure: Summer 2022

3.2 Begin Closure

Macon County will begin closure activities of the Macon County MSW Landfill unit no later than 30 days after the date on which the MSWLF unit receives the known final receipt of wastes or, if the MSWLF unit has remaining capacity and there is a reasonable likelihood that the MSWLF unit will receive additional wastes, no later than one year after the most recent receipt of wastes. Extensions beyond the one-year deadline for beginning closure may be granted by the Division if the owner or operator demonstrates that the MSWLF unit has the capacity to receive additional wastes and the owner or operator has taken and will continue to take all steps necessary to prevent threats to human health and the environment from the unclosed MSWLF unit.

Probable Date: Fall 2022

3.3 Completion of Closure

Macon County will complete closure activities of the Macon County MSW Landfill in accordance with the closure plan within 180 days following the beginning of closure. Extensions of the closure period may be granted by the Division if the owner or operator demonstrates that closure will, of necessity, take longer than 180 days and they have taken and will continue to take all steps to prevent threats to human health and the environment from the unclosed MSWLF unit.

Probable Date: Summer 2023

3.4 Recording of Closure

Following closure of the Macon County MSW Landfill, Macon County will record a notation on the deed to the Macon County MSW landfill facility property, or some other instrument that is normally examined during a title search, and notify the Division that the notation has been recorded.

The notation on the deed must in perpetuity notify any potential purchaser of the property that:

1. The land has been previously used as a landfill facility; and
2. Its use is restricted under the Division of Solid Waste approved Closure Plan

Probable Date: Fall 2023

3.5 Engineer's Certification

Following closure, Macon County shall notify the Division of Solid Waste that a certification, signed by the project engineer verifying that closure has been completed in accordance with the closure plan, has been placed in the operating record.

4.0 POST CLOSURE PLAN

4.1 Inspections

Following closure of each MSWLF unit, the owner or operator shall conduct post-closure care for 30 years, except as provided under .1627(d)(2) of the Solid Waste Rules. Inspections of the final cover will be performed according to the table below and the condition of the facility will be recorded with notes, maps, and photographs. Since Macon County intends to operate the Macon County MSW Landfill after Phase 3 Cell 1 has reached capacity, landfill personnel will be on-site to perform inspections on a frequent basis.

The inspection will take notice of:

1. Eroded banks
2. Patches of dead vegetation
3. Animal burrows

4. Subsidence (settlement)
5. Cracks along the cover
6. Any areas of run-on or eroded run-off.

The inspector will note the condition of:

1. Concrete catch basins and stormwater control facilities
2. Leachate collection and removal pipes
3. Gas monitoring wells
4. Water monitoring wells

Areas showing subsidence, cracking, signs of erosion, or damage are to be repaired.

Schedule of Inspections

Years (following closure)	Minimum Yearly Inspections
0-2	4
2-30	2

4.2 Maintenance

The vegetative cover will be trimmed at least two times a year. In the early stages of development, fertilization and/or compost will be applied annually as needed.

The leachate collection and removal pipes will be flushed and pressure-cleaned annually.

The Gas Removal System will be inspected annually, and cleaned as necessary.

Vegetative growth around gas collection wells will be cleaned away and all wells will be clearly marked to prevent accidental damage.

4.3 Monitoring

Explosive gas monitoring will take place on a quarterly basis according to the procedural outline contained in the LFG Monitoring Plan.

Surface and ground water testing will take place semiannually or as directed by the Division of Solid Waste.

The leachate will also be sampled semi-annually to determine the quality and constituents present. Leachate will be analyzed for Appendix 1 constituents as well as BOD, COD, phosphate, nitrate, sulfate, and pH.

4.4 Leachate collection and treatment

Until it can be demonstrated that leachate concentrations become low enough so as not to pose a threat to human health or the environment, leachate collection and treatment shall continue in accordance with the requirements in Rules .1624 and .1626. Such a demonstration should address

direct exposures of leachate releases to ground water, surface water or seeps. Indirect effects, such as accumulated leachate adversely affecting the chemical, physical, and structural containment systems that prevent leachate release, also should be addressed in the demonstration.

4.5 Planned use and personal contact

Preliminary proposals for the planned use of the facility, following Closure includes developing exercise and bike trails along the periphery of the landfill property and a light industry associated with the combustion of methane gas. Any alternate use of the landfill after closure has been completed will be approved by the Division of Solid Waste prior to implementation. The person to contact regarding the facility during the Post-Closure period is:

Macon County Solid Waste Department
Mr. Chris Stahl, Solid Waste Director
1448 Lakeside Drive
Franklin, North Carolina 28734
Telephone (828) 349-2100

4.6a Water Quality Monitoring Plan

A Design Hydrogeologic Report and Environmental Monitoring Plan for Phase 3 Cell 1 of the Macon County MSW Landfill was prepared by BLE, Inc. This includes discussion of the existing monitoring system, proposed monitoring system, additional well construction, water level monitoring, aquifer testing, and groundwater sampling and analysis.

4.6b Landfill Gas Monitoring Plan

A Landfill Gas Monitoring Plan for Phase 3 Cell 1 of the Macon County MSW Landfill was prepared by BLE, Inc. This includes discussion of the existing monitoring system, proposed monitoring system, and landfill gas testing and reporting procedures.

4.7 Engineer's Certification

Following completion of the post-closure care period, Macon County shall notify the Division of Solid Waste that a certification, signed by the project engineer verifying that post-closure care has been completed in accordance with this post-closure plan, has been placed in the operating record.

5.0 LEACHATE STORAGE CLOSURE PLAN

Macon County shall complete the closure activities outlined in this plan within 180 days after liquid collection has ceased.

A. At closure, the liner and all solid waste shall be removed from the lagoon and connecting lines. The lagoon liner and all solid waste removed shall be properly handled and disposed of according to Federal and State requirements. All connecting lines shall be disconnected and securely capped or plugged.

B. The lagoon site will be modified to act as a stormwater management feature.

6.0 Closure and Post Closure Cost Analysis and Summary

6.1 Closure Cost Estimate

			Unit Cost		Total Cost
Item 1 - Mobilization			Lump Sum		$60,059
Item 2 - Erosion and Sedimentation Control					
400	L.F..	Sediment Barriers	$5.47	/L.F.	$2,188
8	Acres	Grassing	$1,504.91	/Acres	$12,039
30	C.Y.	Rip Rap	$65.67	/C.Y.	$1,970
800	L.F.	Letdown Flume	$19.70	/L.F.	$15,760
Item 3 - Earthwork					
18,500	C.Y.	18-inch Clay Cap	$3.29	/C.Y.	$60,865
25,000	C.Y.	24-inch Vegetative Cover	$2.74	/C.Y.	$68,500
Item 4 - Geosynthetics					
331,056	S.F.	40 Mil Textured HDPE	$0.55	/S.F.	$182,081
331,056	S.F.	Double Sided Geocomposite Drainage Net	$0.43	/S.F.	$142,354
Item 5 - Access Road					
1,300	S.Y.	6" ABC, 6" RR	$9.85	S.Y.	$12,805
Item 6 - Gas Controls					
9	Each	Gas Vents	$1,641.71	Each	$14,775
Item 7 - Testing / Documentation			Lump Sum		$172,529
		Subtotal	Construction Cost		**$745,925**
Item 8 - Engineering / Inspection (@±5% of Const. Cost)					$37,296
Item 9 - Legal / Administration (@±1% of Const. Cost)					$7,459
Item 10 - Contingencies (@±5% of Const. Cost)					$37,296
		MSW Landfill Total Closure Cost			**$827,976**
		Phase 3 Cell 1 Area			7.60
		Cost per Acre			$108,944.21

6.2 Post-Closure Cost Estimate

Item 1 - Environmental Monitoring			**Total Annual Cost**
Semi-Annual Ground Water Monitoring - 4 Wells @ $500.00/well/event x 2 events/yr			$2,000
Semi Annual Surface Water Monitoring - 4 points @ $500.00/each/event x 2 events/yr			$4,000
Semi-Annual Leachate Monitoring - 1 sample @ $500.00/each/event x 2 events/yr			$1,000
Methane monitoring (by County Staff)			$0
Item 2 - Routine Repairs			
0.5 acre repair, 1 foot depth, re-seeding, silt fence			$5,768
Item 3 - Sediment Pond Cleanout			$1,573
Item 4 - Grass Maintenance			
Cutting - 2 cuts/yr			$3,776
Re-seeding - 5 ac/yr @ $1,221.6/ac			$6,293
Item 5 - Leachate Collection/Treatment			
Leachate Pump Operation			$4,195
Leachate System Maintenance			$5,768
Leachate Treatment - (lump sum per agreement with Town of Franklin)			$35,000
	Annual Cost Subtotal		$69,373
Contingencies - 10%			$6,937
Total Annual Cost (7.6 Acres)			$76,310
Phase 3 Cell 1 Area (acres)			7.60
Post-Closure Period			30
Financial Responsibility	**$76,310**	**x 30**	**$2,289,300**

The Closure and Post Closure costs included herein pertain only to Phase 3 Cell 1. Additional costs of the existing landfill cells will be required as well. The overall Macon County MSWLF Financial Assurance Document will be updated once Phase 3 Cell 1 receives a Permit to Operate.

7.0 FINANCIAL ASSURANCE

The Financial Assurance provision of Subtitle D provides that owner and operators of Municipal Solid Waste Landfills (MSWLF) must provide for certain minimum measures to insure that the funds to meet the requirements of the regulations governing closure, post-closure and corrective action activities are available in the event that these actions are not taken by the owner or operator. The regulations addressing financial assurance are embodied in North Carolina Rule .1628.

7.1 NORTH CAROLINA RULE .1628

In general, Rule .1628 provides that the owner and/or operator must:

1. Provide accurate cost estimates for the closure and post-closure care.
2. Select a mechanism for demonstrating financial assurance.
3. Maintain the selected mechanism in compliance with the provisions of Rule .1628 throughout the period for which the owner/operator is subject to the provisions of Subtitle D and Rule .1628.

The Rule provides for the following alternative mechanisms for demonstrating financial assurance:

1. Trust Fund.
2. Surety bond Guaranteeing Payment or Performance.
3. Letter of Credit.
4. Insurance.
5. Capital Reserve Fund.
6. Local Government Financial Test.
7. Multiple Mechanisms.

Macon County has reviewed the requirements associated with each of these mechanisms and assessed the costs related to their use as the County‘s financial assurance mechanism. Although the relative cost of these mechanisms does not appear to vary significantly, there are various factors associated with their availability and practicality, which make certain of the mechanisms less attractive than others.

7.2 LOCAL GOVERNMENT FINANCIAL TEST

Therefore, Macon County has elected to adopt the LOCAL GOVERNMENT FINANCIAL TEST. The Local Government Financial Test is attractive because the County’s excellent financial conditions makes passing the test quite feasible. Macon County has not had any difficulties passing the LOCAL GOVERNMENT FINANCIAL TEST in recent years and there are not any circumstances that would indicate that this would change.

Section 8: Technical Specifications

TECHNICAL SPECIFICATIONS

PERMIT TO CONSTRUCT
MACON COUNTY MSWLF
PHASE 3 CELL 1

MACON COUNTY, NORTH CAROLINA

Mark D. Cathey, PE

McGill ASSOCIATES

Engineering • Planning • Finance
Post Office Box 2259
Asheville, North Carolina 28802

NORTH CAROLINA PROFESSIONAL SEAL 024993 ENGINEER MARK D. CATHEY

6-2-15

May 2015

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02400	LEACHATE COLLECTION REMOVAL SYSTEM (LCR)
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PART 1: GENERAL

1.01 SCOPE OF WORK

A. General: The work included in this section consists of the grading of the project area. The work includes:

1. Site clearing and on-site disposal of all debris and unsuitable material.

2. Removal of all topsoil, organically contaminated soil and existing unsuitable fill. Topsoil shall be stockpiled on site in a location supplied by the owner.

3. Proofrolling and grading of the property to the prescribed elevations.

4. Stockpiling or wasting on site of any excess cut material for providing acceptable material as required to obtain the desired grades.

5. Construction of earthen embankments.

6. Placement of Fill Material in order to bring the site to subgrade elevations, prior to placement of landfill components.

1.02 SITE CONDITIONS

A. Site Information: The boring logs and related information depict approximate subsurface conditions only at these specific locations and at the particular time designated on the logs. Subsurface conditions at other locations may differ from those reported at the boring locations. It is expressly understood that neither the Owner nor the Engineer will be responsible for interpretations or conclusions drawn from the boring data by the Contractor. The data are made available for the convenience of the Contractor. Test borings and other exploratory operations may be undertaken by the Contractor at his own expense, provided such operations are acceptable to the Owner.

PART 2: PRODUCTS

2.01 MATERIALS

A. Unstable Material:

1. The entire area within the limit of work shall be cleared and grubbed and shall be cleaned of all debris. Under the structures, paved, and fill areas; stumps, roots, logs, matted roots and other debris not suitable for foundations purposed shall be removed to a minimum depth of eighteen (18) inches below any subgrade. The resulting excavation shall be backfilled with suitable material and compacted as specified hereinafter for Fill Material. Cleared materials shall be completely removed from within the limits of work and disposed of on site by the Contractor at a location approved by the Owner.

2. Topsoil shall be carefully stripped to its full depth from all areas indicated to be graded, or to be built upon. Stripped topsoil shall be stockpiled on site at a location supplied by the Owner and protected for reuse later.

3. All areas to receive fill shall be stripped of root mat five (5) feet beyond toe of anticipated fills. Topsoil, all vegetation, such as roots, brush, heavy sods, heavy growth of grass, and all decayed vegetable matter, rubbish and other debris within the area upon which fill is to be placed, shall be stripped or otherwise removed before the fill placement begins. In no case will such objectionable material be allowed to remain in or under the fill area.

4. Soft or excessively yielding material shall be removed and replaced with inert controlled fill.

B. Structural Fill Material:

1. Material to be used for structural fill shall be approved by the Project Engineer.

2. All roots, organic matter, trash, debris, and other unsuitable materials that may find their way into otherwise acceptable structural fill material shall be removed during the dumping and spreading operations.

3. Broken rock and boulders larger than six inches (6”) in any dimension may not be used as structural fill without the specific approval of the Project Engineer.

4. Frozen soil shall not be used for fill.

5. Structural Fill material shall meet the following minimum requirements and/or be tested for the following criteria in accordance with the Site Specific Construction Quality Assurance Plan:

Test	Test Method	Frequency	Acceptable Values
Minimum Laboratory Dry Weight	ASTM D-698	1/5,000 YD^3	> 100 lbs. / FT^3
Natural Moisture Content	ASTM D-2216	1/5,000 YD^3	Reference Only
Laboratory Compaction	ASTM D-698	1/5,000 YD^3	95% Maximum Dry Density

PART 3: EXECUTION

3.01 PREPARATION

A. Subgrade Preparation:

1. After removal of all existing topsoil, debris, and other undesirable material, the areas which are to receive fill, which have been cut to the desired grade, or which are at the approximate required subgrade elevation without additional earthwork, should be proofrolled to locate any soft or yielding area. Proofrolling shall be done with a smooth-drum roller (minimum 20 tons) making a minimum of two passes in each direction or other procedures and equipment approved by the Project Engineer. In addition, the following tests shall be performed at the frequencies indicated:

Test	Test Method	Frequency	Acceptable Values
Field Density	ASTM D-6938, ASTM D-1556, ASTM D-2937	1/5,000 YD^3	95% Maximum Dry Density
Field Moisture	ASTM D-2216, ASTM D-6938, ASTM D-4643	1/5,000 YD^3	+/- 2% Optimum

2. Any soft, or excessively yielding material revealed by the proofrolling shall be removed and replaced with inert controlled fill. The Engineer shall be the sole judge of what constitutes soft or excessively yielding material.

3. Drainage from existing watercourses, springs or other sources should be rerouted out of the earthwork area. The Contractor shall take special care to remove all organically contaminated sediment, saturated soil, and other undesirable material from existing watercourses.

B. Blasting and Damages: Where blasting is done, it shall be done by qualified personnel and in accordance with all federal, state or local requirements and procedures. The Contractor shall be responsible for any damage done to adjoining properties, or to persons, by reason of the blasting or other earthwork operations. The Contractor shall also be responsible for damage to embankments and cut areas, and sewer, water, gas or other underground lines which may result from blasting or earthwork operations. All such damage shall be repaired and made good by the Contractor in a timely manner.

3.02 INSTALLATION

A. Filling and Compaction:

1. After a stable non-yielding surface has been established, the surface of the area to be filled shall be scarified with a disc or harrow to a depth of four inches (4") to six inches (6"). An initial three inch (3") layer of fill material shall then be spread over the scarified surface and the entire area compacted as specified below.

2. No fill shall be placed on any area until that area has been inspected and approved by the Engineer. Fill shall not be placed on a snow covered or frozen surface. Fill materials shall be spread in uniform horizontal layers not exceeding 8" in uncompacted thickness. Alternating layers of cohesive and granular fill soils shall not be permitted. Spreading and compacting of fill material should be started at the lowest portion of the site. All fill must be placed in horizontal layers. Sloping fill planes will not be permitted. Fill material shall be distributed over the full width of the embankment, and in no case will deep ruts be allowed to form.

3. Keyways shall be provided at the toe of each fill slope as shown on the drawings. As each layer of fill meets the natural grade of a slope, a bench, approximately 7 to 8 feet wide, shall be cut into the existing grade with each layer of newly placed fill. If rock is encountered at the face of the natural grade, the original ground shall be cut in vertical steps of 4 to 5 feet and a horizontal bench cut into the rock at the top of each vertical increment. A horizontal plateau, approximately 15 to 20 feet wide, should be provided in the existing slope at vertical intervals of roughly 25 feet. Subsurface

drains shall be installed at the toe of the slope and wherever springs or excessive seepage are encountered. Drains should be led to the outside face of the embankment and the water picked up and carried away in such a manner as to avoid softening the embankment or its toe, or producing erosion gullies.

4. Before compaction begins, the fill shall be brought to a water content that will permit proper compaction. This may require aerating the material if it is too wet, or the addition of water if it is too dry. If additional water is required, it should be uniformly distributed and shall be thoroughly incorporated into the material by means of discs or other suitable mixing equipment. Care shall be taken to avoid trapping water within the fill.

5. The standard Proctor method of moisture-density relationship test, ASTM D 698, shall be used to determine the maximum laboratory dry density and the optimum moisture content of the material which is to be used for fill.

6. The fill material shall be compacted and tested in accordance with the following requirements:

Test	**Test Method**	**Frequency**	**Acceptable Values**
Field Density	ASTM D-6938, ASTM D-1556, ASTM D-2937	1/5,000 YD^3	95% Maximum Dry Density
Field Moisture	ASTM D-2216, ASTM D-6938, ASTM D-4643	1/5,000 YD^3	+/- 2% Optimum

7. The above compaction requirements are to be satisfied for all soil and weathered or soft rock fills. Weathered or soft rocks are those that can be broken down and disintegrated under normal compaction procedures and equipment.

8. At the close of each day's work, or where work is to be interrupted for a period of time, the surface of the site shall be shaped to drain freely, and sealed. If after a prolonged rainfall, the surface of the area to be filled or cut is too wet to work properly, the unsuitable material shall be removed to expose workable soil. The wet material removed may be dried and reused. Construction traffic shall be controlled so as to prevent rutting of graded areas and to avoid overrolling of any section.

9. All cut areas shall be rolled and compacted to produce a compaction equal to that of the filled area. If soft or yielding material is encountered in cuts, or fills as a result of trapping water, overrolling or improper control of construction traffic, and cannot be satisfactorily stabilized by moisture control, compaction or other means approved by the Engineer, the unstable material shall be excavated to the depth required by the Engineer. The excavation shall then be filled with suitable compacted material in accordance with the requirements outlined above.

B. Grading:

1. Elevations shown on the plans are finished ground unless otherwise noted. Grading shall be maintained in such a manner as to provide free surface drainage of the site at all times without any ponding of water.

2. Provide ditches and swales to the cross-sections and grades shown on the drawings. Cut ditch subgrades four inches (4") below the grades shown and provide four inches (4") of topsoil where the plans call for seeding or sodding of the ditch. Keep ditches and swales free of accumulations of debris or washed in material until final acceptance of work by the Engineer.

3. Shape all surfaces to within not more than 0.10 feet above or below the required subgrade elevations and free from irregular surface changes.

C. Control and Testing:

1. The services of qualified soils testing personnel will be employed by the Owner for the making of tests to determine the moisture-density relationships, relative densities, plastic and liquid limits and suitability of materials for compaction and for inspection and control of the site preparation, selection, placing and compaction of the fill. A copy of the testing personnel's daily field report including results of in-place density and moisture content tests should be forwarded to the Owner and the Engineer at the end of each working day. If an independent testing firm is hired by the Contractor for the purpose of testing soil used in the construction of the landfill, the testing firm shall submit a field report to the Owner and Engineer at least once per week.

2. The Contractor shall cooperate with the testing personnel so as to permit proper inspection and control of the work without unnecessary delays.

D. Maintenance:

1. The Contractor shall be responsible during construction and until final acceptance for the maintenance of all embankments made under the Contract.

2. During construction and until final acceptance; the Contractor shall construct temporary or permanent earth berms along the outer edges of the top surface of the embankment, construct temporary ditches, shape the embankment surface to provide for the drainage of surface runoff along and throughout the length of the embankments, and use any other methods necessary to maintain the work covered by this section so that the work will not contribute to excessive soil erosion. The Contractor shall construct brush dikes, or install temporary or permanent slope drains or other drainage features to assist in controlling erosion.

3. The Contractor shall replace, at no cost to the Owner, any portion of embankment which have become displaced or damaged due to carelessness or neglect on the part of the Contractor. Where the work has been properly constructed, completely drained and properly maintained, and damage occurs due to natural causes, the Contractor will be paid at the Contract unit price for the excavated material required to make necessary repairs to such damage.

4. All embankments shall be brought to the grade and cross section shown on the plans or established by the Engineer, prior to final inspection and acceptance by the Engineer.

END OF SECTION

02201.1 SCOPE

The work of this section consists of locating, hauling, and processing the soil material used to construct the select backfill layers of soil as shown on the Construction Drawings. The purpose of the select backfill layer is to cushion the geomembrane component of the leak detection layer and protect it from damage. Borrow soils shall meet the requirements of Section 02201.2 and placement of the select backfill shall be in strict accordance with Section 02200 and the construction drawings.

02201.2 SOIL MATERIALS

Select backfill will be the soil placed between the subgrade and the leak detection layer to protect the geomembrane component of the leak detection layer from puncture. This material will have the same preconstruction and testing requirements as the subgrade, with the exception that preconstruction and construction testing will have to be performed to show conformance with the Maximum Particle Size requirements. The testing requirements are as follows.

Preconstruction Qualification			
Test	**ASTM Method**	**Frequency**	**Acceptable Values**
Natural Moisture Content	D2216	1/5,000 YD^3	Reference Only
Laboratory Compaction	D698	1/5,000 YD^3	95% maximum dry density
Grain Size	D422	1/5,000 YD^3	3-inch diameter (lower 6 inches) 1/4-inch diameter (top 6 inches
*** Preconstruction test samples shall be taken from the borrow source and or stockpile prior to construction.**			

2201.3 EXECUTION

The contractor is required to provide soil material for constructing the select backfill portion of the leak detection system in accordance with the material requirements described in 2201.2. The select backfill shall be placed in accordance with Section 02200. The following testing requirements shall apply to the placement of the Select Backfill material:

SELECT BACKFILL CONSTRUCTION TESTING FREQUENCIES			
TEST	ASTM METHOD	QUANTITY	ACCEPTABLE VALUES
Field Density	D6938, D1556, D2937	1/5,000 YD^3	95% maximum dry density
Field Moisture	D2216, D6938, D4643	1/5,000 YD^3	+/- 4% optimum
Grain Size	D422	1/5,000 YD^3	3-inch diameter (lower 6 inches) 1/4-inch diameter (top 6 inches

2201.4 **OTHER TESTING REQUIREMENTS**

The friction angle between the select backfill and the geomembrane shall be a minimum of 20 degrees. The Contractor shall verify and submit to the Project Engineer documentation of such verification prior to beginning construction. The test method used to verify the interface friction angle between the 60-mil geomembrane and the select backfill shall be ASTM D5321 *Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by Direct Shear Method*. Test parameters are to provide 3 points to range over minimum and maximum expected normal loads. Minimum will be a construction load of 260 psf. Maximum will be at the landfill's final filled condition or approximately 1,423 psf. The normal loadings used shall be 250, 750 and 1,500 psf.

The friction angle between the select backfill and the geotextile shall be a minimum of 18 degrees. The Contractor shall verify and submit to the Engineer documentation of such verification prior to beginning construction. The test method used to verify the interface friction angle between the 16-ounce geotextile and the select backfill shall be ASTM D5321 *Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by Direct Shear Method*. Test parameters are to provide 3 points to range over minimum and maximum expected normal loads. Minimum will be a construction load of 260 psf. Maximum will be at the landfill's final filled condition or approximately 1,423 psf. The normal loadings used shall be 250, 750 and 1,500 psf.

END OF SECTION

02300.1 Scope of Work

The landfill cell shall include a 24-inch compacted clay liner or a geosynthetic clay liner (GCL) system that includes an 18-inch compacted clay liner overlain by a GCL material. The Contractor shall furnish all labor, material, supervision, and equipment to complete the Compacted Clay Liner for the cell, including hauling, sieving, raking, discing, compacting, drying, wetting, removal of rainwater and removal of all previously placed material rendered unsuitable due to weather conditions or construction operations, final grading and sealing and all necessary and incidental items as detailed or required to complete the compacted liner, all in accordance with the Contract Documents, and the Site Specific Construction Quality Assurance Plan.

02300.2 Materials

Soil that meets the following requirements of clay liner fill shall be used for construction of the Compacted Clay Liner:

Preconstruction Qualification			
Test	**ASTM Method**	**Frequency**	**Acceptable Values**
Natural Moisture Content	D2216	1/1,000 YD^3 or Change in Material	Reference
Grain Size Analysis	D422 or D1140	1/5,000 YD^3 or Change in Material	< 3” in the lower 18”, < ¼” in the upper 6”, < 5% greater than No. 4 sieve
Classification	D2487	1/5,000 YD^3 or Change in Material	CL,CH,ML,MH, or SM
Atterberg Limits	D4318	1/5,000 YD^3 or Change in Material	Plasticity Index (PI) > 10
Laboratory Compaction	D698 – Standard	1/5,000 YD^3 or Change in Material	95% Maximum Dry Density
Permeability ** 24-inch compacted clay liner	D5084	1/10,000 YD^3 or Change in Material	Less than or equal to 1 x 10^{-7} cm/sec
Permeability** 18-inch compacted clay liner utilized with GCL system	D5084	1/10,000 YD^3 or Change in Material	Less than or equal to 1 x 10^{-5} cm/sec

* Preconstruction test samples shall be taken from the borrow source and or clay stockpiled prior to construction.

** The Moisture-Density Curve shall show the region in which the required maximum permeability is met. A minimum of three (3) permeability tests shall be performed per curve to establish the zone of acceptable moistures and densities at which the required maximum permeability may be achieved. If the Contractor elects to run multiple curves to enlarge the zone of acceptance, all curves must be submitted.

All clay clods will be broken down with tillers and discs to provide a homogeneous clay soil.

The Compacted Clay Liner may consist of fill material modified by the addition of powdered bentonite in sufficient quantity to meet the specifications. Clay liner material modified with bentonite will be subject to the same testing criteria and frequencies as natural clay liner material, with the addition of percentage of bentonite used. If a bentonite admix is used, the mixing procedure shall be approved by the Engineer prior to construction. Material to be placed within the cell, either natural or augmented, shall have a minimum effective internal friction angle of twenty-five (25) degrees. The internal friction angle of the clay liner material shall be verified by the Contractor. The Contractor shall submit such verification prior to beginning construction. The test method used to verify the internal friction angle of the clay liner material shall be ASTM D4767 *Standard Test Method for Consolidated Undrained Triaxial Compression Test on Cohesive Soils*. The specimens must be compacted to design criteria for dry density and moisture content as determined by preconstruction testing. Test parameters require stepped confinement @ 1, 3, and 5ksf (nominally 5, 15 and 30 psi effective confining pressure).

Continuous and repeated visual inspection of the materials will be performed by the Contractor to ensure proper soils are being used. In addition, the Engineer will make frequent inspections of the clay liner placement operations and materials, and will consult with the Contractor on suitable liner fill and locations of such. All soil liner fill proposed shall be inspected by the Engineer prior to actual use.

02300.3 <u>Construction</u>

The following testing requirements and acceptable values shall apply to the construction of the Compacted Clay Liner unless specified otherwise as in the case of the construction of the required Test Pads:

Construction Testing			
Test	**ASTM Method**	**Frequency**	**Acceptable Values**
Field Density	D6938, D1556, D2973	1/10,000 FT^2/Lift	95% Maximum Dry Density
Field Moisture	D2216, D6938, D4643	1/10,000 FT^2/Lift	+0% - +5% optimum- Cell Floor +2% - +6% optimum – Side Slopes
Classification	D2487	1 per acre per lift	CL,CH,ML,MH, or SM
Permeability	Extracted per D1587 Tested per D5084	1/40,000 FT^2/Lift	Less than or equal to 1 x 10^{-7} cm/sec
Atterberg Limits	D4318	1/5,000 YD^3	Plasticity Index (PI) > 10
Grain Size	D422 or D1140	1/5,000 YD^3	< 3" in the lower 18", < ¼" in the upper 6", < 5% greater than No. 4 sieve
Soil Layer Thickness For 24-inch compacted clay liner	Observation, Field Measurement	Continuous Observation, Minimum of Five (5) per Lift	Minimum two (2) foot thick
Soil Layer Thickness For 18-inch compacted clay liner used with GCL	Observation, Field Measurement	Continuous Observation, Minimum of Five (5) per Lift	Minimum 18 inches thick

TEST PADS

Test pads, a minimum of 20 ft x 50 ft in area shall be constructed prior to beginning installation of the compacted clay liner and whenever there is a significant change in soil material properties or the borrow source is changed. The equipment used, liner thickness, subgrade slope, and all other conditions shall be representative of full scale construction. For each lift of the test pad, a minimum of three (3) test locations shall be established for testing moisture content and density. At least one (1) shelby tube sample for lab permeability testing and one (1) composite sample for recompacted lab permeability shall be obtained per lift/test pad. One test pad shall be constructed which shall be representative of the side slope clay liner and one for the cell floor. The test pads can be

constructed independent of each other or in such a manner so that one test pad lies on the cell bottom and the other test pad lies on the side slope. Compaction and soil moisture content shall be in accordance with the previously approved moisture-density-permeability relationship. Field moisture and density tests and laboratory permeability tests will be performed by the Resident CQA Engineer for each lift placed on the test pads to verify the construction method, equipment, and material necessary to achieve the required permeability not greater than 1.0×10^{-7} cm/sec for the 24-inch clay liner or 1.0×10^{-5} for the 18-inch clay liner associated with a GCL system. The Contractor shall allow sufficient time for construction and testing of the test pad prior to placement of the Compacted Clay Liner.

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LINER CONSTRUCTION

Prior to fill placement, the prepared subgrade shall be proofrolled with a smooth-drum roller (minimum 20 tons) by a minimum of two passes in each direction. Proofrolling shall be conducted at the discretion of the Engineer or his representative. Any soft, saturated or yielding areas exhibited by pumping and/or rutting will require removal and replacement with the appropriate soil at no additional cost to the Owner.

02300.4 Final clay liner lift thickness, after compaction, shall be a maximum of six (6) inches. Thinner lifts are permissible to achieve design grade.

02300.5 Equipment or truck traffic shall not be permitted during the period between scarifying and compaction of a lift unless approved by the Engineer.

02300.6 After the lift to be compacted is conditioned, representative samples will be taken by the Resident CQA Engineer and tested for moisture content prior to any compactive efforts. If the moisture content is within the range specified by the moisture-density-permeability relation, compaction may begin. If the moisture content is outside of this range, the clay liner fill will be wetted or dried and reworked accordingly. The soil 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 soil if the material moisture content is too low. The soil fill shall be dozed, wind-rowed, and/or disc-plowed to help air dry the soil if the moisture content is too high.

02300.7 Each lift shall be thoroughly compacted to satisfy moisture and density controls through field testing before a subsequent lift is placed.

02300.8 Compaction of lifts shall be as follows:

1) Compaction of lifts shall be performed with an appropriately heavy, properly ballasted compactor. A minimum of four (4) passes will be required on each lift regardless of whether the lift meets density specifications. A pass is defined as one trip of the compacting equipment over the lift and back to the starting point by a single drum roller or one trip across the lift surface from one side to the other if the compacting equipment has front and back compacting rollers. This requirement is to allow thorough remolding of the soil by kneading action.

2) The daily work area shall extend a distance so as to maintain moist soil conditions (facilitate bonding) and continuous operations.

Desiccation and crusting of the lift surface shall be avoided as much as possible. Each lift shall be protected, at all times after placement, from desiccation and crusting.

3) If desiccation and crusting of the lift surface occurs before placement of the next lift, this area shall be scarified to a sufficient depth to mix with moist materials, or sprinkled with water and then scarified at the direction of the Engineer.

4) The transition between the bottom and side slopes shall be accomplished by compacting parallel (bottom to top) to the slope.

5) Dozer equipment shall not be used for primary compaction efforts.

6) The surface of the underlying lift shall be scarified a minimum of 2 inches prior to compaction of each subsequent lift (i.e., Lift 2 to Lift 3) to facilitate bonding of the lifts.

02300.9 During compaction of the soil liner material, the soil moisture content and dry density shall be maintained within the limits specified below.

1) To assure the moisture content and dry density requirements of the compacted soil are being satisfied, field and laboratory tests shall be made at minimal intervals as specified. Additional testing may be requested at the discretion of the Engineer.

2) Compaction moisture content shall be between 2 and 6 percent wet of optimum moisture content (OMC) on the side slopes.

3) The clay liner shall be compacted to a minimum of 95 percent of the maximum dry density. Where densities are less than 95 percent of the maximum dry density, the soil liner shall be recompacted and/or removed and reworked to meet density objectives.

02300.10 The clay liner, in addition to the other provisions of this section, shall have a permeability not greater than 1.0 $x10^{-7}$ cm/sec on thin wall tube samples taken from the completed clay liner for use with the 24-inch compacted clay liner or a permeability not greater than 1.0 $x10^{-5}$ cm/sec on thin wall tube samples taken from the completed clay liner for use with the 18-inch compacted clay liner associated with the construction of a GCL system. If representative permeability tests do not achieve the required permeability, the clay liner shall be reworked to meet permeability requirements regardless of its previously achieved density. Representative soil samples taken from the clay liner that fail laboratory permeability testing must be re-sampled until passing results are achieved. Each failing sample must be replaced by one successful sample. The Owner will pay for the

permeability testing at the frequency required by the Site Specific Construction Quality Assurance Plan. The Contractor will be responsible for all costs associated with re-sampling and re-testing for failing samples beyond a 5% failure rate by quantity. This includes the cost of lab and Construction Quality Assurance personnel. The minimum charge for re-sampling and re-testing for failing permeability tests exceeding 5% failure rate will be $500.00 per occurrence.

02300.11 Soil fill shall not be placed or compacted during sustained periods with air temperature below 32°F. Soil fill may be placed and compacted during periods of early morning and early evening freezing temperatures with warming trends above 45°F during the day. No fill shall be placed on frozen subgrade. If the clay liner or structural fill freezes or ices the fill section shall be rescarified and recompacted, at the discretion of the Engineer.

02300.12 During construction, finished lifts or sections of compacted clay liner shall be sprinkled with water a minimum of twice per day depending on weather conditions.

02300.13 At the end of each construction day's activities, completed lifts or sections of compacted clay liner shall be sealed by rolling with a rubber tired or smooth drum rollers and sprinkled with water as needed.

02300.14 The compacted clay liner shall be a minimum of twenty-four (24) inches at a permeability no greater than 1.0×10^{-7} cm/sec, or eighteen (18) inches at a permeability no greater than 1.0×10^{-5} cm/sec when used with an overlying GCL material. Thickness of the compacted soil liner on the side slopes shall be measured perpendicular to the slope face.

02300.15 The as-built thickness of the compacted clay liner shall be determined by survey methods (non-destructive) as described below. An individual lift may be sampled upon completion (but prior to subsequent lift placement) with an approved sampler or other investigative tool. Any penetration within any portion or lift of the clay liner shall be promptly backfilled by the Contractor with a 50/50 mix of hand tamped soil and bentonite fill. Samples of the in place compacted soil liner shall be tested and evaluated in accordance with provisions of the Construction Quality Assurance Plan. All test locations shall be filled with a homogeneous mixture of one part bentonite and three parts soil.

02300.16 After completion of a segment of compacted clay liner, but before installation of the geomembrane liner, the surface of the clay liner shall be surveyed by the Contractor to ensure the specified thickness of Compacted Clay Liner (24 inches, or 18 inches with GCL) has been achieved. The survey must be performed and stamped by a registered Professional Land Surveyor in the State of North Carolina. The survey

information shall be provided to the Engineer in a format pre-approved by the Engineer and acceptable to the North Carolina Department of Environment and Natural Resources, Division of Waste Management, Solid Waste Section. At a minimum, survey data shall be collected on a 50-foot grid and at least every 50-foot along all changes in grade.

02300.17 The surface of the compacted clay liner shall be smooth drum rolled and maintained free of rocks, organics, voids and sharp edges.

No vehicles other than a smooth-drum roller will be allowed on the Compacted Clay Liner once the Compacted Clay Liner has been approved. This includes equipment used to deploy geomembrane material. Any exceptions should have prior approval from the Project Engineer.

02300.18 The minimum interface friction angle between the Compacted Clay Liner and the 60 mil textured geomembrane shall be seventeen (17) degrees. This shall be verified by the Contractor and supporting documentation submitted to the Engineer prior to beginning construction.

The test method used to verify the interface friction angle between the clay liner and the 60-mil textured geomembrane shall be ASTM D5321 *Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by Direct Shear Method*. Soil specimens must be compacted to design criteria for dry density and moisture content as determined by preconstruction testing. Test parameters are to provide 3 points to range over minimum and maximum expected normal loads. Minimum will be a construction load of 260 psf. Maximum will be at the landfill's final filled condition or approximately 1,423 psf. The normal loadings used shall be 250, 750 and 1,500 psf.

END OF SECTION

SECTION 02320 GEOSYNTHETIC CLAY LINER (GCL)

02320.1 Scope of Work

The Contractor shall furnish all labor, materials, supervision and equipment to complete the Geosynthetic Clay Liner (GCL) including, but not limited to, anchor trench excavation and backfill, GCL panel layout, seam preparation, patching, and all necessary and incidental items required to complete the Work, in accordance with the Contract Documents and these Specifications.

02320.2 Submittals

A. Contractor shall furnish the following information:

1. Conceptual description of the proposed plan for placement of the GCL panels over the area of installation.
2. GCL manufacturer's Manufacturer's Quality Control (MQC) Plan for documenting compliance to Sections 02320.7 and 02320.8 of these specifications.
3. GCL manufacturer's historical data for a) 10,000-hour creep shear testing per Section 02320.7 E and b) seam flow data at 2 psi confining pressure per Section 02320.7 F.
4. The manufacturer's last 20 weekly values for index flux and permeability prior to the end of the production date of the supplied GCL.
5. A copy of GCL manufacturer's ISO quality Certificate of Registration.

B. At the Engineer's or Owner's request the Contractor shall furnish:

1. A representative sample of the GCLs.
2. A project reference list for the GCL(s) consisting of the principal details of at least ten projects totaling at least 10 million square feet in size.

C. Upon shipment, the Contractor shall furnish the GCL manufacturer's Quality Assurance/Quality Control (QA/QC) certifications to verify that the materials supplied for the project are in accordance with the requirements of this specification.

D. As installation proceeds, the Contractor shall submit certificates of subgrade acceptance, signed by the Contractor and CQA Inspector for each area that is covered by the GCL.

E. The friction angle between the non-woven cover geotextile on the GCL and the geomembrane and the woven base cover and the clay liner shall be a minimum of 20 degrees. The Contractor shall verify and submit to the Engineer proper documentation prior to beginning construction. The test method used to verify the interface friction angle between the 60-mil

geomembrane and the non-woven cover geotextile and the interface friction angle between the woven base cover and the clay liner shall be ASTM D 5321 *Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by Direct Shear Method*.

02320.3 Manufacturer's and Installer's Qualifications

A. GCL Manufacturer must have produced at least 300 million square feet of GCL within the past three years, including at least 30 million square feet with 3.5 lb/in peel strength.

B. The GCL Installer must either have installed at least 1 million square feet of GCL, **or** must provide to the Engineer satisfactory evidence, through similar experience in the installation of other types of geosynthetics, that the GCL will be installed in a competent, professional manner.

02320.4 Construction Quality Assurance (CQA)

A. All GCL sheet will be evaluated prior to and after installation.

B. The Owner and Engineer shall provide a third-party inspector for CQA of the GCL installation. The inspector shall be an individual or company who is independent from the manufacturer, Contractor and Installer, who shall be responsible for monitoring and documenting activities, related to the CQA of the GCL, throughout installation. The inspector shall have provided CQA services for the installation of the proposed or similar GCL for at least 5 completed projects totaling not less than 1 million square feet.

C. Testing of the GCL, as necessary to support the CQA effort, shall be performed by a third party laboratory retained by the Owner and independent from the GCL manufacturer, Contractor and Installer. The laboratory shall have provided GCL CQA testing of the proposed or similar GCL for at least 5 completed projects totaling not less than 1 million square feet.

D. The GCL Installer will be required to adhere to the requirements of the Site Specific Construction Quality Assurance Plan.

02320.5 Products

A. The GCL shall consist of a layer of granular sodium bentonite clay needlepunched between two geotextiles and shall comply with all of the criteria listed in this Section.

B. Bentonite shall be a high-swelling sodium bentonite, with a minimum swell index of 24 mL/2g and a maximum fluid loss of 18 mL. Bentonite

shall be CG-50 granular bentonite, mined and processed by American Colloid Company, or an approved equal.

C. Bentonite shall have a granular consistency (1 percent max. passing a No. 200 sieve, to ensure uniform distribution throughout the GCL and minimal edge loss during handling and installation.

D. The cover geotextile shall be, at a minimum, a 6.0 oz/yd^2 non-woven geotextile. The base geotextile shall be, at a minimum, a 3.2 oz/yd^2 woven geotextile.

02320.6 Materials

A. Acceptable GCL products are Bentomat® ST, as manufactured by CETCO, 2870 Forbs Avenue, Hoffman Estates, Illinois 60192 USA (800-527-9948), or an engineer-approved equal.

B. The GCL shall meet, at a minimum, the properties shown in Table 1, Minimum Required Physical Properties of Geosynthetic Clay Liner.

C. The moisture content of the bentonite in the finished GCL shall be between 20 and 40 percent, to ensure uniform bentonite distribution, consistent needlepunch density, and adequate electrical conductivity to maximize leak location survey sensitivity.

D. GCL shall be needlepunch-reinforced, with a minimum peel strength of 3.5 lb/inch. To maximize large-displacement shear strength, GCL reinforcement shall be achieved solely through needlepunching, without any supplemental heat treatment.

E. The GCL shall have 10,000-hour test data for large-scale constant-load (creep) shear testing under hydrated conditions. The displacement shall be 0.11 in. or less at a constant shear load of 250 psf and a normal load of 500 psf.

F. The GCL shall have seam test data from an independent laboratory showing that the seam flow with a grooved cut in the nonwoven geotextile is less than 1 x 10^{-8} $m^3/m^2/s$ at 2 psi hydraulic pressure.

G. The minimum acceptable dimensions of full-size GCL panels shall be 150 feet in length.

H. A 6-inch overlap guideline shall be imprinted on both edges of the upper geotextile component of the GCL as a means for providing quality assurance of the overlap dimension. Lines shall be printed in easily visible, non-toxic ink.

Table 1

Minimum Required Physical Properties of Geosynthetic Clay Liner

MATERIAL PROPERTY	TEST METHOD	TEST FREQUENCY $ft^2(m^2)$	REQUIRED VALUES
Bentonite Swell Index[1]	ASTM D 5890	1 per 50 tonnes	24 ml/2g min.
Bentonite Fluid Loss[1]	ASTM D 5891	1 per 50 tonnes	18 ml max.
Bentonite Mass/Area[2]	ASTM D 5993	40,000 ft^2 (4,000 m^2)	0.75 lb/ft^2 (3.6 kg/m^2) min
GCL Tensile Strength[3]	ASTM D 6768	200,000 ft^2 (20,000 m^2)	30 lbs/in (53 N/cm) MARV
GCL Peel Strength[3]	ASTM D 6496	40,000 ft^2 (4,000 m^2)	3.5 lbs/in (6.1 N/cm) min
GCL Index Flux[4]	ASTM D 5887	Weekly	1×10^{-8} m^3/m^2/sec max
GCL Hydraulic Conductivity[4]	ASTM D 5887	Weekly	5×10^{-9} cm/sec max
GCL Hydrated Internal Shear Strength[5]	ASTM D 5321 ASTM D 6243	Periodic	500 psf (24 kPa) typ @ 200 psf

Notes

[1] Bentonite property tests performed at a bentonite processing facility before shipment to CETCO's GCL production facilities.

[2] Bentonite mass/area reported at 0 percent moisture content.

[3] All tensile strength testing is performed in the machine direction using ASTM D 6768. All peel strength testing is performed using ASTM D 6496.

[4] Index flux and permeability testing with deaired distilled/deionized water at 80 psi cell pressure, 77 psi headwater pressure and 75 psi tailwater pressure.

[5] Peak values measured at 200 psf normal stress for a specimen hydrated for 48 hours. Site-specific materials, GCL products, and test conditions must be used to verify internal and interface strength of the proposed design.

02320.7 Product Quality Documentation

The GCL manufacturer shall provide the Owner or other designated party with manufacturing QA/QC certifications for each shipment of GCL. The certifications shall be signed by a responsible party employed by the GCL manufacturer and shall include:

A. Certificates of analysis for the bentonite clay used in GCL production demonstrating compliance with the swell index and fluid loss values shown in Table 1, Minimum Required Physical Properties of Geosynthetic Clay Liner.

B. Manufacturer's test data for the finished GCL product demonstrating compliance with the values shown in Table 1, Minimum Required Physical Properties of Geosynthetic Clay Liner.

C. GCL lot and roll numbers supplied for the project (with corresponding shipping information).

02320.8 Product Labeling

A. Prior to shipment, the GCL manufacturer shall label each roll, identifying:

1. Manufacturer's name and address
2. Brand Product Code
3. Lot Number
4. Roll Number
5. Roll Length and width
6. Roll Weight

02320.9 Packaging

A. The GCL shall be wound around a rigid core whose diameter is sufficient to facilitate handling. The core is not necessarily intended to support the roll for lifting but should be sufficiently strong to prevent collapse during transit.

B. All rolls shall be labeled and bagged in packaging that is resistant to photodegradation by ultraviolet (UV) light.

02320.10 Accessory Bentonite

A. The granular bentonite sealing clay used for overlap seaming, penetration sealing and repairs shall be made from the same natural sodium bentonite as used in the GCL and shall be as recommended by the GCL manufacturer. Seaming of GCLs shall be conducted in accordance with the manufacturer's guidelines for each particular GCL.

02320.11 Shipping and Handling

A. The manufacturer assumes responsibility for initial loading the GCL. Shipping will be the responsibility of the party paying the freight. Unloading, on-site handling and storage of the GCL are the responsibility of the Contractor.

B. A visual inspection of each roll should be made during unloading to identify if any packaging has been damaged. Rolls with damaged packaging should be marked and set aside for further inspection. If the geotextile under the torn packaging sleeve is also torn, the outermost wrap of GCL on the roll should be unwound and discarded when the roll is installed. The roll should be marked accordingly so as to alert the Installer that the initial wrap should be cut away and discarded. Upon inspection, at the time of installation, additional rolls may be required to be cut away and discarded. The packaging should be repaired prior to being placed in storage.

C. Rolls of GCL that are accidentally dropped and/or bent during unloading and/or transportation to the installation site should be marked and moved away from the storage site and/or installation site. These rolls will not be installed on the project.

D. The party responsible for unloading the GCL should contact the Manufacturer prior to shipment to ascertain the appropriateness of the proposed unloading methods and equipment.

02320.12 Storage

A. Storage of the GCL rolls shall be the responsibility of the Contractor. A dedicated storage area shall be selected at the job site that is away from high traffic areas and is level, dry and well drained.

B. Rolls should be stored in a manner that prevents sliding or rolling from the stacks and may be accomplished by the use of chock blocks. Rolls should be stacked at a height no higher than that at which the lifting apparatus can be safely handled (typically no higher than four).

C. All stored GCL materials and the accessory bentonite must be covered with a plastic sheet or tarpaulin until their installation.

D. The integrity and legibility of the labels shall be preserved during storage.

2320.13 GCL Placement

A. Any earthen surface upon which the GCL is installed shall be prepared and compacted in accordance with the Project Specifications and Drawings. The surface shall be smooth, firm, and unyielding, and free of:

1. Vegetation.
2. Construction Debris.
3. Sticks.
4. Sharp rocks.
5. Void spaces.
6. Ice.
7. Abrupt elevation changes.
8. Standing water.
9. Cracks larger than one-quarter inch (6 mm) in width.
10. Any other foreign matter that could contact the GCL.

B. Full length panels (150 feet long) will be used on all cell side slopes.

C. The Installer shall certify in writing that the surface on which the GCL will be installed is acceptable.

D. GCL rolls should be delivered to the working area of the site in their original packaging. Immediately prior to deployment, the packaging

should be carefully removed without damaging the GCL. The orientation of the GCL (i.e., which side faces up) should be in accordance with the Engineer's recommendations.

E. Equipment which could damage the GCL shall not be allowed to travel directly on it. If the installation equipment causes rutting of the subgrade, the subgrade must be restored to its originally accepted condition before placement continues.

F. Care must be taken to minimize the extent to which the GCL is dragged across the subgrade in order to avoid damage to the bottom surface of the GCL. A temporary geosynthetic subgrade covering commonly known as a slip sheet or rub sheet may be used to reduce friction damage during placement.

G. The GCL panels shall be placed parallel to the direction of the slope.

H. All GCL panels should lie flat on the underlying surface, with no wrinkles or fold, especially at the exposed edges of the panels.

I. Only as much GCL shall be deployed as can be covered at the end of the working day with a geomembrane. The GCL shall not be left uncovered overnight. If the GCL is hydrated when no confining stress is present, it may be necessary to remove and replace the hydrated material. The project Engineer, CQA inspector, and GCL supplier should be consulted for specific guidance if premature hydration occurs.

02320.14 Anchorage

A. As directed by the Project Specifications and Drawings, the end of the GCL roll shall be placed in an anchor trench at the top of the slope or an equivalent runout design shall be utilized. When utilizing an anchor trench design, the front edge of the trench should be rounded so as to eliminate any sharp corners. Loose soil should be removed from the floor of the trench. The GCL should cover the entire trench floor but does not extend up the rear trench wall.

02320.15 Seaming

A. The GCL seams are constructed by overlapping their adjacent edges. Care should be taken to ensure that the overlap zone is not contaminated with loose soil or other debris.

B. The minimum dimension of the longitudinal overlap should be 6 inches. If the GCL is manufactured with a grooved cut in the nonwoven geotextile that allows bentonite to freely extrude into the longitudinal overlap then no supplemental bentonite is required for this overlap. If the GCL does not have a grooved cut in the nonwoven geotextile longitudinal overlap, then bentonite-enhanced seams are required as described below.

C. End-of-roll overlapped seams should be constructed with a minimum overlap of 24 inches. Seams at the ends of the panels should be constructed such that they are shingled in the direction of the grade to prevent the potential for runoff flow to enter the overlap zone. End-of-roll overlapped seams require bentonite-enhanced seams as described below.

D. Bentonite-enhanced seams are constructed between the overlapping adjacent panels as follows. The underlying edge of the longitudinal overlap is exposed and then a continuous bead of granular sodium bentonite is applied along a zone defined by the edge of the underlying panel and the 6-inch line. The granular bentonite shall be applied at a **minimum** application rate of one quarter pound per lineal foot. A similar bead of granular sodium bentonite is applied at the end-of-roll overlap.

E. Cyclical wetting and drying of GCL covered only with a geomembrane can cause overlap separation. The leachate collection system layer (16 oz/yd^2 non-woven geotextile, leachate collection piping and the 24 inch leachate drainage layer) should be placed without delay to minimize the intensity of wet-dry cycling. If there is the potential for unconfined cyclic wetting and drying over an extended period of time, the longitudinal seam overlaps should be increased based on the Engineer's recommendations.

F. To avoid seam separation, the GCL should not be put in excessive tension by the weight or expansion of textured geomembrane on steep slopes.

02320.16 Damage Repair

A. Slopes flatter than or equal to 10H:1V: If the GCL is damaged (torn, punctured, perforated, etc.) during installation, it may be possible to repair it by cutting a patch to fit over the damaged area. The patch shall be obtained from a new GCL roll and shall be cut to size such that a minimum overlap of 24 inches is achieved around all of the damaged area. Granular bentonite or bentonite mastic should be applied around the damaged area prior to placement of the patch. An adhesive will be used to affix the patch in place so that it is not displaced during geomembrane or cover material placement.

If the damaged area is along the side of the panel or at the Installers option, the panel may be cut off above and below the damaged area and a horizontal seam constructed in accordance with Section 02320.15.

B. Slopes steeper than 10H:1V: Patches will not be allowed on the slopes exceeding a 10H:1V slope.

02320.17 Cover Placement

A. Only as much GCL shall be deployed as can be covered at the end of the day with a properly installed (all seams completed) geomembrane.

B. The leachate collection system layer (16 oz/yd^2 non-woven geotextile, leachate collection piping and the 24 inch leachate drainage layer) should be placed on top of the geomembrane without delay to minimize the intensity of wet-dry cycling.

C. The 24 inch leachate drainage layer shall be pushed up slopes, not down slopes, to minimize tensile forces on the GCL.

D. Although direct vehicular contact with the GCL is to be avoided, lightweight, low ground pressure vehicles (such as 4-wheel all-terrain vehicles) may be used to facilitate the installation of any geosynthetic material placed over the GCL. The GCL supplier or CQA engineer should be contacted with specific recommendations on the appropriate procedures in this situation.

E. When a textured geomembrane is installed over the GCL, a temporary geosynthetic covering known as a slip sheet or rub sheet will be used to minimize friction during placement and to allow the textured geomembrane to be more easily moved into its final position.

02320.18 Geosynthetic Clay Liner Warranty

The installation of the Geosynthetic Clay Liner shall be warranted against defects in workmanship for a period of 1 year from the date of substantial project completion.

END OF SECTION

SECTION 02400 LEACHATE COLLECTION REMOVAL SYSTEM (LCR)

02400.1 Scope of Work

The Contractor shall furnish all labor, materials, supervision, and equipment necessary to complete the LCR System including trench excavation, hauling, spreading, grading, rolling and all necessary and incidental items required to complete the Work, all in accordance with the Contract Drawings and these Contract Specifications.

02400.2 Materials

Pipe for the LCR System shall be High Density Polyethylene (HDPE) pipe.

1. HDPE piping shall have nominal diameters as noted on the Contract Drawing.

2. HDPE piping shall have a maximum Standard Dimension Ratio (SDR) of 17 or as specified on the Contract Drawings.

3. The HDPE pipe shall be manufactured from first quality virgin polyethylene with the following nominal properties.

Property	ASTM Method	Frequency	Acceptable Value
Relative Density	D1505	Per Shipment	.95 gms/cm^3
Melt Index	D1238	Per Shipment	0.08 gms/10 min.
Carbon Black Content	D3350	Per Shipment	Min. 2%
Tensile Strength @ Yield	D638, Type IV	Per Shipment	3200 psi
Elastic Modulus	D638	Per Shipment	> 150,000 psi

The HDPE pipe section to be perforated shall be as follows or approved by the Engineer:

1) Four rows of perforations; Two rows on each side of pipe at approximately 45° and between 75° and 90° from bottom of pipe.

2) Each row of perforations shall have holes approximately 6 inches on center; and

3) Each hole shall be 1/2-inch diameter.

The dual contained force main shall consist of HDPE carrier pipe inside HDPE containment pipe. The carrier pipe shall be concentrically located within containment pipe with spacers. The force main within the tank containment area shall consist of schedule 10 or schedule 40, 304 SS with lap joint stub end flange connections. Back up flanges are galvanized. Bolting is zinc plated grade 5. All necessary pipe supports to prevent sagging or movement shall be furnished.

All proposed exposed piping shall be heat traced and insulated, and any existing piping disturbed during construction shall be restored to original condition with insulation and heat tracing.

The chemical resistance of the HDPE pipe and all fittings shall be in keeping with typical properties of high quality polyethylene products currently available through commercial sources. All mechanical fasteners or fittings shall be stainless steel.

02400.3 Stone bedding surrounding the perforated HDPE piping shall be No. 5 washed stone. The Contractor shall be responsible for providing the stone bedding material.

02400.4 Non-woven Filter Geotextile shall be as indicated below:

<u>Non-woven Geotextile</u>

The geotextile used shall be ultraviolet stabilized 1) a non-woven, needlepunched, continuous filament polyester material or, 2) a non-woven, needlepunched continuous filament polypropylene material or, 3) a non-woven, needlepunched staple fiber polypropylene material.

A 16 oz. Geotextile cushion will be placed between the geomembrane and the drainage layer. The friction angle between the geotextile and the geomembrane shall be a minimum of 20 degrees. The Contractor shall verify and submit to the Engineer proper documentation prior to beginning construction. The test method used to verify the interface friction angle between the 60-mil geomembrane and the geotextile shall be ASTM D5321 *Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by Direct Shear Method*. Test parameters are to provide 3 points to range over minimum and maximum expected normal loads. Minimum will be a construction load of 260 psf. Maximum will be at the landfill's final filled condition or approximately 1,423 psf. The normal loadings used shall be 250, 750 and 1,500 psf.

A 6 oz. Geotextile will be used to wrap the leachate lines and the #5 stone bedding.

The non-woven material shall meet or exceed the following criteria using Minimum Average Values:

Property	ASTM Method	Frequency	Acceptable Values	
			6 oz. Geotextile	16 oz. Geotextile
Grab Tensile Strength	D4632	Every 5th Roll	160 lbs.	370 lbs.
Grab Tensile Elongation	D4632	Every 5th Roll	50 Percent	50 Percent
Puncture (pin) Strength	D4833	Every 5th Roll	110 lbs.	**170 lbs**.
Mass per Unit Area	D5261	Each Roll	6.0 oz.	**16 oz**.
Apparent Opening Size (AOS)	D4751	Every 5th Roll	.212 mm (70 Sieve max.)	0.150 mm (100 Sieve max.)

02400.5 <u>HPDE Sumps, Catch Basins</u>

All HDPE pipe and fittings (both interior carrier and exterior containment pipe) shall be manufactured from first quality virgin polyethylene with the following nominal properties:

Property	ASTM Method	Frequency	Acceptable Value
Relative Density	D1505	Per Shipment	.95 gms/cm^3
Melt Index	D1238	Per Shipment	0.08 gms/10 min.
Carbon Black Content	D3350	Per Shipment	Min. 2%
Tensile Strength @ Yield	D638, Type IV	Per Shipment	3200 psi
Elastic Modulus	D638	Per Shipment	> 150,000 psi

The chemical resistance of the HDPE pipe, welding rod and all fittings shall be equal or greater than that of the 60 mil. HDPE liner specified.

All interior pipe welds must be machine butt fusion welded and demonstrated to be watertight and sufficiently strong to develop the full strength of the joined sections, e.g. failure should not occur in a weld. Air testing of the pipe seams must be performed in accordance with the contract documents before acceptance by the Engineer.

02400.6 Drainage Layer

The drainage layer shall consist of washed stone with a maximum nominal diameter of 5/8". The chemical properties of the stone shall not be adversely affected by waste placement or leachate generated by the landfill. The washed stone material shall have a high permeability that allows lateral drainage through the drainage layer and along the surface of the base liner. The drainage layer material shall contain no more than 5% fines by weight.

The drainage layer shall be placed with a minimum compacted thickness of 24 inches with an overfill variance of + 0.2 feet allowed for a total allowable thickness of 2.2 feet. Any areas of the completed drainage layer that exceed this thickness will be measured and the volume of overfill calculated by the engineer. The Contractor will be required to compensate the owner for the overfill volume, calculated at a rate of $24.00 per cubic yard. The surface of the drainage layer shall be surveyed by the Contractor to ensure the specified thickness. The survey must be performed and stamped by a registered Professional Land Surveyor in the State of North Carolina. The survey information shall be provided to the Engineer in a format pre-approved by the Engineer and acceptable to the North Carolina DEHNR, Division of Waste Management, Solid Waste Section. All inverts, intersections, connection points and cleanouts for the LCS piping shall also be surveyed. At a minimum, survey data shall be collected at a 50-foot grid and every 50 feet along changes in grade.

Equipment used during placement of the drainage layer shall not be allowed to operate directly on the geomembrane. Equipment will not be allowed on any portion of the geomembrane without the protective geotextile and a minimum of 18 inches of stone material in place. The drainage layer shall be stable when placed on the interior slopes of the landfill. The friction angle between the Geotextile and the drainage layer shall be a minimum of 24 degrees. This friction angle shall be verified by the Contractor and proper documentation submitted to the Project Engineer prior to beginning construction. The test method used to verify the interface friction angle between the geotextile and the drainage layer material shall be ASTM D5321 *Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by Direct Shear Method*. Aggregate specimens must be compacted and/or conditioned to represent field conditions. Test parameters are to provide 3 points to range over minimum and maximum expected normal loads. Minimum will be a construction load of 260 psf. Maximum will be at the landfill's final filled condition or approximately 1,423 psf. The normal loadings used shall be 250, 750 and 1,500 psf.

02400.7 **Construction**

The geotextile for the bottom of the cell shall be installed as follows:

The specified geotextile shall be placed over the HDPE liner. The geotextile shall be immediately sewn by a methodology approved by the Engineer. The geotextile shall be extended up the side slopes and placed in the anchor trench as indicated on the Contract Drawings.

The perforated high density polyethylene collector pipe shall be as shown on the Contract Drawings.

a) The pipe section connections shall be made by:

(1) Heat fusion weld;
(2) Material extrusion weld;
(3) Threaded connection;
(4) Snap-couplings (approved mechanical); and/or
(5) Combination of any two or more of the above. No solvent or glued joints are allowed.
(6) The two main 8" leachate collection system trunk lines shall be video-inspected after the stone drainage materials have been installed over the piping, prior to acceptance by the County. Additionally, the leachate gravity sewer beneath MSW Phase 3 shall be video inspected and approved by the Engineer prior to the clay liner placement.

02400.8 The top of the gravel sump shall be completely covered with a 6 oz. filter geotextile to avoid "clogging" during placement of the first two lifts of the operational cover.

1) The sections of the geotextile shall be installed with a minimum overlap of 2 inches and field sewn together;

2) The overlapped edges of the geotextile shall be temporarily secured during periods of windy weather;

END OF SECTION

02620.1 Scope of Work

The Installer shall furnish all labor, materials, supervision and equipment to complete the HDPE Geomembrane Liner including, but not limited to, anchor trench excavation and backfill, liner layout, seaming, patching, and all necessary and incidental items required to complete the Work, in accordance with the Contract Drawings and these Specifications.

02620.2 Materials

The geomembrane liner shall be made of high-density polyethylene (HDPE) that has an absolute minimum thickness of 60 mils. This means that the geomembrane shall have a thickness of 60 mils at any point measured on the sheet. An average minimum thickness will not be considered. If during conformance testing or on-site testing and inspection, a thickness measurement is found to be less than 60 mils, the material will be rejected for use during construction.

The geomembrane used shall meet, at a minimum, the standards included in Tables 1, 2 and 3 located at the end of this section.

The chemical resistance of the geomembrane liner shall be in keeping with typical properties of high quality polyethylene products currently available through commercial sources.

Geomembrane liner shall be shipped rolled with a protective wrap around each roll, labeled with roll number and manufacturer's batch number. Manufacturer's quality control documentation shall be included with each roll.

The geomembrane shall be free of holes, blisters, undispersed raw materials, or any sign of contamination by foreign matter. Any such defect shall be repaired in accordance with the geomembrane manufacturer's recommendations. The Engineer may reject all or portions of units (or rolls) of the geomembrane if in his opinion significant quantities of production or transporting flaws are observed.

The Installer shall submit proposed geomembrane panel layouts to the Engineer at least 14 days prior to mobilization of crews (2 copies). Once the panel layout is approved, the Installer may not change the layout without permission of the Engineer.

02620.3 **Construction**

The geomembrane liner shall be installed by a specialty contractor, and that specialty contractor must have installed a minimum of 5,000,000 square feet of geomembrane liner since November, 1998.

The geomembrane liner shall be constructed as soon as practical after completion and approval of the compacted clay liner or portion thereof. The top of the compacted clay liner will be surveyed to ensure adequate thickness of clay material and proper grades toward the collection sump area have been achieved. The Contractor shall be responsible for providing survey information for all panel locations, seam locations, destructive testing locations, repairs, and liner flap used to construct the temporary liner edge. The survey must be performed and stamped by a registered Professional Land Surveyor in the State of North Carolina. The survey information shall be provided to the Engineer in a format pre-approved by the Engineer and acceptable to the North Carolina DEHNR, Division of Waste Management, Solid Waste Section. The geomembrane is to cover the bottom of the cell and the side slopes in accordance with the Contract Drawings.

Areas to receive liner installation shall be relatively smooth and even, free of ruts, voids, etc., to the extent required by the Engineer. This shall be accomplished by final dressing of the compacted liner with smooth drum rollers. No vehicles are permitted on final dressed surfaces unless authorized by the Engineer.

An anchor trench (as illustrated on the Contract Drawings) will be required to secure the geomembrane. No loose soil will be allowed to underlie the geomembrane in the anchor trenches. The time schedule for excavation and backfilling of the anchor trenches is to be approved by the Engineer so that desiccation of trench soils does not occur prior to backfilling.

02620.4 Installation of the geomembrane shall be as follows:

All geomembrane installed on side slopes will be 60 mil textured material. The textured material shall be extended a minimum of ten (10) feet beyond the toe of slope.

Unroll only those sections that are to be seamed together in one day. Panels should be positioned with the overlap recommended by the manufacturer, but not less than 4 inches. The side slope geomembrane will be placed in an anchor trench that is then backfilled with soil and compacted as shown on the Contract Drawings.

After panels are initially in place, remove wrinkles as directed by the Engineer. Unroll several panels and allow the liner to “relax” before beginning field seaming. The purpose of this is to make the edges, which are to be bonded, as smooth and free of wrinkles as possible.

Once panels are in place and smooth, commence field seaming operations.

The Installer’s Field Superintendent will complete a Daily Report at the end of each day and submit the form daily to the Engineer.

Field seaming shall be in accordance with EPA Technical Guidance document: “The Fabrication of Polyethylene FML Field Seams” EPA/530/SW-89/069 or as follows. Where conflicts exist between the two guidance specifications, the most stringent specification prevails or as directed by the Engineer.

02620.5 All foreign matter (dirt, water, oil, etc.) shall be removed from the edges to be bonded. For extrusion welds, the bonding surfaces must be thoroughly cleaned by mechanical abrasion or alternate methods approved by the Engineer to remove surface cure and prepare the surfaces for bonding. All abrasive buffing shall be performed using No. 80 grit or finer sandpaper. The grinding shall be performed so that any and all grind marks are perpendicular to the edge of sheet. No grinding greater than 1/8 inch outside the welds is permitted or the Engineer can require patching. No solvents shall be used to clean the geomembrane liner.

02620.6 As much as practical, field seaming shall start from the top of the slope down. This will minimize large wrinkles from becoming trapped, which requires cutting and patching. Tack welds (if used) shall use heat only; no double sided tape, glue, or other method will be permitted. The geomembrane should be seamed completely to the ends of all panels to minimize the potential of tear propagation along the seam.

The completed liner shall not exhibit <u>any</u> “trampolining” during any daylight hours (6:00 a.m. to 8:00 p.m.). All areas exhibiting trampolining must be repaired as directed by the Engineer. Additional slack (i..e., 1-3 percent) shall be allowed on the side slopes to reduce the potential for trampolining.

Seaming of the cell bottom membrane to the sidewall membrane (toe seam) shall be conducted when conditions minimize thermal expansion effects. All toe seams must be a minimum of 10 feet horizontally from the toe of the slope. Horizontal seams will not be allowed on the side slopes unless approved by the Engineer.

02620.7 At the end of each day or installation segment, all unseamed edges shall be anchored by sand bags or other approved device. Sand bags securing the geomembrane on the side slopes should be connected by a rope fastened at the top of the slope by a temporary anchor. If high winds are expected, boards along the edge of unseamed panels, with weighted sand bags on top, may be used to anchor the geomembrane on the bottom of the cell. Sand bags fastened by rope should be used to secure unseamed edges on the side slopes. Staples, U-shaped rods or other penetrating anchors shall not be used to secure the geomembrane on the side slopes. Any damage to the liner or clay liner including damage due to wind, rain, hail, or other weather shall be the sole responsibility of the Contractor.

02620.8 Field seaming may be extrusion or fusion welding or a combination of these methods. Solvent welding is not acceptable. The Engineer reserves the right to reject any proposed seaming method they believe unacceptable. Double hot wedge fusion welding shall be the predominant seaming method and shall be used when possible. Additional concepts and requirements of proper field seaming include the following.

02620.9 Extrusion welding applies a molten bead of material to preheated sheets of geomembrane. The sheets are then joined by pressure.

02620.10 The fusion welding process heats the area to be joined to the melting point and then applies pressure to join the melted surfaces.

02620.11 The sheets to be joined shall be overlapped at least four (4) inches after the necessary cleaning, aligning and cutting.

02620.12 The seams should be oriented parallel to the line of maximum slope, i.e., oriented up and down, not across, the slope. In corners and odd shaped geometric locations, the number of field seams shall be minimized.

02620.13 No horizontal seams shall be within ten (10) feet from the toe of the slope. No horizontal seams will be allowed on the side slopes unless approved by the Engineer.

02620.14 No seaming shall be attempted above 40°C (104°F) ambient air temperature. Below 5°C (41°F) ambient air temperature, preheating of the geomembrane will be required, unless it is demonstrated that this is not necessary (i.e., acceptable test (start-up) seams which duplicate, as closely as possible, actual field conditions can be achieved). Preheating may be achieved by natural and/or artificial means (shelters and heating devices). Ambient temperature is measured 18 inches above the liner surface. The Installer shall supply instrumentation for measurement of ambient temperature.

02620.15 A moveable protective layer of plastic or approved material may be placed directly below each overlap of geomembrane that is to be seamed. This is to prevent any moisture build-up between the sheets to be welded. The protective layer must be removed after welding.

02620.16 Seaming will extend to the outside edge of panels to be placed in anchor trenches.

02620.17 If required, a firm substrata should be provided by using a flat board, a conveyor belt, or similar hard surface directly under the seam overlap to achieve proper support.

02620.18 Grinding prior to welding shall be done perpendicular to the sheet edge. Overgrind greater than 1/8 inch beyond the welded seam or improperly ground areas shall be replaced at the Installer's expense.

02620.19 **Seams at the Panel Corners**

Seams at the panel corners of 3 or 4 sheets shall be completed with a circular patch approximately 12 inches in diameter, extrusion welded to the parent sheets.

02620.20 **Quality Control**

All geomembrane sheet, seams, and patches will be tested and evaluated prior to acceptance. In general, testing of the sheet will be conducted by the manufacturer. Testing of the seams will be conducted by the Installer under observation by the Engineer. The Engineer or a designated, independent geosynthetics laboratory may perform additional testing, as required by these detailed Specifications or as required in the judgment of the Engineer or Authorized Representative to verify that the HDPE sheet and seams meet the specifications. The geosynthetics installer will be required to adhere to the requirements of the Site Specific Construction Quality Assurance Plan. Testing requirements are detailed in the following subsections:

02620.21 **Pre-shipping Sheet Tests**

The Installer or supplier (manufacturer) will be required to submit his Quality Control Program to the Owner prior to initiating field work. At a minimum, the Manufacturer will perform the tests, at the frequencies given in Table 3, on the HDPE sheet prior to shipping HDPE material to the site.

02620.22 **Test Seams (Destructive Tests)**

The Installer shall maintain and use equipment and personnel at the site to perform testing of test seams. These seams will be made on fragment pieces of geomembrane liner to verify that seaming conditions are adequate. At a minimum, test seams shall be made upon each start of work for each seaming crew, upon every four hours of continuous seaming, every time seaming equipment is changed or if significant changes in geomembrane temperature and weather conditions are observed. The technician shall complete the Test Seam Form provided by the CQA Engineer immediately after each test. Requirements for test seams are as follows:

02620.23 The test seam sample will be at least 1.8m (6 feet) long by 0.3m (1 foot) wide with the seam centered lengthwise. Six adjoining specimens 25mm (1 inch) wide each will be cut from the test seam sample. At the Engineer's option, the shear tests may be eliminated for test seams. These specimens will be tested in the field with a tensiometer and/or manual seam tester for both shear (3 specimens) and peel (3 specimens). For dual wedge both inside and outside welds should be tested in the peel. Test seams will be tested by the Installer under approval of the Engineer. The specimens should not fail in the weld. The Installer shall supply all necessary knowledgeable personnel and testing equipment. Quantitative strength measurements from a calibrated field tensiometer, supplied by the Installer, shall be obtained for all three (3) specimens in shear and peel for the test seams. A passing test seam will be achieved when the criteria described in Table 1 (located at the end of this section) are satisfied. If a test seam fails, the entire operation will be repeated. If the additional test seam fails, the seaming apparatus or seamer will not be accepted and will not be used for seaming until the deficiencies are corrected and two consecutive successful full test seams are achieved. Test seam failure is defined as failure of any one of the specimens tested in shear or peel.

02620.24 The Engineer will approve all test seam procedures and results. The six (6) test specimens shall be labeled with initials of the technician, date, and A.M. or P.M. as appropriate; bound together with electrical tape; and retained by the Engineer until the project is over. The Engineer will transfer these specimens to the Owner following the Engineer's acceptance of the geomembrane materials and installation.

02620.25 **Production Seams**

One hundred percent of the production seams will be tested by the Installer continuously using non-destructive techniques and at specified intervals using destructive tests.

All areas failing nondestructive test procedures described below shall be clearly marked both on the liner itself and on the Seam Inspection Quality Control Form.

02620.26 Non-Destructive Testing

Single Weld Seams: The Contractor shall maintain and use equipment and personnel at the site to perform continuous vacuum box testing on all single weld production seams except those corner seams where vacuum box testing is impossible. The system shall be capable of applying a vacuum of at least 3 psi. The vacuum shall be held for a minimum of 15 seconds for each section of seam. All vacuum boxes to be used at this job site shall have new gaskets installed prior to reaching the job site. The geosynthetics installer shall also be required to have backup vacuum testing equipment at the job site. If the geosynthetics installer fails to provide the backup equipment, and it results in delays of the project, the geosynthetics installer will be liable for all costs associated with the delay.

Double Weld Seams: The Contractor shall maintain and use equipment and personnel to perform air pressure testing of all double weld seams. The system shall be capable of applying a pressure of at least 30 psi for not less than 5 minutes. All channels between the double weld seam must first be verified that the channel is open throughout the entire test area. The air pressure test results shall be documented. Pressure loss tests shall be conducted in accordance with the procedures outlined in "Pressurized Air Channel Test for Dual Seamed Geomembranes," Geosynthetic Research Institute Test Method GM-6. As outlined by the test method, following a 2 minute pressurized stabilization period, pressure losses over a measurement period of 5 minutes shall not exceed 3 psi.

Double weld seams will also be visually inspected on 100 percent of the seam. If necessary, the outside flap can be pulled back to aid in the visual inspection.

02620.27 Destructive Testing

Laboratory destructive testing (LDT) is defined as 12" X 48" samples cut on 500 foot centers for both extrusion and double welded seams. Field destructive testing (FDT) is defined as 3" X 6" samples cut at the end of each seamed area exceeding 200 feet. Both are described below:

Laboratory destructive testing will be performed on an average of every 500 linear feet of production seam. The locations will be selected by the CQA Engineer. Samples will be 12” X 48” in order to provide one sample to the archive, one sample to the Engineer for laboratory testing, and one sample to be retained by the Installer for possible field and/or additional laboratory testing at the option of the Installer.

Before the sample is sent to the laboratory, two specimens, one from each end of the specimen will be tested in peel in a calibrated field tensiometer, supplied by the Installer. Both specimens must meet the qualitative and quantitative criteria listed in Tables 1 and 2. Testing requirements are as follows: Each sample shall be large enough to test five specimens in peel and five specimens in shear. The average values of each set of five specimens must meet the values shown in Tables 1 and 2. If the average of the five specimens is adequate, but one of the specimens is below the required value, values for the specimen must be at least 90% of the values required for the sample to pass. All samples must fail in film tear bond (FTB). Samples which do not pass the shear and peel tests will be re-sampled from locations at least 10 feet on each side of the original location. These two re-test samples must pass both shear and peel testing. If these two samples do not pass, then the entire seam represented by the test shall be capped. Tests shall be conducted using a calibrated tensiometer and must meet the criteria outlined in Tables 1 and 2 located at the end of this section. The Owner will pay for destructive testing of the original destructive samples. The geosynthetics installer will be responsible for all costs associated with resampling and retesting for failing destructive samples beyond a 5% failure rate by quantity. This includes the cost of lab and CQA personnel. The minimum charge for each destructive re-test exceeding the 5% failure rate will be $500.00 per occurrence.

Field Destructive Testing (FDT) shall be small 2” X 6” samples cut out at the beginning and end of each seam exceeding 200 feet in length. Three 1” X 6” specimens will be tested in peel from each sample using the Installer’s Field Tensiometer or qualitative peel tester at the option of the Installer. No qualitative peel strength values need to be determined with the Field Destructive test, but each specimen must meet all qualitative criteria listed in Tables 1 and 2.

The Engineer will approve all seam field and laboratory test procedures and results. All laboratory destructive test specimens will be marked with the seam number and letters then bound together for a particular seam and stored in the Owner’s archives. The specimens for the FDT need not be retained.

Each sample area will be clearly marked both on the liner itself (LDT or FDT).

All areas cut out for testing shall be immediately patched by the Installer.

02620.28 Repair of Damaged and Sampled Areas

Damaged and sample coupon areas of geomembrane shall be repaired by the Installer by construction of an extrusion welded cap strip. No repairs shall be made to seams by application of an extrusion bead to a seam edge previously welded by fusion or extrusion methods. Repaired areas will be tested for seam integrity as outlined in Section 02620.27 of this specification. Damaged materials are the property of the Contractor and will be removed from the site at the Contractor's expense. The Contractor will retain all ownership and responsibility for the geomembrane until acceptance by the Engineer. The geomembrane shall be accepted by the Engineer after the installation and repair are complete, and after the Engineer has received documentation for the installation.

02620.29 Potentially Damaging Activities

No support equipment of any type, which may be used by the Contractor, shall be allowed on the geomembrane. Personnel working on the geomembrane shall not smoke, wear damaging shoes, or engage in any activity that could damage the geomembrane. No glass or sharp objects shall be allowed on the geomembrane.

02620.30 Anchor Trench Backfilling

The anchor trench will be backfilled and compacted by the Contractor to a dry density not less than 95 percent of the maximum dry density determined by the Standard Proctor (ASTM D-698). Care should be taken when backfilling the trench to prevent any damage to the geomembrane. Anchor trench soil shall be used as backfill material, wherever acceptable by the Engineer.

02620.31 Protection of Leading Edges

Between construction of partial sections of the membrane liner, excluding temporary phaselines, leading edges of the membrane may be exposed or buried for extended periods of time prior to their joining to adjacent, subsequent membrane sections. The combined action of abrasive soil and equipment impact stresses may "etch" unprotected membrane surfaces sufficiently to affect seam strengths. Therefore, it is necessary to protect leading edges in high activity areas with sacrificial layers of geotextile and HDPE sheet until they are ready for final seaming. As a

minimum, each leading edge to be seamed that must be buried or which must be exposed for periods of one month or longer shall be continuously covered by a layer of HDPE sheet. The geotextile shall be nonwoven and have a minimum weight of 8 oz. per square yard. The sacrificial HDPE sheet shall have a minimum thickness equal to that of the membrane liner to be protected. Both protective layers shall have a minimum width of 2 feet. The protective cover sheets shall be either covered with soil or weighted with sand bags to prevent displacement by wind. The edge of the sheet to be protected shall be approximately centered beneath the overlying protective layers prior to burial or weighing with sandbags. Leading edges located in areas expected to receive direct traffic from construction equipment shall be buried under a minimum thickness of one foot of buffer soil.

2620.32 Geomembrane Warranty

The installation shall be warranted against defects in workmanship for a period of 1 year from the date of substantial project completion.

Table 1

Required Physical Properties of Smooth Membrane Liner (HDPE) Sheet

Property	Test Method	Required Values (60 Mil. HDPE)
Thickness	ASTM D5199	60 mil minimum
Specific Gravity (Relative Density)	ASTM D1505	0.940 g/cm^3 min.
% Elongation at Yield (min. avg.)	ASTM D6693 Type IV	12
% Elongation at Break (min. avg.)	ASTM D6693 Type IV	700
Tensile Strength at Yield Min. Avg.)	ASTM D6693 Type IV	126 lb/in. min.
Tensile Strength at Break (min. Avg.)	ASTM D6693 Type IV	228 lb/in. min
Carbon Black Content	ASTM D-1603	2% min. - 3% max.
Carbon Black Dispersion	ASTM D-5596	**1, 2, Cat. (9 of 10 views) Cat. 3 (1 of 10 views)**
Puncture Resistance	ASTM D4833	108 lb. min.
Tear Resistance	ASTM D 1004	42 lb. min.

Seam Strengths

Shear Strength	ASTM D4437, NSF Modified	120 lb/in
Shear Strain @ Yield	ASTM D4437, NSF Modified	10% (min.)
Peel Strength (Fusion Weld)	ASTM D4437, NSF Modified	91 lb/in
Peel Strength (Extrusion Weld)	ASTM D4437, NSF Modified	78 lb/in

Non-Destructive Testing

Single Weld	Continuous Vacuum Box; Impact	Maintain vacuum of 3 psi, hold vacuum for 15 seconds.
Double Weld	Air Testing	Maintain 30 psi for no less than 5 min.; pressure loss not greater than 3 psi for last 3 minutes.

Table 2

Required Physical Properties of Textured Membrane Liner (HDPE) Sheet

Property	Test Method	Required Values (60 Mil. HDPE)
Thickness	ASTM D-5994	**60 mil minimum**
Specific Gravity (Relative Density)	ASTM D-1505	0.940 g/cm^3 min.
% Elongation at Yield	ASTM D6693 Type IV	12
% Elongation at Break	ASTM D6693 Type IV	**100**
Tensile Strength at Yield	ASTM D6693 Type IV	126 lb/in. min.
Tensile Strength at Break	ASTM D6693 Type IV	90 lb/in. min
Carbon Black Content	ASTM D-1603	2% min. - 3% max.
Carbon Black Dispersion	ASTM D-5596	**1, 2, Cat. (9 of 10 views) Cat. 3 (1 of 10 views)**
Puncture Resistance	ASTM D4833	90 lb. min.
Tear Resistance	ASTM D 1004	42 lb. min.

Seam Strengths

Shear Strength	ASTM D4437, NSF Modified	120 lb/in
Shear Strain @ Yield	ASTM D4437, NSF Modified	10% (min.)
Peel Strength (Fusion Weld)	ASTM D4437, NSF Modified	91 lb/in
Peel Strength (Extrusion Weld)	ASTM D4437, NSF Modified	78 lb/in

Non-Destructive Testing

Single Weld	Continuous Vacuum Box; Impact	Maintain vacuum of 3 psi, hold vacuum for 15 seconds.
Double Weld	Air Testing	Maintain 30 psi for no less than 5 min.; pressure loss not greater than 3 psi for last 3 minutes.

Table 3

Required Pre-Shipping Sheet Testing of Membrane Liner (HDPE)

Property	Test Method	Frequency
Thickness	ASTM D5994 (Textured) ASTM D5199 (Smooth)	Each Roll
Specific Gravity (Relative Density)	ASTM D1505	Every 5th roll
Tensile Properties	ASTM D6693 Type IV	Every 5th Roll
Tear Resistance	ASTM D1004	Every 5th Roll
Puncture Resistance	ASTM D-4833	Every 5th Roll
Carbon Black Content	ASTM D1603	Every 5th Roll
Carbon Black Dispersion	ASTM D-5596	Every 5th Roll

END OF SECTION

PART 1: GENERAL

1.01 SCOPE OF WORK

Furnish all labor, equipment, materials and incidentals necessary to install and complete installation of the geocomposite drainage layer.

1.02 WARRANTY

A. Installation shall be warranted against defects in workmanship for a period of 1-year from the date of geocomposite completion.

PART 2: PRODUCTS

2.01 GEOCOMPOSITE PROPERTIES

A. A geocomposite shall be manufactured by extruding two crossing strands to form a bi-planar drainage net structure with a non-woven geotextile bonded to one or both sides.

B. The geocomposite specified shall have properties that meet or exceed the values listed in the following Table:

Standard Property Drainage Sheet			
Tested Property	**Test Method**	**MINIMUM AVERAGE VALUES[c]**	
		6 oz. Fabric	**8 oz. Fabric**
Geocomposite			
Transmissivity[a], m^2/sec	ASTM D4716	$1.0x10^{-4}$	$1.0x10^{-4}$
Ply Adhesion, lb/in	ASTM D7005	1 [b]	1 [b]
Geonett Component [b]			
Transmissivity[a], m^2/sec	ASTM D4716	$1x10^{-3}$	$1x10^{-3}$
Thickness, mil	ASTM D 5199	200	200
Density, g/cm^3	ASTM D 1505 or ASTM D792, Method B	0.94	0.94
Peak Tensile	ASTM D 5035	45	45

Strength (MD), lb/in			
Carbon Black Content, %	ASTM D 1603	2.0 – 3.0	2.0 – 3.0
Geotextile Component [(b)]			
Mass Per Unit Area, oz/yd^2	ASTM D 5261	6	8
AOS, US Sieve	ASTM D 4751	70	80
Grab Tensile Strength	ASTM D4632	160	220
Grab Tensile Elongation	ASTM D4632	50	50
Puncture Strength	ASTM D4833	90	120
Permittivity (min. avg.) (Sec^{-1})	ASTM D 4491	1.6	1.3
UV Stability, % retained (500 hr.)	ASTM D 4355	70	70

(a) Gradient of 0.1, normal load of 10,000 psf, water at 70°, between stainless steel plates and a 15-minute seat time.
(b) Component properties prior to lamination.
(c) These are MARV values that are based on the cumulative results of specimens tested.

C. Resin
1. Resin shall be new first quality, compounded polyethylene resin.

PART 3: EXECUTION

3.01 FAMILIARIZATION

A. Inspection
1. Prior to implementing any of the work in the Section to be lined, the Installer shall carefully inspect the installed work of all other Sections and verify that all work is complete to the point where the installation of the Section may properly commence without adverse impact.

2. If the Installer has any concerns regarding the installed work of other Sections, he shall notify the Project Engineer.

B. Confirmation Testing

The friction angle between the geocomposite and the textured geomembrane shall be a minimum of 25 degrees. The Contractor shall verify prior to beginning construction. The test method used to verify the interface friction angle between the geocomposite and the textured geomembrane shall be ASTM D5321 *Standard Test Method for*

Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by Direct Shear Method. Test parameters are to provide 3 points to range over minimum and maximum expected normal loads. Minimum will be a construction load of 260 psf. Maximum will be at the landfill's final filled condition or approximately 1,423 psf. The normal loadings used shall be 250, 750 and 1,500 psf.

3.02 MATERIAL PLACEMENT

A. The geocomposite roll should be installed in the direction of the slope and in the intended direction of flow unless otherwise specified by the Engineer.

B. If the project contains long, steep slopes, special care should be taken so that only full length rolls are used at the top of the slope.

C. In the presence of wind, all geocomposites shall be weighted down with sandbags or the equivalent. Such sandbags shall be used during placement and remain until replaced with cover material.

D. If the project includes an anchor trench at the top of the slopes, the geocomposite shall be properly anchored to resist sliding. Anchor trench compacting equipment shall not come into direct contact with the geocomposite.

E. In applying fill material, no equipment can drive directly across the geocomposite. The specified fill material shall be placed and spread utilizing vehicles with a low ground pressure.

F. The cover soil shall be placed in the geocomposite in a manner that prevents damage to the geocomposite. Placement of the cover soil shall proceed immediately following the placement and inspection of the geocomposite.

3.03 SEAMS AND OVERLAPS

A. Each component of the geocomposite will be secured or seamed to the like component at overlaps.

B. Geonet Components

1. Adjacent edges of the geonet along the length of the geocomposite roll shall be placed with the edges of each geonet butted against each other.

2. The overlaps shall be joined by tying the geonet structure with cable ties. These ties shall be spaced every 3 feet along the roll length.
3. Adjoining geocomposite rolls (end to end) across the roll width should be shingled down in the direction of the slope, with the geonet portion of the top overlapping the geonet portion of the bottom geocomposite a minimum of 12

inches across the roll width.

4. The geonet portion should be tied every 6 inches in the anchor trench or as specified by the Engineer.

3.04 REPAIR

A. Prior to covering the deployed geocomposite, each roll shall be inspected for damage resulting from construction.

B. Any rips, tears or damaged areas on the deployed geocomposite shall be removed and patched. The patch shall be secured to the original geonet by tying every 6 inches with the approved tying devices. If the area to be repaired is more than 50 percent of the width of the panel, the damaged area shall be cut out and the two portions of the geonet shall be joined in accordance with Subsection 3.03.

END OF SECTION

02630.1 The temporary cover liner for the slopes shall be comprised of a minimum of 20 mil. Medium Density Polyethylene (MDPE) material as manufactured by Raven Industries (Product No. 2010B) or equal and as approved by the Engineer. The liner should be resistant to ultra violet degradation for the operational life of the landfill or until the material is removed by the Owner (18 months minimum). The minimum material properties values must be submitted to the Engineer prior to approval of the material.

02630.2 The liner shall be delivered to the site in a minimum of 15 feet wide rolls. Prefabricated factory seams are permitted using a method approved by the Engineer. The liner will be anchored at the top in the anchor trench.

02630.3 The Installer or Fabricator shall weld all seams with the wedge welding method or as otherwise approved. The quality control testing will include visual inspection and hand pulling of the seam for 100 percent of the factory and field seams.

02630.4 The Owner will periodically remove these portions of the temporary liner where waste is being placed, from the bottom up, and discard the cut-off portion.

02630.5 The Contractor is responsible for designing and installing an appropriate ballast system of the temporary liner to protect the liner against damage from up to 100 mph winds. The liner and ballast should be protected against:

1) Liner pull out from underneath the ballast;

2) Tearing of the liner or the welded seams;

3) Excessive billowing of the liner; and

4) Damage to either the ballast weights or the ropes tying them together.

Should the ballast system not adequately protect the liner against wind damage as defined above from the time the liner is placed until the liner is completely removed by the Owner, the Contractor will replace, repair, and/or supplement the liner and ballast system at no additional cost to the Owner. As a minimum, the ballast system should consist of 50 pound sand bags tied 3’ on center down or parallel to the slope and tied 10’ on center across or perpendicular to the slope. One line of ballast bags should also be placed down each seam. The sandbags and ropes used for the ballast system shall be “CIA Day Bag” manufactured by Dayton Bag & Burlap of Dayton, Ohio, or approved equal. The bags shall have a minimum 3-year warranty against degradation due to ultraviolet light exposure.

02630.6 Stormwater control liner shall have a minimum five (5) year warranty against degradation of material due to ultraviolet light exposure.

END OF SECTION

SECTION 02750 LEACHATE COLLECTION SYSTEM FORCE MAIN & NON-PERFORATED GRAVITY PIPING INSTALLATION

02750.1 DESCRIPTION OF WORK

The work covered under this section shall consist of furnishing all labor, equipment and services for the installation of the HDPE dual contained force main & non-perforated gravity piping for the leachate collection system as shown on the drawings and specified in Section 02400.

02750.2 HANDLING AND STORING MATERIALS

The Contractor shall unload material so as to avoid deformation or other injury thereto. Material shall not be rolled or dragged over gravel or rock during handling. The Contractor shall store the appurtenances on sills above storm drainage level and deliver for installation after the trench is excavated. When any material is damaged during transporting, unloading, handling or storing, the undamaged portions may be used or, if damaged sufficiently, the Engineer will reject the material as being unfit for installation.

If any defective material is discovered after installation, it shall be removed and replaced with sound material or shall be repaired by the Contractor in an approved manner and at his own expense.

02750.3 PIPE ALIGNMENT AND GRADE

The layout of underground force main pipe and gravity sewer lines shall be as shown on the contract drawings.

The Contractor shall do all field layout work for lines and grades from that information shown on the drawings or as furnished by the Engineer.

02750.4 PREPARATION OF PIPE FOUNDATION

The pipe foundation shall be prepared to be uniformly firm and the pipe bedding shall be in accordance with the typical trench cross-sections as shown on the drawings. Under no circumstances shall pipe be laid in water, on rock, or when trench conditions or weather is unsuitable for such work.

The Contractor shall remove all water which may be encountered or which may accumulate in the trenches by pumping or bailing and no pipes shall be laid until the water has been removed from the trench.

02750.5 PIPE LAYING

In all cases, pipe is to be installed in strict accordance with the manufacturer's recommendations and the contract material specifications. The Engineer may augment any manufacturer's installation recommendations if, in his opinion, it will best serve the interest of the Owner.

Proper tools, implements, and facilities satisfactory to the Engineer shall be provided and used for the safe and convenient prosecution of pipe laying. All pipe and other materials used in the laying of pipe will be lowered into the trench piece by piece by means of suitable equipment in such a manner to prevent damage to the pipe, materials, to the protective coating on the pipe materials, and to provide a safe working condition to all personnel in the trench. Each piece of pipe being lowered into the trench shall be clean, sound and free from defects. It shall be laid on the prepared foundation, as specified elsewhere to produce a straight line on a uniform grade, each pipe being laid so as to form a smooth and straight inside flow line. Pipe shall be removed at any time if broken, injured or displaced in the process of laying same, or of backfilling the trench.

During times when pipe laying is not in progress, the open ends of pipe shall be closed and no trench water or other material shall be permitted to enter the pipe.

02750.6 BACKFILLING

All backfill shall be compacted so as not to damage the pipe and appurtenances and shall be compacted to 95 percent of the Standard Proctor Test for the various types of backfill materials.

Methods of backfilling shall be in strict accordance with the pipe manufacturer's recommendations. All backfill materials shall have been approved by the Engineer. Select backfill material shall be used when requested by the Engineer. Select material shall be defined as a finely graded material free from stones over 1/2 inch in diameter, plastic clays, organic material, frozen lumps and various debris and shall be approved by the Engineer prior to its installation.

Care shall be taken during backfill and compaction operations to maintain alignment and prevent damage to the joints. The backfill shall be kept free from stones, frozen lumps, chunks of highly plastic clay, or other objectional material. All pipe backfill areas shall be graded and maintained in such a condition that erosion or saturation will not damage the pipe bed or backfill.

Heavy equipment shall not be operated over any pipe until it has been properly backfilled and has a minimum cover as required by the plans.

Where any part of the required cover is above the proposed finish grade, the Contractor shall place, maintain, and finally remove such material at no cost to the Owner. Pipe which becomes mis-aligned, shows excessive settlement, or has been otherwise damaged by the Contractor's operations shall be removed and replaced by the Contractor at no cost to the Owner. The Contractor shall maintain all pipes installed in a condition that they will function continuously from the time the pipe is installed until the project is accepted.

END OF SECTION

LEACHATE COLLECTION SYSTEM FORCE MAIN & NON-PERFORATED GRAVITY PIPING INSPECTION & TESTING

SECTION 02760

02760.1 DESCRIPTION OF WORK

The work covered under this section shall consist of furnishing all labor, equipment, and services for the proper inspection and testing of the leachate collection system force main lines and non-perforated gravity piping installed in accordance with Section 02750.

02760.2 LINE CLEANING

Prior to testing of any section(s) of the leachate collection system force main and non-perforated gravity piping, the Contractor shall completely clean the lines of all debris, silt, etc. The pipe shall be proved to be ready for use by the Owner and shall be proved to be in first class condition and constructed in accordance with the drawings and specifications.

The Contractor shall maintain the project, insofar as his construction work is concerned, in first class condition for such time as is necessary to satisfy the Engineer that all installations are correct and acceptable.

02760.3 INSPECTION

When the leachate collection system force main and non-perforated gravity piping is completed, the Engineer shall inspect the line for conformance with the provisions of the drawings and specifications, particularly with respect to alignment and depth.

02760.4 TESTING

All newly constructed force mains and non-perforated gravity pipe sections shall be subjected to a hydrostatic pressure-leakage test.

Each completed section of the pipeline shall be plugged at both ends and slowly filled with water. As the main is being filled with water in preparation of the test, all air shall be expelled from the pipe. The main shall be subjected to hydrostatic pressure of 100 pounds per square inch for a period of two hours unless otherwise specified. Pressure shall be applied to the main by means of a hand pump for small lines or by use of a gasoline pump or fire engine for larger lines. Both the Containment pipe and the Carrier pipe shall be tested.

The rate of leakage shall be determined at 15 minute intervals by means of volumetric measure of the water added during the test until the rate has stabilized at the constant value for three consecutive 15 minute periods.

Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled. No piping installation will be accepted until the leakage tests have been performed with no leakage observed.

Cracked or defective pipe, joints, fittings, or valves discovered in consequence of this test shall be removed and replaced with sound materials, and the test shall be repeated until the test results are satisfactory. Precautions shall be taken to remove or otherwise protect equipment in, or attached to, pipe to prevent damage or injury thereto.

Tests of insulated and concealed piping shall be made before the piping is covered or concealed.

The Contractor shall notify the Engineer when the work is ready for testing with all testing done in the presence of the Engineer. All labor, equipment, water and materials, including meters and gauges, shall be furnished by the Contractor at his own expense.

END OF SECTION

11310.1 Scope of Work

The leachate pumping system as outlined in this section shall consist of riser pipe, pump, motor, control panel, level sensor, power cable, electrical wiring, control wiring, and related associated discharge pipe and fittings, complete and per the operating conditions as shown on drawings and specifications.

11310.2 Quality Assurance

All equipment listed in this section shall be provided by a single supplier who has complete responsibility for the system. The supplier must have a minimum of five years experience in providing complete systems for side slope leachate removal applications.

The supplier of the leachate removal system will provide all warranty services which shall be one year from date of installation or eighteen months from date of shipment.

11310.3 Submittals

The submittal package shall include a complete list of components provided, pump curves, motor data, layout drawing, control electrical schematic, controller bill of materials, and warranty statement.

A fabrication drawing of the side slope riser and sump assembly shall be provided to the pump manufacturer with the approved submittal package.

11310.4 Equipment - Pumps

The contractor shall furnish and install two complete leachate pumping systems (Pumps 1 and 2) as manufactured by EPG, or approved equal.

The pumps shall be modified as required for suitable service in landfill leachate applications and shall be capable of operating in the horizontal or slope position, capable of pumping contaminated water to within inches of the sump bottom.

Pumps 1 and 2 shall be a EPG Series 8 SurePump Wheeled Sump Drainer, Model 8-4, or approved equal, rated 47 GPM at 63’ total dynamic head. Motor horsepower shall be a minimum of 1.0 horsepower. Operating voltage shall be three phase, 60 hertz, 460 volts.

Pump design shall include the following feature:

1. Integral check valve of 304 series stainless steel.

2. All series 304 stainless steel construction shall include impellers, bowls, guide vanes, and inlet screen

3. Each impeller shall have a E-Glide seal ring to reduce hydraulic losses, and shall consist of 304 stainless steel.

4. All shaft bearing shall be 304 stainless steel.

5. A stainless steel flow inducer shall be provided at the pump inlet.

11310.5 Equipment - Motor Design

The motor shall be a Franklin motor, suitable for submersible operation.

All materials in contact with leachate shall be 304 series stainless steel.

The motor shall not use any oils or greases for lubrication.

A jacketed power cable suitable for leachate service and properly sized shall be provided, with a suitable length such that splices are not needed.

11310.6 Equipment - Carriage

The pumps shall be mounted in a (patented) 304 series stainless steel carriage for use in an 24” HDPE riser pipe set at an approximate 1:1 slope.

The carriage shall provide a low center of gravity and all wheels shall remain in contact with the contour of the riser pipe. The wheels shall be of non-corrosive materials with self-lubricating qualities and the unit must be able to travel over welding beads as typically found in riser pipe fabrications. A stainless steel inlet suction screen shall be provided in prevent debris from entering carriage and pump inlet.

The pump and motor must be easily removed from the carriage in the field should the pump or motor require service.

A 0.25” X 100’ safety/retrieval cable assembly with properly sized cable clips, snap hook of 304 series stainless steel shall be provided. An additional .25” cable will be attached to the 3” x 3” tee to ensure that the piping assembly can be retrieved from the side slope riser.

11310.7 Equipment - Discharge Hose Assembly

Discharge hose shall be 2.0” hose, rated 300 PSI and -20 to +180 degrees Fahrenheit. Each section shall be provided with threaded stainless steel couplings. The pipe shall be properly selected for the pump performance and shall be able to handle surge conditions of the system.

All hose fittings shall be 304 series stainless steel. Hose fitting shall be long shank type and suitable for the application. All hose bands shall be hi-torque 304 series stainless steel.

A riser side exit disconnect will be provided, which will allow quick connection/disconnection of the pump discharge hose and allow the pump to be removed without interference of the stationary fittings. The exit arrangement shall thread through the riser pipe as to provide a gas tight connection. The exit connection will penetrate the riser wall approximately 6” from the top of the riser pipe.

All side exit components shall be 304 series stainless steel.

A stainless steel liquid filled pressure gauge sized to the range of the pump shall be provided with fitting outside the riser pipe. The gauge is to be shipped separately and installed in the fitting provided by the pump manufacturer at the time of installation and start up.

A 2” PVC ball type check valve with threaded unions shall be provided and mounted within the side slope riser pipe.

A 3” polypropylene full port ball valve shall be provided to provide isolation of the system. The system shall terminate inside the riser pipe.

11310.8 Controls - Control Panel

The control panel shall provide level control, pump operation, and motor protection.

Control panel shall consist of NEMA 4 X 14 gauge 304 stainless steel enclosure with a rain guard and lockable outer cover. The door shall open a minimum of 180 degrees. A window on the outer door shall allow a view of all indicators without entering the enclosure. The inner door shall be an aluminum dead front mounted on a continuous aircraft type hinge. The dead front door shall contain cutouts for the mounted equipment and operator accessible equipment and provide protection of personnel from live internal wiring.

Operator accessible components mounted on the dead front door shall include the following:

1. H-O-A switch
2. STAND-BY indicating light (amber).
3. RUN indicating light (green).
4. OVERLOAD indicating light (red).
5. DIGITAL READ OUT level indicator.
6. ELAPSED RUN TIME meter (mechanical non-reset type).
7. MAIN disconnect breaker.
8. PUMP MOTOR breaker.
9. CONTROL CIRCUIT breaker.
10. OVERLOAD RE-SET button.
11. FAULT indicating light (red).
12. LOW LEVEL indicating light (red).

The back plate shall consist of 12 gauge sheet steel and finished with a primer coat and two coats of baked on enamel. All hardware mounted to the subpanel shall be accomplished with machine thread tapped holes. Sheet metal screws are not acceptable. All devices shall be permanently identified with phenolic engraved nameplates.

The panel power distribution shall include all necessary components and shall be completely wired with standard copper conductors. Control wiring shall be properly sized and installed in Panduit type wiring trays.

An individual circuit breakers shall be provided for main power, pump, and control circuits. All circuit breakers shall be heavy duty thermal magnetic or motor circuit protectors similar and equal to Square D type FAL. Circuit breakers shall be indicting type, providing ON-OFF-TRIP positions. When the breaker is tripped automatically, the handle shall assume a middle position indicating TRIP.

Thermal magnetic breakers shall be quick-make and quick-break on manual and automatic operation and have inverse time characteristics secured through the use of bi-metallic tripping elements supplemented by a magnetic trip.

Breakers shall be designed so that an overload on one pole automatically trips and opens all legs. Field installed handle ties shall not be acceptable.

Motor starter shall be open frame, across the line, NEMA rated with individual overload protection in each leg. Motor starter contact and coil shall be replaceable from the front of the starter without removing it from

its position. Overload heaters shall be block type, utilizing melting alloy spindles and shall provide visual trip indication and an alarm contact for alarming signals. The overload shall be sized fro the full load amperage draw of the pump. Adjustable type overloads, definite purpose contractors, fractional size starters, and horsepower rated contactors or relays shall not be acceptable.

A fused type control transformer shall be used to provide the 120 VAC for control circuits.

Surge protection for incoming main power and control circuit, and a plug in type indicating phase monitor shall be provided.

A thermostat controlled heater shall be provided to control the inside temperature below the dew point and alleviate the buildup of condensate in the control enclosure.

A corrosion inhibitor shall be provided within the enclosure.

A top-mounted red visual high level alarm beacon, which shall be weatherproof, shatterproof, shall be provided with a 40 watt light.

A low level relay shall be provided, which shall provide positive pump lock out and indication should the liquid level drop below the transducer (in case of a false reading due to gas pressure). This device shall provide protection from dry run conditions.

Panel mounted intrinsically safe barriers shall be provided for all sump probes. The control panel shall have the capability to accept an external interlock for the purpose of stopping the leachate pumps.

11310.9 Controls - Level Control

A panel mounted controller digital readout display shall provide level indication of the side slope sump with 4 1/2 digits. The pump “ON-OFF-HIGH LEVEL” selection shall be through set point located on the indicator.

Pumps 1 and 2 controls shall be set to the following: Pump Off - 6” above bottom of sump; Pump On - 12” above bottom of sump; both Pumps On – 18” above bottom of sump; High Water Alarm - 36” above bottom of sump; High Water Off - 30” above bottom of sump. Pumps shall alternate on successful starts.

The controller unit will accept a 4 to 20 ma signal from the transducer and provide a level indication readout of 0 to 138.6 inches of liquid.

A submersible transducer shall be provided with a length of cable sufficient to reach the control panel without splices. Cable splices within the riser pipe are not acceptable. The transducer shall be all 316 stainless steel and shall be mounted to the pump carriage. The unit shall provide a 4-20 ma signal output to the control unit. Static accuracy rating shall be no less than 1.0 percent.

A filter/dryer shall be provided to be mounted in control panel or properly sized junction box to prevent moisture in the vent tube.

A low level sensor shall be provided with a length of cable sufficient to reach the control panel without splices. Cable splices within the riser pipe are not acceptable. The probe shall be non-corrosive construction and have no moving parts.

11310.10 Miscellaneous Items - Cable Fittings

Non-metallic gas tight cable exit fittings properly sized for the power and control cables shall be provided.

A stainless steel eye bolt shall be provided and installed in the riser. A stainless steel snap hook will be provided as part of the safety cable assembly.

11310.11 Execution - Start-Up

The manufacturer of the system shall provide field supervision assistance to insure proper system installation and start-up of the system. The scheduling of this service shall be coordinated with the Contractor to insure the riser is in place and the control panel is connected to power prior to arrival of the factory field technician. Installation and start-up typically requires one day to complete.

11310.12 Execution - Operational Test

The system shall be tested for proper operation at the time of start-up.

11310.13 Execution - Work by Contractor

Mounting control panel mounting posts and control panel to posts.

Assembly and installation of the leachate system. This includes installation of discharge and cable exit fittings.

Provide power to the leachate pump control panel from the electrical panel located at the leachate storage lagoon.

All electrical wiring, control wiring, conduit work and junction boxes between the leachate pump and control panel.

Electrical heat tracing and insulation of piping as required.

Connection of discharge piping from system termination point This should be completed at the time of system installation so the system may be tested.

Assistance in the operational testing including providing or removing water in the sump as required to allow for tests during the visit of factory technicians.

11310.14 Execution - Side Slope Riser Pipe

The riser pipes shall be provided by the Contractor and shall be 24" HDPE. The riser pipe shall have a constant inside diameter with welding beads not to exceed .25". All riser pipe fittings shall be the same inside diameter as the riser pipe or within 1/2" without sharp steps.

An "AS BUILT" of the riser pipe and sump assembly shall be provided to the Engineer and made available to the pump system manufacturer prior to start-up.

END OF SECTION

Section 9: Erosion Control Plan

To be submitted to the Land Quality Section under separate cover

Section 10: Design Hydrologic Report

Prepared by BLE and submitted under separate cover

Design Hydrogeologic Report

See BLE submittal under separate cover.

Section 11: Water Quality Monitoring Plan

Prepared by BLE and submitted under separate cover

Water Quality Monitoring Plan

See BLE submittal under separate cover.

Section 12: Landfill Gas Monitoring Plan

Prepared by BLE and submitted under separate cover

Landfill Gas Monitoring Plan

See BLE submittal under separate cover.

Section 13: HELP Model Analysis

HELP MODEL ANALYSIS

MACON COUNTY MSW LANDFILL
PHASE 3 CELL 1
MACON COUNTY, NORTH CAROLINA

MARK D. CATHEY, P.E.

McGill ASSOCIATES

Engineering • Planning • Finance
Asheville, North Carolina

NORTH CAROLINA PROFESSIONAL SEAL 024993 ENGINEER MARK D. CATHEY

6-2-15

May 2015

13.00726

Hydrological Evaluation of Landfill Performance (HELP) Model Analysis for the Macon County Phase 3 Cell 1 Municipal Solid Waste Landfill

1. INTRODUCTION

Macon County hired McGill Associates, P.A. to design Phase 3 Cell 1 of their municipal solid waste landfill. As part of the design process, the leachate collection pipes, pumps, and storage structures must be sized for the landfill cell. The Hydrological Evaluation of Landfill Performance (HELP) model version 3.07, which was developed by the environmental laboratory of the United States Army Corps of Engineers, was used to estimate the daily peak, monthly average, and annual average leachate collected in the drainage layer of the landfill cell. The HELP model utilizes the layer arrangement of the landfill, the weather conditions at the landfill site, and the hydraulic conductivity properties of each landfill layer to estimate leachate rates that are collected in the leachate drainage layer at the bottom of the landfill cell. The HELP model also estimates the amount of head on the bottom liner system using the above data.

2. MODEL INPUTS

The HELP model requires several inputs from the user to determine leachate generation. To calculate leachate flows, the **layers** of materials that make up the construction of a landfill were evaluated. The layers were grouped to form three typical landfill **cross-sections** to simulate the major stages of landfill development to evaluate leachate production. Mean historical monthly precipitation values for Franklin, NC were entered into the HELP model to estimate rainfall at the site.

2.1 LAYERS

Landfill layers were examined as the basis for calculating leachate flows for Phases 3 Cell 1 at the Macon County MSW Landfill. The layers consist of the clay barrier soils and geomembranes that make up the base and cap liner systems, the stone leachate drainage layer, the municipal solid waste layers, and the daily, intermediate, and final vegetative soil cover layers. The properties of the various layers and the classification in the HELP model are presented in Table 1. The soil and geosynthetics properties were selected from default values provided by the HELP model.

The landfill layers evaluated include the following, from top to bottom of the completed landfill:

1. 24-inch vegetative layer
2. Double sided 8 oz geocomposite
3. 40-mil HDPE geomembrane
4. 18-inch barrier soil (clay with max. hydraulic conductivity = 1×10^{-5})
5. 12-inch local soil as intermediate cover

6. 6-inch local soil as daily cover over 10-foot waste lifts
7. 10-foot lifts of municipal solid waste (94 feet at maximum fill)
8. 24-inch gravel leachate drainage layer
9. 60-mil HDPE geomembrane
10. 24-inch barrier soil (clay with max. hydraulic conductivity = 1 x 10^{-7})

Table 1: Layer Properties and HELP Model Classifications

Material	HELP Model Classification	HELP Model Texture Number	Porosity (Vol/Vol)	Effective Saturated Hydraulic Conductivity (cm/sec)
Vegetation Layer	Type 1 – Vertical Percolation	6	0.4530	$7.2x10^{-04}$
Geocomposite	Type 2 – Lateral Drainage Layer	20	0.85	10.0
Geomembrane	Type 4 – Flexible Membrane Liner	35	0.000	$2x10^{-13}$
Clay	Type 3 – Barrier Soil Liner	16	0.4510-Cap 0.4270-Base	$1x10^{-05}$-Cap $1x10^{-07}$-Base
Intermediate Cover	Type 1 – Vertical Percolation	6	0.4530	$7.2x10^{-04}$
Municipal Waste	Type 1 – Vertical Percolation	18	0.6710	$1x10^{-03}$
Daily Cover	Type 1 – Vertical Percolation	6	0.4530	$7.2x10^{-04}$
Gravel Leachate Collection Layer	Type 2 – Lateral Drainage Layer	21	0.3970	0.300

The version of the HELP model that was utilized did not include a layer to select a geosynthetic clay liner. Therefore, only the 24" clay liner system was included in the evaluated cross sections.

2.2 CROSS-SECTIONS

Three cross-sections of landfill construction were examined and utilized to produce the HELP model results based on past models. The cross-sections consist of the landfill layers listed in Section 2.1 above and were designed to represent a wide range of landfill construction, from the initial ten-foot lifts of waste with six inches of daily cover across the entire cell, to the final fill condition of the landfill consisting of approximately 94 feet of waste, and final cover soils and geomembrane.

The runoff Curve Number was computed by the HELP model based on the soil texture of the upper most layer in each landfill cross-section evaluated. Bare ground was assumed for the cases with either daily cover or intermediate cover. It was assumed that

100 percent of the area allowed runoff, although in the initial stages of landfill development prior to the time that the working face elevations reach the elevations of the periphery berms, runoff will be collected and treated as leachate (Cross-Sections 1).

In order to model the leachate production rates, the HELP model is used to determine the rates based on 30 years of simulation. Because the active life of a landfill consists of a variety of waste thickness and cover types, leachate production rates were determined by evaluating three cross-sections of the landfill that represent typical landfill construction throughout the lifetime of the landfill. The variations in the cross-sections are related to the waste thickness and the type of cover, which include daily cover (6-inches of local soil), intermediate cover (12-inches of local soil), or final cap construction (24-inches of vegetative support layer, geomembrane, and 18-inches of clay barrier soil). All of the cross-sections used in this analysis include beneath the waste layers, a 24-inch layer of washed stone on top of a 60-mil HDPE liner on top of a 24-inch layer of clay barrier soil (hydraulic conductivity of 1×10^{-7} cm/sec). The three cross-sections used in this evaluation are as follows:

- **Cross-Section 1**: A 10-foot layer of compacted waste covered with a 6-inch layer of daily cover soil, at a slope of 5%; however, all runoff is collected and treated as leachate. To evaluate the worst case scenario of leachate production, the drainage length was evaluated at 800 feet (longest length across entire cell area to sump).
- **Cross-Section 2**: Four 10-foot layers of compacted waste covered with four 6-inch layers of daily cover soil and one 12 inch layer of intermediate cover, at a 3:1 slope; however, all runoff is collected and treated as leachate. The drainage length was evaluated at 400 feet (length from the high point in the middle of the cell to the sump).
- **Cross-Section 13**: 94 feet of compacted waste covered ,a 12-inch layer of intermediate cover soil, an 18-inch layer of clay barrier soil (hydraulic conductivity of 1×10^{-5} cm/sec), a 40-mil HDPE liner, a double-sided geocomposite, and an 18-inch vegetative soil layer, at a 5% slope. This is the final cap. The drainage length was evaluated at 400 feet (length from the high point in the middle of the cell to the sump). Daily cover layers were neglected in this cross section due to the limited amount of input layers available within the HELP model.

2.3 GEOMEMBRANE INPUT

In order to design the leachate collection system for the a realistic scenario, the geomembrane in the bottom and top liner systems were assumed to have approximately 1 pinhole per acre, 1 installment defect per acre and have a good placement quality. These assumptions lead to a realistic leakage through the liner system as well as a realistic head on the bottom liner and drainage into the leachate collection pipes.

3. MODEL OUTPUT

The HELP model calculates a conservative value for the daily peak, the monthly average, and the annual average of leachate collected in the stone drainage layer (the leachate collection layer) of the landfill cell. These values than can then be used to design the necessary leachate piping, pump, and storage sizes.

3.1 DAILY LEACHATE PRODUCTION RESULTS

Tables 2, 3, and 4 pertain to daily leachate production calculations. Table 2 shows the peak daily production for each cross-section while Table 3 shows the total leachate volume collected. Table 4 lists the average and maximum daily head on the bottom liner during the modeling period. At no time during the 30 year model did the head on the bottom liner exceed 12 inches.

Table 2: Peak Daily Leachate Production Rates by Cross-Section

Cross-Section	Peak Leachate Production Rate/Acre	
	Daily (Inches)	Daily (Cu. Ft.)
1	2.476*	8,986.8*
2	0.223	809.5
3	0.000	0.002

*Includes runoff totals as well as drainage layer totals, all of which will be treated as leachate.

Table 3: Peak Daily Leachate Production Volume Totals for 7.6 Acres of Landfill

Cross-Section	Peak Leachate Production Volume (Cubic Feet)
1	68,300
2	6,152
3	0.0152

Table 4: Head on Bottom Geomembrane By Cross-Section

Cross-Section	Head on Bottom Geomembrane	
	Daily Average (Inches)	Daily Maximum (Inches)
1	5.253	9.563
2	1.803	3.355
3	.001	.002

3.2 MONTHLY AND ANNUAL LEACHATE PRODUCTION RESULTS

Tables 5 and 6 refer to monthly and annual average leachate production results. Table 5 illustrates the monthly and annual average leachate production rates calculated for each cross-section of landfill construction. Table 6 shows the monthly leachate volume totals calculated by summing the total leachate produced by each cross-section.

Table 5: Monthly and Annual Average Leachate Production Rates By Cross-Sections

Cross-Section	Monthly Average Production Rate/Acre		Annual Average
	(Inches)	(Cu. Ft.)	(Inches)
1	1.937*	7,030.1*	23.24*
2	1.635	5,935.1	19.62
3	0.00	0.00	0.00

*Includes runoff totals as well as drainage layer totals, all of which will be treated as leachate.

Table 6: Average Monthly Leachate Production Totals for 7.6 Acres of Landfill Area

Cross-Section	Monthly Leachate Production Volume (Cubic Feet)
1	53,430
2	45,105
3	0

4. CONCLUSIONS

The period when the greatest peak daily, average monthly, and average yearly leachate production will be observed is during the time period when waste lifts are thin and waste elevations are such that stormwater runoff does not reach periphery ditching. This will occur in Cross Section 1. This cross section assumes that 10 feet of waste will be placed over the entire landfill area, which is very conservative estimate based on the actual fill progression that will take place. However, we chose to model as such to demonstrate that 12” of head on the liner shall not take place, as well as determine a worst case scenario to evaluate our sump volume. Detailed calculations pertaining to leachate are included in the Engineering Plan. The HELP Model output in the next section only includes Year 1 daily output values of the 30 years of precipitation simulated for the analysis, along with the overall analysis summary. The additional daily outputs for the years not included may be provided upon request.

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:    C:\DATA4.D4
TEMPERATURE DATA FILE:      C:\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\DATA10.D10
OUTPUT DATA FILE:           C:\INITIAL.OUT


TIME:  17: 4     DATE:   5/12/2015



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     TITLE:  MACON COUNTY MSW LANDFILL PHASE 3 CELL 1

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


                                   LAYER  1
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   6
          THICKNESS                   =      6.00   INCHES
          POROSITY                    =      0.4530 VOL/VOL
          FIELD CAPACITY              =      0.1900 VOL/VOL
          WILTING POINT               =      0.0850 VOL/VOL
          INITIAL SOIL WATER CONTENT  =      0.3344 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.720000011000E-03 CM/SEC



                                   LAYER  2
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
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              MATERIAL TEXTURE NUMBER  18
THICKNESS                   =    120.00   INCHES
POROSITY                    =      0.6710 VOL/VOL
FIELD CAPACITY              =      0.2920 VOL/VOL
WILTING POINT               =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.2964 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


                        LAYER  3
                        --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER  21
THICKNESS                   =     24.00   INCHES
POROSITY                    =      0.3970 VOL/VOL
FIELD CAPACITY              =      0.0320 VOL/VOL
WILTING POINT               =      0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0888 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.300000012000     CM/SEC
SLOPE                       =      3.00   PERCENT
DRAINAGE LENGTH             =    800.0    FEET


                        LAYER  4
                        --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.06   INCHES
POROSITY                    =      0.0000 VOL/VOL
FIELD CAPACITY              =      0.0000 VOL/VOL
WILTING POINT               =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY         =      1.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      1.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD


                        LAYER  5
                        --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  16
THICKNESS                   =     24.00   INCHES
POROSITY                    =      0.4270 VOL/VOL
FIELD CAPACITY              =      0.4180 VOL/VOL
WILTING POINT               =      0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.4270 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000001000E-06 CM/SEC


         GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                             Page 2
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NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE # 6 WITH BARE
         GROUND CONDITIONS, A SURFACE SLOPE OF  5.% AND
         A SLOPE LENGTH OF  800. FEET.

SCS RUNOFF CURVE NUMBER             =     85.30
FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
EVAPORATIVE ZONE DEPTH              =      9.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE   =      3.243  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE  =      4.731  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE  =      0.741  INCHES
INITIAL SNOW WATER                  =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS    =     49.958  INCHES
TOTAL INITIAL WATER                 =     49.958  INCHES
TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR


              EVAPOTRANSPIRATION AND WEATHER DATA
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NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
         ASHEVILLE             NORTH CAROLINA

     STATION LATITUDE                        =  35.26 DEGREES
     MAXIMUM LEAF AREA INDEX                 =   0.00
     START OF GROWING SEASON (JULIAN DATE)   =     96
     END OF GROWING SEASON (JULIAN DATE)     =    298
     EVAPORATIVE ZONE DEPTH                  =   9.0  INCHES
     AVERAGE ANNUAL WIND SPEED               =   7.60 MPH
     AVERAGE 1ST QUARTER RELATIVE HUMIDITY   =  71.00 %
     AVERAGE 2ND QUARTER RELATIVE HUMIDITY   =  75.00 %
     AVERAGE 3RD QUARTER RELATIVE HUMIDITY   =  84.00 %
     AVERAGE 4TH QUARTER RELATIVE HUMIDITY   =  77.00 %


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

         NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
-------     -------     -------     -------     -------     -------
  5.12        4.72        4.92        3.90        4.72        4.65
  4.57        4.65        4.61        3.35        4.57        4.61


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

     NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
-------     -------     -------     -------     -------     -------
 35.50       39.00       46.00       53.50       61.50       69.00
 72.50       72.00       66.00       55.50       46.50       38.00
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NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ASHEVILLE NORTH CAROLINA
AND STATION LATITUDE = 35.26 DEGREES

HEAD #1: AVERAGE HEAD ON TOP OF LAYER 4
DRAIN #1: LATERAL DRAINAGE FROM LAYER 3 (RECIRCULATION AND COLLECTION)
LEAK #1: PERCOLATION OR LEAKAGE THROUGH LAYER 5

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DAILY OUTPUT FOR YEAR 1

DAY	AIR	SOIL	RAIN IN.	RUNOFF IN.	ET IN.	E. ZONE WATER IN./IN.	HEAD #1 IN.	DRAIN #1 IN.	LEAK #1 IN.
1			0.00	0.000	0.048	0.2612	1.9915	.1269	.1954E-05
2			0.00	0.000	0.044	0.2469	2.0195	.1287	.1979E-05
3	*		0.00	0.000	0.046	0.2344	1.9042	.1213	.1875E-05
4	*		0.00	0.000	0.034	0.2251	1.7086	.1089	.1697E-05
5			0.00	0.000	0.043	0.2161	1.5078	.9608E-01	.1514E-05
6			0.00	0.000	0.055	0.2063	1.3055	.8319E-01	.1326E-05
7			0.00	0.000	0.048	0.1983	1.0955	.6981E-01	.1130E-05
8			0.00	0.000	0.048	0.1904	0.9191	.5857E-01	.9623E-06
9			0.00	0.000	0.053	0.1821	0.8380	.5340E-01	.8844E-06
10	*		0.00	0.000	0.040	0.1755	0.7662	.4882E-01	.8149E-06
11			0.00	0.000	0.047	0.1685	0.6585	.4196E-01	.7096E-06
12	*		0.00	0.000	0.040	0.1625	0.5837	.3719E-01	.6358E-06
13	*		0.00	0.000	0.036	0.1572	0.5837	.3720E-01	.6358E-06
14	*		0.21	0.000	0.028	0.1583	0.6540	.4168E-01	.7053E-06
15	*		0.03	0.000	0.023	0.1594	0.7596	.4840E-01	.8085E-06
16	*		0.00	0.000	0.032	0.1606	0.8768	.5587E-01	.9218E-06
17	*		0.00	0.000	0.036	0.1618	0.9898	.6307E-01	.1030E-05
18			0.00	0.000	0.044	0.1608	1.0900	.6946E-01	.1125E-05
19			0.00	0.000	0.067	0.1522	1.1743	.7483E-01	.1204E-05
20			0.02	0.000	0.065	0.1471	1.2488	.7958E-01	.1274E-05
21			0.00	0.000	0.092	0.1369	1.2810	.8162E-01	.1304E-05
22			0.00	0.000	0.069	0.1292	1.3942	.8884E-01	.1409E-05
23			0.63	0.000	0.070	0.1914	1.5349	.9781E-01	.1539E-05
24			0.64	0.000	0.071	0.2547	1.5926	.1015	.1591E-05
25			0.26	0.000	0.063	0.2766	1.4859	.9468E-01	.1494E-05
26			0.71	0.007	0.056	0.2955	1.3380	.8526E-01	.1357E-05
27			0.00	0.000	0.076	0.2659	1.1875	.7567E-01	.1216E-05
28			0.00	0.000	0.076	0.2442	1.0461	.6666E-01	.1083E-05
29			0.00	0.000	0.069	0.2284	0.9180	.5849E-01	.9612E-06
30			0.00	0.000	0.072	0.2150	0.8038	.5122E-01	.8514E-06
31			0.14	0.000	0.055	0.2200	0.7028	.4478E-01	.7531E-06
32			0.00	0.000	0.058	0.2101	0.6042	.3850E-01	.6560E-06
33			0.01	0.000	0.046	0.2031	0.5062	.3225E-01	.5582E-06
34			0.03	0.000	0.052	0.1980	0.4234	.2698E-01	.4744E-06
35	*		0.00	0.000	0.049	0.1910	0.3838	.2446E-01	.4338E-06
36	*		0.27	0.000	0.028	0.1911	0.3554	.2265E-01	.4044E-06
37			0.00	0.000	0.034	0.2103	0.2973	.1894E-01	.3437E-06

38		0.00	0.000	0.092	0.1982	0.2544	.1621E-01	.2982E-06
39		0.00	0.000	0.083	0.1880	0.2827	.1802E-01	.3283E-06
40		0.00	0.000	0.071	0.1802	0.3848	.2452E-01	.4347E-06
41		0.11	0.000	0.073	0.1841	0.5043	.3213E-01	.5562E-06
42		0.46	0.000	0.083	0.2260	0.6423	.4093E-01	.6937E-06
43		0.22	0.000	0.076	0.2417	0.7801	.4971E-01	.8284E-06
44		0.33	0.000	0.076	0.2699	0.9121	.5812E-01	.9556E-06
45		0.48	0.000	0.077	0.2848	1.0340	.6589E-01	.1072E-05
46		0.00	0.000	0.095	0.2521	1.2498	.7964E-01	.1275E-05
47		0.02	0.000	0.062	0.2371	1.4046	.8950E-01	.1418E-05
48		0.00	0.000	0.085	0.2218	1.4000	.8921E-01	.1414E-05
49		0.22	0.000	0.067	0.2354	1.2897	.8218E-01	.1312E-05
50		0.13	0.000	0.064	0.2393	1.1515	.7337E-01	.1183E-05
51		1.35	0.140	0.063	0.3350	0.9988	.6364E-01	.1038E-05
52		0.05	0.000	0.076	0.2635	0.8900	.5671E-01	.9344E-06
53		0.62	0.000	0.051	0.2928	0.7584	.4833E-01	.8074E-06
54		0.00	0.000	0.065	0.2620	0.6997	.4459E-01	.7501E-06
55		0.70	0.001	0.055	0.2996	0.7115	.4534E-01	.7617E-06
56		0.00	0.000	0.061	0.2670	0.6613	.4214E-01	.7124E-06
57		0.03	0.000	0.053	0.2509	0.6516	.4152E-01	.7030E-06
58		0.00	0.000	0.091	0.2323	0.6526	.4159E-01	.7039E-06
59		0.00	0.000	0.084	0.2176	0.6161	.3926E-01	.6678E-06
60		0.61	0.000	0.064	0.2748	0.5291	.3371E-01	.5812E-06
61	*	0.05	0.000	0.046	0.2644	0.4590	.2925E-01	.5106E-06
62	*	0.00	0.000	0.065	0.2503	0.4495	.2864E-01	.5010E-06
63		0.66	0.000	0.056	0.3070	0.4226	.2693E-01	.4735E-06
64		0.00	0.000	0.105	0.2606	0.4333	.2761E-01	.4845E-06
65		0.15	0.000	0.051	0.2607	0.4114	.2621E-01	.4620E-06
66		0.00	0.000	0.067	0.2458	0.5565	.3546E-01	.6084E-06
67		0.00	0.000	0.121	0.2259	0.7381	.4703E-01	.7875E-06
68		0.00	0.000	0.085	0.2121	0.8357	.5325E-01	.8822E-06
69		0.27	0.000	0.071	0.2313	0.8720	.5556E-01	.9172E-06
70		0.00	0.000	0.076	0.2212	0.8663	.5520E-01	.9117E-06
71		0.00	0.000	0.066	0.2121	0.8860	.5646E-01	.9306E-06
72	*	0.04	0.000	0.041	0.2102	0.8556	.5452E-01	.9014E-06
73		0.00	0.000	0.095	0.1989	0.8300	.5289E-01	.8768E-06
74		0.01	0.000	0.076	0.1894	0.9417	.6001E-01	.9839E-06
75		0.00	0.000	0.109	0.1757	1.1572	.7374E-01	.1188E-05
76		0.00	0.000	0.066	0.1674	1.3715	.8739E-01	.1388E-05
77		0.00	0.000	0.079	0.1586	1.5498	.9875E-01	.1552E-05
78		0.00	0.000	0.131	0.1441	1.6908	.1077	.1681E-05
79		0.39	0.000	0.089	0.1776	1.8141	.1156	.1793E-05
80		0.76	0.000	0.074	0.2538	1.9175	.1222	.1887E-05
81		0.04	0.000	0.100	0.2472	1.9970	.1272	.1959E-05
82		0.00	0.000	0.136	0.2320	2.0531	.1308	.2009E-05
83		0.00	0.000	0.128	0.2149	2.0848	.1328	.2037E-05
84		0.00	0.000	0.131	0.1968	2.1339	.1360	.2081E-05
85		0.60	0.000	0.111	0.2479	2.1521	.1371	.2098E-05
86		0.10	0.000	0.089	0.2483	2.1221	.1352	.2071E-05
87		0.31	0.000	0.097	0.2720	2.0480	.1305	.2004E-05
88		0.00	0.000	0.153	0.2509	1.9556	.1246	.1921E-05
89		0.00	0.000	0.154	0.2236	1.8980	.1209	.1869E-05
90		0.13	0.000	0.106	0.2200	1.8780	.1197	.1851E-05
91		0.00	0.000	0.111	0.2030	1.9157	.1221	.1885E-05
92		0.01	0.000	0.087	0.1905	1.9092	.1217	.1879E-05
93		0.00	0.000	0.131	0.1727	1.8617	.1186	.1836E-05
94		0.00	0.000	0.121	0.1582	1.7916	.1142	.1773E-05
95		0.01	0.000	0.095	0.1488	1.6451	.1048	.1639E-05
96		0.00	0.000	0.071	0.1410	1.4672	.9349E-01	.1476E-05
97		0.00	0.000	0.085	0.1316	1.3332	.8495E-01	.1352E-05
98		0.00	0.000	0.073	0.1235	1.2443	.7929E-01	.1270E-05
99		0.00	0.000	0.077	0.1150	1.3362	.8515E-01	.1355E-05
100		0.35	0.000	0.098	0.1429	1.4699	.9366E-01	.1479E-05

101	0.11	0.000	0.098	0.1442	1.4623	.9318E-01	.1472E-05
102	0.83	0.002	0.074	0.2272	1.3375	.8523E-01	.1356E-05
103	0.99	0.065	0.107	0.3181	1.2004	.7649E-01	.1228E-05
104	0.00	0.000	0.119	0.2520	1.0681	.6806E-01	.1104E-05
105	0.00	0.000	0.111	0.2297	0.9410	.5996E-01	.9832E-06
106	0.00	0.000	0.145	0.2091	0.8319	.5301E-01	.8786E-06
107	0.00	0.000	0.187	0.1856	0.7332	.4672E-01	.7829E-06
108	0.00	0.000	0.146	0.1663	0.6390	.4072E-01	.6905E-06
109	0.00	0.000	0.190	0.1452	0.5435	.3463E-01	.5956E-06
110	0.31	0.000	0.167	0.1611	0.4788	.3051E-01	.5306E-06
111	0.00	0.000	0.214	0.1373	0.4081	.2600E-01	.4587E-06
112	0.00	0.000	0.155	0.1201	0.3414	.2175E-01	.3898E-06
113	0.00	0.000	0.128	0.1042	0.2856	.1820E-01	.3313E-06
114	0.00	0.000	0.163	0.0861	0.2628	.1675E-01	.3072E-06
115	0.00	0.000	0.034	0.0823	0.3566	.2273E-01	.4056E-06
116	0.04	0.000	0.006	0.0861	0.4687	.2986E-01	.5203E-06
117	0.00	0.000	0.004	0.0856	0.7123	.4539E-01	.7622E-06
118	0.00	0.000	0.013	0.0842	0.9546	.6083E-01	.9961E-06
119	0.00	0.000	0.006	0.0835	1.0557	.6727E-01	.1092E-05
120	0.00	0.000	0.007	0.0827	1.0136	.6459E-01	.1052E-05
121	0.00	0.000	0.003	0.0824	0.9333	.5947E-01	.9759E-06
122	0.00	0.000	0.000	0.0823	0.8436	.5376E-01	.8899E-06
123	0.07	0.000	0.004	0.0897	0.7552	.4812E-01	.8043E-06
124	0.87	0.000	0.021	0.1841	0.6723	.4284E-01	.7233E-06
125	0.13	0.000	0.077	0.1900	0.5967	.3802E-01	.6486E-06
126	0.00	0.000	0.188	0.1691	0.5288	.3369E-01	.5809E-06
127	0.00	0.000	0.200	0.1469	0.4683	.2984E-01	.5200E-06
128	0.00	0.000	0.169	0.1281	0.4149	.2644E-01	.4656E-06
129	0.00	0.000	0.077	0.1196	0.3678	.2344E-01	.4172E-06
130	0.00	0.000	0.058	0.1131	0.3265	.2081E-01	.3744E-06
131	0.00	0.000	0.049	0.1077	0.2904	.1850E-01	.3364E-06
132	0.00	0.000	0.043	0.1029	0.2588	.1649E-01	.3029E-06
133	0.06	0.000	0.040	0.1051	0.2311	.1473E-01	.2733E-06
134	0.00	0.000	0.037	0.1010	0.2070	.1319E-01	.2471E-06
135	0.36	0.000	0.036	0.1370	0.1859	.1184E-01	.2241E-06
136	0.20	0.000	0.034	0.1555	0.1674	.1067E-01	.2038E-06
137	0.00	0.000	0.031	0.1521	0.1513	.9639E-02	.1858E-06
138	0.00	0.000	0.029	0.1488	0.1371	.8738E-02	.1699E-06
139	0.67	0.000	0.029	0.2200	0.1247	.7947E-02	.1559E-06
140	0.22	0.000	0.119	0.2312	0.1133	.7221E-02	.1429E-06
141	0.05	0.000	0.131	0.2222	0.1034	.6590E-02	.1315E-06
142	0.71	0.002	0.189	0.2799	0.0952	.6067E-02	.1219E-06
143	0.00	0.000	0.233	0.2449	0.0879	.5603E-02	.1134E-06
144	0.00	0.000	0.163	0.2192	0.0765	.4873E-02	.9991E-07
145	0.00	0.000	0.188	0.1931	0.0640	.4076E-02	.8495E-07
146	0.00	0.000	0.144	0.1723	0.0535	.3410E-02	.7296E-07
147	0.00	0.000	0.165	0.1530	0.0483	.3075E-02	.6708E-07
148	0.28	0.000	0.116	0.1712	0.0528	.3363E-02	.7215E-07
149	1.27	0.054	0.140	0.2907	0.0448	.2855E-02	.6318E-07
150	0.00	0.000	0.267	0.2386	0.0543	.3461E-02	.7423E-07
151	0.00	0.000	0.200	0.2097	0.1276	.8133E-02	.1592E-06
152	0.00	0.000	0.229	0.1782	0.1530	.9750E-02	.1877E-06
153	0.00	0.000	0.235	0.1503	0.1846	.1176E-01	.2226E-06
154	0.00	0.000	0.217	0.1261	0.2261	.1441E-01	.2679E-06
155	0.00	0.000	0.180	0.1061	0.2351	.1498E-01	.2776E-06
156	0.80	0.000	0.080	0.1861	0.2043	.1302E-01	.2443E-06
157	0.00	0.000	0.203	0.1635	0.1709	.1089E-01	.2076E-06
158	0.00	0.000	0.162	0.1455	0.2168	.1381E-01	.2573E-06
159	0.35	0.000	0.173	0.1652	0.4600	.2931E-01	.5113E-06
160	0.78	0.002	0.140	0.2361	0.5716	.3642E-01	.6237E-06
161	0.21	0.000	0.100	0.2484	0.5852	.3729E-01	.6372E-06
162	0.57	0.000	0.103	0.2818	0.5639	.3593E-01	.6160E-06
163	0.31	0.000	0.165	0.2813	0.5261	.3353E-01	.5783E-06

164	0.14	0.000	0.204	0.2629	0.4550	.2899E-01	.5065E-06
165	0.02	0.000	0.153	0.2405	0.3989	.2542E-01	.4493E-06
166	0.24	0.000	0.182	0.2427	0.3945	.2514E-01	.4447E-06
167	0.00	0.000	0.196	0.2150	0.3718	.2369E-01	.4214E-06
168	0.02	0.000	0.176	0.1941	0.3387	.2158E-01	.3871E-06
169	0.11	0.000	0.152	0.1882	0.3036	.1935E-01	.3504E-06
170	0.00	0.000	0.194	0.1662	0.2912	.1855E-01	.3372E-06
171	0.20	0.000	0.117	0.1754	0.2751	.1753E-01	.3202E-06
172	0.00	0.000	0.250	0.1476	0.2327	.1483E-01	.2750E-06
173	0.16	0.000	0.255	0.1370	0.1986	.1265E-01	.2380E-06
174	0.26	0.000	0.175	0.1465	0.2234	.1423E-01	.2649E-06
175	0.23	0.000	0.255	0.1437	0.3065	.1953E-01	.3531E-06
176	0.10	0.000	0.209	0.1316	0.5608	.3573E-01	.6125E-06
177	0.24	0.000	0.216	0.1343	0.8224	.5240E-01	.8692E-06
178	0.05	0.000	0.200	0.1176	0.9218	.5874E-01	.9650E-06
179	0.58	0.000	0.134	0.1672	0.8931	.5691E-01	.9375E-06
180	0.00	0.000	0.174	0.1479	0.8286	.5280E-01	.8754E-06
181	0.18	0.000	0.204	0.1452	0.7539	.4804E-01	.8030E-06
182	0.00	0.000	0.220	0.1208	0.6788	.4325E-01	.7296E-06
183	0.01	0.000	0.143	0.1060	0.6074	.3871E-01	.6593E-06
184	0.18	0.000	0.078	0.1174	0.5417	.3452E-01	.5939E-06
185	0.00	0.000	0.059	0.1108	0.4822	.3073E-01	.5341E-06
186	0.06	0.000	0.053	0.1116	0.4289	.2733E-01	.4800E-06
187	0.00	0.000	0.045	0.1066	0.3816	.2432E-01	.4315E-06
188	0.04	0.000	0.043	0.1063	0.3397	.2165E-01	.3881E-06
189	1.59	0.107	0.038	0.2668	0.3028	.1929E-01	.3495E-06
190	0.00	0.000	0.204	0.2441	0.2703	.1722E-01	.3152E-06
191	0.00	0.000	0.226	0.2144	0.2359	.1503E-01	.2784E-06
192	0.08	0.000	0.204	0.1955	0.1973	.1257E-01	.2366E-06
193	0.06	0.000	0.216	0.1733	0.1651	.1052E-01	.2012E-06
194	0.05	0.000	0.197	0.1569	0.1516	.9661E-02	.1862E-06
195	0.03	0.000	0.207	0.1372	0.1840	.1172E-01	.2220E-06
196	0.00	0.000	0.237	0.1108	0.2025	.1291E-01	.2423E-06
197	0.23	0.000	0.191	0.1152	0.2094	.1334E-01	.2498E-06
198	0.29	0.000	0.081	0.1384	0.2090	.1332E-01	.2494E-06
199	0.76	0.000	0.087	0.2125	0.2008	.1279E-01	.2404E-06
200	0.21	0.000	0.134	0.2209	0.1928	.1228E-01	.2317E-06
201	0.00	0.000	0.222	0.1962	0.1865	.1189E-01	.2248E-06
202	0.31	0.000	0.104	0.2191	0.1786	.1138E-01	.2161E-06
203	0.00	0.000	0.236	0.1928	0.1697	.1081E-01	.2063E-06
204	0.22	0.000	0.148	0.2008	0.1604	.1022E-01	.1960E-06
205	0.07	0.000	0.149	0.1919	0.1503	.9579E-02	.1847E-06
206	0.00	0.000	0.236	0.1656	0.1395	.8888E-02	.1726E-06
207	0.00	0.000	0.208	0.1425	0.1315	.8379E-02	.1636E-06
208	0.06	0.000	0.091	0.1390	0.1238	.7887E-02	.1548E-06
209	0.34	0.000	0.110	0.1646	0.1164	.7416E-02	.1464E-06
210	0.00	0.000	0.198	0.1427	0.1094	.6971E-02	.1384E-06
211	0.00	0.000	0.166	0.1242	0.1028	.6552E-02	.1308E-06
212	0.00	0.000	0.183	0.1039	0.0967	.6161E-02	.1237E-06
213	0.00	0.000	0.077	0.0954	0.0910	.5797E-02	.1170E-06
214	0.00	0.000	0.060	0.0888	0.0857	.5459E-02	.1108E-06
215	0.00	0.000	0.051	0.0832	0.0807	.5145E-02	.1050E-06
216	0.00	0.000	0.008	0.0823	0.0762	.4856E-02	.9960E-07
217	0.00	0.000	0.000	0.0823	0.0720	.4588E-02	.9460E-07
218	0.00	0.000	0.000	0.0823	0.0681	.4342E-02	.8996E-07
219	1.24	0.025	0.026	0.2145	0.0646	.4114E-02	.8566E-07
220	0.00	0.000	0.163	0.1963	0.0613	.3903E-02	.8167E-07
221	0.00	0.000	0.154	0.1792	0.0582	.3709E-02	.7817E-07
222	0.00	0.000	0.156	0.1619	0.0554	.3530E-02	.7505E-07
223	0.00	0.000	0.151	0.1451	0.0528	.3364E-02	.7216E-07
224	0.00	0.000	0.166	0.1267	0.0504	.3210E-02	.6946E-07
225	1.25	0.028	0.081	0.2535	0.0481	.3068E-02	.6696E-07
226	0.01	0.000	0.079	0.2458	0.0461	.2936E-02	.6462E-07

227	0.00	0.000	0.176	0.2253	0.0441	.2813E-02	.6245E-07
228	0.10	0.000	0.115	0.2193	0.0389	.2480E-02	.5647E-07
229	0.11	0.000	0.161	0.2092	0.0326	.2075E-02	.4910E-07
230	0.00	0.000	0.219	0.1810	0.0272	.1735E-02	.4282E-07
231	0.00	0.000	0.173	0.1618	0.0334	.2128E-02	.5001E-07
232	0.00	0.000	0.130	0.1473	0.0533	.3399E-02	.7275E-07
233	0.00	0.000	0.184	0.1268	0.0673	.4286E-02	.8890E-07
234	0.00	0.000	0.165	0.1084	0.0767	.4885E-02	.1001E-06
235	0.00	0.000	0.078	0.0998	0.0826	.5266E-02	.1072E-06
236	0.59	0.000	0.063	0.1583	0.0861	.5486E-02	.1113E-06
237	0.23	0.000	0.078	0.1752	0.0876	.5584E-02	.1131E-06
238	0.05	0.000	0.155	0.1635	0.0878	.5593E-02	.1132E-06
239	0.00	0.000	0.175	0.1440	0.0869	.5536E-02	.1122E-06
240	0.51	0.000	0.087	0.1910	0.0852	.5432E-02	.1103E-06
241	0.28	0.000	0.133	0.2074	0.0831	.5295E-02	.1078E-06
242	0.00	0.000	0.171	0.1884	0.0806	.5137E-02	.1048E-06
243	0.12	0.000	0.114	0.1889	0.0774	.4934E-02	.1011E-06
244	0.89	0.010	0.095	0.2762	0.0735	.4684E-02	.9639E-07
245	0.00	0.000	0.153	0.2508	0.0711	.4529E-02	.9348E-07
246	1.42	0.137	0.112	0.3376	0.0651	.4147E-02	.8629E-07
247	0.27	0.000	0.134	0.2839	0.0621	.3955E-02	.8266E-07
248	0.57	0.000	0.113	0.2842	0.0633	.4035E-02	.8417E-07
249	0.00	0.000	0.133	0.2492	0.0600	.3821E-02	.8016E-07
250	0.00	0.000	0.128	0.2269	0.0640	.4081E-02	.8504E-07
251	0.00	0.000	0.102	0.2117	0.0673	.4290E-02	.8899E-07
252	0.00	0.000	0.112	0.1961	0.0679	.4326E-02	.8967E-07
253	0.00	0.000	0.125	0.1789	0.0590	.3759E-02	.7912E-07
254	0.00	0.000	0.120	0.1625	0.0493	.3145E-02	.6831E-07
255	0.19	0.000	0.089	0.1723	0.0413	.2630E-02	.5918E-07
256	0.38	0.000	0.088	0.2047	0.0632	.4029E-02	.8429E-07
257	0.21	0.000	0.055	0.2219	0.0723	.4606E-02	.9493E-07
258	0.07	0.000	0.137	0.2141	0.0605	.3853E-02	.8084E-07
259	0.14	0.000	0.082	0.2205	0.0506	.3223E-02	.6969E-07
260	0.00	0.000	0.090	0.2105	0.1172	.7466E-02	.1463E-06
261	0.00	0.000	0.131	0.1955	0.3398	.2165E-01	.3875E-06
262	0.00	0.000	0.135	0.1805	0.6036	.3846E-01	.6552E-06
263	0.00	0.000	0.117	0.1675	0.8310	.5295E-01	.8776E-06
264	0.00	0.000	0.144	0.1515	1.0230	.6518E-01	.1061E-05
265	0.00	0.000	0.141	0.1359	1.1812	.7526E-01	.1210E-05
266	0.00	0.000	0.124	0.1221	1.3079	.8334E-01	.1329E-05
267	0.00	0.000	0.120	0.1087	1.4068	.8964E-01	.1421E-05
268	0.00	0.000	0.146	0.0925	1.4817	.9441E-01	.1490E-05
269	0.00	0.000	0.078	0.0838	1.5362	.9789E-01	.1540E-05
270	0.00	0.000	0.013	0.0823	1.5687	.9996E-01	.1570E-05
271	0.00	0.000	0.000	0.0823	1.7070	.1088	.1696E-05
272	0.00	0.000	0.000	0.0823	1.7980	.1146	.1779E-05
273	0.00	0.000	0.000	0.0823	1.7827	.1136	.1765E-05
274	0.00	0.000	0.000	0.0823	1.6303	.1039	.1626E-05
275	0.00	0.000	0.000	0.0823	1.4529	.9258E-01	.1463E-05
276	0.00	0.000	0.000	0.0823	1.2803	.8158E-01	.1303E-05
277	0.00	0.000	0.000	0.0823	1.1218	.7148E-01	.1155E-05
278	0.00	0.000	0.000	0.0823	0.9799	.6244E-01	.1020E-05
279	0.00	0.000	0.000	0.0823	0.8546	.5446E-01	.9005E-06
280	0.00	0.000	0.000	0.0823	0.7450	.4747E-01	.7943E-06
281	0.00	0.000	0.000	0.0823	0.6496	.4139E-01	.7009E-06
282	0.00	0.000	0.000	0.0823	0.5668	.3612E-01	.6189E-06
283	0.00	0.000	0.000	0.0823	0.4952	.3155E-01	.5472E-06
284	0.00	0.000	0.000	0.0823	0.4333	.2761E-01	.4844E-06
285	0.00	0.000	0.000	0.0823	0.3799	.2421E-01	.4297E-06
286	0.00	0.000	0.000	0.0823	0.3338	.2127E-01	.3819E-06
287	0.00	0.000	0.000	0.0823	0.2940	.1873E-01	.3402E-06
288	0.00	0.000	0.000	0.0823	0.2597	.1655E-01	.3038E-06
289	0.83	0.000	0.017	0.1726	0.2301	.1466E-01	.2721E-06

290		0.27	0.000	0.020	0.2004	0.2045	.1303E-01	.2444E-06
291		0.04	0.000	0.065	0.1977	0.1823	.1162E-01	.2202E-06
292		1.56	0.212	0.052	0.3417	0.1632	.1040E-01	.1991E-06
293		0.14	0.000	0.067	0.2731	0.1466	.9341E-02	.1806E-06
294		0.00	0.000	0.102	0.2523	0.1322	.8422E-02	.1643E-06
295		0.00	0.000	0.082	0.2373	0.1196	.7624E-02	.1501E-06
296		0.00	0.000	0.069	0.2235	0.1087	.6929E-02	.1376E-06
297		0.00	0.000	0.069	0.2112	0.0988	.6295E-02	.1261E-06
298		0.00	0.000	0.071	0.1991	0.0844	.5376E-02	.1092E-06
299		0.01	0.000	0.054	0.1909	0.0706	.4497E-02	.9288E-07
300		0.35	0.000	0.057	0.2204	0.0590	.3762E-02	.7918E-07
301		0.00	0.000	0.078	0.2091	0.0541	.3450E-02	.7365E-07
302		0.35	0.000	0.054	0.2400	0.0504	.3211E-02	.6947E-07
303		0.44	0.000	0.055	0.2827	0.0422	.2686E-02	.6017E-07
304		0.00	0.000	0.074	0.2583	0.0353	.2247E-02	.5225E-07
305		0.00	0.000	0.090	0.2360	0.0295	.1879E-02	.4550E-07
306		0.00	0.000	0.077	0.2210	0.0800	.5099E-02	.1038E-06
307		0.00	0.000	0.076	0.2084	0.3345	.2132E-01	.3818E-06
308		0.00	0.000	0.072	0.1968	0.5786	.3687E-01	.6305E-06
309		1.02	0.008	0.062	0.3008	0.7306	.4655E-01	.7802E-06
310		1.66	0.390	0.075	0.3383	0.8276	.5274E-01	.8745E-06
311		0.22	0.000	0.079	0.2807	0.7914	.5043E-01	.8393E-06
312		1.95	0.486	0.073	0.3503	0.7360	.4690E-01	.7855E-06
313		0.00	0.000	0.078	0.2584	0.7500	.4779E-01	.7992E-06
314		0.00	0.000	0.104	0.2384	0.8629	.5498E-01	.9084E-06
315		0.00	0.000	0.092	0.2212	0.8717	.5554E-01	.9169E-06
316		0.00	0.000	0.099	0.2051	0.7914	.5043E-01	.8394E-06
317		0.00	0.000	0.092	0.1912	0.7193	.4583E-01	.7693E-06
318		0.00	0.000	0.081	0.1786	0.6734	.4291E-01	.7244E-06
319		0.00	0.000	0.089	0.1657	0.5881	.3747E-01	.6401E-06
320		0.01	0.000	0.066	0.1571	0.4923	.3137E-01	.5442E-06
321		0.90	0.000	0.051	0.2495	0.4587	.2923E-01	.5103E-06
322		0.00	0.000	0.061	0.2428	0.5055	.3221E-01	.5575E-06
323		0.00	0.000	0.047	0.2370	0.7222	.4602E-01	.7717E-06
324		0.00	0.000	0.066	0.2284	1.0782	.6871E-01	.1113E-05
325		0.00	0.000	0.046	0.2196	1.4347	.9142E-01	.1446E-05
326		0.10	0.000	0.041	0.2227	1.7387	.1108	.1725E-05
327		0.00	0.000	0.049	0.2138	1.9375	.1235	.1905E-05
328		0.00	0.000	0.044	0.2062	2.0703	.1319	.2024E-05
329		0.00	0.000	0.043	0.1988	2.1492	.1369	.2095E-05
330		0.00	0.000	0.053	0.1905	2.2028	.1404	.2143E-05
331		0.03	0.000	0.036	0.1880	2.2370	.1425	.2174E-05
332		0.68	0.000	0.037	0.2581	2.2540	.1436	.2189E-05
333		0.25	0.000	0.046	0.2799	2.2591	.1440	.2193E-05
334		0.00	0.000	0.041	0.2631	2.2446	.1430	.2180E-05
335		1.82	0.331	0.041	0.3538	2.2931	.1461	.2224E-05
336		0.00	0.000	0.043	0.2579	2.2290	.1420	.2167E-05
337		0.00	0.000	0.043	0.2449	2.3059	.1469	.2235E-05
338		0.00	0.000	0.045	0.2343	2.3675	.1509	.2290E-05
339		0.00	0.000	0.045	0.2243	2.3427	.1493	.2268E-05
340		0.00	0.000	0.047	0.2150	2.1760	.1387	.2119E-05
341		0.00	0.000	0.040	0.2073	1.9699	.1255	.1934E-05
342		0.00	0.000	0.051	0.1988	1.7663	.1126	.1750E-05
343		0.00	0.000	0.057	0.1899	1.5511	.9884E-01	.1553E-05
344		0.00	0.000	0.043	0.1827	1.3774	.8777E-01	.1393E-05
345	*	0.00	0.000	0.033	0.1769	1.1885	.7573E-01	.1217E-05
346	*	0.00	0.000	0.000	0.1751	1.0740	.6844E-01	.1110E-05
347	*	0.00	0.000	0.000	0.1735	1.1379	.7251E-01	.1170E-05
348	*	0.00	0.000	0.000	0.1720	1.2997	.8282E-01	.1321E-05
349	*	0.00	0.000	0.032	0.1670	1.4740	.9393E-01	.1483E-05
350		0.01	0.000	0.038	0.1627	1.6309	.1039	.1627E-05
351		0.00	0.000	0.051	0.1561	1.7588	.1121	.1743E-05
352		0.08	0.000	0.031	0.1608	1.8601	.1185	.1835E-05

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 353  *      0.76  0.000  0.020  0.1624    1.9352 .1233     .1903E-05
 354  *      0.00  0.000  0.014  0.1639    1.9897 .1268     .1952E-05
 355  *      0.00  0.000  0.015  0.1655    2.0295 .1293     .1988E-05
 356         0.00  0.000  0.020  0.1700    2.0543 .1309     .2010E-05
 357         0.00  0.000  0.000  0.2345    2.0649 .1316     .2020E-05
 358         0.00  0.000  0.062  0.2276    2.0638 .1315     .2019E-05
 359         0.00  0.000  0.061  0.2208    2.0465 .1304     .2003E-05
 360         0.00  0.000  0.059  0.2142    2.0259 .1291     .1985E-05
 361         0.00  0.000  0.056  0.2078    2.0047 .1277     .1965E-05
 362         0.00  0.000  0.074  0.1995    1.9853 .1265     .1948E-05
 363         0.00  0.000  0.067  0.1921    1.9577 .1247     .1923E-05
 364         0.11  0.000  0.050  0.1982    1.9176 .1222     .1887E-05
 365         1.75  0.175  0.038  0.3597    1.9300 .1230     .1898E-05

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                  MONTHLY TOTALS (IN INCHES) FOR YEAR    1
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                                JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
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PRECIPITATION                    2.64    5.03    4.12    2.65    4.89    5.55
                                 4.59    4.49    4.14    3.99    6.82    4.53

RUNOFF                           0.007   0.141   0.000   0.067   0.056   0.002
                                 0.107   0.053   0.146   0.212   0.885   0.505

EVAPOTRANSPIRATION               1.645   1.869   2.839   3.022   3.179   5.432
                                 4.714   3.549   3.017   0.987   1.966   1.172

LATERAL DRAINAGE COLLECTED       2.2914  1.3063  2.5431  1.9798  0.5469  0.8072
  FROM LAYER  3                  0.4873  0.1301  1.1263  0.8449  2.1123  3.6836

PERCOLATION/LEAKAGE THROUGH      0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
  LAYER  5                       0.0000  0.0000  0.0000  0.0000  0.0000  0.0001


-------------------------------------------------------------------------------
                  MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


AVERAGE DAILY HEAD ON            1.160   0.732   1.287   1.036   0.277   0.422
  TOP OF LAYER  4                0.247   0.066   0.589   0.428   1.105   1.865

STD. DEVIATION OF DAILY          0.414   0.341   0.654   0.520   0.255   0.232
  HEAD ON TOP OF LAYER  4        0.153   0.019   0.677   0.450   0.729   0.359

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


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

                         ANNUAL TOTALS FOR YEAR    1
-------------------------------------------------------------------------------
                                       INCHES          CU. FEET     PERCENT
                                      --------        ----------    -------
```

PRECIPITATION	53.44	193987.156	100.00
RUNOFF	2.182	7919.515	4.08
EVAPOTRANSPIRATION	33.392	121212.969	62.49
DRAINAGE COLLECTED FROM LAYER 3	17.8592	64828.902	33.42
PERC./LEAKAGE THROUGH LAYER 5	0.000289	1.049	0.00
AVG. HEAD ON TOP OF LAYER 4	0.7678		
CHANGE IN WATER STORAGE	0.007	24.731	0.01
SOIL WATER AT START OF YEAR	49.958	181348.766	
SOIL WATER AT END OF YEAR	49.965	181373.484	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.010	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.76	4.70	4.38	4.07	5.15	5.22
	4.40	4.57	3.63	3.46	4.26	4.45
STD. DEVIATIONS	2.30	2.20	2.15	2.07	1.88	1.98
	1.91	2.17	2.16	2.16	2.69	2.30
RUNOFF						
TOTALS	0.608	1.083	0.234	0.064	0.257	0.228
	0.118	0.186	0.224	0.187	0.456	0.265
STD. DEVIATIONS	0.728	1.707	0.390	0.074	0.325	0.268
	0.217	0.297	0.365	0.335	0.726	0.327
EVAPOTRANSPIRATION						
TOTALS	1.180	1.464	2.831	2.940	3.811	4.000
	3.653	3.278	2.251	1.920	1.494	0.965
STD. DEVIATIONS	0.331	0.415	0.438	1.008	0.926	1.180
	1.196	1.017	1.044	0.589	0.351	0.247

LATERAL DRAINAGE COLLECTED FROM LAYER 3

```
    TOTALS                 2.4469   2.7174   2.7398   2.0132   1.4126   1.0846
                           0.9816   0.6290   0.9628   1.0697   1.3104   1.9671

    STD. DEVIATIONS        1.1544   1.4683   1.4440   1.3346   1.1381   0.8235
                           0.8007   0.6534   0.9421   0.8713   1.0170   1.3519

  PERCOLATION/LEAKAGE THROUGH LAYER  5
  -------------------------------------
    TOTALS                 0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                           0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

    STD. DEVIATIONS        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                           0.0000   0.0000   0.0000   0.0000   0.0000   0.0000


-------------------------------------------------------------------------------
               AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


  DAILY AVERAGE HEAD ON TOP OF LAYER  4
  -------------------------------------
    AVERAGES               1.2387   1.5149   1.3870   1.0531   0.7151   0.5673
                           0.4969   0.3184   0.5037   0.5415   0.6855   0.9958

    STD. DEVIATIONS        0.5844   0.8251   0.7310   0.6982   0.5761   0.4308
                           0.4054   0.3308   0.4928   0.4411   0.5320   0.6844
*******************************************************************************


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

     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH   30
-------------------------------------------------------------------------------
                                     INCHES            CU. FEET       PERCENT
                                 -------------------   -------------   ---------
 PRECIPITATION                    53.06    (   5.948)     192619.9     100.00

 RUNOFF                            3.910   (  2.1704)      14192.29      7.368

 EVAPOTRANSPIRATION               29.789   (  3.1363)     108134.25     56.139

 LATERAL DRAINAGE COLLECTED       19.33498 (  5.01199)     70185.969   36.43754
   FROM LAYER  3

 PERCOLATION/LEAKAGE THROUGH       0.00031 (  0.00008)         1.122     0.00058
   LAYER  5

 AVERAGE HEAD ON TOP               0.835 (    0.218)
   OF LAYER  4

 CHANGE IN WATER STORAGE           0.029   (  3.3298)        106.28      0.055
*******************************************************************************


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

                PEAK DAILY VALUES FOR YEARS    1 THROUGH   30
```

	(INCHES)	(CU. FT.)
PRECIPITATION	5.08	18440.400
RUNOFF	2.141	7771.7739
DRAINAGE COLLECTED FROM LAYER 3	0.33470	1214.95789
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000005	0.01734
AVERAGE HEAD ON TOP OF LAYER 4	5.253	
MAXIMUM HEAD ON TOP OF LAYER 4	9.563	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	71.1 FEET	
SNOW WATER	9.08	32963.9844

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4593

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0823

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

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

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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	1.2899	0.2150
2	37.9068	0.3159
3	1.3920	0.0580
4	0.0000	0.0000
5	10.2480	0.4270
SNOW WATER	0.000	

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************



PRECIPITATION DATA FILE:    C:\DATA4.D4
TEMPERATURE DATA FILE:      C:\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\INTERMED.D10
OUTPUT DATA FILE:           C:\INTERMED.OUT


TIME:  86:47     DATE:   5/12/2015



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

     TITLE:  MACON COUNTY MSW LANDFILL PHASE 3 CELL 1

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


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


                                   LAYER  1
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   6
          THICKNESS                   =     12.00   INCHES
          POROSITY                    =      0.4530 VOL/VOL
          FIELD CAPACITY              =      0.1900 VOL/VOL
          WILTING POINT               =      0.0850 VOL/VOL
          INITIAL SOIL WATER CONTENT  =      0.3187 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.720000011000E-03 CM/SEC



                                   LAYER  2
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
```

```
              MATERIAL TEXTURE NUMBER  18
THICKNESS                    =    120.00   INCHES
POROSITY                     =      0.6710 VOL/VOL
FIELD CAPACITY               =      0.2920 VOL/VOL
WILTING POINT                =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2943 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC


                        LAYER  3
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   6
THICKNESS                    =      6.00   INCHES
POROSITY                     =      0.4530 VOL/VOL
FIELD CAPACITY               =      0.1900 VOL/VOL
WILTING POINT                =      0.0850 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2778 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.720000011000E-03 CM/SEC


                        LAYER  4
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  18
THICKNESS                    =    120.00   INCHES
POROSITY                     =      0.6710 VOL/VOL
FIELD CAPACITY               =      0.2920 VOL/VOL
WILTING POINT                =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.3196 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC


                        LAYER  5
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   6
THICKNESS                    =      6.00   INCHES
POROSITY                     =      0.4530 VOL/VOL
FIELD CAPACITY               =      0.1900 VOL/VOL
WILTING POINT                =      0.0850 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2598 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.720000011000E-03 CM/SEC


                        LAYER  6
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  18
THICKNESS                    =    120.00   INCHES
POROSITY                     =      0.6710 VOL/VOL
```

```
FIELD CAPACITY              =      0.2920 VOL/VOL
WILTING POINT               =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.3009 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC
```

LAYER 7

```
          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   6
THICKNESS                   =      6.00   INCHES
POROSITY                    =      0.4530 VOL/VOL
FIELD CAPACITY              =      0.1900 VOL/VOL
WILTING POINT               =      0.0850 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.2482 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.720000011000E-03 CM/SEC
```

LAYER 8

```
          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  18
THICKNESS                   =    120.00   INCHES
POROSITY                    =      0.6710 VOL/VOL
FIELD CAPACITY              =      0.2920 VOL/VOL
WILTING POINT               =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC
```

LAYER 9

```
            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER  21
THICKNESS                   =     24.00   INCHES
POROSITY                    =      0.3970 VOL/VOL
FIELD CAPACITY              =      0.0320 VOL/VOL
WILTING POINT               =      0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0493 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.300000012000     CM/SEC
SLOPE                       =      3.00   PERCENT
DRAINAGE LENGTH             =    400.0    FEET
```

LAYER 10

```
            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.06   INCHES
POROSITY                    =      0.0000 VOL/VOL
FIELD CAPACITY              =      0.0000 VOL/VOL
```

```
WILTING POINT                =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY          =      1.00   HOLES/ACRE
FML INSTALLATION DEFECTS     =      1.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD
```

LAYER 11

```
TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER  16
THICKNESS                    =     24.00   INCHES
POROSITY                     =      0.4270 VOL/VOL
FIELD CAPACITY               =      0.4180 VOL/VOL
WILTING POINT                =      0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.4270 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000001000E-06 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 6 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 33.% AND A SLOPE LENGTH OF 420. FEET.

```
SCS RUNOFF CURVE NUMBER             =     86.50
FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
EVAPORATIVE ZONE DEPTH              =      9.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE   =      2.949  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE  =      4.077  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE  =      0.765  INCHES
INITIAL SNOW WATER                  =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS    =    164.779  INCHES
TOTAL INITIAL WATER                 =    164.779  INCHES
TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM ASHEVILLE NORTH CAROLINA

```
STATION LATITUDE                        =  35.26 DEGREES
MAXIMUM LEAF AREA INDEX                 =   0.00
START OF GROWING SEASON (JULIAN DATE)   =     96
END OF GROWING SEASON (JULIAN DATE)     =    298
EVAPORATIVE ZONE DEPTH                  =   9.0  INCHES
AVERAGE ANNUAL WIND SPEED               =   7.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY   =  71.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY   =  75.00 %
```

AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 84.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 77.00 %

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

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
5.12	4.72	4.92	3.90	4.72	4.65
4.57	4.65	4.61	3.35	4.57	4.61

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

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
35.50	39.00	46.00	53.50	61.50	69.00
72.50	72.00	66.00	55.50	46.50	38.00

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ASHEVILLE NORTH CAROLINA
AND STATION LATITUDE = 35.26 DEGREES

HEAD #1: AVERAGE HEAD ON TOP OF LAYER 10
DRAIN #1: LATERAL DRAINAGE FROM LAYER 9 (RECIRCULATION AND COLLECTION)
LEAK #1: PERCOLATION OR LEAKAGE THROUGH LAYER 11

****

DAILY OUTPUT FOR YEAR 1

DAY	AIR	SOIL	RAIN IN.	RUNOFF IN.	ET IN.	E. ZONE WATER IN./IN.	HEAD #1 IN.	DRAIN #1 IN.	LEAK #1 IN.
1			0.00	0.000	0.048	0.2407	0.0579	.7379E-02	.7798E-07
2			0.00	0.000	0.044	0.2311	0.0791	.1008E-01	.1030E-06
3	*		0.00	0.000	0.046	0.2216	0.0720	.9182E-02	.9465E-07
4	*		0.00	0.000	0.035	0.2135	0.0655	.8347E-02	.8679E-07
5			0.00	0.000	0.043	0.2053	0.0997	.1271E-01	.1269E-06
6			0.00	0.000	0.055	0.1962	0.1414	.1803E-01	.1748E-06
7			0.00	0.000	0.048	0.1888	0.1764	.2247E-01	.2134E-06
8			0.00	0.000	0.048	0.1813	0.2418	.3081E-01	.2847E-06
9			0.00	0.000	0.053	0.1736	0.2517	.3208E-01	.2954E-06
10	*		0.00	0.000	0.040	0.1673	0.2360	.3008E-01	.2785E-06

11		0.00	0.000	0.047	0.1605	0.2811	.3582E-01	.3266E-06
12	*	0.00	0.000	0.040	0.1548	0.2799	.3568E-01	.3254E-06
13	*	0.00	0.000	0.036	0.1495	0.2459	.3133E-01	.2891E-06
14	*	0.21	0.000	0.028	0.1508	0.1793	.2285E-01	.2168E-06
15	*	0.03	0.000	0.023	0.1523	0.1648	.2100E-01	.2008E-06
16	*	0.00	0.000	0.032	0.1540	0.1310	.1669E-01	.1629E-06
17	*	0.00	0.000	0.036	0.1558	0.1038	.1323E-01	.1319E-06
18		0.00	0.000	0.044	0.1553	0.2281	.2907E-01	.2696E-06
19		0.00	0.000	0.067	0.1479	0.3031	.3863E-01	.3498E-06
20		0.02	0.000	0.065	0.1428	0.2995	.3817E-01	.3460E-06
21		0.00	0.000	0.092	0.1326	0.3070	.3913E-01	.3539E-06
22		0.00	0.000	0.069	0.1249	0.2680	.3415E-01	.3126E-06
23		0.63	0.000	0.070	0.1871	0.2176	.2773E-01	.2587E-06
24		0.64	0.001	0.071	0.2503	0.2190	.2790E-01	.2601E-06
25		0.26	0.000	0.063	0.2550	0.2520	.3212E-01	.2956E-06
26		0.71	0.014	0.056	0.2692	0.3408	.4344E-01	.3892E-06
27		0.00	0.000	0.076	0.2487	0.4382	.5585E-01	.4891E-06
28		0.00	0.000	0.076	0.2294	0.5995	.7640E-01	.6514E-06
29		0.00	0.000	0.069	0.2155	0.6413	.8173E-01	.6928E-06
30		0.00	0.000	0.072	0.2033	0.6261	.7980E-01	.6778E-06
31		0.14	0.000	0.055	0.2092	0.6210	.7914E-01	.6727E-06
32		0.00	0.000	0.058	0.2000	0.5838	.7440E-01	.6358E-06
33		0.01	0.000	0.046	0.1936	0.5198	.6624E-01	.5719E-06
34		0.03	0.000	0.052	0.1893	0.4970	.6334E-01	.5490E-06
35	*	0.00	0.000	0.049	0.1820	0.4474	.5702E-01	.4988E-06
36	*	0.27	0.000	0.028	0.1826	0.4517	.5757E-01	.5032E-06
37		0.00	0.000	0.034	0.2023	0.4473	.5701E-01	.4987E-06
38		0.00	0.000	0.093	0.1908	0.3613	.4604E-01	.4104E-06
39		0.00	0.000	0.083	0.1804	0.3224	.4109E-01	.3701E-06
40		0.00	0.000	0.071	0.1717	0.2975	.3791E-01	.3439E-06
41		0.11	0.000	0.073	0.1753	0.2618	.3336E-01	.3061E-06
42		0.46	0.000	0.083	0.2172	0.2257	.2876E-01	.2674E-06
43		0.22	0.000	0.076	0.2331	0.1930	.2460E-01	.2319E-06
44		0.33	0.000	0.076	0.2613	0.1649	.2101E-01	.2009E-06
45		0.48	0.000	0.077	0.2582	0.1375	.1752E-01	.1703E-06
46		0.00	0.000	0.095	0.2364	0.1038	.1323E-01	.1319E-06
47		0.02	0.000	0.062	0.2238	0.0849	.1082E-01	.1099E-06
48		0.00	0.000	0.085	0.2105	0.0589	.7511E-02	.7919E-07
49		0.22	0.000	0.067	0.2251	0.0445	.5675E-02	.6286E-07
50		0.13	0.000	0.064	0.2296	0.0417	.5315E-02	.5965E-07
51		1.35	0.181	0.063	0.2978	0.1062	.1354E-01	.1343E-06
52		0.05	0.000	0.076	0.2476	0.1750	.2231E-01	.2122E-06
53		0.62	0.001	0.051	0.2683	0.1475	.1880E-01	.1816E-06
54		0.00	0.000	0.066	0.2481	0.1804	.2299E-01	.2178E-06
55		0.70	0.007	0.055	0.2692	0.3137	.3998E-01	.3608E-06
56		0.00	0.000	0.061	0.2492	0.3958	.5044E-01	.4460E-06
57		0.03	0.000	0.053	0.2360	0.4523	.5764E-01	.5038E-06
58		0.00	0.000	0.091	0.2195	0.4702	.5992E-01	.5219E-06
59		0.00	0.000	0.084	0.2059	0.4069	.5186E-01	.4575E-06
60		0.61	0.000	0.064	0.2632	0.4065	.5180E-01	.4570E-06
61	*	0.05	0.000	0.046	0.2484	0.5231	.6667E-01	.5751E-06
62	*	0.00	0.000	0.065	0.2358	0.5836	.7438E-01	.6357E-06
63		0.66	0.001	0.056	0.2679	0.5220	.6653E-01	.5741E-06
64		0.00	0.000	0.105	0.2450	0.4190	.5340E-01	.4698E-06
65		0.15	0.000	0.051	0.2462	0.3497	.4457E-01	.3985E-06
66		0.00	0.000	0.067	0.2328	0.3003	.3827E-01	.3468E-06
67		0.00	0.000	0.121	0.2138	0.2341	.2983E-01	.2764E-06
68		0.00	0.000	0.085	0.2004	0.1837	.2341E-01	.2217E-06
69		0.27	0.000	0.071	0.2210	0.1549	.1974E-01	.1898E-06
70		0.00	0.000	0.076	0.2120	0.1698	.2164E-01	.2064E-06
71		0.00	0.000	0.066	0.2034	0.1953	.2489E-01	.2344E-06
72	*	0.04	0.000	0.041	0.2017	0.2313	.2948E-01	.2735E-06
73		0.00	0.000	0.095	0.1894	0.2779	.3542E-01	.3232E-06

74	0.01	0.000	0.076	0.1805	0.2476	.3156E-01	.2909E-06
75	0.00	0.000	0.109	0.1672	0.2362	.3010E-01	.2787E-06
76	0.00	0.000	0.066	0.1586	0.2851	.3633E-01	.3308E-06
77	0.00	0.000	0.079	0.1488	0.2904	.3700E-01	.3364E-06
78	0.00	0.000	0.131	0.1335	0.2972	.3788E-01	.3436E-06
79	0.39	0.000	0.089	0.1670	0.4004	.5102E-01	.4505E-06
80	0.76	0.002	0.074	0.2430	0.5616	.7157E-01	.6137E-06
81	0.04	0.000	0.100	0.2363	0.5699	.7263E-01	.6220E-06
82	0.00	0.000	0.136	0.2212	0.5788	.7377E-01	.6309E-06
83	0.00	0.000	0.128	0.2035	0.6759	.8614E-01	.7268E-06
84	0.00	0.000	0.131	0.1862	0.7837	.9988E-01	.8319E-06
85	0.60	0.000	0.111	0.2377	0.8719	.1111	.9171E-06
86	0.10	0.000	0.089	0.2364	0.8602	.1096	.9058E-06
87	0.31	0.000	0.097	0.2575	0.7937	.1012	.8417E-06
88	0.00	0.000	0.154	0.2339	0.7511	.9572E-01	.8003E-06
89	0.00	0.000	0.154	0.2101	0.7417	.9452E-01	.7911E-06
90	0.13	0.000	0.106	0.2078	0.7653	.9753E-01	.8141E-06
91	0.00	0.000	0.111	0.1917	0.8080	.1030	.8555E-06
92	0.01	0.000	0.087	0.1802	0.8276	.1055	.8744E-06
93	0.00	0.000	0.131	0.1633	0.8111	.1034	.8585E-06
94	0.00	0.000	0.121	0.1477	0.7728	.9849E-01	.8214E-06
95	0.01	0.000	0.095	0.1363	0.7224	.9207E-01	.7723E-06
96	0.00	0.000	0.071	0.1272	0.6729	.8575E-01	.7238E-06
97	0.00	0.000	0.085	0.1169	0.6291	.8018E-01	.6808E-06
98	0.00	0.000	0.073	0.1082	0.5930	.7557E-01	.6450E-06
99	0.00	0.000	0.077	0.0997	0.5596	.7131E-01	.6117E-06
100	0.35	0.000	0.098	0.1277	0.5216	.6648E-01	.5738E-06
101	0.11	0.000	0.098	0.1274	0.4676	.5959E-01	.5193E-06
102	0.83	0.007	0.055	0.2127	0.4287	.5464E-01	.4798E-06
103	0.99	0.086	0.098	0.2819	0.3928	.5006E-01	.4430E-06
104	0.00	0.000	0.120	0.2374	0.3978	.5070E-01	.4481E-06
105	0.00	0.000	0.111	0.2192	0.5102	.6502E-01	.5623E-06
106	0.00	0.000	0.145	0.1998	0.5457	.6954E-01	.5978E-06
107	0.00	0.000	0.187	0.1760	0.5479	.6983E-01	.6001E-06
108	0.00	0.000	0.147	0.1568	0.5488	.6994E-01	.6008E-06
109	0.00	0.000	0.190	0.1327	0.7092	.9039E-01	.7594E-06
110	0.31	0.000	0.167	0.1458	0.7862	.1002	.8344E-06
111	0.00	0.000	0.214	0.1203	0.8299	.1058	.8767E-06
112	0.00	0.000	0.155	0.1032	0.8034	.1024	.8510E-06
113	0.00	0.000	0.128	0.0890	0.7344	.9359E-01	.7840E-06
114	0.00	0.000	0.034	0.0852	0.6872	.8758E-01	.7379E-06
115	0.00	0.000	0.001	0.0851	0.7428	.9466E-01	.7921E-06
116	0.04	0.000	0.006	0.0888	0.8821	.1124	.9268E-06
117	0.00	0.000	0.004	0.0883	0.9905	.1262	.1030E-05
118	0.00	0.000	0.013	0.0869	1.0280	.1310	.1066E-05
119	0.00	0.000	0.006	0.0862	0.9704	.1237	.1011E-05
120	0.00	0.000	0.007	0.0854	0.9284	.1183	.9712E-06
121	0.00	0.000	0.003	0.0851	0.9204	.1173	.9636E-06
122	0.00	0.000	0.001	0.0850	0.9479	.1208	.9899E-06
123	0.07	0.000	0.004	0.0924	1.0243	.1305	.1063E-05
124	0.87	0.002	0.020	0.1866	1.0731	.1368	.1109E-05
125	0.13	0.000	0.077	0.1925	1.0572	.1347	.1094E-05
126	0.00	0.000	0.188	0.1716	1.0360	.1320	.1074E-05
127	0.00	0.000	0.200	0.1494	1.0219	.1302	.1060E-05
128	0.00	0.000	0.169	0.1306	1.0096	.1287	.1049E-05
129	0.00	0.000	0.076	0.1221	1.0221	.1303	.1061E-05
130	0.00	0.000	0.057	0.1158	0.9969	.1270	.1037E-05
131	0.00	0.000	0.049	0.1103	0.9367	.1194	.9792E-06
132	0.00	0.000	0.043	0.1056	0.8884	.1132	.9330E-06
133	0.06	0.000	0.040	0.1078	0.9061	.1155	.9499E-06
134	0.00	0.000	0.037	0.1038	0.8936	.1139	.9379E-06
135	0.36	0.000	0.035	0.1399	0.8491	.1082	.8952E-06
136	0.20	0.000	0.033	0.1584	0.8300	.1058	.8768E-06

137	0.00	0.000	0.030	0.1550	0.8333	.1062	.8799E-06
138	0.00	0.000	0.029	0.1518	0.8410	.1072	.8873E-06
139	0.67	0.000	0.029	0.2231	0.8266	.1053	.8734E-06
140	0.22	0.000	0.119	0.2343	0.7804	.9946E-01	.8288E-06
141	0.05	0.000	0.131	0.2253	0.6420	.8182E-01	.6934E-06
142	0.71	0.007	0.189	0.2656	0.5134	.6543E-01	.5654E-06
143	0.00	0.000	0.233	0.2292	0.4678	.5962E-01	.5196E-06
144	0.00	0.000	0.163	0.2062	0.4462	.5686E-01	.4976E-06
145	0.00	0.000	0.188	0.1810	0.3914	.4988E-01	.4416E-06
146	0.00	0.000	0.144	0.1610	0.3092	.3940E-01	.3561E-06
147	0.00	0.000	0.186	0.1374	0.2644	.3370E-01	.3089E-06
148	0.28	0.000	0.116	0.1531	0.2627	.3348E-01	.3071E-06
149	1.27	0.079	0.140	0.2677	0.2510	.3199E-01	.2946E-06
150	0.00	0.000	0.267	0.2246	0.2216	.2824E-01	.2630E-06
151	0.00	0.000	0.201	0.1966	0.1829	.2330E-01	.2207E-06
152	0.00	0.000	0.229	0.1665	0.1716	.2187E-01	.2084E-06
153	0.00	0.000	0.257	0.1337	0.2698	.3439E-01	.3144E-06
154	0.00	0.000	0.218	0.1061	0.4183	.5331E-01	.4690E-06
155	0.00	0.000	0.144	0.0850	0.5495	.7003E-01	.6016E-06
156	0.80	0.000	0.053	0.1679	0.6655	.8481E-01	.7166E-06
157	0.00	0.000	0.167	0.1494	0.6426	.8190E-01	.6941E-06
158	0.00	0.000	0.148	0.1329	0.5580	.7112E-01	.6101E-06
159	0.35	0.000	0.158	0.1542	0.4537	.5782E-01	.5051E-06
160	0.78	0.006	0.128	0.2260	0.3480	.4436E-01	.3967E-06
161	0.21	0.000	0.097	0.2386	0.2779	.3542E-01	.3232E-06
162	0.57	0.002	0.103	0.2640	0.2331	.2970E-01	.2753E-06
163	0.31	0.000	0.165	0.2658	0.1638	.2087E-01	.1996E-06
164	0.14	0.000	0.204	0.2480	0.1351	.1722E-01	.1677E-06
165	0.02	0.000	0.153	0.2268	0.1622	.2067E-01	.1979E-06
166	0.24	0.000	0.182	0.2275	0.1842	.2347E-01	.2223E-06
167	0.00	0.000	0.196	0.2014	0.2348	.2993E-01	.2772E-06
168	0.02	0.000	0.177	0.1831	0.2681	.3417E-01	.3128E-06
169	0.11	0.000	0.152	0.1771	0.2770	.3530E-01	.3222E-06
170	0.00	0.000	0.194	0.1534	0.2590	.3301E-01	.3031E-06
171	0.20	0.000	0.117	0.1613	0.2798	.3566E-01	.3252E-06
172	0.00	0.000	0.250	0.1324	0.3588	.4573E-01	.4079E-06
173	0.16	0.000	0.255	0.1218	0.4454	.5677E-01	.4968E-06
174	0.26	0.000	0.175	0.1313	0.4780	.6092E-01	.5298E-06
175	0.23	0.000	0.248	0.1293	0.4933	.6287E-01	.5452E-06
176	0.10	0.000	0.142	0.1247	0.5220	.6653E-01	.5741E-06
177	0.24	0.000	0.159	0.1336	0.4250	.5417E-01	.4760E-06
178	0.05	0.000	0.170	0.1203	0.5173	.6592E-01	.5693E-06
179	0.58	0.000	0.132	0.1700	0.6172	.7866E-01	.6690E-06
180	0.00	0.000	0.174	0.1507	0.6486	.8266E-01	.7000E-06
181	0.18	0.000	0.204	0.1480	0.6869	.8754E-01	.7376E-06
182	0.00	0.000	0.220	0.1236	0.6848	.8728E-01	.7356E-06
183	0.01	0.000	0.143	0.1088	0.6733	.8581E-01	.7243E-06
184	0.18	0.000	0.077	0.1203	0.6615	.8430E-01	.7126E-06
185	0.00	0.000	0.058	0.1138	0.6604	.8416E-01	.7115E-06
186	0.06	0.000	0.052	0.1147	0.7054	.8990E-01	.7557E-06
187	0.00	0.000	0.043	0.1099	0.7749	.9875E-01	.8234E-06
188	0.04	0.000	0.042	0.1097	0.8294	.1057	.8761E-06
189	1.59	0.143	0.038	0.2662	0.8680	.1106	.9134E-06
190	0.00	0.000	0.204	0.2317	0.9289	.1184	.9717E-06
191	0.00	0.000	0.226	0.2015	0.9923	.1265	.1032E-05
192	0.08	0.000	0.204	0.1833	1.0170	.1296	.1056E-05
193	0.06	0.000	0.216	0.1620	0.9974	.1271	.1037E-05
194	0.05	0.000	0.197	0.1428	0.9968	.1270	.1036E-05
195	0.03	0.000	0.207	0.1200	0.9678	.1233	.1009E-05
196	0.00	0.000	0.237	0.0936	0.9206	.1173	.9638E-06
197	0.23	0.000	0.142	0.1034	0.8811	.1123	.9259E-06
198	0.29	0.000	0.035	0.1317	0.8857	.1129	.9303E-06
199	0.76	0.003	0.060	0.2092	0.8612	.1098	.9068E-06

200	0.21	0.000	0.122	0.2190	0.8414	.1072	.8877E-06
201	0.00	0.000	0.215	0.1951	0.8331	.1062	.8798E-06
202	0.31	0.000	0.104	0.2179	0.8607	.1097	.9063E-06
203	0.00	0.000	0.234	0.1919	0.8494	.1082	.8954E-06
204	0.22	0.000	0.148	0.1999	0.8476	.1080	.8937E-06
205	0.07	0.000	0.149	0.1910	0.8919	.1137	.9363E-06
206	0.00	0.000	0.236	0.1648	0.9094	.1159	.9531E-06
207	0.00	0.000	0.208	0.1416	0.8169	.1041	.8641E-06
208	0.06	0.000	0.091	0.1382	0.6760	.8615E-01	.7269E-06
209	0.34	0.000	0.110	0.1638	0.5599	.7136E-01	.6120E-06
210	0.00	0.000	0.198	0.1418	0.4576	.5832E-01	.5092E-06
211	0.00	0.000	0.166	0.1234	0.3889	.4956E-01	.4390E-06
212	0.00	0.000	0.180	0.1034	0.3615	.4607E-01	.4108E-06
213	0.00	0.000	0.076	0.0949	0.3655	.4657E-01	.4148E-06
214	0.00	0.000	0.059	0.0884	0.3680	.4690E-01	.4175E-06
215	0.00	0.000	0.031	0.0850	0.4717	.6012E-01	.5234E-06
216	0.00	0.000	0.000	0.0850	0.5798	.7389E-01	.6319E-06
217	0.00	0.000	0.000	0.0850	0.5606	.7144E-01	.6127E-06
218	0.00	0.000	0.000	0.0850	0.4899	.6243E-01	.5418E-06
219	1.24	0.042	0.026	0.2153	0.4165	.5308E-01	.4673E-06
220	0.00	0.000	0.163	0.1971	0.3525	.4492E-01	.4014E-06
221	0.00	0.000	0.154	0.1800	0.3003	.3827E-01	.3468E-06
222	0.00	0.000	0.161	0.1621	0.2589	.3299E-01	.3030E-06
223	0.00	0.000	0.151	0.1453	0.2265	.2887E-01	.2683E-06
224	0.00	0.000	0.166	0.1269	0.2014	.2567E-01	.2411E-06
225	1.25	0.047	0.080	0.2516	0.1819	.2318E-01	.2197E-06
226	0.01	0.000	0.079	0.2409	0.1666	.2123E-01	.2029E-06
227	0.00	0.000	0.176	0.2131	0.1545	.1969E-01	.1894E-06
228	0.10	0.000	0.115	0.2070	0.1448	.1845E-01	.1786E-06
229	0.11	0.000	0.161	0.1975	0.1395	.1777E-01	.1726E-06
230	0.00	0.000	0.219	0.1701	0.1344	.1712E-01	.1668E-06
231	0.00	0.000	0.173	0.1480	0.1256	.1600E-01	.1568E-06
232	0.00	0.000	0.130	0.1311	0.1168	.1489E-01	.1469E-06
233	0.00	0.000	0.185	0.1089	0.1098	.1399E-01	.1388E-06
234	0.00	0.000	0.166	0.0905	0.1046	.1333E-01	.1328E-06
235	0.00	0.000	0.050	0.0850	0.1007	.1283E-01	.1283E-06
236	0.59	0.000	0.028	0.1475	0.0919	.1171E-01	.1181E-06
237	0.23	0.000	0.053	0.1671	0.0887	.1131E-01	.1144E-06
238	0.05	0.000	0.128	0.1584	0.0928	.1182E-01	.1191E-06
239	0.00	0.000	0.160	0.1406	0.0985	.1255E-01	.1258E-06
240	0.51	0.000	0.080	0.1884	0.1033	.1317E-01	.1314E-06
241	0.28	0.000	0.123	0.2058	0.1064	.1356E-01	.1350E-06
242	0.00	0.000	0.167	0.1873	0.1092	.1392E-01	.1382E-06
243	0.12	0.000	0.113	0.1880	0.1120	.1427E-01	.1413E-06
244	0.89	0.020	0.095	0.2741	0.1133	.1444E-01	.1428E-06
245	0.00	0.000	0.153	0.2343	0.1097	.1398E-01	.1387E-06
246	1.42	0.178	0.113	0.3007	0.1082	.1378E-01	.1369E-06
247	0.27	0.000	0.134	0.2641	0.0981	.1250E-01	.1253E-06
248	0.57	0.002	0.113	0.2596	0.0876	.1116E-01	.1130E-06
249	0.00	0.000	0.133	0.2350	0.0768	.9788E-02	.1003E-06
250	0.00	0.000	0.128	0.2163	0.0602	.7666E-02	.8049E-07
251	0.00	0.000	0.102	0.2019	0.0562	.7162E-02	.7595E-07
252	0.00	0.000	0.112	0.1859	0.0659	.8398E-02	.8727E-07
253	0.00	0.000	0.125	0.1688	0.0729	.9292E-02	.9568E-07
254	0.00	0.000	0.120	0.1528	0.0745	.9498E-02	.9761E-07
255	0.19	0.000	0.089	0.1617	0.0723	.9212E-02	.9493E-07
256	0.38	0.000	0.088	0.1922	0.0557	.7094E-02	.7542E-07
257	0.21	0.000	0.055	0.2079	0.0395	.5036E-02	.5715E-07
258	0.07	0.000	0.137	0.1995	0.0463	.5899E-02	.6485E-07
259	0.14	0.000	0.082	0.2052	0.0512	.6528E-02	.7041E-07
260	0.00	0.000	0.090	0.1948	0.0377	.4800E-02	.5501E-07
261	0.00	0.000	0.131	0.1801	0.0267	.3398E-02	.4213E-07
262	0.00	0.000	0.135	0.1652	0.0325	.4144E-02	.4903E-07

263	0.00	0.000	0.117	0.1521	0.0364	.4645E-02	.5362E-07
264	0.00	0.000	0.144	0.1361	0.0345	.4390E-02	.5129E-07
265	0.00	0.000	0.141	0.1204	0.0557	.7101E-02	.7547E-07
266	0.00	0.000	0.124	0.1066	0.0702	.8949E-02	.9246E-07
267	0.00	0.000	0.105	0.0949	0.0760	.9688E-02	.9938E-07
268	0.00	0.000	0.089	0.0850	0.0703	.8961E-02	.9255E-07
269	0.00	0.000	0.000	0.0850	0.0501	.6384E-02	.6912E-07
270	0.00	0.000	0.000	0.0850	0.0348	.4430E-02	.5166E-07
271	0.00	0.000	0.000	0.0850	0.0241	.3075E-02	.3909E-07
272	0.00	0.000	0.000	0.0850	0.0191	.2428E-02	.3292E-07
273	0.00	0.000	0.000	0.0850	0.0192	.2450E-02	.3309E-07
274	0.00	0.000	0.000	0.0850	0.0593	.7561E-02	.7988E-07
275	0.00	0.000	0.000	0.0850	0.0993	.1266E-01	.1267E-06
276	0.00	0.000	0.000	0.0850	0.1167	.1488E-01	.1468E-06
277	0.00	0.000	0.000	0.0850	0.1121	.1429E-01	.1415E-06
278	0.00	0.000	0.000	0.0850	0.0951	.1212E-01	.1218E-06
279	0.00	0.000	0.000	0.0850	0.1032	.1315E-01	.1312E-06
280	0.00	0.000	0.000	0.0850	0.1251	.1594E-01	.1562E-06
281	0.00	0.000	0.000	0.0850	0.1617	.2060E-01	.1974E-06
282	0.00	0.000	0.000	0.0850	0.1466	.1868E-01	.1805E-06
283	0.00	0.000	0.000	0.0850	0.1289	.1643E-01	.1607E-06
284	0.00	0.000	0.000	0.0850	0.1336	.1703E-01	.1659E-06
285	0.00	0.000	0.000	0.0850	0.1563	.1992E-01	.1914E-06
286	0.00	0.000	0.000	0.0850	0.1554	.1980E-01	.1904E-06
287	0.00	0.000	0.000	0.0850	0.1388	.1769E-01	.1718E-06
288	0.00	0.000	0.000	0.0850	0.1344	.1713E-01	.1669E-06
289	0.83	0.000	0.017	0.1753	0.1130	.1440E-01	.1424E-06
290	0.27	0.000	0.020	0.2031	0.0786	.1002E-01	.1024E-06
291	0.04	0.000	0.065	0.2004	0.0546	.6955E-02	.7418E-07
292	1.56	0.256	0.051	0.3081	0.0492	.6272E-02	.6815E-07
293	0.14	0.000	0.067	0.2568	0.0745	.9497E-02	.9753E-07
294	0.00	0.000	0.103	0.2384	0.1108	.1412E-01	.1399E-06
295	0.00	0.000	0.082	0.2243	0.1468	.1870E-01	.1807E-06
296	0.00	0.000	0.069	0.2113	0.1812	.2309E-01	.2189E-06
297	0.00	0.000	0.069	0.1997	0.1604	.2044E-01	.1960E-06
298	0.00	0.000	0.072	0.1885	0.1378	.1757E-01	.1707E-06
299	0.01	0.000	0.054	0.1808	0.1314	.1674E-01	.1634E-06
300	0.35	0.000	0.057	0.2110	0.1408	.1794E-01	.1740E-06
301	0.00	0.000	0.078	0.2005	0.1672	.2130E-01	.2035E-06
302	0.35	0.000	0.054	0.2316	0.1742	.2219E-01	.2112E-06
303	0.44	0.000	0.055	0.2581	0.1583	.2017E-01	.1935E-06
304	0.00	0.000	0.074	0.2402	0.1209	.1540E-01	.1515E-06
305	0.00	0.000	0.090	0.2223	0.1292	.1646E-01	.1609E-06
306	0.00	0.000	0.077	0.2093	0.1330	.1694E-01	.1652E-06
307	0.00	0.000	0.076	0.1975	0.1148	.1464E-01	.1446E-06
308	0.00	0.000	0.072	0.1866	0.0805	.1026E-01	.1047E-06
309	1.02	0.020	0.062	0.2889	0.0649	.8269E-02	.8606E-07
310	1.66	0.459	0.075	0.2998	0.0693	.8828E-02	.9130E-07
311	0.22	0.000	0.079	0.2659	0.0649	.8270E-02	.8614E-07
312	1.95	0.564	0.073	0.3140	0.0746	.9508E-02	.9761E-07
313	0.00	0.000	0.078	0.2433	0.1374	.1751E-01	.1701E-06
314	0.00	0.000	0.104	0.2245	0.1732	.2207E-01	.2101E-06
315	0.00	0.000	0.093	0.2087	0.1917	.2443E-01	.2305E-06
316	0.00	0.000	0.099	0.1935	0.1592	.2029E-01	.1947E-06
317	0.00	0.000	0.092	0.1802	0.1377	.1755E-01	.1706E-06
318	0.00	0.000	0.081	0.1684	0.1578	.2011E-01	.1931E-06
319	0.00	0.000	0.090	0.1562	0.1567	.1997E-01	.1919E-06
320	0.01	0.000	0.066	0.1479	0.1173	.1495E-01	.1474E-06
321	0.90	0.004	0.051	0.2403	0.0872	.1112E-01	.1126E-06
322	0.00	0.000	0.061	0.2320	0.1058	.1348E-01	.1340E-06
323	0.00	0.000	0.047	0.2265	0.1445	.1841E-01	.1782E-06
324	0.00	0.000	0.066	0.2176	0.1322	.1685E-01	.1644E-06
325	0.00	0.000	0.046	0.2089	0.1409	.1795E-01	.1741E-06

326		0.10	0.000	0.041	0.2123	0.1213	.1545E-01	.1519E-06
327		0.00	0.000	0.049	0.2039	0.1301	.1658E-01	.1620E-06
328		0.00	0.000	0.044	0.1968	0.1883	.2399E-01	.2267E-06
329		0.00	0.000	0.043	0.1899	0.1940	.2472E-01	.2330E-06
330		0.00	0.000	0.053	0.1823	0.1617	.2061E-01	.1974E-06
331		0.03	0.000	0.035	0.1799	0.1473	.1877E-01	.1813E-06
332		0.68	0.000	0.037	0.2499	0.2137	.2723E-01	.2543E-06
333		0.25	0.000	0.046	0.2615	0.3116	.3971E-01	.3586E-06
334		0.00	0.000	0.041	0.2440	0.4192	.5342E-01	.4700E-06
335		1.82	0.396	0.041	0.3180	0.5351	.6819E-01	.5872E-06
336		0.00	0.000	0.043	0.2442	0.6148	.7835E-01	.6666E-06
337		0.00	0.000	0.043	0.2337	0.6428	.8192E-01	.6943E-06
338		0.00	0.000	0.045	0.2222	0.6677	.8510E-01	.7187E-06
339		0.00	0.000	0.045	0.2128	0.7858	.1001	.8339E-06
340		0.00	0.000	0.047	0.2044	0.8304	.1058	.8771E-06
341		0.00	0.000	0.040	0.1972	0.8129	.1036	.8602E-06
342		0.00	0.000	0.051	0.1892	0.7422	.9459E-01	.7917E-06
343		0.00	0.000	0.057	0.1807	0.6611	.8425E-01	.7122E-06
344		0.00	0.000	0.043	0.1742	0.5470	.6971E-01	.5991E-06
345	*	0.00	0.000	0.033	0.1686	0.4269	.5440E-01	.4778E-06
346	*	0.00	0.000	0.000	0.1670	0.3913	.4987E-01	.4415E-06
347	*	0.00	0.000	0.000	0.1658	0.3945	.5027E-01	.4447E-06
348	*	0.00	0.000	0.000	0.1648	0.4573	.5828E-01	.5089E-06
349	*	0.00	0.000	0.032	0.1602	0.4913	.6261E-01	.5433E-06
350		0.01	0.000	0.038	0.1561	0.5322	.6783E-01	.5844E-06
351		0.00	0.000	0.051	0.1496	0.6084	.7753E-01	.6602E-06
352		0.08	0.000	0.031	0.1546	0.7153	.9117E-01	.7654E-06
353	*	0.76	0.000	0.020	0.1565	0.7797	.9937E-01	.8281E-06
354	*	0.00	0.000	0.014	0.1586	0.7182	.9153E-01	.7682E-06
355	*	0.00	0.000	0.015	0.1608	0.6165	.7857E-01	.6683E-06
356		0.00	0.000	0.020	0.1660	0.5191	.6615E-01	.5712E-06
357		0.00	0.000	0.000	0.2311	0.4355	.5550E-01	.4866E-06
358		0.00	0.000	0.062	0.2242	0.3681	.4692E-01	.4176E-06
359		0.00	0.000	0.061	0.2174	0.3271	.4169E-01	.3750E-06
360		0.00	0.000	0.059	0.2108	0.2860	.3644E-01	.3317E-06
361		0.00	0.000	0.056	0.2046	0.2448	.3120E-01	.2879E-06
362		0.00	0.000	0.074	0.1957	0.2079	.2650E-01	.2481E-06
363		0.00	0.000	0.067	0.1864	0.1684	.2146E-01	.2048E-06
364		0.11	0.000	0.050	0.1908	0.1185	.1511E-01	.1488E-06
365		1.75	0.226	0.038	0.3277	0.0823	.1048E-01	.1067E-06

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.64	5.03	4.12	2.65	4.89	5.55
	4.59	4.49	4.14	3.99	6.82	4.53
RUNOFF	0.015	0.189	0.004	0.094	0.088	0.008
	0.146	0.089	0.200	0.256	1.046	0.622
EVAPOTRANSPIRATION	1.647	1.870	2.840	2.834	3.195	5.151
	4.565	3.372	2.856	0.987	1.967	1.173
LATERAL DRAINAGE COLLECTED	1.0410	1.0059	1.8176	2.6572	2.8862	1.4968

```
  FROM LAYER  9                  3.1352  0.8760  0.2263  0.4927  0.5684  2.0046

PERCOLATION/LEAKAGE THROUGH      0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
  LAYER 11                       0.0000  0.0000  0.0000  0.0000  0.0000  0.0000


-------------------------------------------------------------------------------
                   MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


AVERAGE DAILY HEAD ON            0.264   0.282   0.460   0.695   0.731   0.391
  TOP OF LAYER 10                0.794   0.222   0.059   0.125   0.149   0.507

STD. DEVIATION OF DAILY          0.166   0.165   0.231   0.178   0.301   0.172
  HEAD ON TOP OF LAYER 10        0.174   0.152   0.027   0.035   0.072   0.212
*******************************************************************************


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                         ANNUAL TOTALS FOR YEAR    1
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                          53.44         193987.156    100.00

  RUNOFF                                  2.758         10010.948      5.16

  EVAPOTRANSPIRATION                     32.458        117822.195     60.74

  DRAINAGE COLLECTED FROM LAYER  9       18.2078        66094.164     34.07

  PERC./LEAKAGE THROUGH LAYER 11          0.000158          0.572      0.00

  AVG. HEAD ON TOP OF LAYER 10            0.3898

  CHANGE IN WATER STORAGE                 0.016            59.322      0.03

  SOIL WATER AT START OF YEAR           164.779        598147.125

  SOIL WATER AT END OF YEAR             164.795        598206.437

  SNOW WATER AT START OF YEAR             0.000             0.000      0.00

  SNOW WATER AT END OF YEAR               0.000             0.000      0.00

  ANNUAL WATER BUDGET BALANCE             0.0000           -0.045      0.00
*******************************************************************************


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         AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH   30
-------------------------------------------------------------------------------

                         JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                         -------  -------  -------  -------  -------  -------
```

```
PRECIPITATION
-------------
  TOTALS                 4.76     4.70     4.38     4.07     5.15     5.22
                         4.40     4.57     3.63     3.46     4.26     4.45

  STD. DEVIATIONS        2.30     2.20     2.15     2.07     1.88     1.98
                         1.91     2.17     2.16     2.16     2.69     2.30

RUNOFF
------
  TOTALS                 0.681    1.143    0.280    0.092    0.319    0.285
                         0.151    0.234    0.267    0.225    0.534    0.322

  STD. DEVIATIONS        0.781    1.720    0.414    0.099    0.376    0.318
                         0.256    0.345    0.408    0.375    0.810    0.373

EVAPOTRANSPIRATION
------------------
  TOTALS                 1.176    1.454    2.775    2.843    3.658    3.883
                         3.532    3.176    2.161    1.860    1.478    0.962

  STD. DEVIATIONS        0.328    0.408    0.487    1.003    0.916    1.177
                         1.163    0.999    1.013    0.591    0.359    0.252

LATERAL DRAINAGE COLLECTED FROM LAYER  9
----------------------------------------
  TOTALS                 1.0818   1.3452   1.6287   1.6049   2.2311   2.7754
                         2.6076   1.9632   1.4606   0.9878   0.7726   1.1620

  STD. DEVIATIONS        0.6270   0.6340   0.7481   0.6829   1.0819   1.4690
                         1.0884   1.2614   1.0523   0.6854   0.5429   0.7884

PERCOLATION/LEAKAGE THROUGH LAYER 11
------------------------------------
  TOTALS                 0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

  STD. DEVIATIONS        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000


-------------------------------------------------------------------------------
              AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


DAILY AVERAGE HEAD ON TOP OF LAYER 10
-------------------------------------
  AVERAGES               0.2738   0.3743   0.4123   0.4198   0.5647   0.7259
                         0.6600   0.4969   0.3820   0.2500   0.2021   0.2941

  STD. DEVIATIONS        0.1587   0.1774   0.1894   0.1786   0.2739   0.3842
                         0.2755   0.3193   0.2752   0.1735   0.1420   0.1995

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     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH   30
-------------------------------------------------------------------------------
                                     INCHES            CU. FEET       PERCENT
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PRECIPITATION	53.06	(5.948)	192619.9	100.00
RUNOFF	4.533	(2.2434)	16455.36	8.543
EVAPOTRANSPIRATION	28.957	(3.0241)	105112.27	54.570
LATERAL DRAINAGE COLLECTED FROM LAYER 9	19.62092	(4.47058)	71223.945	36.97641
PERCOLATION/LEAKAGE THROUGH LAYER 11	0.00017	(0.00004)	0.611	0.00032
AVERAGE HEAD ON TOP OF LAYER 10	0.421	(0.096)		
CHANGE IN WATER STORAGE	-0.047	(3.8841)	-172.28	-0.089

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	5.08	18440.400
RUNOFF	2.336	8478.1719
DRAINAGE COLLECTED FROM LAYER 9	0.22983	834.28375
PERCOLATION/LEAKAGE THROUGH LAYER 11	0.000002	0.00647
AVERAGE HEAD ON TOP OF LAYER 10	1.803	
MAXIMUM HEAD ON TOP OF LAYER 10	3.355	
LOCATION OF MAXIMUM HEAD IN LAYER 9 (DISTANCE FROM DRAIN)	27.6 FEET	
SNOW WATER	9.08	32963.9844

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4200

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0850

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

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

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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	2.8085	0.2340
2	37.7742	0.3148
3	1.3761	0.2293
4	35.6896	0.2974
5	1.5671	0.2612
6	36.2107	0.3018
7	1.4057	0.2343
8	35.0400	0.2920
9	1.2352	0.0515
10	0.0000	0.0000
11	10.2480	0.4270
SNOW WATER	0.000	

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************



PRECIPITATION DATA FILE:    C:\DATA4.D4
TEMPERATURE DATA FILE:      C:\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\FINAL.D10
OUTPUT DATA FILE:           C:\FINAL.OUT


TIME: 177:54     DATE:   5/12/2015



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

     TITLE:  MACON COUNTY MSW LANDFILL PHASE 3 CELL 1

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


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


                                   LAYER  1
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   6
          THICKNESS                   =     24.00   INCHES
          POROSITY                    =      0.4530 VOL/VOL
          FIELD CAPACITY              =      0.1900 VOL/VOL
          WILTING POINT               =      0.0850 VOL/VOL
          INITIAL SOIL WATER CONTENT  =      0.2815 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.720000011000E-03 CM/SEC



                                   LAYER  2
                                   --------

                       TYPE 2 - LATERAL DRAINAGE LAYER
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```
              MATERIAL TEXTURE NUMBER  20
THICKNESS                   =      0.20   INCHES
POROSITY                    =      0.8500 VOL/VOL
FIELD CAPACITY              =      0.0100 VOL/VOL
WILTING POINT               =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0100 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =   10.0000000000     CM/SEC
SLOPE                       =     33.00   PERCENT
DRAINAGE LENGTH             =    400.0    FEET


                        LAYER  3
                        --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.04   INCHES
POROSITY                    =      0.0000 VOL/VOL
FIELD CAPACITY              =      0.0000 VOL/VOL
WILTING POINT               =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY         =      1.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      1.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD


                        LAYER  4
                        --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                   =     18.00   INCHES
POROSITY                    =      0.4510 VOL/VOL
FIELD CAPACITY              =      0.4180 VOL/VOL
WILTING POINT               =      0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.4510 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-05 CM/SEC


                        LAYER  5
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   6
THICKNESS                   =     12.00   INCHES
POROSITY                    =      0.4530 VOL/VOL
FIELD CAPACITY              =      0.1900 VOL/VOL
WILTING POINT               =      0.0850 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.1900 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.720000011000E-03 CM/SEC


                        LAYER  6
                        --------
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          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  18
THICKNESS                   =   1128.00   INCHES
POROSITY                    =      0.6710 VOL/VOL
FIELD CAPACITY              =      0.2920 VOL/VOL
WILTING POINT               =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


                        LAYER  7
                        --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER  21
THICKNESS                   =     24.00   INCHES
POROSITY                    =      0.3970 VOL/VOL
FIELD CAPACITY              =      0.0320 VOL/VOL
WILTING POINT               =      0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0320 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.300000012000     CM/SEC
SLOPE                       =      3.00   PERCENT
DRAINAGE LENGTH             =    400.0    FEET


                        LAYER  8
                        --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.06   INCHES
POROSITY                    =      0.0000 VOL/VOL
FIELD CAPACITY              =      0.0000 VOL/VOL
WILTING POINT               =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY         =      1.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      1.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD


                        LAYER  9
                        --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  16
THICKNESS                   =     24.00   INCHES
POROSITY                    =      0.4270 VOL/VOL
FIELD CAPACITY              =      0.4180 VOL/VOL
WILTING POINT               =      0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.4270 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000001000E-06 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 6 WITH A FAIR STAND OF GRASS, A SURFACE SLOPE OF 5.% AND A SLOPE LENGTH OF 420. FEET.

SCS RUNOFF CURVE NUMBER	=	69.30	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	9.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.087	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	4.077	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.765	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	357.549	INCHES
TOTAL INITIAL WATER	=	357.549	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM ASHEVILLE NORTH CAROLINA

STATION LATITUDE	=	35.26	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	96	
END OF GROWING SEASON (JULIAN DATE)	=	298	
EVAPORATIVE ZONE DEPTH	=	9.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	7.60	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	71.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	75.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	84.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	77.00	%

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

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
5.12	4.72	4.92	3.90	4.72	4.65
4.57	4.65	4.61	3.35	4.57	4.61

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

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
35.50	39.00	46.00	53.50	61.50	69.00

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      72.50       72.00       66.00       55.50       46.50       38.00


         NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR    ASHEVILLE           NORTH CAROLINA
                    AND STATION LATITUDE  =  35.26 DEGREES




    HEAD  #1:  AVERAGE HEAD ON TOP OF LAYER  3
    DRAIN #1:  LATERAL DRAINAGE FROM LAYER  2 (RECIRCULATION AND COLLECTION)
    LEAK  #1:  PERCOLATION OR LEAKAGE THROUGH LAYER  4
    HEAD  #2:  AVERAGE HEAD ON TOP OF LAYER  8
    DRAIN #2:  LATERAL DRAINAGE FROM LAYER  7 (RECIRCULATION AND COLLECTION)
    LEAK  #2:  PERCOLATION OR LEAKAGE THROUGH LAYER  9

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                                     DAILY OUTPUT FOR YEAR    1

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          S
  DAY  A  O  RAIN  RUNOFF   ET   E. ZONE   HEAD      DRAIN     LEAK      HEAD
DRAIN     LEAK
       I  I                      WATER     #1        #1        #1        #2
#2        #2
       R  L   IN.    IN.    IN.  IN./IN.    IN.       IN.       IN.       IN.
IN.       IN.
  ---  -  -  ----- ------ ------ ------- --------- --------- --------- ---------
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    1         0.00  0.000  0.048  0.2626    0.0006 .2610E-01 .3359E-07    0.0000
.1208E-07 .6804E-08
    2         0.00  0.000  0.044  0.2418    0.0050 .2098     .2422E-06    0.0000
.4235E-07 .6805E-08
    3  *      0.00  0.000  0.046  0.2281    0.0046 .1922     .2244E-06    0.0000
.9923E-07 .6806E-08
    4  *      0.00  0.000  0.035  0.2189    0.0036 .1527     .1837E-06    0.0000
.1304E-06 .6807E-08
    5         0.00  0.000  0.043  0.2098    0.0028 .1179     .1470E-06    0.0000
.1401E-06 .6807E-08
    6         0.00  0.000  0.055  0.2006    0.0023 .9787E-01 .1253E-06    0.0000
.1375E-06 .6807E-08
    7         0.00  0.000  0.048  0.1926    0.0019 .8159E-01 .1074E-06    0.0000
.1295E-06 .6807E-08
    8         0.00  0.000  0.048  0.1850    0.0016 .6940E-01 .9380E-07    0.0000
.1189E-06 .6807E-08
    9         0.00  0.000  0.053  0.1769    0.0014 .5918E-01 .8219E-07    0.0000
.1077E-06 .6806E-08
   10  *      0.00  0.000  0.040  0.1707    0.0013 .5437E-01 .7663E-07    0.0000
.9715E-07 .6806E-08
   11         0.00  0.000  0.047  0.1637    0.0011 .4686E-01 .6790E-07    0.0000
.8771E-07 .6806E-08
   12  *      0.00  0.000  0.040  0.1578    0.0010 .4396E-01 .6449E-07    0.0000
.7914E-07 .6806E-08
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   13  *      0.00  0.000  0.036  0.1525    0.0010 .4073E-01 .6066E-07    0.0000
.7210E-07 .6805E-08
   14  *      0.21  0.000  0.028  0.1535    0.0009 .3732E-01 .5659E-07    0.0000
.6601E-07 .6805E-08
   15  *      0.03  0.000  0.023  0.1549    0.0009 .3633E-01 .5539E-07    0.0000
.6090E-07 .6805E-08
   16  *      0.00  0.000  0.032  0.1564    0.0008 .3420E-01 .5283E-07    0.0000
.5681E-07 .6805E-08
   17  *      0.00  0.000  0.036  0.1581    0.0008 .3187E-01 .4998E-07    0.0000
.5316E-07 .6805E-08
   18         0.00  0.000  0.044  0.1575    0.0007 .2958E-01 .4718E-07    0.0000
.4976E-07 .6805E-08
   19         0.00  0.000  0.067  0.1498    0.0007 .2870E-01 .4609E-07    0.0000
.4675E-07 .6805E-08
   20         0.02  0.000  0.064  0.1449    0.0007 .2815E-01 .4542E-07    0.0000
.4439E-07 .6805E-08
   21         0.00  0.000  0.092  0.1347    0.0006 .2571E-01 .4240E-07    0.0000
.4225E-07 .6805E-08
   22         0.00  0.000  0.069  0.1270    0.0006 .2365E-01 .3982E-07    0.0000
.3989E-07 .6804E-08
   23         0.63  0.000  0.070  0.1892    0.0005 .2188E-01 .3759E-07    0.0000
.3751E-07 .6804E-08
   24         0.64  0.000  0.071  0.2525    0.0005 .2034E-01 .3563E-07    0.0000
.3521E-07 .6804E-08
   25         0.26  0.000  0.063  0.2744    0.0005 .1901E-01 .3393E-07    0.0000
.3305E-07 .6804E-08
   26         0.71  0.000  0.056  0.3177    0.0002 .1012E-01 .2156E-07    0.0000
.2971E-07 .6804E-08
   27         0.00  0.000  0.076  0.2593    0.0000 .2548E-03 .1317E-08    0.0000
.2263E-07 .6804E-08
   28         0.00  0.000  0.076  0.2357    0.0014 .5746E-01 .7708E-07    0.0000
.2338E-07 .6804E-08
   29         0.00  0.000  0.069  0.2205    0.0029 .1229     .1523E-06    0.0000
.4703E-07 .6805E-08
   30         0.00  0.000  0.072  0.2073    0.0027 .1137     .1425E-06    0.0000
.7596E-07 .6806E-08
   31         0.14  0.000  0.055  0.2128    0.0023 .9805E-01 .1255E-06    0.0000
.9214E-07 .6806E-08
   32         0.00  0.000  0.058  0.2032    0.0020 .8328E-01 .1093E-06    0.0000
.9827E-07 .6806E-08
   33         0.01  0.000  0.046  0.1966    0.0017 .7294E-01 .9778E-07    0.0000
.9814E-07 .6806E-08
   34         0.03  0.000  0.052  0.1919    0.0015 .6318E-01 .8675E-07    0.0000
.9459E-07 .6806E-08
   35  *      0.00  0.000  0.049  0.1847    0.0014 .5817E-01 .8103E-07    0.0000
.8940E-07 .6806E-08
   36  *      0.27  0.000  0.028  0.1852    0.0012 .5049E-01 .7215E-07    0.0000
.8366E-07 .6806E-08
   37         0.00  0.000  0.034  0.2047    0.0011 .4625E-01 .6718E-07    0.0000
.7744E-07 .6806E-08
   38         0.00  0.000  0.093  0.1933    0.0010 .4319E-01 .6357E-07    0.0000
.7177E-07 .6805E-08
   39         0.00  0.000  0.083  0.1825    0.0008 .3515E-01 .5396E-07    0.0000
.6599E-07 .6805E-08
   40         0.00  0.000  0.071  0.1736    0.0009 .3634E-01 .5540E-07    0.0000
.6041E-07 .6805E-08
   41         0.11  0.000  0.073  0.1769    0.0008 .3475E-01 .5349E-07    0.0000
.5656E-07 .6805E-08
   42         0.46  0.000  0.083  0.2185    0.0008 .3499E-01 .5377E-07    0.0000
.5357E-07 .6805E-08
   43         0.22  0.000  0.076  0.2344    0.0008 .3398E-01 .5255E-07    0.0000
.5140E-07 .6805E-08
   44         0.33  0.000  0.076  0.2627    0.0007 .3056E-01 .4839E-07    0.0000
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.4915E-07 .6805E-08
   45         0.48  0.000  0.077  0.3062    0.0006 .2637E-01 .4304E-07    0.0000
.4618E-07 .6805E-08
   46         0.00  0.000  0.095  0.2579    0.0000 .6005E-07 .3503E-09    0.0000
.3786E-07 .6804E-08
   47         0.02  0.000  0.062  0.2383    0.0001 .2199E-02 .4957E-08    0.0000
.2487E-07 .6804E-08
   48         0.00  0.000  0.085  0.2212    0.0013 .5415E-01 .7627E-07    0.0000
.2550E-07 .6804E-08
   49         0.22  0.000  0.067  0.2329    0.0017 .7247E-01 .9723E-07    0.0000
.4154E-07 .6805E-08
   50         0.13  0.000  0.064  0.2360    0.0017 .7269E-01 .9749E-07    0.0000
.5653E-07 .6805E-08
   51         1.35  0.000  0.063  0.3350    0.0013 .5529E-01 .7396E-07    0.0000
.6408E-07 .6805E-08
   52         0.05  0.000  0.076  0.2653    0.0059 .2473     .2648E-06    0.0000
.8859E-07 .6806E-08
   53         0.62  0.000  0.051  0.3119    0.0083 .3515     .3795E-06    0.0000
.1546E-06 .6808E-08
   54         0.00  0.000  0.066  0.2607    0.0052 .2180     .2398E-06    0.0000
.2041E-06 .6809E-08
   55         0.70  0.000  0.055  0.3153    0.0080 .3387     .3678E-06    0.0000
.2288E-06 .6809E-08
   56         0.00  0.000  0.061  0.2606    0.0056 .2348     .2557E-06    0.0000
.2554E-06 .6810E-08
   57         0.03  0.000  0.053  0.2428    0.0083 .3516     .3814E-06    0.0000
.2689E-06 .6810E-08
   58         0.00  0.000  0.091  0.2246    0.0055 .2325     .2650E-06    0.0000
.2869E-06 .6811E-08
   59         0.00  0.000  0.084  0.2100    0.0038 .1623     .1936E-06    0.0000
.2693E-06 .6810E-08
   60         0.61  0.000  0.064  0.2666    0.0029 .1237     .1532E-06    0.0000
.2390E-06 .6810E-08
   61  *      0.05  0.000  0.046  0.2643    0.0025 .1046     .1325E-06    0.0000
.2081E-06 .6809E-08
   62  *      0.00  0.000  0.065  0.2432    0.0004 .1667E-01 .2707E-07    0.0000
.1699E-06 .6808E-08
   63         0.66  0.000  0.056  0.3014    0.0018 .7695E-01 .1015E-06    0.0000
.1333E-06 .6807E-08
   64         0.00  0.000  0.105  0.2570    0.0009 .3997E-01 .5204E-07    0.0000
.1154E-06 .6807E-08
   65         0.15  0.000  0.051  0.2533    0.0040 .1707     .2022E-06    0.0000
.1124E-06 .6806E-08
   66         0.00  0.000  0.067  0.2382    0.0041 .1739     .2056E-06    0.0000
.1382E-06 .6807E-08
   67         0.00  0.000  0.121  0.2183    0.0032 .1329     .1629E-06    0.0000
.1515E-06 .6807E-08
   68         0.00  0.000  0.085  0.2043    0.0027 .1138     .1426E-06    0.0000
.1504E-06 .6807E-08
   69         0.27  0.000  0.071  0.2245    0.0025 .1067     .1350E-06    0.0000
.1450E-06 .6807E-08
   70         0.00  0.000  0.076  0.2152    0.0021 .8854E-01 .1151E-06    0.0000
.1374E-06 .6807E-08
   71         0.00  0.000  0.066  0.2066    0.0016 .6708E-01 .9116E-07    0.0000
.1255E-06 .6807E-08
   72  *      0.04  0.000  0.041  0.2048    0.0012 .5253E-01 .7450E-07    0.0000
.1109E-06 .6806E-08
   73         0.00  0.000  0.095  0.1926    0.0011 .4628E-01 .6720E-07    0.0000
.9675E-07 .6806E-08
   74         0.01  0.000  0.076  0.1834    0.0010 .4085E-01 .6076E-07    0.0000
.8483E-07 .6806E-08
   75         0.00  0.000  0.109  0.1701    0.0010 .4048E-01 .6036E-07    0.0000
.7533E-07 .6805E-08
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   76         0.00  0.000  0.066  0.1613    0.0008 .3361E-01 .5210E-07    0.0000
.6765E-07 .6805E-08
   77         0.00  0.000  0.079  0.1513    0.0008 .3354E-01 .5202E-07    0.0000
.6080E-07 .6805E-08
   78         0.00  0.000  0.131  0.1357    0.0008 .3230E-01 .5052E-07    0.0000
.5584E-07 .6805E-08
   79         0.39  0.000  0.089  0.1688    0.0008 .3487E-01 .5363E-07    0.0000
.5251E-07 .6805E-08
   80         0.76  0.000  0.074  0.2450    0.0008 .3424E-01 .5287E-07    0.0000
.5068E-07 .6805E-08
   81         0.04  0.000  0.100  0.2384    0.0007 .3075E-01 .4863E-07    0.0000
.4874E-07 .6805E-08
   82         0.00  0.000  0.136  0.2232    0.0007 .2787E-01 .4508E-07    0.0000
.4619E-07 .6805E-08
   83         0.00  0.000  0.128  0.2081    0.0004 .1822E-01 .3243E-07    0.0000
.4220E-07 .6805E-08
   84         0.00  0.000  0.131  0.1913    0.0002 .6726E-02 .1730E-07    0.0000
.3526E-07 .6804E-08
   85         0.60  0.000  0.111  0.2435    0.0002 .8849E-02 .2033E-07    0.0000
.2806E-07 .6804E-08
   86         0.10  0.000  0.089  0.2421    0.0001 .4945E-02 .1476E-07    0.0000
.2292E-07 .6804E-08
   87         0.31  0.000  0.097  0.2631    0.0002 .7636E-02 .1693E-07    0.0000
.1861E-07 .6804E-08
   88         0.00  0.000  0.153  0.2443    0.0004 .1610E-01 .2949E-07    0.0000
.1756E-07 .6804E-08
   89         0.00  0.000  0.154  0.2212    0.0002 .7433E-02 .1264E-07    0.0000
.1705E-07 .6804E-08
   90         0.13  0.000  0.106  0.2174    0.0000 .0000E+00 .0000E+00    0.0000
.1206E-07 .6804E-08
   91         0.00  0.000  0.111  0.1998    0.0001 .2591E-02 .9549E-08    0.0000
.7465E-08 .6803E-08
   92         0.01  0.000  0.087  0.1879    0.0005 .2091E-01 .3631E-07    0.0000
.9325E-08 .6804E-08
   93         0.00  0.000  0.126  0.1706    0.0005 .2208E-01 .3765E-07    0.0000
.1567E-07 .6804E-08
   94         0.00  0.000  0.121  0.1553    0.0008 .3549E-01 .5428E-07    0.0000
.2236E-07 .6804E-08
   95         0.01  0.000  0.095  0.1445    0.0008 .3580E-01 .5474E-07    0.0000
.3011E-07 .6804E-08
   96         0.00  0.000  0.070  0.1353    0.0008 .3193E-01 .5005E-07    0.0000
.3499E-07 .6804E-08
   97         0.00  0.000  0.085  0.1248    0.0008 .3263E-01 .5091E-07    0.0000
.3762E-07 .6804E-08
   98         0.00  0.000  0.073  0.1153    0.0006 .2733E-01 .4441E-07    0.0000
.3880E-07 .6804E-08
   99         0.00  0.000  0.077  0.1058    0.0007 .2892E-01 .4638E-07    0.0000
.3868E-07 .6804E-08
  100         0.35  0.000  0.098  0.1331    0.0007 .3050E-01 .4778E-07    0.0000
.3913E-07 .6804E-08
  101         0.11  0.000  0.098  0.1343    0.0007 .3147E-01 .4945E-07    0.0000
.3990E-07 .6804E-08
  102         0.83  0.000  0.074  0.2181    0.0007 .2785E-01 .4498E-07    0.0000
.4019E-07 .6804E-08
  103         0.99  0.000  0.107  0.3162    0.0006 .2625E-01 .4307E-07    0.0000
.3934E-07 .6804E-08
  104         0.00  0.000  0.120  0.2555    0.0000 .1816E-02 .3744E-08    0.0000
.3354E-07 .6804E-08
  105         0.00  0.000  0.111  0.2289    0.0003 .1444E-01 .2234E-07    0.0000
.2463E-07 .6804E-08
  106         0.00  0.000  0.145  0.2056    0.0017 .7087E-01 .9533E-07    0.0000
.3086E-07 .6804E-08
  107         0.00  0.000  0.187  0.1804    0.0020 .8509E-01 .1113E-06    0.0000
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.5048E-07 .6805E-08
 108         0.00  0.000  0.147  0.1604    0.0018 .7562E-01 .1008E-06    0.0000
.6571E-07 .6805E-08
 109         0.00  0.000  0.190  0.1362    0.0016 .6879E-01 .9308E-07    0.0000
.7341E-07 .6805E-08
 110         0.31  0.000  0.167  0.1489    0.0014 .5774E-01 .8028E-07    0.0000
.7577E-07 .6805E-08
 111         0.00  0.000  0.214  0.1230    0.0014 .6006E-01 .8320E-07    0.0000
.7543E-07 .6805E-08
 112         0.00  0.000  0.137  0.1065    0.0014 .5930E-01 .8203E-07    0.0000
.7558E-07 .6805E-08
 113         0.00  0.000  0.120  0.0930    0.0014 .5858E-01 .8149E-07    0.0000
.7540E-07 .6805E-08
 114         0.00  0.000  0.068  0.0853    0.0011 .4812E-01 .6923E-07    0.0000
.7367E-07 .6805E-08
 115         0.00  0.000  0.001  0.0850    0.0010 .4220E-01 .6240E-07    0.0000
.6939E-07 .6805E-08
 116         0.04  0.000  0.006  0.0888    0.0009 .3816E-01 .5759E-07    0.0000
.6457E-07 .6805E-08
 117         0.00  0.000  0.004  0.0883    0.0008 .3397E-01 .5254E-07    0.0000
.5973E-07 .6805E-08
 118         0.00  0.000  0.012  0.0870    0.0007 .3054E-01 .4837E-07    0.0000
.5493E-07 .6805E-08
 119         0.00  0.000  0.006  0.0863    0.0007 .2772E-01 .4489E-07    0.0000
.5041E-07 .6805E-08
 120         0.00  0.000  0.007  0.0854    0.0006 .2533E-01 .4193E-07    0.0000
.4627E-07 .6805E-08
 121         0.00  0.000  0.002  0.0851    0.0005 .2310E-01 .3913E-07    0.0000
.4252E-07 .6805E-08
 122         0.00  0.000  0.001  0.0851    0.0005 .2166E-01 .3731E-07    0.0000
.3917E-07 .6804E-08
 123         0.07  0.000  0.004  0.0925    0.0005 .2015E-01 .3539E-07    0.0000
.3628E-07 .6804E-08
 124         0.87  0.000  0.020  0.1869    0.0004 .1879E-01 .3364E-07    0.0000
.3371E-07 .6804E-08
 125         0.13  0.000  0.077  0.1927    0.0004 .1768E-01 .3221E-07    0.0000
.3143E-07 .6804E-08
 126         0.00  0.000  0.185  0.1721    0.0004 .1664E-01 .3087E-07    0.0000
.2942E-07 .6804E-08
 127         0.00  0.000  0.190  0.1510    0.0004 .1572E-01 .2966E-07    0.0000
.2763E-07 .6804E-08
 128         0.00  0.000  0.161  0.1332    0.0004 .1488E-01 .2857E-07    0.0000
.2604E-07 .6804E-08
 129         0.00  0.000  0.075  0.1249    0.0003 .1413E-01 .2757E-07    0.0000
.2461E-07 .6804E-08
 130         0.00  0.000  0.057  0.1185    0.0003 .1345E-01 .2667E-07    0.0000
.2332E-07 .6804E-08
 131         0.00  0.000  0.048  0.1132    0.0003 .1282E-01 .2584E-07    0.0000
.2216E-07 .6804E-08
 132         0.00  0.000  0.043  0.1084    0.0003 .1225E-01 .2507E-07    0.0000
.2111E-07 .6804E-08
 133         0.06  0.000  0.040  0.1107    0.0003 .1173E-01 .2437E-07    0.0000
.2015E-07 .6804E-08
 134         0.00  0.000  0.035  0.1065    0.0002 .1019E-01 .2219E-07    0.0000
.1909E-07 .6804E-08
 135         0.36  0.000  0.034  0.1425    0.0002 .9830E-02 .2173E-07    0.0000
.1790E-07 .6804E-08
 136         0.20  0.000  0.032  0.1610    0.0002 .9113E-02 .2072E-07    0.0000
.1686E-07 .6804E-08
 137         0.00  0.000  0.030  0.1577    0.0002 .1032E-01 .2246E-07    0.0000
.1618E-07 .6804E-08
 138         0.00  0.000  0.029  0.1545    0.0002 .9943E-02 .2194E-07    0.0000
.1595E-07 .6804E-08
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  139         0.67  0.000  0.029  0.2257    0.0002 .9587E-02 .2145E-07    0.0000
.1564E-07 .6804E-08
  140         0.22  0.000  0.118  0.2371    0.0002 .9255E-02 .2100E-07    0.0000
.1528E-07 .6804E-08
  141         0.05  0.000  0.129  0.2283    0.0002 .8944E-02 .2058E-07    0.0000
.1490E-07 .6804E-08
  142         0.71  0.000  0.189  0.2862    0.0002 .8650E-02 .2015E-07    0.0000
.1450E-07 .6804E-08
  143         0.00  0.000  0.233  0.2448    0.0001 .3641E-02 .9209E-08    0.0000
.1280E-07 .6804E-08
  144         0.00  0.000  0.163  0.2144    0.0000 .0000E+00 .0000E+00    0.0000
.8480E-08 .6804E-08
  145         0.00  0.000  0.188  0.1867    0.0000 .0000E+00 .0000E+00    0.0000
.3802E-08 .6803E-08
  146         0.00  0.000  0.144  0.1661    0.0000 .0000E+00 .0000E+00    0.0000
.6285E-09 .3935E-08
  147         0.00  0.000  0.186  0.1418    0.0001 .3283E-02 .7098E-08    0.0000
.4440E-09 .5102E-08
  148         0.28  0.000  0.116  0.1570    0.0002 .6475E-02 .1582E-07    0.0000
.1589E-08 .6803E-08
  149         1.27  0.000  0.140  0.2803    0.0003 .1447E-01 .2798E-07    0.0000
.5364E-08 .6803E-08
  150         0.00  0.000  0.267  0.2419    0.0004 .1509E-01 .2567E-07    0.0000
.9918E-08 .6804E-08
  151         0.00  0.000  0.200  0.2079    0.0000 .0000E+00 .0000E+00    0.0000
.9486E-08 .6804E-08
  152         0.00  0.000  0.229  0.1758    0.0003 .1157E-01 .2021E-07    0.0000
.6997E-08 .6803E-08
  153         0.00  0.000  0.257  0.1420    0.0006 .2619E-01 .4184E-07    0.0000
.1163E-07 .6804E-08
  154         0.00  0.000  0.218  0.1123    0.0008 .3197E-01 .4816E-07    0.0000
.1957E-07 .6804E-08
  155         0.00  0.000  0.177  0.0897    0.0015 .6180E-01 .8292E-07    0.0000
.3053E-07 .6804E-08
  156         0.80  0.000  0.079  0.1694    0.0014 .6107E-01 .8427E-07    0.0000
.4465E-07 .6805E-08
  157         0.00  0.000  0.180  0.1494    0.0013 .5454E-01 .7683E-07    0.0000
.5377E-07 .6805E-08
  158         0.00  0.000  0.134  0.1345    0.0011 .4653E-01 .6751E-07    0.0000
.5760E-07 .6805E-08
  159         0.35  0.000  0.158  0.1559    0.0010 .4049E-01 .6038E-07    0.0000
.5767E-07 .6805E-08
  160         0.78  0.000  0.128  0.2283    0.0008 .3557E-01 .5447E-07    0.0000
.5568E-07 .6805E-08
  161         0.21  0.000  0.097  0.2408    0.0008 .3175E-01 .4983E-07    0.0000
.5266E-07 .6805E-08
  162         0.57  0.000  0.100  0.2930    0.0007 .2906E-01 .4654E-07    0.0000
.4930E-07 .6805E-08
  163         0.31  0.000  0.165  0.2864    0.0002 .8346E-02 .1429E-07    0.0000
.4239E-07 .6805E-08
  164         0.14  0.000  0.204  0.2617    0.0000 .0000E+00 .0000E+00    0.0000
.2995E-07 .6804E-08
  165         0.02  0.000  0.153  0.2350    0.0002 .8313E-02 .1628E-07    0.0000
.2071E-07 .6804E-08
  166         0.24  0.000  0.182  0.2346    0.0013 .5467E-01 .7672E-07    0.0000
.2473E-07 .6804E-08
  167         0.00  0.000  0.196  0.2083    0.0017 .7052E-01 .9504E-07    0.0000
.4082E-07 .6805E-08
  168         0.02  0.000  0.176  0.1894    0.0019 .8195E-01 .1078E-06    0.0000
.5691E-07 .6805E-08
  169         0.11  0.000  0.152  0.1840    0.0017 .7196E-01 .9668E-07    0.0000
.6902E-07 .6805E-08
  170         0.00  0.000  0.195  0.1607    0.0013 .5283E-01 .7484E-07    0.0000
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.7271E-07 .6805E-08
  171         0.20  0.000  0.117  0.1678    0.0010 .4248E-01 .6272E-07    0.0000
.6978E-07 .6805E-08
  172         0.00  0.000  0.252  0.1379    0.0009 .3982E-01 .5957E-07    0.0000
.6515E-07 .6805E-08
  173         0.16  0.000  0.243  0.1279    0.0010 .4416E-01 .6469E-07    0.0000
.6199E-07 .6805E-08
  174         0.26  0.000  0.172  0.1377    0.0011 .4578E-01 .6663E-07    0.0000
.6098E-07 .6805E-08
  175         0.23  0.000  0.255  0.1349    0.0009 .3992E-01 .5969E-07    0.0000
.5977E-07 .6805E-08
  176         0.10  0.000  0.190  0.1247    0.0008 .3426E-01 .5279E-07    0.0000
.5681E-07 .6805E-08
  177         0.24  0.000  0.155  0.1342    0.0008 .3194E-01 .5008E-07    0.0000
.5316E-07 .6805E-08
  178         0.05  0.000  0.158  0.1221    0.0007 .2794E-01 .4515E-07    0.0000
.4953E-07 .6805E-08
  179         0.58  0.000  0.129  0.1721    0.0006 .2651E-01 .4339E-07    0.0000
.4589E-07 .6805E-08
  180         0.00  0.000  0.174  0.1528    0.0006 .2394E-01 .4016E-07    0.0000
.4264E-07 .6805E-08
  181         0.18  0.000  0.197  0.1509    0.0005 .2225E-01 .3806E-07    0.0000
.3954E-07 .6804E-08
  182         0.00  0.000  0.220  0.1265    0.0005 .2094E-01 .3639E-07    0.0000
.3680E-07 .6804E-08
  183         0.01  0.000  0.150  0.1109    0.0005 .1942E-01 .3446E-07    0.0000
.3435E-07 .6804E-08
  184         0.18  0.000  0.077  0.1223    0.0004 .1830E-01 .3302E-07    0.0000
.3212E-07 .6804E-08
  185         0.00  0.000  0.058  0.1157    0.0004 .1670E-01 .3091E-07    0.0000
.3006E-07 .6804E-08
  186         0.06  0.000  0.048  0.1171    0.0004 .1620E-01 .3029E-07    0.0000
.2816E-07 .6804E-08
  187         0.00  0.000  0.043  0.1122    0.0003 .1443E-01 .2793E-07    0.0000
.2644E-07 .6804E-08
  188         0.04  0.000  0.041  0.1121    0.0003 .1466E-01 .2827E-07    0.0000
.2486E-07 .6804E-08
  189         1.59  0.000  0.038  0.2846    0.0003 .1400E-01 .2740E-07    0.0000
.2371E-07 .6804E-08
  190         0.00  0.000  0.204  0.2477    0.0002 .6534E-02 .1363E-07    0.0000
.2106E-07 .6804E-08
  191         0.00  0.000  0.226  0.2099    0.0000 .0000E+00 .0000E+00    0.0000
.1502E-07 .6804E-08
  192         0.08  0.000  0.204  0.1897    0.0000 .0000E+00 .0000E+00    0.0000
.8341E-08 .6804E-08
  193         0.06  0.000  0.216  0.1676    0.0000 .1263E-02 .3491E-08    0.0000
.4137E-08 .6803E-08
  194         0.05  0.000  0.201  0.1472    0.0003 .1159E-01 .2412E-07    0.0000
.4405E-08 .6803E-08
  195         0.03  0.000  0.210  0.1235    0.0004 .1595E-01 .2818E-07    0.0000
.8858E-08 .6804E-08
  196         0.00  0.000  0.225  0.0953    0.0008 .3407E-01 .5095E-07    0.0000
.1550E-07 .6804E-08
  197         0.23  0.000  0.156  0.1032    0.0010 .4289E-01 .6309E-07    0.0000
.2577E-07 .6804E-08
  198         0.29  0.000  0.039  0.1310    0.0009 .3884E-01 .5840E-07    0.0000
.3453E-07 .6804E-08
  199         0.76  0.000  0.060  0.2087    0.0008 .3438E-01 .5303E-07    0.0000
.3909E-07 .6804E-08
  200         0.21  0.000  0.123  0.2184    0.0007 .3100E-01 .4893E-07    0.0000
.4077E-07 .6805E-08
  201         0.00  0.000  0.215  0.1945    0.0007 .2827E-01 .4557E-07    0.0000
.4077E-07 .6805E-08
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  202         0.31  0.000  0.101  0.2177    0.0006 .2582E-01 .4253E-07    0.0000
.3978E-07 .6804E-08
  203         0.00  0.000  0.229  0.1923    0.0006 .2374E-01 .3993E-07    0.0000
.3822E-07 .6804E-08
  204         0.22  0.000  0.148  0.2003    0.0005 .2196E-01 .3769E-07    0.0000
.3638E-07 .6804E-08
  205         0.07  0.000  0.149  0.1914    0.0005 .2004E-01 .3525E-07    0.0000
.3440E-07 .6804E-08
  206         0.00  0.000  0.236  0.1650    0.0004 .1781E-01 .3236E-07    0.0000
.3222E-07 .6804E-08
  207         0.00  0.000  0.208  0.1418    0.0004 .1808E-01 .3273E-07    0.0000
.3023E-07 .6804E-08
  208         0.06  0.000  0.091  0.1384    0.0004 .1700E-01 .3134E-07    0.0000
.2874E-07 .6804E-08
  209         0.34  0.000  0.110  0.1640    0.0004 .1604E-01 .3008E-07    0.0000
.2730E-07 .6804E-08
  210         0.00  0.000  0.198  0.1420    0.0004 .1517E-01 .2895E-07    0.0000
.2593E-07 .6804E-08
  211         0.00  0.000  0.166  0.1236    0.0003 .1439E-01 .2792E-07    0.0000
.2464E-07 .6804E-08
  212         0.00  0.000  0.180  0.1036    0.0003 .1369E-01 .2698E-07    0.0000
.2345E-07 .6804E-08
  213         0.00  0.000  0.077  0.0950    0.0003 .1304E-01 .2613E-07    0.0000
.2234E-07 .6804E-08
  214         0.00  0.000  0.058  0.0885    0.0003 .1204E-01 .2474E-07    0.0000
.2125E-07 .6804E-08
  215         0.00  0.000  0.031  0.0850    0.0003 .1195E-01 .2467E-07    0.0000
.2022E-07 .6804E-08
  216         0.00  0.000  0.000  0.0850    0.0003 .1145E-01 .2400E-07    0.0000
.1942E-07 .6804E-08
  217         0.00  0.000  0.000  0.0850    0.0003 .1099E-01 .2337E-07    0.0000
.1866E-07 .6804E-08
  218         0.00  0.000  0.000  0.0850    0.0003 .1056E-01 .2279E-07    0.0000
.1795E-07 .6804E-08
  219         1.24  0.000  0.026  0.2199    0.0002 .1016E-01 .2224E-07    0.0000
.1728E-07 .6804E-08
  220         0.00  0.000  0.163  0.2018    0.0002 .9793E-02 .2174E-07    0.0000
.1665E-07 .6804E-08
  221         0.00  0.000  0.154  0.1847    0.0002 .9447E-02 .2126E-07    0.0000
.1607E-07 .6804E-08
  222         0.00  0.000  0.156  0.1674    0.0002 .9125E-02 .2082E-07    0.0000
.1552E-07 .6804E-08
  223         0.00  0.000  0.151  0.1506    0.0002 .8822E-02 .2041E-07    0.0000
.1501E-07 .6804E-08
  224         0.00  0.000  0.166  0.1322    0.0002 .8538E-02 .2000E-07    0.0000
.1453E-07 .6804E-08
  225         1.25  0.000  0.083  0.2618    0.0002 .8270E-02 .1963E-07    0.0000
.1407E-07 .6804E-08
  226         0.01  0.000  0.079  0.2541    0.0002 .8018E-02 .1928E-07    0.0000
.1365E-07 .6804E-08
  227         0.00  0.000  0.176  0.2258    0.0000 .1282E-02 .3746E-08    0.0000
.1137E-07 .6804E-08
  228         0.10  0.000  0.115  0.2177    0.0000 .0000E+00 .0000E+00    0.0000
.6492E-08 .6803E-08
  229         0.11  0.000  0.161  0.2075    0.0000 .0000E+00 .0000E+00    0.0000
.2423E-08 .6803E-08
  230         0.00  0.000  0.219  0.1794    0.0000 .0000E+00 .0000E+00    0.0000
.9864E-10 .1338E-08
  231         0.00  0.000  0.159  0.1593    0.0000 .9279E-03 .3164E-08    0.0000
.1234E-09 .3041E-08
  232         0.00  0.000  0.131  0.1422    0.0000 .7024E-04 .9909E-09    0.0000
.6221E-11 .7370E-09
  233         0.00  0.000  0.185  0.1192    0.0001 .2210E-02 .7032E-08    0.0000
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.1041E-09 .6803E-08
  234         0.00  0.000  0.161  0.0995    0.0003 .1468E-01 .2604E-07    0.0000
.2489E-08 .6803E-08
  235         0.00  0.000  0.128  0.0850    0.0005 .2053E-01 .3584E-07    0.0000
.8825E-08 .6804E-08
  236         0.59  0.000  0.035  0.1466    0.0005 .1951E-01 .3457E-07    0.0000
.1485E-07 .6804E-08
  237         0.23  0.000  0.054  0.1662    0.0004 .1827E-01 .3297E-07    0.0000
.1861E-07 .6804E-08
  238         0.05  0.000  0.128  0.1575    0.0004 .1713E-01 .3151E-07    0.0000
.2074E-07 .6804E-08
  239         0.00  0.000  0.145  0.1414    0.0004 .1619E-01 .3027E-07    0.0000
.2180E-07 .6804E-08
  240         0.51  0.000  0.080  0.1892    0.0004 .1529E-01 .2910E-07    0.0000
.2217E-07 .6804E-08
  241         0.28  0.000  0.122  0.2066    0.0003 .1362E-01 .2689E-07    0.0000
.2193E-07 .6804E-08
  242         0.00  0.000  0.157  0.1891    0.0003 .1387E-01 .2723E-07    0.0000
.2141E-07 .6804E-08
  243         0.12  0.000  0.111  0.1901    0.0003 .1323E-01 .2638E-07    0.0000
.2100E-07 .6804E-08
  244         0.89  0.000  0.092  0.2788    0.0003 .1252E-01 .2543E-07    0.0000
.2045E-07 .6804E-08
  245         0.00  0.000  0.150  0.2528    0.0002 .7207E-02 .1545E-07    0.0000
.1866E-07 .6804E-08
  246         1.42  0.000  0.112  0.3364    0.0001 .2299E-02 .5425E-08    0.0000
.1436E-07 .6804E-08
  247         0.27  0.000  0.134  0.2850    0.0013 .5438E-01 .6588E-07    0.0000
.1701E-07 .6804E-08
  248         0.57  0.000  0.113  0.3099    0.0052 .2202     .2475E-06    0.0000
.5231E-07 .6805E-08
  249         0.00  0.000  0.133  0.2542    0.0056 .2382     .2650E-06    0.0000
.1121E-06 .6806E-08
  250         0.00  0.000  0.128  0.2261    0.0081 .3396     .3698E-06    0.0000
.1698E-06 .6808E-08
  251         0.00  0.000  0.102  0.2078    0.0053 .2228     .2553E-06    0.0000
.2148E-06 .6809E-08
  252         0.00  0.000  0.112  0.1903    0.0036 .1532     .1842E-06    0.0000
.2163E-06 .6809E-08
  253         0.00  0.000  0.125  0.1729    0.0028 .1199     .1491E-06    0.0000
.2001E-06 .6809E-08
  254         0.00  0.000  0.120  0.1567    0.0023 .9628E-01 .1236E-06    0.0000
.1792E-06 .6808E-08
  255         0.19  0.000  0.089  0.1651    0.0018 .7750E-01 .1029E-06    0.0000
.1576E-06 .6808E-08
  256         0.38  0.000  0.088  0.1955    0.0016 .6942E-01 .9383E-07    0.0000
.1376E-06 .6807E-08
  257         0.21  0.000  0.055  0.2110    0.0014 .6030E-01 .8346E-07    0.0000
.1209E-06 .6807E-08
  258         0.07  0.000  0.137  0.2020    0.0013 .5286E-01 .7490E-07    0.0000
.1063E-06 .6806E-08
  259         0.14  0.000  0.082  0.2076    0.0012 .5085E-01 .7257E-07    0.0000
.9430E-07 .6806E-08
  260         0.00  0.000  0.090  0.1969    0.0011 .4574E-01 .6659E-07    0.0000
.8483E-07 .6806E-08
  261         0.00  0.000  0.131  0.1822    0.0011 .4497E-01 .6567E-07    0.0000
.7705E-07 .6806E-08
  262         0.00  0.000  0.135  0.1672    0.0009 .3971E-01 .5944E-07    0.0000
.7071E-07 .6805E-08
  263         0.00  0.000  0.117  0.1542    0.0008 .3517E-01 .5399E-07    0.0000
.6451E-07 .6805E-08
  264         0.00  0.000  0.144  0.1382    0.0007 .3152E-01 .4957E-07    0.0000
.5866E-07 .6805E-08
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  265         0.00  0.000  0.141  0.1226    0.0007 .2853E-01 .4590E-07    0.0000
.5334E-07 .6805E-08
  266         0.00  0.000  0.123  0.1090    0.0006 .2604E-01 .4281E-07    0.0000
.4860E-07 .6805E-08
  267         0.00  0.000  0.121  0.0956    0.0006 .2393E-01 .4017E-07    0.0000
.4442E-07 .6805E-08
  268         0.00  0.000  0.093  0.0850    0.0005 .2186E-01 .3753E-07    0.0000
.4071E-07 .6805E-08
  269         0.00  0.000  0.000  0.0850    0.0005 .2069E-01 .3608E-07    0.0000
.3748E-07 .6804E-08
  270         0.00  0.000  0.000  0.0850    0.0005 .1931E-01 .3431E-07    0.0000
.3475E-07 .6804E-08
  271         0.00  0.000  0.000  0.0850    0.0004 .1809E-01 .3274E-07    0.0000
.3234E-07 .6804E-08
  272         0.00  0.000  0.000  0.0850    0.0004 .1701E-01 .3135E-07    0.0000
.3021E-07 .6804E-08
  273         0.00  0.000  0.000  0.0850    0.0004 .1604E-01 .3009E-07    0.0000
.2832E-07 .6804E-08
  274         0.00  0.000  0.000  0.0850    0.0004 .1518E-01 .2896E-07    0.0000
.2664E-07 .6804E-08
  275         0.00  0.000  0.000  0.0850    0.0003 .1440E-01 .2793E-07    0.0000
.2514E-07 .6804E-08
  276         0.00  0.000  0.000  0.0850    0.0003 .1369E-01 .2699E-07    0.0000
.2379E-07 .6804E-08
  277         0.00  0.000  0.000  0.0850    0.0003 .1305E-01 .2613E-07    0.0000
.2258E-07 .6804E-08
  278         0.00  0.000  0.000  0.0850    0.0003 .1246E-01 .2534E-07    0.0000
.2149E-07 .6804E-08
  279         0.00  0.000  0.000  0.0850    0.0003 .1191E-01 .2462E-07    0.0000
.2050E-07 .6804E-08
  280         0.00  0.000  0.000  0.0850    0.0003 .1142E-01 .2395E-07    0.0000
.1959E-07 .6804E-08
  281         0.00  0.000  0.000  0.0850    0.0003 .1096E-01 .2332E-07    0.0000
.1877E-07 .6804E-08
  282         0.00  0.000  0.000  0.0850    0.0002 .1053E-01 .2275E-07    0.0000
.1801E-07 .6804E-08
  283         0.00  0.000  0.000  0.0850    0.0002 .1013E-01 .2221E-07    0.0000
.1731E-07 .6804E-08
  284         0.00  0.000  0.000  0.0850    0.0002 .9767E-02 .2170E-07    0.0000
.1666E-07 .6804E-08
  285         0.00  0.000  0.000  0.0850    0.0002 .9423E-02 .2123E-07    0.0000
.1606E-07 .6804E-08
  286         0.00  0.000  0.000  0.0850    0.0002 .9101E-02 .2079E-07    0.0000
.1551E-07 .6804E-08
  287         0.00  0.000  0.000  0.0850    0.0002 .8800E-02 .2058E-07    0.0000
.1502E-07 .6804E-08
  288         0.00  0.000  0.000  0.0850    0.0002 .8517E-02 .1997E-07    0.0000
.1456E-07 .6804E-08
  289         0.83  0.000  0.017  0.1753    0.0002 .8110E-02 .1939E-07    0.0000
.1406E-07 .6804E-08
  290         0.27  0.000  0.020  0.2031    0.0002 .8012E-02 .1927E-07    0.0000
.1360E-07 .6804E-08
  291         0.04  0.000  0.061  0.2007    0.0002 .7775E-02 .1893E-07    0.0000
.1321E-07 .6804E-08
  292         1.56  0.000  0.050  0.3399    0.0001 .6234E-02 .1599E-07    0.0000
.1251E-07 .6804E-08
  293         0.14  0.000  0.067  0.2765    0.0000 .0000E+00 .0000E+00    0.0000
.9522E-08 .6804E-08
  294         0.00  0.000  0.102  0.2499    0.0010 .4215E-01 .5861E-07    0.0000
.1176E-07 .6804E-08
  295         0.00  0.000  0.082  0.2312    0.0023 .9752E-01 .1250E-06    0.0000
.3221E-07 .6804E-08
  296         0.00  0.000  0.069  0.2169    0.0026 .1088     .1372E-06    0.0000
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.6002E-07 .6805E-08
 297         0.00  0.000  0.069  0.2045    0.0024 .1029     .1308E-06    0.0000
.8077E-07 .6806E-08
 298         0.00  0.000  0.072  0.1927    0.0021 .8769E-01 .1142E-06    0.0000
.9195E-07 .6806E-08
 299         0.01  0.000  0.054  0.1849    0.0019 .7946E-01 .1051E-06    0.0000
.9554E-07 .6806E-08
 300         0.35  0.000  0.057  0.2148    0.0016 .6727E-01 .9140E-07    0.0000
.9469E-07 .6806E-08
 301         0.00  0.000  0.078  0.2041    0.0015 .6238E-01 .8584E-07    0.0000
.9091E-07 .6806E-08
 302         0.35  0.000  0.054  0.2350    0.0013 .5323E-01 .7533E-07    0.0000
.8598E-07 .6806E-08
 303         0.44  0.000  0.055  0.2760    0.0012 .4871E-01 .7006E-07    0.0000
.7999E-07 .6806E-08
 304         0.00  0.000  0.074  0.2596    0.0008 .3315E-01 .4813E-07    0.0000
.7216E-07 .6805E-08
 305         0.00  0.000  0.090  0.2345    0.0000 .2749E-03 .9366E-09    0.0000
.5689E-07 .6805E-08
 306         0.00  0.000  0.077  0.2185    0.0010 .4121E-01 .6091E-07    0.0000
.4509E-07 .6805E-08
 307         0.00  0.000  0.076  0.2051    0.0015 .6483E-01 .8861E-07    0.0000
.5127E-07 .6805E-08
 308         0.00  0.000  0.072  0.1930    0.0015 .6477E-01 .8855E-07    0.0000
.6061E-07 .6805E-08
 309         1.02  0.000  0.062  0.2966    0.0016 .6571E-01 .8960E-07    0.0000
.6721E-07 .6805E-08
 310         1.66  0.069  0.075  0.3401    0.0004 .1591E-01 .2279E-07    0.0000
.6373E-07 .6805E-08
 311         0.22  0.000  0.079  0.2845    0.0209 .8822     .8564E-06    0.0000
.1520E-06 .6807E-08
 312         1.95  0.065  0.073  0.3444    0.0145 .6095     .5951E-06    0.0000
.3333E-06 .6812E-08
 313         0.00  0.000  0.078  0.2599    0.0316 1.333     .1244E-05    0.0000
.4914E-06 .6816E-08
 314         0.00  0.000  0.104  0.2330    0.0107 .4496     .4734E-06    0.0000
.6245E-06 .6819E-08
 315         0.00  0.000  0.093  0.2152    0.0060 .2524     .2846E-06    0.0000
.5529E-06 .6817E-08
 316         0.00  0.000  0.099  0.1995    0.0040 .1703     .2018E-06    0.0000
.4585E-06 .6815E-08
 317         0.00  0.000  0.092  0.1856    0.0030 .1247     .1542E-06    0.0000
.3720E-06 .6813E-08
 318         0.00  0.000  0.081  0.1733    0.0023 .9689E-01 .1243E-06    0.0000
.2995E-06 .6811E-08
 319         0.00  0.000  0.090  0.1609    0.0020 .8287E-01 .1089E-06    0.0000
.2419E-06 .6810E-08
 320         0.01  0.000  0.066  0.1522    0.0016 .6831E-01 .9257E-07    0.0000
.1971E-06 .6809E-08
 321         0.90  0.000  0.051  0.2447    0.0015 .6153E-01 .8487E-07    0.0000
.1621E-06 .6808E-08
 322         0.00  0.000  0.061  0.2364    0.0013 .5436E-01 .7662E-07    0.0000
.1353E-06 .6807E-08
 323         0.00  0.000  0.047  0.2301    0.0012 .5182E-01 .7368E-07    0.0000
.1149E-06 .6807E-08
 324         0.00  0.000  0.066  0.2225    0.0012 .5040E-01 .7200E-07    0.0000
.1000E-06 .6806E-08
 325         0.00  0.000  0.046  0.2139    0.0004 .1823E-01 .3274E-07    0.0000
.8451E-07 .6806E-08
 326         0.10  0.000  0.041  0.2170    0.0005 .2030E-01 .3557E-07    0.0000
.6693E-07 .6805E-08
 327         0.00  0.000  0.049  0.2082    0.0006 .2351E-01 .3962E-07    0.0000
.5575E-07 .6805E-08
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  328          0.00  0.000  0.044  0.2006    0.0007 .2835E-01 .4563E-07    0.0000
.4947E-07 .6805E-08
  329          0.00  0.000  0.043  0.1935    0.0008 .3201E-01 .5017E-07    0.0000
.4677E-07 .6805E-08
  330          0.00  0.000  0.053  0.1856    0.0008 .3199E-01 .5014E-07    0.0000
.4573E-07 .6805E-08
  331          0.03  0.000  0.035  0.1833    0.0008 .3253E-01 .5079E-07    0.0000
.4507E-07 .6805E-08
  332          0.68  0.000  0.037  0.2531    0.0007 .3004E-01 .4775E-07    0.0000
.4437E-07 .6805E-08
  333          0.25  0.000  0.046  0.2740    0.0007 .2795E-01 .4517E-07    0.0000
.4300E-07 .6805E-08
  334          0.00  0.000  0.041  0.2619    0.0006 .2449E-01 .3749E-07    0.0000
.4063E-07 .6805E-08
  335          1.82  0.007  0.041  0.3438    0.0001 .5060E-02 .8651E-08    0.0000
.3403E-07 .6804E-08
  336          0.00  0.000  0.043  0.2631    0.0158 .6674     .6592E-06    0.0000
.1045E-06 .6806E-08
  337          0.00  0.000  0.043  0.2424    0.0103 .4349     .4599E-06    0.0000
.2476E-06 .6810E-08
  338          0.00  0.000  0.045  0.2287    0.0059 .2489     .2812E-06    0.0000
.2884E-06 .6811E-08
  339          0.00  0.000  0.045  0.2184    0.0041 .1746     .2063E-06    0.0000
.2749E-06 .6811E-08
  340          0.00  0.000  0.047  0.2090    0.0030 .1282     .1580E-06    0.0000
.2458E-06 .6810E-08
  341          0.00  0.000  0.040  0.2014    0.0025 .1033     .1313E-06    0.0000
.2136E-06 .6809E-08
  342          0.00  0.000  0.051  0.1930    0.0020 .8308E-01 .1091E-06    0.0000
.1836E-06 .6808E-08
  343          0.00  0.000  0.057  0.1844    0.0017 .7219E-01 .9693E-07    0.0000
.1572E-06 .6808E-08
  344          0.00  0.000  0.043  0.1775    0.0014 .6104E-01 .8431E-07    0.0000
.1351E-06 .6807E-08
  345  *       0.00  0.000  0.033  0.1721    0.0013 .5541E-01 .7784E-07    0.0000
.1167E-06 .6807E-08
  346  *       0.00  0.000  0.000  0.1703    0.0011 .4768E-01 .6886E-07    0.0000
.1016E-06 .6806E-08
  347  *       0.00  0.000  0.000  0.1688    0.0011 .4466E-01 .6532E-07    0.0000
.8906E-07 .6806E-08
  348  *       0.00  0.000  0.000  0.1676    0.0010 .4168E-01 .6179E-07    0.0000
.7927E-07 .6806E-08
  349  *       0.00  0.000  0.032  0.1631    0.0009 .3888E-01 .5845E-07    0.0000
.7143E-07 .6805E-08
  350          0.01  0.000  0.038  0.1588    0.0008 .3331E-01 .5173E-07    0.0000
.6455E-07 .6805E-08
  351          0.00  0.000  0.051  0.1522    0.0008 .3200E-01 .5015E-07    0.0000
.5835E-07 .6805E-08
  352          0.08  0.000  0.031  0.1570    0.0008 .3168E-01 .4975E-07    0.0000
.5371E-07 .6805E-08
  353  *       0.76  0.000  0.020  0.1587    0.0007 .3054E-01 .4837E-07    0.0000
.5024E-07 .6805E-08
  354  *       0.00  0.000  0.014  0.1605    0.0007 .2835E-01 .4567E-07    0.0000
.4725E-07 .6805E-08
  355  *       0.00  0.000  0.015  0.1627    0.0007 .2888E-01 .4632E-07    0.0000
.4477E-07 .6805E-08
  356          0.00  0.000  0.020  0.1678    0.0006 .2657E-01 .4347E-07    0.0000
.4281E-07 .6805E-08
  357          0.00  0.000  0.000  0.2330    0.0006 .2438E-01 .4074E-07    0.0000
.4059E-07 .6805E-08
  358          0.00  0.000  0.062  0.2261    0.0005 .2251E-01 .3838E-07    0.0000
.3826E-07 .6804E-08
  359          0.00  0.000  0.061  0.2193    0.0005 .2089E-01 .3634E-07    0.0000
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.3596E-07 .6804E-08
  360         0.00  0.000  0.059  0.2127    0.0005 .1933E-01 .3434E-07    0.0000
.3375E-07 .6804E-08
  361         0.00  0.000  0.056  0.2065    0.0004 .1826E-01 .3297E-07    0.0000
.3168E-07 .6804E-08
  362         0.00  0.000  0.074  0.1982    0.0004 .1694E-01 .3126E-07    0.0000
.2978E-07 .6804E-08
  363         0.00  0.000  0.067  0.1894    0.0001 .4811E-02 .1449E-07    0.0000
.2608E-07 .6804E-08
  364         0.11  0.000  0.050  0.1939    0.0000 .2914E-03 .2329E-08    0.0000
.1895E-07 .6804E-08
  365         1.75  0.000  0.038  0.3430    0.0001 .2576E-02 .6815E-08    0.0000
.1233E-07 .6804E-08


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                   MONTHLY TOTALS (IN INCHES) FOR YEAR    1
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                                 JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
                                 ------- ------- ------- ------- ------- -------

 PRECIPITATION                    2.64    5.03    4.12    2.65    4.89    5.55
                                  4.59    4.49    4.14    3.99    6.82    4.53

 RUNOFF                           0.000   0.000   0.000   0.000   0.000   0.000
                                  0.000   0.000   0.000   0.000   0.135   0.007

 EVAPOTRANSPIRATION               1.645   1.870   2.840   2.865   3.164   5.220
                                  4.571   3.412   2.867   0.982   1.967   1.173

 LATERAL DRAINAGE COLLECTED       1.9319  3.0431  1.6927  1.1521  0.3418  1.1581
   FROM LAYER  2                  0.5832  0.3090  2.1662  0.9827  4.8098  2.5483

 PERCOLATION/LEAKAGE THROUGH      0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
   LAYER  4                       0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

 LATERAL DRAINAGE COLLECTED       0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
   FROM LAYER  7                  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

 PERCOLATION/LEAKAGE THROUGH      0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
   LAYER  9                       0.0000  0.0000  0.0000  0.0000  0.0000  0.0000


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                    MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)
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 AVERAGE DAILY HEAD ON            0.001   0.003   0.001   0.001   0.000   0.001
   TOP OF LAYER  3                0.000   0.000   0.002   0.001   0.004   0.002

 STD. DEVIATION OF DAILY          0.001   0.003   0.001   0.000   0.000   0.000
   HEAD ON TOP OF LAYER  3        0.000   0.000   0.002   0.001   0.007   0.003

 AVERAGE DAILY HEAD ON            0.000   0.000   0.000   0.000   0.000   0.000
   TOP OF LAYER  8                0.000   0.000   0.000   0.000   0.000   0.000
```

STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 8	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	53.44	193987.156	100.00
RUNOFF	0.141	513.268	0.26
EVAPOTRANSPIRATION	32.575	118247.242	60.96
DRAINAGE COLLECTED FROM LAYER 2	20.7190	75209.953	38.77
PERC./LEAKAGE THROUGH LAYER 4	0.000027	0.097	0.00
AVG. HEAD ON TOP OF LAYER 3	0.0014		
DRAINAGE COLLECTED FROM LAYER 7	0.0000	0.088	0.00
PERC./LEAKAGE THROUGH LAYER 9	0.000002	0.009	0.00
AVG. HEAD ON TOP OF LAYER 8	0.0000		
CHANGE IN WATER STORAGE	0.005	16.617	0.01
SOIL WATER AT START OF YEAR	357.549	1297901.120	
SOIL WATER AT END OF YEAR	357.553	1297917.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.023	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.76	4.70	4.38	4.07	5.15	5.22
	4.40	4.57	3.63	3.46	4.26	4.45

```
  STD. DEVIATIONS        2.30     2.20     2.15     2.07     1.88     1.98
                         1.91     2.17     2.16     2.16     2.69     2.30

RUNOFF
------
  TOTALS                 0.214    0.789    0.070    0.000    0.013    0.009
                         0.004    0.012    0.033    0.023    0.069    0.031

  STD. DEVIATIONS        0.433    1.568    0.337    0.002    0.037    0.031
                         0.017    0.050    0.088    0.085    0.165    0.079

EVAPOTRANSPIRATION
------------------
  TOTALS                 1.177    1.457    2.786    2.860    3.690    3.897
                         3.542    3.209    2.178    1.871    1.471    0.962

  STD. DEVIATIONS        0.328    0.410    0.473    1.002    0.928    1.187
                         1.164    1.011    1.024    0.588    0.382    0.251

LATERAL DRAINAGE COLLECTED FROM LAYER  2
-----------------------------------------
  TOTALS                 3.4604   2.8461   2.3330   1.3919   1.5118   1.2483
                         1.0176   1.1238   1.2517   1.5431   2.3866   2.5992

  STD. DEVIATIONS        2.0908   2.0593   1.5927   1.2027   1.2594   1.0960
                         0.9128   1.2756   1.0648   1.6412   2.1913   1.6746

PERCOLATION/LEAKAGE THROUGH LAYER  4
-------------------------------------
  TOTALS                 0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

  STD. DEVIATIONS        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

LATERAL DRAINAGE COLLECTED FROM LAYER  7
-----------------------------------------
  TOTALS                 0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

  STD. DEVIATIONS        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

PERCOLATION/LEAKAGE THROUGH LAYER  9
-------------------------------------
  TOTALS                 0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

  STD. DEVIATIONS        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000


-------------------------------------------------------------------------------
              AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


DAILY AVERAGE HEAD ON TOP OF LAYER  3
-------------------------------------
  AVERAGES               0.0026   0.0024   0.0018   0.0011   0.0012   0.0010
                         0.0008   0.0009   0.0010   0.0012   0.0019   0.0020

  STD. DEVIATIONS        0.0016   0.0017   0.0012   0.0010   0.0010   0.0009
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                          0.0007   0.0010   0.0008   0.0013   0.0017   0.0013

  DAILY AVERAGE HEAD ON TOP OF LAYER  8
  ------------------------------------
    AVERAGES              0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

    STD. DEVIATIONS       0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH   30
-------------------------------------------------------------------------------
                                     INCHES            CU. FEET       PERCENT
                                 -------------------   -------------   ---------
 PRECIPITATION                    53.06    (   5.948)     192619.9     100.00

 RUNOFF                            1.265   (  1.6792)       4593.25      2.385

 EVAPOTRANSPIRATION               29.101   (  3.0435)     105636.21     54.842

 LATERAL DRAINAGE COLLECTED       22.71356 (  5.75340)     82450.219   42.80461
   FROM LAYER  2

 PERCOLATION/LEAKAGE THROUGH       0.00003 (  0.00001)         0.104     0.00005
   LAYER  4

 AVERAGE HEAD ON TOP               0.001 (    0.000)
   OF LAYER  3

 LATERAL DRAINAGE COLLECTED        0.00003 (  0.00001)         0.095    0.00005
   FROM LAYER  7

 PERCOLATION/LEAKAGE THROUGH       0.00000 (  0.00000)         0.009     0.00000
   LAYER  9

 AVERAGE HEAD ON TOP               0.000 (    0.000)
   OF LAYER  8

 CHANGE IN WATER STORAGE          -0.016   (  2.2154)        -59.88     -0.031

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                PEAK DAILY VALUES FOR YEARS    1 THROUGH   30
   ------------------------------------------------------------------------
                                                (INCHES)      (CU. FT.)
                                               ----------   -------------
      PRECIPITATION                              5.08         18440.400

      RUNOFF                                     1.734         6294.0122

      DRAINAGE COLLECTED FROM LAYER  2           1.86229       6760.11572
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PERCOLATION/LEAKAGE THROUGH LAYER  4       0.000002         0.00601

AVERAGE HEAD ON TOP OF LAYER  3            0.044

MAXIMUM HEAD ON TOP OF LAYER  3            0.165

LOCATION OF MAXIMUM HEAD IN LAYER  2
      (DISTANCE FROM DRAIN)                0.0 FEET

DRAINAGE COLLECTED FROM LAYER  7           0.00000          0.00297

PERCOLATION/LEAKAGE THROUGH LAYER  9       0.000000         0.00002

AVERAGE HEAD ON TOP OF LAYER  8            0.000

MAXIMUM HEAD ON TOP OF LAYER  8            0.002

LOCATION OF MAXIMUM HEAD IN LAYER  7
      (DISTANCE FROM DRAIN)                0.0 FEET

SNOW WATER                                 9.08         32963.9844


MAXIMUM VEG. SOIL WATER (VOL/VOL)                  0.4177

MINIMUM VEG. SOIL WATER (VOL/VOL)                  0.0850


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

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

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                 FINAL WATER STORAGE AT END OF YEAR   30
    ----------------------------------------------------------------------
                  LAYER        (INCHES)       (VOL/VOL)
                  -----        --------       ---------
                    1            6.2578         0.2607

                    2            0.0059         0.0296

                    3            0.0000         0.0000

                    4            8.1180         0.4510

                    5            2.2800         0.1900

                    6          329.3760         0.2920

                    7            0.7680         0.0320

                    8            0.0000         0.0000
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                9            10.2480          0.4270

            SNOW WATER        0.000
*******************************************************************************
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Section 14: Landfill Leachate Production Records

MACON COUNTY MSW LANDFILL PERMIT # 57-03
ANNUAL LEACHATE VOLUMES PUMPED AND TREATED AT FRANKLIN WWTP
2003

MONTH	TOTAL GALLONS	DAILY MAXIMUM (GALLONS)	# DAYS PUMPED THIS MONTH	AVERAGE GALLONS PER DAY PUMPED	AVERAGE MONTHLY GALLONS
JANUARY	158,510	27,600	7	22644	5113
FEBRUARY	186,440	31,510	8	23305	6658
MARCH	566,570	37,970	22	25753	18276
APRIL	380,590	33,700	21	18123	12686
MAY	606,050	39,990	23	26350	19550
JUNE	261,400	26,010	13	20107	8713
JULY	652,030	39,910	20	32601	21033
AUGUST	508,620	37,430	22	23119	16407
SEPTEMBER	451,230	32,130	19	23748	15041
OCTOBER	350,140	31,420	12	29178	11294
NOVEMBER	415,730	35,300	15	27715	13857
DECEMBER	540,290	29,000	25	21611	17428

TOTAL GALLONS TREATED IN 2003:	5,077,600
TOTAL DAYS PUMPED FROM LEACHATE POND:	207
AVERAGE GALLONS TREATED PER DAY (PUMPED):	24,529
ANNUAL DAILY AVERAGE GALLONS TREATED:	13,911

MACON COUNTY MSW LANDFILL PERMIT # 57-03
ANNUAL LEACHATE VOLUMES PUMPED AND TREATED AT FRANKLIN WWTP
2004

MONTH	TOTAL GALLONS	DAILY MAXIMUM (GALLONS)	# DAYS PUMPED THIS MONTH	AVERAGE GALLONS PER DAY PUMPED	AVERAGE MONTHLY GALLONS
JANUARY	573,520	32,360	24	23896	18500
FEBRUARY	703,000	39,680	24	29291	24241
MARCH	364,510	39,870	14	26036	11758
APRIL	411,660	30,510	20	20583	13722
MAY	257,300	28,160	12	21441	8300
JUNE	265,230	40,160	14	18945	8841
JULY	438,620	36,990	19	23085	14149
AUGUST	526,090	38,500	20	26304	16970
SEPTEMBER	570,300	39,950	20	28515	19010
OCTOBER	881,270	39,950	25	35250	28428
NOVEMBER	708,120	39,700	21	33720	23604
DECEMBER	463,310	40,000	13	35639	14945

TOTAL GALLONS TREATED IN 2004:	6,162,930
TOTAL DAYS PUMPED FROM LEACHATE POND:	226
AVERAGE GALLONS TREATED PER DAY (PUMPED):	27,270
ANNUAL DAILY AVERAGE GALLONS TREATED:	16,838

MACON COUNTY MSW LANDFILL PERMIT # 57-03
ANNUAL LEACHATE VOLUMES PUMPED AND TREATED AT FRANKLIN WWTP
2005

MONTH	TOTAL GALLONS	DAILY MAXIMUM (GALLONS)	# DAYS PUMPED THIS MONTH	AVERAGE GALLONS PER DAY PUMPED	AVERAGE MONTHLY GALLONS
JANUARY	350,110	40,630	11	31828	11293
FEBRUARY	329,080	37,800	10	32908	11752
MARCH	423,546	47,167	13	32580	13662
APRIL	321,042	36,694	11	29185	10701
MAY	503,177	35,775	17	29598	16231
JUNE	439,781	39,000	13	33829	14659
JULY	862,974	38,146	24	35957	27837
AUGUST	500,447	39,500	17	29438	16143
SEPTEMBER	651,429	38,950	21	31020	21714
OCTOBER	465,290	38,520	19	24488	15009
NOVEMBER	416,238	33,709	15	27749	13874
DECEMBER	563,253	36,420	21	26821	18169

TOTAL GALLONS TREATED IN 2005:	5,826,367
TOTAL DAYS PUMPED FROM LEACHATE POND:	192
AVERAGE GALLONS TREATED PER DAY (PUMPED):	30,346
ANNUAL DAILY AVERAGE GALLONS TREATED:	15,962

MACON COUNTY MSW LANDFILL PERMIT # 57-03
ANNUAL LEACHATE VOLUMES PUMPED AND TREATED AT FRANKLIN WWTP
2006

MONTH	TOTAL GALLONS	DAILY MAXIMUM (GALLONS)	# DAYS PUMPED THIS MONTH	AVERAGE GALLONS PER DAY PUMPED	AVERAGE MONTHLY GALLONS
JANUARY	580,807	39,702	22	26400	18735
FEBRUARY	498,495	27,485	20	24924	17803
MARCH	463,404	48,180	15	30893	14948
APRIL	206,701	29,210	9	22966	6890
MAY	244,464	27,657	16	15279	7885
JUNE	284,993	28,442	14	20356	9499
JULY	110,211	24,642	6	18368	3555
AUGUST	311,397	39,850	10	31139	10045
SEPTEMBER	326,141	33,262	14	23295	10871
OCTOBER	196,001	27,771	12	16333	6322
NOVEMBER	418,050	38,442	17	24591	13935
DECEMBER	312,384	34,682	12	26032	10076

TOTAL GALLONS TREATED IN 2005:	3,953,048
TOTAL DAYS PUMPED FROM LEACHATE POND:	167
AVERAGE GALLONS TREATED PER DAY (PUMPED):	23,671
ANNUAL DAILY AVERAGE GALLONS TREATED:	10,830

MACON COUNTY MSW LANDFILL PERMIT # 57-03
ANNUAL LEACHATE VOLUMES PUMPED AND TREATED AT FRANKLIN WWTP
2007

MONTH	TOTAL GALLONS	DAILY MAXIMUM (GALLONS)	# DAYS PUMPED THIS MONTH	AVERAGE GALLONS PER DAY PUMPED	AVERAGE MONTHLY GALLONS
JANUARY	386,888	39,565	14	27634	12480
FEBRUARY	282,593	39,836	9	31399	9744
MARCH	251,763	38,420	10	25176	8121
APRIL	218,308	35,882	10	21830	7276
MAY	170,158	34,489	6	28359	5488
JUNE	189,674	32,183	8	23709	6322
JULY	345,944	31,120	17	20349	11159
AUGUST	243,946	29,647	9	27105	7869
SEPTEMBER	109,986	33,109	4	27496	3666
OCTOBER	189,535	38,445	7	27076	6114
NOVEMBER	250,743	36,616	11	22794	8358
DECEMBER	156,223	38,196	8	19527	5039

TOTAL GALLONS TREATED IN 2005:	2,795,761
TOTAL DAYS PUMPED FROM LEACHATE POND:	113
AVERAGE GALLONS TREATED PER DAY (PUMPED):	24,741
ANNUAL DAILY AVERAGE GALLONS TREATED:	7,638

MACON COUNTY MSW LANDFILL PERMIT # 57-03
ANNUAL LEACHATE VOLUMES PUMPED AND TREATED AT FRANKLIN WWTP
2008

MONTH	TOTAL GALLONS	DAILY MAXIMUM (GALLONS)	# DAYS PUMPED THIS MONTH	AVERAGE GALLONS PER DAY PUMPED	AVERAGE MONTHLY GALLONS
JANUARY	211,287	29,325	11	19207	6815
FEBRUARY	211,282	20,568	14	15091	7285
MARCH	401,771	36,552	19	21145	12960
APRIL	319,611	33,803	16	19975	10653
MAY	223,457	22,799	12	18621	7208
JUNE	90,019	27,884	4	22504	3000
JULY	261,734	35,000	11	23794	8443
AUGUST	165,729	34,033	7	23675	5346
SEPTEMBER	186,980	28,230	8	23372	6232
OCTOBER	9,845	9,845	1	9845	317
NOVEMBER	107,329	29,138	4	26832	3577
DECEMBER	231,558	39,950	10	23155	7469

TOTAL GALLONS TREATED IN 2008:	2,420,602
TOTAL DAYS PUMPED FROM LEACHATE POND:	117
AVERAGE GALLONS TREATED PER DAY (PUMPED):	20,689
ANNUAL DAILY AVERAGE GALLONS TREATED:	6,613

MACON COUNTY MSW LANDFILL PERMIT # 57-03
ANNUAL LEACHATE VOLUMES PUMPED AND TREATED AT FRANKLIN WWTP
2009

MONTH	TOTAL GALLONS	DAILY MAXIMUM (GALLONS)	# DAYS PUMPED THIS MONTH	AVERAGE GALLONS PER DAY PUMPED	AVERAGE MONTHLY GALLONS
JANUARY	125,112	32,430	4	31278	4035
FEBRUARY	236,087	38,960	7	33726	8140
MARCH	301,509	32,810	11	27409	9726
APRIL	149,457	38,910	4	37364	4981
MAY	231,572	30,931	12	19297	7470
JUNE	250,817	39,152	10	25081	8360
JULY	292,239	34,180	12	24353	9427
AUGUST	151,987	29,204	6	25331	4902
SEPTEMBER	186,678	39,180	5	37335	6222
OCTOBER	216,802	29,055	8	27100	6993
NOVEMBER	297,429	35,500	10	29742	9914
DECEMBER	334,602	37,386	11	30418	10793

TOTAL GALLONS TREATED IN 2009:	2,774,291
TOTAL DAYS PUMPED FROM LEACHATE POND:	100
AVERAGE GALLONS TREATED PER DAY (PUMPED):	27,743
ANNUAL DAILY AVERAGE GALLONS TREATED:	7,580

MACON COUNTY MSW LANDFILL PERMIT # 57-03
ANNUAL LEACHATE VOLUMES PUMPED AND TREATED AT FRANKLIN WWTP
2010

MONTH	TOTAL GALLONS	DAILY MAXIMUM (GALLONS)	# DAYS PUMPED THIS MONTH	AVERAGE GALLONS PER DAY PUMPED	AVERAGE MONTHLY GALLONS
JANUARY	74,381	30,127	3	24793	2399
FEBRUARY	401,587	25,799	17	23622	13847
MARCH	201,967	30,157	8	25245	6515
APRIL	224,187	18,312	15	14945	7472
MAY	155,812	19,051	9	17312	5026
JUNE	93,769	17,410	6	15628	3125
JULY	83,732	18,103	5	16746	2701
AUGUST	274,953	21,061	15	18330	8869
SEPTEMBER	107,490	20,104	6	17915	3583
OCTOBER	156,475	17,753	11	14225	5047
NOVEMBER	144,733	18,472	11	13157	4824
DECEMBER	142,189	29,207	8	17773	4586

TOTAL GALLONS TREATED IN 2010:	2,061,275
TOTAL DAYS PUMPED FROM LEACHATE POND:	114
AVERAGE GALLONS TREATED PER DAY (PUMPED):	18,081
ANNUAL DAILY AVERAGE GALLONS TREATED:	5,631

MACON COUNTY MSW LANDFILL PERMIT # 57-03
ANNUAL LEACHATE VOLUMES PUMPED AND TREATED AT FRANKLIN WWTP
2011

MONTH	TOTAL GALLONS	DAILY MAXIMUM (GALLONS)	# DAYS PUMPED THIS MONTH	AVERAGE GALLONS PER DAY PUMPED	AVERAGE MONTHLY GALLONS
JANUARY	70,809	18,906	4	17702	2284
FEBRUARY	161,218	20,056	9	17913	5757
MARCH	362,610	36,820	12	30217	11697
APRIL	197,220	36,240	7	28174	6574
MAY	245,300	25,350	13	18869	7912
JUNE	121,480	17,840	7	17354	4049
JULY	92,200	19,100	5	18440	2974
AUGUST	89,240	24,600	4	22310	2878
SEPTEMBER	135,646	20,150	7	19378	4521
OCTOBER	100,300	36,900	3	33433	3235
NOVEMBER	180,300	35,200	6	30050	6010
DECEMBER	326,100	38,100	15	21740	10519

TOTAL GALLONS TREATED IN 2011:	2,082,423
TOTAL DAYS PUMPED FROM LEACHATE POND:	92
AVERAGE GALLONS TREATED PER DAY (PUMPED):	22,635
ANNUAL DAILY AVERAGE GALLONS TREATED:	5,689

MACON COUNTY MSW LANDFILL PERMIT # 57-03
ANNUAL LEACHATE VOLUMES PUMPED AND TREATED AT FRANKLIN WWTP
2012

MONTH	TOTAL GALLONS	DAILY MAXIMUM (GALLONS)	# DAYS PUMPED THIS MONTH	AVERAGE GALLONS PER DAY PUMPED	AVERAGE MONTHLY GALLONS
JANUARY	240,800	40,400	9	26755	7767
FEBRUARY	249,800	32,500	11	22709	8921
MARCH	183,000	19,500	10	18300	5903
APRIL	329,800	19,600	18	18322	10993
MAY	206,900	20,900	11	18809	6674
JUNE	223,800	22,600	11	20345	7460
JULY	245,800	27,700	11	22345	7929
AUGUST	169,900	31,800	9	18877	5480
SEPTEMBER	102,700	16,700	7	14671	3423
OCTOBER	165,300	26,500	10	16530	5332
NOVEMBER	105,900	16,300	7	15128	3530
DECEMBER	118,700	25,400	8	14837	3829

TOTAL GALLONS TREATED IN 2011:	2,342,400
TOTAL DAYS PUMPED FROM LEACHATE POND:	122
AVERAGE GALLONS TREATED PER DAY (PUMPED):	19,200
ANNUAL DAILY AVERAGE GALLONS TREATED:	6,400

MACON COUNTY MSW LANDFILL PERMIT # 57-03
ANNUAL LEACHATE VOLUMES PUMPED AND TREATED AT FRANKLIN WWTP
2013

MONTH	TOTAL GALLONS	DAILY MAXIMUM (GALLONS)	# DAYS PUMPED THIS MONTH	AVERAGE GALLONS PER DAY PUMPED	AVERAGE MONTHLY GALLONS
JANUARY	210,700	39,000	7	30100	6796
FEBRUARY	259,300	36,300	10	25930	9260
MARCH	254,400	38,900	9	28266	8206
APRIL	192,100	31,900	9	21344	6403
MAY	282,000	36,000	11	25636	9096
JUNE	206,500	19,300	12	17208	6883
JULY	222,000	35,100	7	31714	7161
AUGUST	183,000	23,300	8	22875	5903
SEPTEMBER	153,000	38,200	5	30600	5100
OCTOBER	167,800	16,400	11	15254	5412
NOVEMBER	94,100	19,800	6	15683	3136
DECEMBER	300,700	35,600	14	21478	9700

TOTAL GALLONS TREATED IN 2011:	2,525,600
TOTAL DAYS PUMPED FROM LEACHATE POND:	109
AVERAGE GALLONS TREATED PER DAY (PUMPED):	23,171
ANNUAL DAILY AVERAGE GALLONS TREATED:	6,900

MACON COUNTY MSW LANDFILL PERMIT # 57-03
ANNUAL LEACHATE VOLUMES PUMPED AND TREATED AT FRANKLIN WWTP
2014

MONTH	TOTAL GALLONS	DAILY MAXIMUM (GALLONS)	# DAYS PUMPED THIS MONTH	AVERAGE GALLONS PER DAY PUMPED	AVERAGE MONTHLY GALLONS
JANUARY	112,600	30,700	6	18766	3632
FEBRUARY	178,100	35,500	7	25442	6360
MARCH	172,600	15,600	13	13276	5567
APRIL	216,700	28,600	12	18058	7223
MAY	159,400	19,300	9	17711	5141
JUNE	148,400	19,000	8	18550	4946
JULY	91,200	18,700	5	18240	2941
AUGUST	136,800	35,900	5	27360	4412
SEPTEMBER	147,800	26,000	7	21114	4926
OCTOBER	147,800	20,700	11	13436	4767
NOVEMBER	38,200	13,500	3	12733	1273
DECEMBER	175,700	18,100	12	14641	5667

TOTAL GALLONS TREATED IN 2011:	1,725,300
TOTAL DAYS PUMPED FROM LEACHATE POND:	98
AVERAGE GALLONS TREATED PER DAY (PUMPED):	17,605
ANNUAL DAILY AVERAGE GALLONS TREATED:	4,713

Section 15: 404/401 Permits – Stream/Wetlands Impact

U.S. ARMY CORPS OF ENGINEERS
WILMINGTON DISTRICT

Action ID. **2012-01916** County: **Macon** U.S.G.S. Quad: **Franklin and Corbin Knob**

GENERAL PERMIT (REGIONAL AND NATIONWIDE) VERIFICATION

Permittee: **Macon County / Attn.: Derek Roland**
Address: **5 West Main Street**
Franklin, NC 28734
Telephone Number: **828-349-2022**

Size (acres): **196** Nearest Town: **Franklin**
Nearest Waterway: **UTs to Little Tennessee River & Little Tennessee River (Lake Emory)** Coordinates: **35.203517 N, 83.376731 W**
River Basin/ HUC: **Upper Little Tennessee River (06010202)**

Location description: **The project site is located on a tract of land (PINs 6595-37-1587, 6595-27-2249, 6595-27-3034, and 6595-26-0611) known as the Macon County Municipal Solid Waste Landfill Phase 3 at 1448 Lakeside Drive in Franklin, Macon County North Carolina.**

Description of projects area and activity: **This permit verification authorizes 10 linear feet of temporary stream impacts and 149 linear feet of permanent stream impacts to an unnamed tributary of the Little Tennessee River and 0.08 acres of permanent impacts to wetlands associated construction of a stream crossing and road for access to Cell 1 of Phase 3 at the landfill.**

Applicable Law: ☒ Section 404 (Clean Water Act, 33 USC 1344)
☐ Section 10 (Rivers and Harbors Act, 33 USC 403)

Authorization: Regional General Permit Number or Nationwide Permit Number: **NWP 39**
SEE ATTACHED RGP or NWP GENERAL, REGIONAL AND SPECIAL CONDITIONS

Your work is authorized by the above referenced permit provided it is accomplished in strict accordance with the attached conditions and attached information dated January 20, 2015. Any violation of the attached conditions or deviation from your submitted plans may subject the permittee to a stop work order, a restoration order, a Class I administrative penalty, and/or appropriate legal action.

This verification will remain valid until the expiration date identified below unless the nationwide/regional authorization is modified, suspended or revoked. If, prior to the expiration date identified below, the nationwide/regional permit authorization is reissued and/or modified, this verification will remain valid until the expiration date identified below, provided it complies with all requirements of the modified nationwide/regional permit. If the nationwide/regional permit authorization expires or is suspended, revoked, or is modified, such that the activity would no longer comply with the terms and conditions of the nationwide/regional permit, activities which have commenced (i.e., are under construction) or are under contract to commence in reliance upon the nationwide/regional permit, will remain authorized provided the activity is completed within twelve months of the date of the nationwide/regional permit's expiration, modification or revocation, unless discretionary authority has been exercised on a case-by-case basis to modify, suspend or revoke the authorization.

Activities subject to Section 404 (as indicated above) may also require an individual Section 401 Water Quality Certification. You should contact the NC Division of Water Resources (telephone 919-807-6300) to determine Section 401 requirements.

For activities occurring within the twenty coastal counties subject to regulation under the Coastal Area Management Act (CAMA), prior to beginning work you must contact the N.C. Division of Coastal Management.

This Department of the Army verification does not relieve the permittee of the responsibility to obtain any other required Federal, State or local approvals/permits.

If there are any questions regarding this verification, any of the conditions of the Permit, or the Corps of Engineers regulatory program, please contact **David Brown** at **828-271-7980, ext. 232** or **david.w.brown@usace.army.mil**.

Corps Regulatory Official: _____ Date: **February 27, 2015**
David Brown

Expiration Date of Verification: **March 18, 2017**

Determination of Jurisdiction:

A. ☐ Based on preliminary information, there appear to be waters of the US including wetlands within the above described project area. This preliminary determination is not an appealable action under the Regulatory Program Administrative Appeal Process (Reference 33 CFR Part 331).

B. ☐ There are Navigable Waters of the United States within the above described project area subject to the permit requirements of Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act. Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

C. ☐ There are waters of the US and/or wetlands within the above described project area subject to the permit requirements of Section 404 of the Clean Water Act (CWA)(33 USC § 1344). Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

D. ☒ The jurisdictional areas within the above described project area have been identified under a previous action. Please reference jurisdictional determination issued **February 3, 2015**. Action ID: **SAW-2012-01916**.

Basis for Determination:

The site contains wetlands as determined by the *1987 Corps of Engineers Wetland Delineation Manual* and the *Regional Supplement to the Corps of Engineers Wetlands Delineation Manual: Eastern Mountain and Piedmont Region, Version 2.0*. These wetlands are abutting to stream channels located on the property that exhibit indicators of ordinary high water marks and have perennial and intermittent flow. The stream channels on the property are unnamed tributaries (UTs) of the Little Tennessee River and the Little Tennessee River (Lake Emory). The UTs of the Little Tennessee River, relatively permanent waters (RPW), which flow into the Little Tennessee River, traditional navigable water and a section 10 River below the Main Street Bridge in Franklin, NC. The Little Tennessee River flows into the Tennessee River, which drains into the Ohio River then to the Mississippi River before entering the Gulf of Mexico.

Remarks:
The waters of the U.S., at this site, were verified on-site by the Corps on December 9, 2014. The location of the jurisdictional streams and wetlands are as approximately depicted on the Wetland Delineation Map, dated December 18, 2014, submitted by McGill Associates.

E. Attention USDA Program Participants

This delineation/determination has been conducted to identify the limits of Corps' Clean Water Act jurisdiction for the particular site identified in this request. The delineation/determination may not be valid for the wetland conservation provisions of the Food Security Act of 1985. If you or your tenant are USDA Program participants, or anticipate participation in USDA programs, you should request a certified wetland determination from the local office of the Natural Resources Conservation Service, prior to starting work.

F. Appeals Information (This information applies only to approved jurisdictional determinations as indicated in B and C above).

This correspondence constitutes an approved jurisdictional determination for the above described site. If you object to this determination, you may request an administrative appeal under Corps regulations at 33 CFR Part 331. Enclosed you will find a Notification of Appeal Process (NAP) fact sheet and request for appeal (RFA) form. If you request to appeal this determination you must submit a completed RFA form to the following address:

US Army Corps of Engineers
South Atlantic Division
Attn: Jason Steele, Review Officer
60 Forsyth Street SW, Room 10M15
Atlanta, Georgia 30303-8801
Phone: (404) 562-5137

In order for an RFA to be accepted by the Corps, the Corps must determine that it is complete, that it meets the criteria for appeal under 33 CFR part 331.5, and that it has been received by the Division Office within 60 days of the date of the NAP. Should you decide to submit an RFA form, it must be received at the above address by April 4, 2015.

It is not necessary to submit an RFA form to the Division Office if you do not object to the determination in this correspondence.

Corps Regulatory Official: _____

David Brown

Issue Date of JD: **February 3, 2015**

Expiration Date of JD: Five years from *Issue Date*

The Wilmington District is committed to providing the highest level of support to the public. To help us ensure we continue to do so, please complete our Customer Satisfaction Survey, located online at http://regulatory.usacesurvey.com/.

Copy furnished:
McGill Associates, PA, Attn.: John Vilas, 468 New Market Boulevard, Suite B, Boone, NC 28607

Macon County – Solid Waste Department, Attn.: Chris Stahl, 109 Sierra Drive, Franklin, NC 28734

Action ID Number: 2012-01916 County: Macon

Permittee: Macon County / Attn.: Derek Roland

Project Name: Macon County Municipal Solid Waste Landfill – Phase 3, Cell 1

Date Verification Issued: February 27, 2015

Project Manager: David Brown

Upon completion of the activity authorized by this permit and any mitigation required by the permit, sign this certification and return it to the following address:

US ARMY CORPS OF ENGINEERS
WILMINGTON DISTRICT
Attn.: CESAW-RG-A
151 Patton Avenue, Room 208
Asheville, North Carolina 28801-5006

Please note that your permitted activity is subject to a compliance inspection by a U. S. Army Corps of Engineers representative. Failure to comply with any terms or conditions of this authorization may result in the Corps suspending, modifying or revoking the authorization and/or issuing a Class I administrative penalty, or initiating other appropriate legal action.

I hereby certify that the work authorized by the above referenced permit has been completed in accordance with the terms and condition of the said permit, and required mitigation was completed in accordance with the permit conditions.

_____ _____

Signature of Permittee Date

NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL

Applicant: **Macon County / Attn.: Derek Roland**	File Number: **SAW-2012-01916**	Date: **February 27, 2015**

Attached is:	See Section below
☐ INITIAL PROFFERED PERMIT (Standard Permit or Letter of permission)	A
☐ PROFFERED PERMIT (Standard Permit or Letter of permission)	B
☐ PERMIT DENIAL	C
☒ APPROVED JURISDICTIONAL DETERMINATION	D
☐ PRELIMINARY JURISDICTIONAL DETERMINATION	E

SECTION I - The following identifies your rights and options regarding an administrative appeal of the above decision. Additional information may be found at http://www.usace.army.mil/Missions/CivilWorks/RegulatoryProgramandPermits.aspx or Corps regulations at 33 CFR Part 331.

A: INITIAL PROFFERED PERMIT: You may accept or object to the permit.

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- OBJECT: If you object to the permit (Standard or LOP) because of certain terms and conditions therein, you may request that the permit be modified accordingly. You must complete Section II of this form and return the form to the district engineer. Your objections must be received by the district engineer within 60 days of the date of this notice, or you will forfeit your right to appeal the permit in the future. Upon receipt of your letter, the district engineer will evaluate your objections and may: (a) modify the permit to address all of your concerns, (b) modify the permit to address some of your objections, or (c) not modify the permit having determined that the permit should be issued as previously written. After evaluating your objections, the district engineer will send you a proffered permit for your reconsideration, as indicated in Section B below.

B: PROFFERED PERMIT: You may accept or appeal the permit

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- APPEAL: If you choose to decline the proffered permit (Standard or LOP) because of certain terms and conditions therein, you may appeal the declined permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

C: PERMIT DENIAL: You may appeal the denial of a permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

D: APPROVED JURISDICTIONAL DETERMINATION: You may accept or appeal the approved JD or provide new information.

- ACCEPT: You do not need to notify the Corps to accept an approved JD. Failure to notify the Corps within 60 days of the date of this notice, means that you accept the approved JD in its entirety, and waive all rights to appeal the approved JD.
- APPEAL: If you disagree with the approved JD, you may appeal the approved JD under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the district engineer. This form must be received by the division engineer within 60 days of the date of this notice.

E: PRELIMINARY JURISDICTIONAL DETERMINATION: You do not need to respond to the Corps regarding the preliminary JD. The Preliminary JD is not appealable. If you wish, you may request an approved JD (which may be appealed), by contacting the Corps district for further instruction. Also you may provide new information for further consideration by the Corps to reevaluate the JD.

SECTION II - REQUEST FOR APPEAL or OBJECTIONS TO AN INITIAL PROFFERED PERMIT

REASONS FOR APPEAL OR OBJECTIONS: (Describe your reasons for appealing the decision or your objections to an initial proffered permit in clear concise statements. You may attach additional information to this form to clarify where your reasons or objections are addressed in the administrative record.)

ADDITIONAL INFORMATION: The appeal is limited to a review of the administrative record, the Corps memorandum for the record of the appeal conference or meeting, and any supplemental information that the review officer has determined is needed to clarify the administrative record. Neither the appellant nor the Corps may add new information or analyses to the record. However, you may provide additional information to clarify the location of information that is already in the administrative record.

POINT OF CONTACT FOR QUESTIONS OR INFORMATION:

If you have questions regarding this decision and/or the appeal process you may contact: **District Engineer, Wilmington Regulatory Division, Attn.: David Brown** **828-271-7980, ext 232**	If you only have questions regarding the appeal process you may also contact: Mr. Jason Steele, Administrative Appeal Review Officer CESAD-PDO U.S. Army Corps of Engineers, South Atlantic Division 60 Forsyth Street, Room 10M15 Atlanta, Georgia 30303-8801 Phone: (404) 562-5137

RIGHT OF ENTRY: Your signature below grants the right of entry to Corps of Engineers personnel, and any government consultants, to conduct investigations of the project site during the course of the appeal process. You will be provided a 15 day notice of any site investigation, and will have the opportunity to participate in all site investigations.

_____ Signature of appellant or agent.	Date:	Telephone number:

For appeals on Initial Proffered Permits send this form to:

District Engineer, Wilmington Regulatory Division, Attn.: David Brown, 69 Darlington Avenue, Wilmington, North Carolina 28403

For Permit denials, Proffered Permits and approved Jurisdictional Determinations send this form to:

Division Engineer, Commander, U.S. Army Engineer Division, South Atlantic, Attn: Mr. Jason Steele, Administrative Appeal Officer, CESAD-PDO, 60 Forsyth Street, Room 10M15, Atlanta, Georgia 30303-8801
Phone: (404) 562-5137

NCDENR

North Carolina Department of Environment and Natural Resources

FILE

Pat McCrory
Governor

Donald R. van der Vaart
Secretary

March 24, 2015

DWR # 15-0092
Macon County

Macon County
Attn: Derek Roland, County Manager
5 West Main Street
Franklin, NC 28734

Macon County Solid Waste Department
Attn: Chris Stahl
109 Sierra Drive
Franklin, NC 28734

Subject: **APPROVAL OF 401 WATER QUALITY CERTIFICATION**
Macon County Municipal Solid Waste Landfill – Phase 3 Cell 1 Access Road

Dear Mr. Roland & Mr. Stahl:

In accordance with your application dated January 8, 2015, and additional information received via email on March 11, 2015, approval has been granted for the impacts listed in the table below. **This approval requires you to follow the conditions listed in the enclosed certification(s) or general permit and any additional conditions listed below.**

Project impacts are covered by the attached Water Quality General Certification Number 3890 and the conditions listed below. This certification is associated with the use of Nationwide Permit Number 39 once it is issued to you by the U.S. Army Corps of Engineers. Please note that you should obtain or otherwise comply with any other federal, state or local permits before proceeding with your project, including those required by (but not limited to) Erosion and Sediment Control, Water Supply Watershed and Trout Buffer regulations.

IMPACTS APPROVED

The following impacts are hereby approved provided that all of the other specific and general conditions of the Certification, General Permit and/or Buffer Rules are met. No other impacts are approved, including incidental impacts.

Water Quality Regional Operations – Asheville Regional Office
2090 US Hwy 70, Swannanoa, NC 28778
Phone: 828-296-4500 \ FAX: 828-299-7043
Internet: http://portal.ncdenr.org/web/wq/ws
An Equal Opportunity \ Affirmative Action Employer

Type of Impact	Amount Approved Permanent	Amount Approved Temporary
Stream S1 (culvert)	130 (linear feet)	
Stream S2 (rip-rap apron)	19 (linear feet)	
Stream S3 (pump around)		10 (linear feet)
Wetland W1	0.02 (acres)	
Wetland W2	0.06 (acres)	

ADDITIONAL CONDITIONS

1. This approval is for the purpose and design described in your application. The plans and specifications for this project are incorporated by reference as part of the Certification/Authorization. If you change your project, you must notify the Division and you may be required to submit a new application package with the appropriate fee. If the property is sold, the new owner must be given a copy of this approval letter and General Certification(s)/Permit/Authorization and is responsible for complying with all conditions.

2. Upon completion of the culvert at the site, please send upstream and downstream photographs to document correct installation to the North Carolina Division of Water Resources Asheville Regional Office, tim.fox@ncdenr.gov. [15A NCAC 02H .0506 (b)(2)]

This approval and its conditions are final and binding unless contested.

This Certification can be contested as provided in Articles 3 and 4 of General Statute 150B by filing a written petition for an administrative hearing to the Office of Administrative Hearings (hereby known as OAH) **within sixty (60) calendar days.**

A petition form may be obtained from the OAH at http://www.ncoah.com/ or by calling the OAH Clerk's Office at (919) 431-3000 for information. A petition is considered filed when the original and one (1) copy along with any applicable OAH filing fee is received in the OAH during normal office hours (Monday through Friday between 8:00am and 5:00pm, excluding official state holidays).

The petition may be faxed to the OAH at (919) 431-3100, provided the original and one copy of the petition along with any applicable OAH filing fee is received by the OAH within five (5) business days following the faxed transmission.

Mailing address for the OAH:

If sending via US Postal Service:

Office of Administrative Hearings
6714 Mail Service Center
Raleigh, NC 27699-6714

If sending via delivery service (UPS, FedEx, etc):

Office of Administrative Hearings
1711 New Hope Church Road
Raleigh, NC 27609-6285

One (1) copy of the petition must also be served to DENR:

John Evans, General Counsel
Department of Environment and Natural Resources
1601 Mail Service Center
Raleigh, NC 27699-1601

This letter completes the review of the Division under section 401 of the Clean Water Act as described in 15A NCAC .0500. Please contact Tim Fox at 828-296-4664 or tim.fox@ncdenr.gov if you have any questions or concerns.

Sincerely,

G. Landon Davidson, P.G., Regional Supervisor
Water Quality Regional Operations
Asheville Regional Office

Enclosures: GC 3890
Certificate of Completion

cc: DWR ARO 401 files

ec: John Vilas – McGill Associates
David Brown - USACE Asheville Regulatory Field Office
Andrea Leslie - NCWRC

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Section 16: Permit to Construct Drawings

Saved as separate file (DIN 24489)