Tim Jewett

North Carolina
Department of Environment and Natural Resources

Division of Waste Management

Michael F. Easley, Governor
William G. Ross Jr., Secretary
Dexter R. Matthews, Director

September 4, 2003

SCANNED by Carson Johnson 3/2/15

Mr. Michael Plummer, PE
HDR Engineering, Inc.
128 S. Tryon Street, Suite 1400
Charlotte, North Carolina 28202

RE: Revised Design Hydrogeological Report for Phases IV, V, and VI
Old Salisbury Road C&D Landfill, Winston-Salem, N.C.
Forsyth County, N.C. Permit No. 34-~~02~~ 12

Dear Mr. Plummer,

The above referenced revised Report, dated July 31, 2003, has been reviewed for hydrogeologic concerns. There are still a few items that need to be addressed before the hydrogeologic review can be completed. Please respond to the following questions and comments:

Pg 4 The Solid Waste Section generally defines PWR as beginning at blow counts of 100 bpf. This has been the generally accepted definition among the majority of consultants *and* has been the definition used by the Solid Waste Section since the early days of the program. In order to "compare apples to apples" this definition should be used. The Solid Waste Section will not require PWR revisions for this report, but in the future the accepted definition of 100 bbf must be used.

Pg24 Table 2-8: Because of the limited amount of data for the newer piezometers and the fact that the baseline data is from a time of drought of historic proportions, there is still some uncertainty regarding the seasonal high water table estimates. In my last review letter I made several requests for additional water table measurements. The recent revisions did not contain any additional water table data. The Solid Waste Section consistently recommends taking at least monthly water table measurements for all piezometers in the study area from the time of installation until an approval letter is sent.

I am not comfortable with only one or two sets of water table measurements for the newer piezometers. If additional water table measurements have been taken, please forward a copy of the data to me immediately. If additional measurements have not been made, then measurements for all the piezometers in the study area should be made as soon as possible. Also, if so much emphasis is to be given to the off-site USGS well in the evaluation of seasonal high water table, then detailed documentation needs to be provided for this well, including location, total depth, screen interval, formation materials, aspect, etc.

Pg25 Table 2-9: I was not able to duplicate the Kh or Vs values for the Transition Zone. How were these values generated?

Drawing D-02 Ground-Water Potentiometric Map - March 4, 2003: The water table elevation for PZ-33 is still incorrect. Additional water table readings may clarify some anomalies, especially for the piezometers having only one or two water table readings.

Drawing D-02A Estimated Long-Term Seasonal High Ground-Water Potentiometric Map: Because of the significant topographic relief, limited boring density, and limited water table data for the newer piezometers, there is still some concern about the seasonal high water table estimates.

Drawing C-05 Existing And Proposed Ground-Water and Methane Monitoring Well Locations: Proposed well MW-9 is on the top of a knoll and would not appear to provide meaningful data. There are not enough wells in this area to provide sufficient detail of ground-water flow, however one would assume with the ridge lines and knoll that there would be some divergence of ground-water flow. Proposed well MW-9 needs to be relocated and/or possibly replaced with two wells in better locations. Although the scale makes it somewhat difficult to interpret, it appears that the locations of proposed wells MW-12 and MW-13 still need to be slightly adjusted to ensure they are in the mouth of the drainage features. Proposed well MW-11 really should be located at the mouth of the large drainage feature. Is it possible to reconfigure the design of the sediment basin to enable the proper location for well MW-11?

Drawing C-02 Excavation Plan: There are still some concerns about adequate vertical separation. In a couple of areas there is apparently only 3 to 5 feet of separation from the seasonal high water table. There is a possible problem with rock at the B-19 location. And the outlets for Sedimentation Basins #6 and #7 are still shown to be at or below the seasonal high water table. The piezometer and boring locations need to appear on this drawing.

Figure-1 Wetland Delineation Map: This Map is still confusing. Although I think I was finally able to get oriented for the upper diagram, I have still not been able to figure out the lower diagram. Could some directions or points of reference be added that would help?

There are still some important items requiring further evaluation that affect vertical separation issues and ground-water monitoring. If you have any questions about this letter, we can discuss them at our meeting scheduled for next week or you may call me at (919) 733-0692, extension 258.

Sincerely,

Bobby Lutfy

Bobby Lutfy
Hydrogeologist
Solid Waste Section

cc: Jim Barber, Solid Waste Section
Tim Jewett, Solid Waste Section
Wendy Simmons, SWS Winston-Salem
Ed Gibson, City of Winston-Salem

RECEIVED
N.C. Dept. of EHNR
JUN 02 2003
Winston-Salem
Regional Office

Tim Jewett

North Carolina
Department of Environment and Natural Resources

Division of Waste Management

Michael F. Easley, Governor
William G. Ross Jr., Secretary
Dexter R. Matthews, Director

NCDENR

May 28, 2003

SCANNED
3/3/15 Carmen Johnson

Mr. Michael Plummer, PE
HDR Engineering, Inc.
128 S. Tryon Street, Suite 1400
Charlotte, North Carolina 28202

RE: Revised Design Hydrogeological Report for Phases IV, V, and VI
Old Salisbury Road C&D Landfill, Winston-Salem, N.C.
Forsyth County, N.C. Permit No. 34-~~02~~ 12

Dear Mr. Plummer,

The above referenced revised Report, submitted this past month, has been reviewed for hydrogeologic concerns. There are several remaining items that need to be addressed before the hydrogeologic review can be completed. Please respond to the following questions and comments:

Pg 2 According to Drawing D-01, topography at the site ranges from about 722 to 852 feet.

Pg 4 The Solid Waste Section generally defines PWR as beginning at blow counts of 100 bpf.

Pg 5 The Core Location reference should be to PZ-32A.

Pg 6 The two deeper sample locations for locations B-26 and B-31 should also be described as saprolite. The "effective porosity" estimations for the finer grained upper soils at location B-31A are actually out of the range that can be quantified on the Textual Classification Triangle, but would be estimated at about 2. Since these two samples are from silts with some plasticity that are not representative of the silty sand saprolite unit that characterizes most of the site, these values should not be averaged with the others in calculating an average effective porosity value for this unit. (This would change the Effective Porosity value on Table 2-3.)

Pg 6 There do not appear to be any distinct representative samples for the PWR Transition Zone, as defined by the Solid Waste Section, however based upon the discussion in the Report, one would assume the PWR to have similar characteristics to that of the predominantly silty sand saprolite. Thus it would appear the shallow fine-grained silts would have an average effective porosity of about 2, the silty sand saprolite and transition zone materials that are predominant at the site would have an average effective porosity of about 18, and the assumed secondary porosity for the bedrock would be 2.

Pg 7 The slug test reference should be to Table 2-3. PZ-33 is referenced as Transition Zone in the text, but Saprolite in Table 2-3. Since this boring was done with an air hammer, without testing, there is no way to really know if the screened interval is in Saprolite or PWR. Some of the Aquifer Unit references in Table 2-3 do not match the descriptions in the boring logs. This could make it necessary to recalculate the average hydraulic conductivities for the different aquifer units.

Pg 8 On Table 2-2, the Percent Fines for the last three samples (PZ-31A and PZ-32A) are incorrect. According to the boring log descriptions, all Geologic Units should be Saprolite.

Pg 9 On Table 2-3, the Aquifer Unit for PZ-22A should be Transition Zone. The upper part of the screened interval for PZ-31A is Saprolite and the lower part is Transition Zone. Because an air hammer was used for PZ-33 the Aquifer Unit is uncertain. As previously referenced, the Effective Porosity value needs to be recalculated.

Pg10 It appears that the reference in the last sentence of the first paragraph should be to Table 2-4 on Page 12.

Pg12 On Table 2-4, it appears the Date Installed is incorrect for Piezometers PZ-18A, PZ-32a, and MW2R. The Total Depth for Piezometer B-31 is incorrect. The upper Sand Pack Elevation for MW-6R is incorrect.

Pg13 It is not clear how the average sand, silt, and clay contents were calculated. As previously referenced, some of the percent fines on Table 2-2 are incorrect *and* the values for the three fine-grained samples are not representative of the predominant silty sands that cover most of the site.

Pg14 The references in the first two paragraphs of Page 14 should be to Table 2-2. I was not able to locate the documentation for the Total Porosity values referenced for PZ-29 and PZ-31.

Pg17 The beginning of paragraph one should reference Table 2-5. The beginning of paragraph two should reference Table 2-6.

Pg18 The 24-Hour Water Level for PZ-32A in Table 2-5 does not appear to match the level on the Boring Log.

Pg20 For Table 2-6, the AVERAGE for B-13 is incorrect. The MAX and DIFF values are incorrect for the following locations: B-15-A, B-15-B, B-16-A, B-16-B, B-21-A, and B-21-B.

Pg21 The reference in the last paragraph should be to Table 2-7.

Pg23 The reference in the last sentence should be to Table 2-8.

Pg24 Table 2-8: Because of the limited amount of data for the newer piezometers and the fact that the baseline data is from a time of drought of historic proportions, there is still some uncertainty regarding the seasonal high water table estimates. It may help to have another round of measurements taken, since this has been a wet spring.

Pg25 The reference in the second paragraph should be to Table 2-9 on page 25. Table 2-9: As previously referenced, the Kn and Pe values need to be recalculated for each hydrogeologic unit. Why is the Hydraulic Gradient value different from that presented in the previous Table? The headers for the last two columns appear to be reversed.

Pg26 The reference in the first line of the second paragraph should be to Table 2-10. Table 2-10: According to Table 2-6, the March 2003 Ground-Water Elevation for PZ-21A should be 742.**2**3. According to the boring logs, it appears the Screen Separation should be 14.71 (or 14.70 according to Table 2-4).

Pgs 28-30 Some of the values referenced in the Summary will need to be modified, based upon the comments and questions raised above.

Pg30 The reference at the bottom of the page should be to Drawing D-02**A**.

Drawing D-02 Ground-Water Potentiometric Map - March 4, 2003: The water table elevation for PZ-33 is incorrect. The ground-water contour in the vicinity of PZ-29 is incorrect. Several of the contours need to be adjusted in order to make them more proportional to the data presented. Additional water table readings may clarify some anomalies, especially for the piezometers having only one or two water table readings.

Drawing D-02A Estimated Long-Term Seasonal High Ground-Water Potentiometric Map: Because of the significant topographic relief and limited boring density, it appears that the ground-water contours are somewhat distorted. Additional water table readings for the newer piezometers may provide some clarification. Perhaps using topography more in the interpretation of the data will help. One would expect the knoll around PZ-18A to have a more significant effect on the water table. The seasonal high readings have been estimated in a way that may exaggerate the apparent anomalies.

Drawing C-05 Existing And Proposed Ground-Water and Methane Monitoring Well Locations: Proposed well MW-9 is on the top of a knoll and would not appear to provide meaningful data. The proposed wells, MW-11, MW-12, and MW-13, should each be moved further North into the mouth of the drainage features. For shallow wells the sand pack should extend no more than one foot above the top of the screen in order to ensure a good seal that will prevent surface water infiltrating the well. (The top of the well screen should be no shallower than five feet below ground surface and the top of the sand pack should be no shallower than four feet below ground surface.)

Drawing C-02 Excavation Plan: As discussed on numerous previous occasions, because of the relatively sparse boring density inside the proposed expansion footprint and the significant topographic relief, excavation depths should be planned very conservatively. This is further necessary due to some remaining uncertainty regarding representative seasonal high water table conditions. For much of the proposed excavation area there is apparently only 3 to 5 feet of separation from the seasonal high water table. This does not appear very conservative given the conditions at the site. The outlets for Sedimentation Basins #6 and #7 are shown to be significantly below the seasonal high water table.

Figure-1 Wetland Delineation Map: This Map is confusing. It is difficult to get oriented, contour lines do not match, etc.

There are still some important items requiring further evaluation that affect vertical separation issues and ground-water monitoring. If you have any questions about this letter or would like to arrange a meeting to discuss these issues, please contact me at (919) 733-0692, extension 258.

Sincerely,

Bobby Lutfy

Bobby Lutfy
Hydrogeologist
Solid Waste Section

cc: Jim Barber, Solid Waste Section
Tim Jewett, Solid Waste Section
Wendy Simmons, SWS Winston-Salem
Ed Gibson, City of Winston-Salem

Old Salisbury Road
Construction and Demolition Landfill
Winston-Salem, North Carolina

Construction Permit Application
Phases IV, V and VI

SCANNED 3/2/15

APPROVED
DIVISION OF WASTE MANAGEMENT
SOLID WASTE SECTION
DATE 5/28/2004 BY
PERMIT #34-12
RALEIGH CENTRA FILE COPY

October 2002
Revised April 2003
Revised December 2003

HDR Project No. 00162-525-018

Prepared for:

City/County Utility Commission
City of Winston-Salem
P.O. Box 2511
Winston-Salem, North Carolina 27102

Prepared by:

HDR Engineering, Inc. of the Carolinas
128 South Tryon Street, Suite 1400
Charlotte, North Carolina 28202

NCDENR
North Carolina Department of Environment and Natural Resources

Dexter R. Matthews, Director | Division of Waste Management | Michael F. Easley, Governor
William G. Ross Jr., Secretary

December 12, 2003

RECEIVED
N.C. Dept. of ENR
DEC 16 2003
Winston-Salem
Regional Office

MEMORANDUM

To: Tim Jewett

From: Bobby Lutfy BL

RE: Old Salisbury Road C&D Landfill
Winston-Salem, North Carolina
Design Hydrogeological Investigation Report
for Phases IV, V, and VI
Permit Number 34-~~02~~ 12

The Design Hydrogeological Investigation Report for Phases IV, V, and VI of the Old Salisbury Road C&D Landfill was submitted by HDR Engineering, Inc. on behalf of the City of Winston-Salem in September, 2002. Further revisions to the report were received in April 2003, July 2003, and December 2003. With these revisions, including the most recent revisions of December 2, 2003, this report now meets the hydrogeologic requirements of the current rules and policies of the Solid Waste Section.

CC: Jim Barber Solid Waste Section
Wendy Simmons SWS Winston-Salem

1646 Mail Service Center, Raleigh, North Carolina 27699-1646
Phone 919-733-4996 \ FAX 919-715-3605 \ Internet http://wastenotnc.org
An Equal Opportunity / Affirmative Action Employer – Printed on Dual Purpose Recycled Paper

April 14, 2003

Mr. Timothy A. Jewett
Western Area Engineer
North Carolina Department of
Environment and Natural Resources
Division of Solid Waste Management
Solid Waste Section
585 Waughtown Street
Winston-Salem, NC 28107-2241

Re: Old Salisbury Road C&D Landfill
Construction Permit Application
Phases IV, V, and VI
HDR Project No. 00162-525-018

Dear Mr. Jewett:

On behalf of the Winston-Salem City/County Utility Commission, HDR Engineering, Inc. of the Carolinas is submitting this response letter to the North Carolina Department of Environment and Natural Resources (NCDENR) comment letter dated November 6, 2002. Comments are based on HDR's Design Hydrogeological Investigation Report submitted on September 6, 2002. This package should be incorporated into the Construction Permit Application for the OSR Phase IV, V, and VI expansion, dated October 2002.

The following items are to be placed into or exchanged with existing information:

- **Replace** inside cover sheet.
- **Replace** Appendix C in its entirety with the April 2003 revised Design Hydrogeological Investigation Report.
- **Insert** in Appendix E the US Corp. approved and signed drawing for the Wetland Delineation.
- **Insert** in Appendix G the "Supplemental Revisions to Revised Ground-water Monitoring Plan" letter.
- **Replace** the revised Drawing C-02 – *Excavation Plan* in the Drawing Appendix.

HDR Engineering, Inc. of the Carolinas

128 S Tryon Street
Suite 1400
Charlotte, NC 28202-5004

Phone: (704) 338-6700
Fax: (704) 338-6760
www.hdrinc.com

If you have any questions regarding this submittal, please do not hesitate to contact me.

Sincerely,

HDR Engineering, Inc. of the Carolinas

Michael D. Plummer, P.E.
Project Engineer

MDP/jvd

Enclosures

cc: Bobby Lufty, NCDENR
Edward Gibson, P.E., w/enclosures (4 sets)

October 22, 2002

Mr. Timothy A. Jewett
Western Area Engineer
North Carolina Department of
Environment and Natural Resources
Division of Solid Waste Management
Solid Waste Section
585 Waughtown Street
Winston-Salem, NC 28107-2241

Re: Old Salisbury Road C&D Landfill
Construction Permit Application
Phases IV, V, and VI
HDR Project No. 00162-525-018

Dear Mr. Jewett:

On behalf of the Winston-Salem City/County Utility Commission, HDR Engineering, Inc. of the Carolinas is pleased to submit the Construction Permit Application for Phases IV, V, and VI of the Old Salisbury Road Construction and Demolition Landfill. Enclosed is one copy of the Construction Plan Application for your review. When your review is completed, we will forward additional copies of the Construction Permit Application for section approval and processing.

If you have any questions regarding this submittal, please do not hesitate to contact me.

Sincerely,

HDR Engineering, Inc. of the Carolinas

Michael D. Plummer, P.E.
Project Engineer

MDP/jvd

Enclosure

cc: Edward Gibson, P.E., w/enclosures (4 sets)

128 S Tryon Street
Suite 1400
Charlotte, NC 28202-5004

Phone: (704) 338-6700
Fax: (704) 338-6760
www.hdrinc.com

Old Salisbury Road C&D Landfill

Winston-Salem, North Carolina

Construction Permit Application

for Phases IV, V, and VI

October 2002

HDR Project No: 00162-525-018

HDR Engineering, Inc. of the Carolinas
128 South Tryon Street, Suite 1400
Charlotte, North Carolina 28202

Note: See Large Drawings at end of file.

TABLE OF CONTENTS

Winston-Salem C&D Landfill
Construction Plan Application
Phases IV, V, and VI

Page

SECTION 1 – INTRODUCTION 1

1.1 Background Information 1
1.2 Regulatory History 1
1.3 Deed/Legal Description 2
1.4 Responsible Party 2
1.5 Lifetime of the Site 3
1.6 Projected Use After Closure 3

SECTION 2 – ENGINEERING AND DESIGN 4

2.1 Existing Features 4
2.2 Facility Design 4
2.3 Grading Plan 5
2.4 Earthwork and Landfill Life Calculations 5
2.5 Cross-Sections 5
2.6 Ground-Water Monitoring 8
2.7 Methane Gas Monitoring 8
2.8 Erosion Control 9

SECTION 3 – CONSTRUCTION AND OPERATIONS 11

3.1 Construction and Operations 11
3.2 Progression of Fill 12
3.3 Site Development/Proposed Final Contours 12

APPENDICES

A. Related Correspondence

Permit to Operate a C&DLF, April 25, 2001
Permit to Construct a C&DLF, August 2, 2000
Permit to Operate a C&DLF, October 15, 1999
Permit to Construct a C&DLF, October 15, 1999
Letter to Bobby Lutfy, NCDENR, Div. of Solid Waste Management, March 8, 1999
Permit to Operate a C&DLF, August 13, 1998
Permit to Operate a C&DLF, July 3, 1996
Permit to Construct and Operate a C&DLF, November 9, 1995
Property Deeds

B. Calculations

Airspace Calculations

C. Design Hydrogeological Investigation Report

D. Erosion Control

Erosion Control Plan and Approval Letter, for Phases IV, V, and VI

E. Wetland Delineation

Wetland Delineation Approval Letter

F. Operation Plan

G. Ground-Water Monitoring Plan

Supplemental Revisions, July 19, 2002
Ground-Water Monitoring Plan Letter, October 8, 1999
Supplemental Revisions, August 19, 1999
Revised Ground-Water Monitoring Plan, January 1996

LIST OF TABLES

Table 1 Construction and Demolition Landfill Projected Operations

LIST OF FIGURES

Figure A C&D Tonnage History

LIST OF DRAWINGS

C-1 Overall Site Plan

C-2 Excavation Plan

C-3 Phases IV, V, and VI Proposed Final Grades

C-4 Cross-Sections

C-5 Existing and Proposed Groundwater Monitoring Well Locations

C-6 Proposed Final Grades

SECTION 1 – INTRODUCTION

1.1 Background Information

The City/County Utility Commission of Forsyth County and Winston-Salem, North Carolina, (Winston-Salem) is proposing to permit and construct Phases IV, V, and VI of the Old Salisbury Road Construction and Demolition Debris Landfill (C&DLF) in southern Forsyth County, North Carolina. The site lies west of Old Salisbury Road (SR 3011) and north of Friedberg Road (SR 3132) at the Forsyth/Davidson County Line.

The entire property consists of approximately 140 acres. At this time, a permit is being pursued for approximately 25 acres.

The information contained in this submittal is intended to fulfill the requirements of North Carolina Solid Waste Management Rule 15A NCAC 13B .0504 (2) of the Construction Plan Application for the construction of Phases IV, V, and VI.

1.2 Regulatory History

The Site Plan Application was submitted to the North Carolina Department of Environment and Natural Resources (NCDENR) for review on April 6, 1995, and approved August 8, 1995. Following approval, Permit No. 34-12 was issued to Construct and Operate the C&DLF. The Construction Plan Application for Phase I was submitted to NCDENR on June 26, 1995, and approved on November 9, 1995. On July 3, 1996, Permit No. 34-12 was reissued as a Permit to Operate a C&DLF. Five subsequent subcells of Phase I were submitted and certified. After each subcell was certified, the Permit to Operate was modified and reissued. A Construction Plan Application for Phases II and III was submitted to NCDENR on April 14, 1999. The Permit to Construct Phase II was issued on October 15, 1999. A modified Construction Plan Application for Phases II and III was submitted to NCDENR on April 17, 2000. NCDENR issued a Permit to Construct for Phase III on August 2, 2000. Phase II was certified in two subcells. NCDENR issued the Permit to Operate after each certification. The Permit to Operate dated April 25, 2001, was issued after subcell number 8 (Phase III) was certified. These permits can be found in Appendix A.

The following are the subcell numbers and the corresponding date each were certified.

Phase	Subcell No.	Certification Date
Phase 1	1	June 28, 1996
Phase 1	2	June 26, 1997
Phase 1	3	November 18, 1997, revised January 12, 1998
Phase 1	4	April 1, 1998
Phase 1	5	July 30, 1998
Phase 1	6	May 11, 1999
Phase II	7	December 30, 1999
Phase II and III	8	February 1, 2001

1.3 Deed/Legal Description

The landfill site is comprised of one property. A copy of the deed with a legal description of the property is included in Appendix A. Following the Phase I Construction Plan Application submittal, Winston-Salem acquired a property adjacent to the northwest boundary of the existing site. This property is not intended for C&D disposal; however, the property may be used for stockpiling soil from excavation of the proposed phases.

1.4 Responsible Party

The individual responsible for the operation and maintenance of the site is the Solid Waste Administrator for Winston-Salem. The current individual is:

Edward Gibson, PE
Solid Waste Administrator
P.O. Box 2511
Winston-Salem, NC 27102
(336) 727-8418

The site currently has a lockable gate at the main entrance from Old Salisbury Road, which is locked at the end of each working day. Fencing has been constructed around the site to further control access.

1.5 Lifetime of the Site

It is expected that full development of the site will allow usage as a C&DLF for the next 12 to 15 years. The lifetimes are based on projected waste disposal rate for the site of 105,000 tons per year. This waste disposal rate is based on historical acceptance rates for the site and the City's knowledge of factors affecting their waste stream. Phases IV, V, and VI are estimated to have a waste capacity of 979,000 cubic yards (cy) and is expected to be operational for approximately five years.

1.6 Projected Use After Closure

After closure of Phases IV, V, and VI and final closure of the entire landfill, the site will be maintained and monitored. No post-closure uses have been identified or are planned for the site at this time.

SECTION 2 – ENGINEERING AND DESIGN

2.1 Existing Features

A topographic map of the existing features of the site can be found on Drawing C-1. This drawing uses topography compiled by photogrammetric methods by Cartographic Aerial Mapping, dated September 29, 2001 for Phases I, II, and III areas and for the remainder of the site dated April 2, 1999. An entrance road with scale and scalehouse has been constructed to serve the site.

The United States Geological Survey (USGS) quadrangles for the property, Winston-Salem West, North Carolina, and Welcome, North Carolina, identify one stream located on the eastern edge of the property. The property is located on a ridge with drainage swales extending in several directions.

2.2 Facility Design

The overall C&DLF is designed to operate as a series of phases and subcells. Phases I, II, and III were developed as a series of subcells. Phases IV, V, and VI shall be developed in the same fashion with Phase IV being developed first, Phase V second and Phase VI last.

This site is required to maintain the following regulatory buffers:

- 200-foot buffer between property line and waste (per Solid Waste Section Policy memo).
- 500-foot buffer from private dwellings and wells to waste.
- 50-foot buffer from streams and rivers to waste.

The site is also required by the unified development ordinance to maintain a 200-foot buffer from all property lines to waste. The area within the first 100 feet from the property line is to remain undisturbed. Several private dwellings and two groundwater wells are located on the western edge of the property. These buffer requirements are currently being met and are shown on Drawing C-1.

2.3 Grading Plan

The proposed excavation plan for Phases IV, V, and VI can be found on Drawing C-2. These basegrades were determined from the estimated seasonal high groundwater surface. Drawing C-2 depicts the seasonal high potentiometric surface based on data compiled by HDR. The subgrade for the proposed phases is positioned such that it is at least 14 feet above the June 20, 2002 potentiometric lines depicted on HDR's drawing D-2 located in the Design Hydrogeological Investigation Report Appendix. The seasonal high groundwater levels may be as much as 10 feet above the potentiometric levels shown on this drawing. The additional 4 feet of separation complies with the minimum regulatory separation from the seasonal high water table.

The original excavation plan submitted with the Site Plan Application was revised to optimize the use of the site. The revised Excavation Plan, Drawing C-2, complies with the horizontal and vertical separation requirements. The vertical separation of groundwater and the proposed base grade of each phase can be seen on Drawing C-4.

2.4 Earthwork and Landfill Life Calculations

Phase IV, V, and VI development of the site is expected to have a combined operational life of approximately five years. The estimated waste volume of the phases is approximately 979,000 cubic yards. The estimated soil required for operational cover is approximately 98,000 cubic yards. Earthwork calculations and landfill life calculations can be found in Appendix B. Detailed information regarding Phases IV, V, and VI can be found on the following page. The estimated life assumes 105,000 tons per year. A graph of the tonnage history for C&D disposal in Winston-Salem can be found on the following page. The graph shows the monthly waste stream tonnage and a rolling 12-month waste stream average. Based on the City of Winston-Salem's knowledge of the waste stream, the acceptance rate is anticipated to remain constant at 105,000 tons per year.

2.5 Cross-Sections

Cross sections of each phase can be found on Drawing C-4. There are two cross sections for each operational area as required by .0504(2)(f).

TABLE 1

Construction and Demolition Landfill
Projected Operations

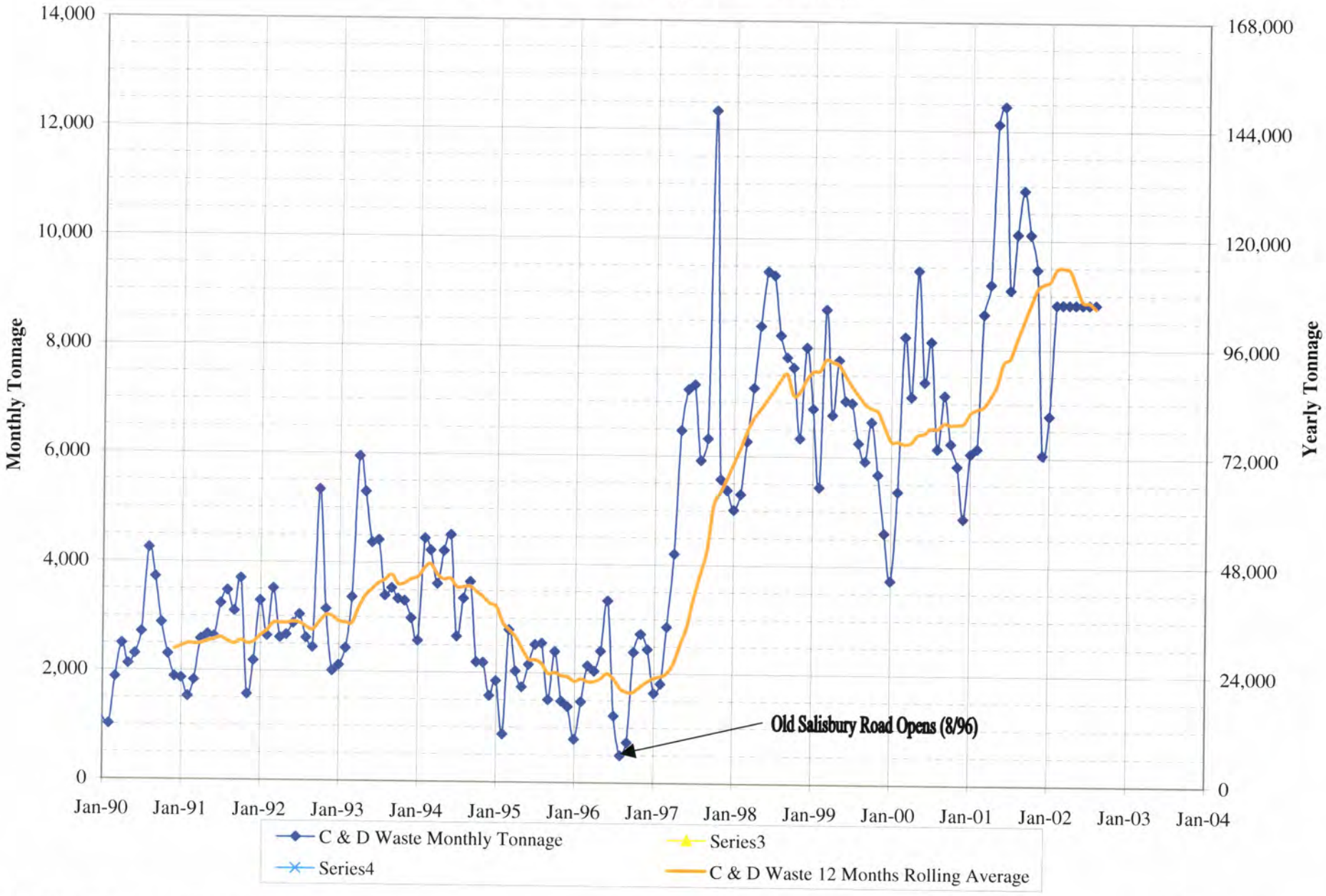
Phase	Area (acres)	Volume Excavated (cy)	Gross Capacity (cy)	Estimated Volume		Final Cover Soil (cy)	Excess Soil (cy)	Estimated	
				Waste (cy)	Cover Soil (cy)			Fill Rate (tpy)	Life (years)
IV	11	372,658	517,485	438,000	44,000	35,000	293,658	105,000	2.3
V	4	271,027	225,642	194,000	19,000	13,000	239,027	105,000	1.0
VI	10	457,088	415,033	347,000	35,000	33,000	389,088	105,000	1.8
Total	25	1,100,773	1,158,160	979,000	98,000	81,000	921,773	105,000	5.1

NOTES:

Volumes are based on the Phase IV, V, and VI cap shown on Drawing C-3 Proposed Final Grade
10 :1 waste to cover ratio assumed for both scenarios
2 ft Final Cover (allocated by phase, not area at final grades)
1,000 lb/cy effective waste density (average density over from 8/96 to 9/01)
Volume excavated assumes a 3:1 cut slope at phase line
Gross Capacity assumes 3:1 slopes on all faces
Phase I opened August of 1996
73,015 tons - Average since opening until 12/31/2001
110,400 tpy - 12 month rolling average ending in December 2001
105,000 tpy - Average fill rate to achieve stated life(Based on the City of Winston-Salem's knowledge of their waste stream)

Figure A

C&D Tonnage History



2.6 Ground-Water Monitoring

A Ground-Water Monitoring Plan was originally prepared and submitted by S&ME, Inc. (April 11, 1995). The plan was based on a conceptual layout of Phase I and required modification based on the revised drawings contained herewith. A revised plan was prepared by HDR in January 1996 and amended in August 1999. This plan is currently being used for ground-water monitoring events.

Two existing monitoring wells, MW-3 and MW-6, were located in the proposed footprints of Phases II and III. Two replacement wells, MW-3R and MW-6R, shown on Drawing C-5, were installed in July 1999 to replace MW-3 and MW-6. MW-3R is located south of Sediment Basin (SB) #4 and outside the Phase II footprint. MW-6R is located east of the Phase III footprint. In addition, MW-8 has been installed adjacent to the northwestern boundary of Phase III near SB #5, as shown on Drawing C-5. HDR submitted a request on March 8, 1999, to NCDENR Division of Solid Waste Management to modify the existing ground-water monitoring plan by replacing MW-3 and MW-6 and adding MW-8. Correspondence with NCDENR can be found in Appendix A.

Conceptual monitoring well locations for the long-term development plan of the C&DLF are shown on Drawing C-5. Proposed monitoring wells MW-9 and MW-10 would serve as down gradient monitoring locations for Phases IV and V. During development of Phase VI, it is anticipated that monitoring wells MW-6R, MW-21A, and MW-21B will need to be abandoned and replaced with MW-6RR as a down gradient monitoring well located adjacent to SB #7. Proposed monitoring well MW-6RR and existing wells PZ-27 and PZ-29 would be down gradient monitoring wells for Phase VI.

2.7 Methane Gas Monitoring

Methane monitoring probes were installed in August 1999. These probes are periodically sampled. The last sampling event was in April 2002. Currently, the site is in compliance with methane gas levels. Refer to Drawings C-5 for the locations of methane gas monitoring probes.

2.8 Erosion Control

A history of Erosion Control Plans for the site is listed below.

Title	Submitted	Approved
Phase I and Entrance Road	2/95 revised 3-16-95	3-30-95
Cell 1A Stockpile	2-9-96	2-21-96
Modified Cell 1A Stockpile	9-10-97	10-9-97
North Stockpile	11-12-97	11-25-97
Modified North Stockpile	11-10-98	11-23-98
Off-Site Stockpile	3-24-99	1-7-00
Phases II and III Expansion	5-6-99	12-1-99
Phases IV, V, and VI Expansion	7-15-02	8-22-02

The Phase I and Entrance Road Erosion Control Plan was for the Entrance Road to the site and a portion of Phase I. The Cell 1A stockpile Erosion Control Plan was for the stockpile material from excavation of Cell 1 of Phase I located directly north of Phase I. The modified Cell 1A stockpile was for an additional 1-acre stockpile on the northeast corner of the Cell 1A stockpile. These measures have been eliminated since the stockpile has been moved due to Phase I development and excavation of Phase II to meet cover requirements. The North Stockpile Erosion Control Plan was for an additional stockpile for Phase I excavation located north of the Cell 1A stockpile. This stockpile covered most of Phase III and part of Phase IV. The Modified North Stockpile Erosion Control Plan provides erosion control for Phase II. This modification replaced Sediment Trap #1 (TST #1) in the North Stockpile Erosion Control Plan with SB #4. This new SB #4 is designed to handle runoff from Phase II during excavation and also runoff from Phase II and a portion of Phase III after closure of the two phases. An erosion control plan for 12 acres of the off-site stockpile property was approved, which covered the material excavated from Phase III. An Erosion Control Plan for SB #5 was submitted and approved. SB#5 was designed to handle the runoff from Phases II and III before closure and Phases III and IV after closure. The Erosion Control Plan for Phases IV, V, and VI was approved on August 22, 2002. This erosion control plan contains the designs for SB#6 and SB#7 to handle runoff from Phases IV, V, and VI from the start of construction to the closure of the C&DLF. A system of sideslope diversion channels, slope drains, and perimeter channels are designed to convey the runoff to the sediment basins. Please refer to Drawing ES-03 for the existing and proposed erosion control devices. With these

erosion control plans in place, the site will comply with the Sedimentation Pollution Control Act.

According to the NCDENR, Division of Water Quality (DWQ), a National Pollutant Discharge Elimination System (NPDES) General Permit is appropriate for landfills. The Permit is modified and issued by DWQ when an erosion control plan is approved.

Storm water runoff will be directed around the waste and collected in the erosion control structures (sediment basins). The erosion control structures will discharge into the natural drainage features and are located at the lowest point of each phase.

SECTION 3 – CONSTRUCTION AND OPERATIONS

3.1 Construction and Operations

The initial work will involve installation of the erosion control devices for the Phases IV, V, and VI area, followed by excavation and removal of soils. Excavation for the phases will be done by either city forces, a contractor, or a combination of both. It is anticipated that the bulk of the excess excavated material will be hauled off site pending approval of a Mining Permit.

Excavation of an on-site stockpile located in the Phase IV area has begun in order to meet cover requirements for the current landfill operations. As excavation continues, the excavation area will expand into the future Phases V and VI to meet operational cover requirements. Phase IV will be excavated initially and certified with the excavation of Phases V and VI to follow. In order to minimize the amount of water which comes in contact with the waste, diversions may be installed to route the surface water runoff around the active area to the sediment basins. Monitoring of the excavation will be performed to ensure excavation does not exceed the proposed base grade of the future phases.

All aspects of the current operation of the facility are anticipated to continue. Operation hours are from 7:00 a.m. to 5:00 p.m. Monday through Friday, with Saturday hours from 8:00 a.m. to 4:00 p.m. Staff will be stationed in the scalehouse to handle incoming trucks, while an additional staff person will be responsible for handling the daily placement of waste. Information regarding on-site equipment and other operational issues is included in the Operations Plan, Appendix F.

In the event there is a period when the scales are temporarily out of operation, the incoming material will be handled on a cubic-yardage basis. The same scales and scale house will continue to be used for Phases IV, V, and VI. Please refer to the Operation Plan in Appendix F for more information on the contingency of the facility.

3.2 Progression of Fill

Phases IV, V, and VI are anticipated to be developed as complete phases. Once a phase is excavated to base grade, it will be certified prior to waste placement. Excavation and filling will begin in the southern corner of Phases IV, V, and VI, progressing north to the northern edge of the phases. Once a lift is in place, filling will begin again on an adjacent lift along the southern edge of the phase and progress towards the northern edge of the phase. Positive drainage will be maintained to the sediment basins. This fill pattern will continue across both phases with lifts being placed over existing lifts as space allows. The excavated soil will be used as cover material for the previous phase, stockpiled, or hauled off site.

3.3 Site Development/Proposed Final Contours

An overall Master Plan of the site was developed by HDR in July 1998. Please refer to Drawing C-6 for the proposed final contours for the entire site. The remaining development will consist of vertical expansions to achieve the Master Plan final contours. No post-closure uses have been identified or planned for the site at this time.

APPENDIX A

RELATED CORRESPONDENCE

North Carolina
Department of Environment and Natural Resources

Division of Waste Management

Michael F. Easley, Governor
William G. Ross Jr., Secretary
William L. Meyer, Director

NCDENR

April 25, 2001

RECEIVED
HDR E... OF THE CAROLINAS, INC

Mr. Dave Saunders, Utilities Supervisor
City of Winston-Salem
P.O. Box 2511
Winston-Salem, North Carolina 27102

Re: Solid Waste Permit No. 34-12: Phase III Permit to Operate (PTO), for the City of Winston-Salem C&D Landfill on Old Salisbury Road, Winston-Salem, Forsyth County, North Carolina

Dear Mr. Saunders:

The above referenced PERMIT TO OPERATE is issued in accordance with N.C.G.S. 130A-294 and the N.C. Solid Waste Management Rules 15A NCAC 13B. The revisions to the Construction Plan Application, Phase II & III submitted to the Section, dated 17 April 2000 by Eric Wright of HDR, will be listed in Attachment 1 as item #12 and is included in the Approved Plans for this facility. This permit amendment is to add Phase III into the operations permit (Phase I & II already included).

Please refer to the Conditions of the Permit, GENERAL section, for the definition of the approved plan and for general terms of the Solid Waste Permit. The CONSTRUCTION AND OPERATION conditions describe permitted fill areas, acceptable waste types, landfill operation, and requirements which must be satisfied prior to operation of the facility as a C&D landfill. Specific requirements for groundwater monitoring and facility record keeping and reporting are described in the MONITORING AND REPORTING conditions.

Please review the Conditions of Permit thoroughly. If you need further clarification, please contact me at (336) 771-4608 ext. 204 or Ms. Wendy Simmons, the Waste Management Specialist for this area, at (336) 771-4608 ext. 208.

Sincerely,

Timothy A. Jewett
Western Area Engineer
Solid Waste Section

cc: Jim Coffey, SWS
Brent Rockett, SWS
Wendy Simmons, SWS
Michael D. Plummer, HDR Engineering, Inc.
Raleigh Central File: Forsyth County, Permit No. 34-12

North Carolina
Department of Environment and Natural Resources

Division of Waste Management

Michael F. Easley, Governor
William G. Ross Jr., Secretary
William L. Meyer, Director

PERMIT NUMBER 34-12
PHASE I PERMIT ISSUED 3 JULY 1996 (PTO)
AMENDMENT 1: 15 OCTOBER 1999 (PTC PHASE II, PTO Cert. #6)
AMENDMENT 2: 7 FEBRUARY 2000 (PTO Cert. #7)
AMENDMENT 3: 2 AUGUST 2000 (PTC PHASE III)
AMENDMENT 4: 25 APRIL 2001 (PTO PHASE III)

SOLID WASTE PERMIT

THE CITY OF WINSTON-SALEM

is hereby issued a PERMIT TO OPERATE for Phase III of a

CONSTRUCTION AND DEMOLITION LANDFILL

located within the Old Salisbury Road C&D Landfill Facility

located on Old Salisbury Road in Forsyth County, North Carolina based on the site plan submitted to the Section dated April 2000 and referenced as item #12 and #13 of the approved documents; in accordance with Article 9, Chapter 130A, of the General Statutes of North Carolina and all rules promulgated thereunder and subject to the conditions set forth in this permit.

James C. Coffey

James C. Coffey, Supervisor
Permitting Branch
Solid Waste Section

1646 Mail Service Center, Raleigh, North Carolina 27699-1646
Phone: 919-733-4996 \ FAX: 919-715-3605 \ Internet: www.enr.state.nc.us

AN EQUAL OPPORTUNITY \ AFFIRMATIVE ACTION EMPLOYER – 50% RECYCLED / 10% POST CONSUMER PAPER

PERMIT NUMBER 34-12
PHASE I PERMIT ISSUED 3 JULY 1996 (PTO)
AMENDMENT 1: 15 OCTOBER 1999 (PTC PHASE II, PTO Cert. #6)
AMENDMENT 2: 7 FEBRUARY 2000 (PTO Cert. #7)
AMENDMENT 3: 2 AUGUST 2000 (PTC PHASE III)
AMENDMENT 4: 25 APRIL 2001 (PTO PHASE III)

CITY OF WINSTON-SALEM

SOLID WASTE PERMIT
CONSTRUCTION AND DEMOLITION LANDFILL

CONDITIONS OF PERMIT

General:

1. This permit shall not be effective unless the certified copy is filed in the Register of Deeds office and indexed in the grantor index under the name of the owner of the land in the county or counties in which the land is located. The certified copy of the permit, affixed with the Register's seal and the date, book, and page number of recording shall be returned to the Division of Solid Waste Management (the Division).

2. When this property is sold, leased, transferred or conveyed, the deed or other instrument of transfer shall contain in the description section in no smaller type than that used in the body of the deed or instrument, a statement that the property has been used as a sanitary landfill.

3. The approved plan for this facility is described in Attachment 1, "List of Documents for Approved Plan". Where discrepancies exist, the most recent submittal and these Conditions shall govern. Some components of the approved plan may be reiterated in these Conditions.

4. This permit is not transferable.

5. A copy of this permit and the approved plan shall be maintained at the facility.

6. The owner/operator is responsible for obtaining any and all permits and approvals necessary for the development of this project including approval from appropriate agencies for a General or Individual NPDES Stormwater Discharge Permit.

7. This permit is subject to review every five years, on or before 15 October 2004, as per 15A NCAC 13B .0201(c), according to the issuance date of the permit. Modifications may be required in accordance with the rules in effect at the time of review.

Construction and Operation:

8. This permit is for the development of the landfill within the approved facility description, Document 8 and Document 12 (revisions) of the approved plan. Within the approved facility, development of the landfill unit is approved in Phase II and III. Operation is approved for the Phase I, II, & III areas according to Certification No. 8 as shown on Drawing CERT-8 of Document 13.

9. All sedimentation and erosion control measures shall be conducted in accordance with the Sedimentation Control Act codified at 15 NCAC 4. Native vegetation shall be established on the completed landfill.

10. The following requirements shall be met prior to operation of this facility:

a. The City of Winston-Salem or its consultant shall provide documentation to the Division that site preparation (grading, placement of fill if applicable, etc.) has occurred in accordance with the construction plan and the conditions specified herein.
b. Site inspection shall be made by a representative of the Division.
c. Signs shall be posted at the facility in accordance with the NC Solid Waste Management Rules.
d. Groundwater monitoring wells shall be installed in accordance with the approved groundwater monitoring plan, as described in *Appendix E: Groundwater Monitoring Plan* of Document 8, and the modifications described in Document 10. A baseline sampling event for background water quality shall be performed. (See Monitoring and Reporting Conditions 1(d) and 1(e).)
e. Recordation shall be implemented as described in General Conditions 1 and 2.
f. The existing monitoring wells that will be replaced with new wells, MW-3 and MW-6, will be properly abandoned in accordance with 15A NCAC 2C .0113(a)(2). The new MW-8 will be constructed according to the plan and added to the semiannual sampling schedule prior to construction of Phase III.
g. A comprehensive operations plan shall be submitted to the Division.

11. Operation of the facility shall occur in accordance with the NC Solid Waste Management Rules 15A NCAC 13B .0505, "Operational Requirements for Sanitary Landfills", the approved Operations Plan, and the following specific conditions:

Waste Acceptance and Disposal

a. This solid waste management facility is approved to receive only the following:
   i. Land-clearing debris as defined in G.S. 130A-290;
   ii. Asphalt in accordance with G.S. 130A-294(m);

iii. Construction and demolition debris defined as solid waste resulting solely from construction, remodeling, repair or demolition operations on pavement, buildings, or other structures;

iv. Inert debris defined as solid waste which is virtually inert, such as brick, concrete, rock and uncontaminated soil.

Note: Yard trash defined as solid waste consisting solely of vegetative matter resulting from landscaping maintenance (see G.S. 130A-290) is banned from disposal in this facility as per NC General Statutes.

b. Waste shall be restricted to the smallest area feasible and compacted as densely as practical into cells.

The permittee shall implement a program for detecting and preventing the disposal of unacceptable wastes. The program shall include, at a minimum:

i. Random inspections of incoming loads or other comparable procedures;
ii. Record keeping that documents these inspections;
iii. Training of personnel to recognize hazardous and other unauthorized waste types;
iv. Development of a contingency plan to properly manage any identified problem wastes; including provisions for removal, storage, and final disposition of these wastes.

Cover Material Requirements

d. Operational soil cover of at least six inches shall be placed at least once per week or when the active area reaches ½ acre in size or more often as necessitated by the nature of the waste so as to prevent the site from becoming a visual nuisance and to prevent fire, windblown materials, vectors or water infiltration.

e. Areas which will not have additional waste placed on them for 12 months or more, but where final elevations have not been reached, shall be covered with one foot of soil cover.

f. Within six months of termination of disposal operations the final cover system shall be installed.

Miscellaneous Operational

g. All pertinent landfill operating personnel shall receive training and supervision necessary to carry out their duties in a safe manner.

h. Upon closure of this facility, the closure and post-closure plan that is included in the approved plan must be implemented. The soils that are to be utilized for the

eighteen inch compacted soil layer must be tested and construction specifications for the placement of this soil be submitted to the Section for approval. All measures necessary shall be taken to close the facility in accordance with all rules in effect at that time.

Monitoring and Reporting

12. Groundwater quality at this facility is subject to the classification and remedial action provisions of 15 NCAC 2L. Water quality monitoring shall occur in accordance with the following specific conditions:

    a. The permittee shall sample the monitoring wells on a semi-annual basis, or as directed by the Section Hydrogeologist.
    b. Sampling methods and equipment shall conform to specifications found in Attachment 2, "North Carolina Water Quality Monitoring Guidance Document for Solid Waste Facilities". Sampling parameters shall conform to those found in Attachment 3, "Sampling and Analysis Requirements".
    c. The permittee shall maintain a record of all monitoring events and analytical data. Reports of the analytical data for each sampling event shall be submitted to the Division in a timely manner.
    d. Prior to the acceptance of waste, a background sampling event shall be performed. The results of this sampling event shall be submitted to the Section Hydrogeologist in a timely manner. (See Construction and Operation Condition 3(d).)
    e. Well completion records and boring logs shall be submitted to the Division at the same time as the results of the initial sampling event. (See Construction and Operation Condition 3(d).)

13. Explosive gas monitoring shall be performed as needed to ensure compliance with the standards in Rule .0503 (2)(a).

14. The permittee shall maintain a record of the amount of waste (in tons) that is received at the facility, compiled on a monthly basis by type and county of origin.

15. On or before 01 August of each year the permittee shall report the amount of waste received at this facility and disposed of in the landfill to the Division and to all counties from which waste was accepted, on forms prescribed by the Division.

16. All pertinent records and reports shall be kept on site and made available to the Division upon request.

PERMIT NUMBER 34-12
PHASE I PERMIT ISSUED 3 JULY 1996 (PTO)
AMENDMENT 1: 15 OCTOBER 1999 (PTC PHASE II, PTO Cert. #6)
AMENDMENT 2: 7 FEBRUARY 2000 (PTO Cert. #7)
AMENDMENT 3: 2 AUGUST 2000 (PTC PHASE III)
AMENDMENT 4: 25 APRIL 2001 (PTO PHASE III)

ATTACHMENT 1

List of Documents for the Approved Plan

1. Site Plan Application; submitted by HDR Engineering, Inc. April, 1995

2. Construction Plan Application; submitted by HDR Engineering, Inc. June, 1995

3. Legal Description of the Facility

4. Letter dated 17 June 1997 submitted to the Section by HDR Engineering, Inc. certifying the western half of Phase 1A.

5. Letter dated 12 January 1998 submitted to the Section by HDR Engineering, Inc. providing Certification No.3 for Phase I.

6. Letter dated 1 April 1998 submitted to the Section by HDR Engineering, Inc. providing Certification No. 4 for the Phase 1 Area.

7. Letter dated 30 July 1998 submitted to the Section by HDR Engineering, Inc. providing Certification No. 5 for the Phase 1 Area.

8. Construction Plan Application Phase II & III; submitted by HDR Engineering, Inc. April 1999

9. Letter dated 11 May 1999 submitted to the Section by HDR Engineering, Inc. providing Certification No. 6 for Phase I and II Areas.

10. Letter Dated 8 October 1999 submitted to the Section by HDR Engineering, Inc. providing amendments to the Groundwater Monitoring Plan.

11. Letter dated 30 December 1999 submitted to the Section by HDR Engineering, Inc. providing Certification No. 7 for Phase I and II Areas.

12. Letter dated 17 April 2000 submitted to the Section by HDR Engineering, Inc. providing revisions to Document #8 (Construction Plan Application, Phase II & III) for Phase III development.

13. Letter dated 1 February 2001 submitted to the Section by HDR Engineering, Inc. providing Certification No. 8 for all of Phase III.

NCDENR

NORTH CAROLINA DEPARTMENT OF
ENVIRONMENT AND NATURAL RESOURCES

DIVISION OF WASTE MANAGEMENT

RECEIVED
AUG 7 2000
HDR ENGINEERING, INC
OF THE CAROLINAS

August 2, 2000

JAMES B. HUNT JR.
GOVERNOR

BILL HOLMAN
SECRETARY

WILLIAM L. MEYER
DIRECTOR

Mr. Dave Saunders, Utilities Supervisor
City of Winston-Salem
P.O. Box 2511
Winston-Salem, North Carolina 27102

Re: Solid Waste Permit No. 34-12: Phase III Permit to Construct (PTC), for the City of Winston-Salem C&D Landfill on Old Salisbury Road, Winston-Salem, Forsyth County, North Carolina

Dear Mr. Saunders:

The above referenced PERMIT TO CONSTRUCT is issued in accordance with N.C.G.S. 130A-294 and the N.C. Solid Waste Management Rules 15A NCAC 13B. The revisions to the Construction Plan Application, Phase II & III submitted to the Section, dated 17 April 2000 by Eric Wright of HDR, will be listed in Attachment 1 as item #12 and is included in the Approved Plans for this facility. This permit is for the construction and development of Phase III. Operation of areas within Phase II have previously been approved in the Permit to Operate dated 7 February 2000.

Please refer to the Conditions of the Permit, GENERAL section, for the definition of the approved plan and for general terms of the Solid Waste Permit. The CONSTRUCTION AND OPERATION conditions describe permitted fill areas, acceptable waste types, landfill operation, and requirements which must be satisfied prior to operation of the facility as a C&D landfill. Specific requirements for groundwater monitoring and facility record keeping and reporting are described in the MONITORING AND REPORTING conditions.

Please review the Conditions of Permit thoroughly. If you need further clarification, please contact me at (336) 771-4608 ext. 204 or Mr. Danny Hockett, the Waste Management Specialist for this area, at (336) 771-4608 ext. 208.

Sincerely,

Timothy A. Jewett
Western Area Engineer
Solid Waste Section

cc: Jim Coffey, SWS
Brent Rockett, SWS
Danny Hockett, SWS
Eric Wright, HDR Engineering, Inc.
Raleigh Central File: Forsyth County, Permit No. 34-12

BE TECHNOLOGY FIRST IN AMERICA 2010

1646 MAIL SERVICE CENTER, RALEIGH, NORTH CAROLINA 27699-1646
401 OBERLIN ROAD, SUITE 150, RALEIGH, NC 27605
PHONE 919-733-4996 FAX 919-715-3605

AN EQUAL OPPORTUNITY / AFFIRMATIVE ACTION EMPLOYER - 50% RECYCLED/10% POST-CONSUMER PAPER

NCDENR

NORTH CAROLINA DEPARTMENT OF
ENVIRONMENT AND NATURAL RESOURCES

DIVISION OF WASTE MANAGEMENT

JAMES B. HUNT JR.
GOVERNOR

BILL HOLMAN
SECRETARY

WILLIAM L. MEYER
DIRECTOR

PERMIT NUMBER 34-12
PHASE I PERMIT ISSUED 3 JULY 1996 (PTO)
AMENDMENT 1: 15 OCTOBER 1999 (PTC PHASE II, PTO Cert. #6)
AMENDMENT 2: 7 FEBRUARY 2000 (PTO Cert. #7)
AMENDMENT 3: 2 AUGUST 2000 (PTC PHASE III)

SOLID WASTE PERMIT

THE CITY OF WINSTON-SALEM

is hereby issued a PERMIT TO CONSTRUCT for Phase III of a

CONSTRUCTION AND DEMOLITION LANDFILL

located within the Old Salisbury Road C&D Landfill Facility

located on Old Salisbury Road in Forsyth County, North Carolina based on the site plan submitted to the Section dated April 2000 and referenced as item #12 of the approved documents; in accordance with Article 9, Chapter 130A, of the General Statutes of North Carolina and all rules promulgated thereunder and subject to the conditions set forth in this permit.

James C Coffey

James C. Coffey, Supervisor
Permitting Branch
Solid Waste Section

1646 MAIL SERVICE CENTER, RALEIGH, NORTH CAROLINA 27699-1646
401 OBERLIN ROAD, SUITE 150, RALEIGH, NC 27605
PHONE 919-733-4996 FAX 919-715-3605
AN EQUAL OPPORTUNITY / AFFIRMATIVE ACTION EMPLOYER - 50% RECYCLED/10% POST-CONSUMER PAPER

PERMIT NUMBER 34-12
PHASE I PERMIT ISSUED 3 JULY 1996 (PTO)
AMENDMENT 1: 15 OCTOBER 1999 (PTC PHASE II, PTO Cert. #6)
AMENDMENT 2: 7 FEBRUARY 2000 (PTO Cert. #7)
AMENDMENT 3: 2 AUGUST 2000 (PTC PHASE III)

CITY OF WINSTON-SALEM

SOLID WASTE PERMIT
CONSTRUCTION AND DEMOLITION LANDFILL

CONDITIONS OF PERMIT

General:

1. This permit shall not be effective unless the certified copy is filed in the Register of Deeds office and indexed in the grantor index under the name of the owner of the land in the county or counties in which the land is located. The certified copy of the permit, affixed with the Register's seal and the date, book, and page number of recording shall be returned to the Division of Solid Waste Management (the Division).

2. When this property is sold, leased, transferred or conveyed, the deed or other instrument of transfer shall contain in the description section in no smaller type than that used in the body of the deed or instrument, a statement that the property has been used as a sanitary landfill.

3. The approved plan for this facility is described in Attachment 1, "List of Documents for Approved Plan". Where discrepancies exist, the most recent submittal and these Conditions shall govern. Some components of the approved plan may be reiterated in these Conditions.

4. This permit is not transferable.

5. A copy of this permit and the approved plan shall be maintained at the facility.

6. The owner/operator is responsible for obtaining any and all permits and approvals necessary for the development of this project including approval from appropriate agencies for a General or Individual NPDES Stormwater Discharge Permit.

7. This permit is subject to review every five years, on or before 15 October 2004, as per 15A NCAC 13B .0201(c), according to the issuance date of the permit. Modifications may be required in accordance with the rules in effect at the time of review.

Construction and Operation:

8. This permit is for the development of the landfill within the approved facility description, Document 8 and Document 12 (revisions) of the approved plan. Within the approved facility, development of the landfill unit is approved in Phase II and III. Operation is approved for the Phase I & II areas according to Certification No. 7 as shown on Drawing CERT-7 of Document 11.

9. All sedimentation and erosion control measures shall be conducted in accordance with the Sedimentation Control Act codified at 15 NCAC 4. Native vegetation shall be established on the completed landfill.

10. The following requirements shall be met prior to operation of this facility:

    a. The City of Winston-Salem or its consultant shall provide documentation to the Division that site preparation (grading, placement of fill if applicable, etc.) has occurred in accordance with the construction plan and the conditions specified herein.
    b. Site inspection shall be made by a representative of the Division.
    c. Signs shall be posted at the facility in accordance with the NC Solid Waste Management Rules.
    d. Groundwater monitoring wells shall be installed in accordance with the approved groundwater monitoring plan, as described in *Appendix E: Groundwater Monitoring Plan* of Document 8, and the modifications described in Document 10. A baseline sampling event for background water quality shall be performed. (See Monitoring and Reporting Conditions 1(d) and 1(e).)
    e. Recordation shall be implemented as described in General Conditions 1 and 2.
    f. The existing monitoring wells that will be replaced with new wells, MW-3 and MW-6, will be properly abandoned in accordance with 15A NCAC 2C .0113(a)(2). The new MW-8 will be constructed according to the plan and added to the semiannual sampling schedule prior to construction of Phase III.
    g. A comprehensive operations plan shall be submitted to the Division.

11. Operation of the facility shall occur in accordance with the NC Solid Waste Management Rules 15A NCAC 13B .0505, "Operational Requirements for Sanitary Landfills", the approved Operations Plan, and the following specific conditions:

    Waste Acceptance and Disposal

    a. This solid waste management facility is approved to receive only the following:
        i. Land-clearing debris as defined in G.S. 130A-290;
        ii. Asphalt in accordance with G.S. 130A-294(m);

iii. Construction and demolition debris defined as solid waste resulting solely from construction, remodeling, repair or demolition operations on pavement, buildings, or other structures;

iv. Inert debris defined as solid waste which is virtually inert, such as brick, concrete, rock and uncontaminated soil.

Note: Yard trash defined as solid waste consisting solely of vegetative matter resulting from landscaping maintenance (see G.S. 130A-290) is banned from disposal in this facility as per NC General Statutes.

b. Waste shall be restricted to the smallest area feasible and compacted as densely as practical into cells.

c. The permittee shall implement a program for detecting and preventing the disposal of unacceptable wastes. The program shall include, at a minimum:

i. Random inspections of incoming loads or other comparable procedures;

ii. Record keeping that documents these inspections;

iii. Training of personnel to recognize hazardous and other unauthorized waste types;

iv. Development of a contingency plan to properly manage any identified problem wastes; including provisions for removal, storage, and final disposition of these wastes.

Cover Material Requirements

d. Operational soil cover of at least six inches shall be placed at least once per week or when the active area reaches ½ acre in size or more often as necessitated by the nature of the waste so as to prevent the site from becoming a visual nuisance and to prevent fire, windblown materials, vectors or water infiltration.

e. Areas which will not have additional waste placed on them for 12 months or more, but where final elevations have not been reached, shall be covered with one foot of soil cover.

f. Within six months of termination of disposal operations the final cover system shall be installed.

Miscellaneous Operational

g. All pertinent landfill operating personnel shall receive training and supervision necessary to carry out their duties in a safe manner.

h. Upon closure of this facility, the closure and post-closure plan that is included in the approved plan must be implemented. The soils that are to be utilized for the

eighteen inch compacted soil layer must be tested and construction specifications for the placement of this soil be submitted to the Section for approval. All measures necessary shall be taken to close the facility in accordance with all rules in effect at that time.

Monitoring and Reporting

12. Groundwater quality at this facility is subject to the classification and remedial action provisions of 15 NCAC 2L. Water quality monitoring shall occur in accordance with the following specific conditions:

    a. The permittee shall sample the monitoring wells on a semi-annual basis, or as directed by the Section Hydrogeologist.
    b. Sampling methods and equipment shall conform to specifications found in Attachment 2, "North Carolina Water Quality Monitoring Guidance Document for Solid Waste Facilities". Sampling parameters shall conform to those found in Attachment 3, "Sampling and Analysis Requirements".
    c. The permittee shall maintain a record of all monitoring events and analytical data. Reports of the analytical data for each sampling event shall be submitted to the Division in a timely manner.
    d. Prior to the acceptance of waste, a background sampling event shall be performed. The results of this sampling event shall be submitted to the Section Hydrogeologist in a timely manner. (See Construction and Operation Condition 3(d).)
    e. Well completion records and boring logs shall be submitted to the Division at the same time as the results of the initial sampling event. (See Construction and Operation Condition 3(d).)

13. Explosive gas monitoring shall be performed as needed to ensure compliance with the standards in Rule .0503 (2)(a).

14. The permittee shall maintain a record of the amount of waste (in tons) that is received at the facility, compiled on a monthly basis by type and county of origin.

15. On or before 01 August of each year the permittee shall report the amount of waste received at this facility and disposed of in the landfill to the Division and to all counties from which waste was accepted, on forms prescribed by the Division.

16. All pertinent records and reports shall be kept on site and made available to the Division upon request.

ATTACHMENT 1

List of Documents for the Approved Plan

1. Site Plan Application; submitted by HDR Engineering, Inc. April, 1995
2. Construction Plan Application; submitted by HDR Engineering, Inc. June, 1995
3. Legal Description of the Facility
4. Letter dated 17 June 1997 submitted to the Section by HDR Engineering, Inc. certifying the western half of Phase 1A.
5. Letter dated 12 January 1998 submitted to the Section by HDR Engineering, Inc. providing Certification No.3 for Phase I.
6. Letter dated 1 April 1998 submitted to the Section by HDR Engineering, Inc. providing Certification No. 4 for the Phase 1 Area.
7. Letter dated 30 July 1998 submitted to the Section by HDR Engineering, Inc. providing Certification No. 5 for the Phase 1 Area.
8. Construction Plan Application Phase II & III; submitted by HDR Engineering, Inc. April 1999
9. Letter dated 11 May 1999 submitted to the Section by HDR Engineering, Inc. providing Certification No. 6 for Phase I and II Areas.
10. Letter Dated 8 October 1999 submitted to the Section by HDR Engineering, Inc. providing amendments to the Groundwater Monitoring Plan.
11. Letter dated 30 December 1999 submitted to the Section by HDR Engineering, Inc. providing Certification No. 7 for Phase I and II Areas.
12. Letter dated 17 April 2000 submitted to the Section by HDR Engineering, Inc. providing revisions to Document #8 (Construction Plan Application, Phase II & III) for Phase III development.

NCDENR

NORTH CAROLINA DEPARTMENT OF
ENVIRONMENT AND NATURAL RESOURCES

DIVISION OF WASTE MANAGEMENT

RECEIVED
10

October 15, 1999

HDR ENGINEERING, INC
OF THE CAROLINAS

JAMES B. HUNT JR.
GOVERNOR

BILL HOLMAN
SECRETARY

WILLIAM L. MEYER
DIRECTOR

Mr. Dave Saunders, Utilities Supervisor
City of Winston-Salem
P.O. Box 2511
Winston-Salem, North Carolina 27102

Re: Solid Waste Permit No. 34-12: Phase II, Certification No. 7 for the City of Winston-Salem C&D Landfill on Old Salisbury Road, Winston-Salem, Forsyth County, North Carolina

Dear Mr. Saunders:

The referenced PERMIT TO OPERATE is issued in accordance with N.C.G.S. 130A-294 and the N.C. Solid Waste Management Rules 15A NCAC 13B. The certification letter submitted to the Section, dated 30 December 1999 by Joe Readling of HDR, will be listed in Attachment 1 as item #11 and is included in the Approved Plans for this facility. This permit is for a five-year period and will be reviewed on 15 October 2004, consistent with Solid Waste Management Rules. At the end of this five-year period, the City of Winston-Salem may apply for an expansion for the use of additional cells, but will be subject to all rules in effect at that time. This permit is issued to the City of Winston-Salem as the owner and operator of the facility.

Please refer to the Conditions of the Permit, GENERAL section, for the definition of the approved plan and for general terms of the Solid Waste Permit. The CONSTRUCTION AND OPERATION conditions describe permitted fill areas, acceptable waste types, landfill operation, and requirements which must be satisfied prior to operation of the facility as a C&D landfill. Specific requirements for groundwater monitoring and facility record keeping and reporting are described in the MONITORING AND REPORTING conditions.

As stated previously, this permit is for the development of Phase II only and for the operation of areas within Phase II as they are constructed and certified. Portions of the Construction Plan Application for Phase II & III, date April 1999 by HDR Engineering, did not supply all of the information necessary to grant approval for Phase III construction. The Section is still awaiting revisions to the Construction Plan Application that would allow Phase III to be approved and thereby incorporated into the Permit to Construct.

FIRST IN AMERICA 2010

1646 MAIL SERVICE CENTER, RALEIGH, NORTH CAROLINA 27699-1646
401 OBERLIN ROAD, SUITE 150, RALEIGH, NC 27605
PHONE 919-733-4996 FAX 919-715-3605
AN EQUAL OPPORTUNITY / AFFIRMATIVE ACTION EMPLOYER - 50% RECYCLED/10% POST-CONSUMER PAPER

Please review the Conditions of Permit thoroughly. If you need further clarification, please contact me at (336) 771-4608 ext. 204 or Mr. Danny Hockett, the Waste Management Specialist for this area, at (336) 771-4608 ext. 208.

Sincerely,

Timothy A. Jewett
Western Area Engineer
Solid Waste Section

cc: Jim Coffey, SWS
Brent Rockett, SWS
Danny Hockett, SWS
Joe Readling, HDR Engineering, Inc.
Raleigh Central File: Forsyth County, Permit No. 34-12

NORTH CAROLINA DEPARTMENT OF
ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF WASTE MANAGEMENT

PERMIT NUMBER 34-12
PHASE I PERMIT ISSUED 3 JULY 1996
PHASE II PERMIT ISSUED 15 OCTOBER 1999
AMENDED 7 FEBRUARY 2000

JAMES B. HUNT JR.
GOVERNOR

WAYNE MCDEVITT
SECRETARY

WILLIAM L. MEYER
DIRECTOR

SOLID WASTE PERMIT

THE CITY OF WINSTON-SALEM

is hereby issued a PERMIT TO OPERATE for Phase II of a

CONSTRUCTION AND DEMOLITION LANDFILL

located within the Old Salisbury Road C&D Landfill Facility

located on Old Salisbury Road in Forsyth County, North Carolina based on the site plan submitted to the Section dated April 1995 and referenced as item #1 of the approved documents; in accordance with Article 9, Chapter 130A, of the General Statutes of North Carolina and all rules promulgated thereunder and subject to the conditions set forth in this permit.

James C Coffey

James C. Coffey, Supervisor
Permitting Branch
Solid Waste Section

401 OBERLIN ROAD, SUITE 150, RALEIGH, NC 27605
PHONE 919-733-4996 FAX 919-715-3605
AN EQUAL OPPORTUNITY / AFFIRMATIVE ACTION EMPLOYER - 50% RECYCLED/10% POST-CONSUMER PAPER

PERMIT NUMBER 34-12
PHASE I PERMIT ISSUED 3 JULY 1996
PHASE II PERMIT ISSUED 15 OCTOBER 1999
AMENDED 7 FEBRUARY 2000

CITY OF WINSTON-SALEM

SOLID WASTE PERMIT
CONSTRUCTION AND DEMOLITION LANDFILL

CONDITIONS OF PERMIT

General:

1. This permit shall not be effective unless the certified copy is filed in the Register of Deeds office and indexed in the grantor index under the name of the owner of the land in the county or counties in which the land is located. The certified copy of the permit, affixed with the Register's seal and the date, book, and page number of recording shall be returned to the Division of Solid Waste Management (the Division).

2. When this property is sold, leased, transferred or conveyed, the deed or other instrument of transfer shall contain in the description section in no smaller type than that used in the body of the deed or instrument, a statement that the property has been used as a sanitary landfill.

3. The approved plan for this facility is described in Attachment 1, "List of Documents for Approved Plan". Where discrepancies exist, the most recent submittal and these Conditions shall govern. Some components of the approved plan may be reiterated in these Conditions.

4. This permit is not transferable.

5. A copy of this permit and the approved plan shall be maintained at the facility.

6. The owner/operator is responsible for obtaining any and all permits and approvals necessary for the development of this project including approval from appropriate agencies for a General or Individual NPDES Stormwater Discharge Permit.

7. This permit is subject to review every five years, on or before 15 October 2004, as per 15A NCAC 13B .0201(c), according to the issuance date of the permit. Modifications may be required in accordance with the rules in effect at the time of review.

Construction and Operation:

8. This permit is for the development of the landfill within the approved facility description, Document 8 of the approved plan. Within the approved facility, development of the landfill unit is approved in Phase II only and operation is approved for the Phase I & II areas according to Certification No. 7 as shown on Drawing CERT-7 of Document 11.

9. All sedimentation and erosion control measures shall be conducted in accordance with the Sedimentation Control Act codified at 15 NCAC 4. Native vegetation shall be established on the completed landfill.

10. The following requirements shall be met prior to operation of this facility:

    a. The City of Winston-Salem or its consultant shall provide documentation to the Division that site preparation (grading, placement of fill if applicable, etc.) has occurred in accordance with the construction plan and the conditions specified herein.
    b. Site inspection shall be made by a representative of the Division.
    c. Signs shall be posted at the facility in accordance with the NC Solid Waste Management Rules.
    d. Groundwater monitoring wells shall be installed in accordance with the approved groundwater monitoring plan, as described in *Appendix E: Groundwater Monitoring Plan* of Document 8, and the modifications described in Document 10. A baseline sampling event for background water quality shall be performed. (See Monitoring and Reporting Conditions 1(d) and 1(e).)
    e. Recordation shall be implemented as described in General Conditions 1 and 2.
    f. The existing monitoring wells that will be replaced with new wells, MW-3 and MW-6, will be properly abandoned in accordance with 15A NCAC 2C .0113(a)(2). The new MW-8 will be constructed according to the plan and added to the semiannual sampling schedule prior to construction of Phase III.
    g. A comprehensive operations plan shall be submitted to the Division.

11. Operation of the facility shall occur in accordance with the NC Solid Waste Management Rules 15A NCAC 13B .0505, "Operational Requirements for Sanitary Landfills", the approved Operations Plan, and the following specific conditions:

    Waste Acceptance and Disposal

    a. This solid waste management facility is approved to receive only the following:
        i. Land-clearing debris as defined in G.S. 130A-290;
        ii. Asphalt in accordance with G.S. 130A-294(m);

iii. Construction and demolition debris defined as solid waste resulting solely from construction, remodeling, repair or demolition operations on pavement, buildings, or other structures;

iv. Inert debris defined as solid waste which is virtually inert, such as brick, concrete, rock and uncontaminated soil.

Note: Yard trash defined as solid waste consisting solely of vegetative matter resulting from landscaping maintenance (see G.S. 130A-290) is banned from disposal in this facility as per NC General Statutes.

b. Waste shall be restricted to the smallest area feasible and compacted as densely as practical into cells.

c. The permittee shall implement a program for detecting and preventing the disposal of unacceptable wastes. The program shall include, at a minimum:

i. Random inspections of incoming loads or other comparable procedures;
ii. Record keeping that documents these inspections;
iii. Training of personnel to recognize hazardous and other unauthorized waste types;
iv. Development of a contingency plan to properly manage any identified problem wastes; including provisions for removal, storage, and final disposition of these wastes.

Cover Material Requirements

d. Operational soil cover of at least six inches shall be placed at least once per week or when the active area reaches ½ acre in size or more often as necessitated by the nature of the waste so as to prevent the site from becoming a visual nuisance and to prevent fire, windblown materials, vectors or water infiltration.

e. Areas which will not have additional waste placed on them for 12 months or more, but where final elevations have not been reached, shall be covered with one foot of soil cover.

f. Within six months of termination of disposal operations the final cover system shall be installed.

Miscellaneous Operational

g. All pertinent landfill operating personnel shall receive training and supervision necessary to carry out their duties in a safe manner.

h. Upon closure of this facility, the closure and post-closure plan that is included in the approved plan must be implemented. The soils that are to be utilized for the

eighteen inch compacted soil layer must be tested and construction specifications for the placement of this soil be submitted to the Section for approval. All measures necessary shall be taken to close the facility in accordance with all rules in effect at that time.

Monitoring and Reporting

12. Groundwater quality at this facility is subject to the classification and remedial action provisions of 15 NCAC 2L. Water quality monitoring shall occur in accordance with the following specific conditions:

    a. The permittee shall sample the monitoring wells on a semi-annual basis, or as directed by the Section Hydrogeologist.
    b. Sampling methods and equipment shall conform to specifications found in Attachment 2, "North Carolina Water Quality Monitoring Guidance Document for Solid Waste Facilities". Sampling parameters shall conform to those found in Attachment 3, "Sampling and Analysis Requirements".
    c. The permittee shall maintain a record of all monitoring events and analytical data. Reports of the analytical data for each sampling event shall be submitted to the Division in a timely manner.
    d. Prior to the acceptance of waste, a background sampling event shall be performed. The results of this sampling event shall be submitted to the Section Hydrogeologist in a timely manner. (See Construction and Operation Condition 3(d).)
    e. Well completion records and boring logs shall be submitted to the Division at the same time as the results of the initial sampling event. (See Construction and Operation Condition 3(d).)

13. Explosive gas monitoring shall be performed as needed to ensure compliance with the standards in Rule .0503 (2)(a).

14. The permittee shall maintain a record of the amount of waste (in tons) that is received at the facility, compiled on a monthly basis by type and county of origin.

15. On or before 01 August of each year the permittee shall report the amount of waste received at this facility and disposed of in the landfill to the Division and to all counties from which waste was accepted, on forms prescribed by the Division.

16. All pertinent records and reports shall be kept on site and made available to the Division upon request.

PERMIT NUMBER 34-12
PHASE I PERMIT ISSUED 3 JULY 1996
PHASE II PERMIT ISSUED 15 OCTOBER 1999
AMENDED 7 FEBRUARY 2000

ATTACHMENT 1

List of Documents for the Approved Plan

1. Site Plan Application; submitted by HDR Engineering, Inc. April, 1995

2. Construction Plan Application; submitted by HDR Engineering, Inc. June, 1995

3. Legal Description of the Facility

4. Letter dated 17 June 1997 submitted to the Section by HDR Engineering, Inc. certifying the western half of Phase 1A.

5. Letter dated 12 January 1998 submitted to the Section by HDR Engineering, Inc. providing Certification No.3 for Phase I.

6. Letter dated 1 April 1998 submitted to the Section by HDR Engineering, Inc. providing Certification No. 4 for the Phase 1 Area.

7. Letter dated 30 July 1998 submitted to the Section by HDR Engineering, Inc. providing Certification No. 5 for the Phase 1 Area.

8. Construction Plan Application Phase II & III; submitted by HDR Engineering, Inc. April 1999

9. Letter dated 11 May 1999 submitted to the Section by HDR Engineering, Inc. providing Certification No. 6 for Phase I and II Areas.

10. Letter Dated 8 October 1999 submitted to the Section by HDR Engineering, Inc. providing amendments to the Groundwater Monitoring Plan.

11. Letter dated 30 December 1999 submitted to the Section by HDR Engineering, Inc. providing Certification No. 7 for Phase I and II Areas.

NCDENR

JAMES B. HUNT JR.
GOVERNOR

WAYNE MCDEVITT
SECRETARY

WILLIAM L. MEYER
DIRECTOR

NORTH CAROLINA DEPARTMENT OF
ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF WASTE MANAGEMENT

October 15, 1999

RECEIVED
OCT 20 1999
HDR ENGINEERING, INC.
OF THE CAROLINAS

Mr. Dave Saunders, Utilities Supervisor
City of Winston-Salem
P.O. Box 2511
Winston-Salem, North Carolina 27102

Re: Solid Waste Permit No. 34-12
Phase II of the City of Winston-Salem Construction and Demolition Landfill
located on Old Salisbury Road, Winston-Salem, Forsyth County, North Carolina

Dear Mr. Saunders:

The referenced PERMIT TO CONSTRUCT for Phase II is issued in accordance with N.C.G.S. 130A-294 and the N.C. Solid Waste Management Rules 15A NCAC 13B. The Construction Plan Application submitted to the Section, dated 14 April 1999 by Eric Wright of HDR Engineering, Inc., will be listed as item #8 in Attachment 1- List of Documents for the Approved Plans for this facility. The referenced PERMIT TO OPERATE, also issued in accordance with the above statutes and rules, is specifically for the area described as Certification Number 6 in the letter from HDR Engineering dated 11 May 1999 (designated as item #9 in Attachment 1).

This permit is for a five-year period and will be reviewed on 15 October 2004, consistent with Solid Waste Management Rules. At the end of this five-year period, the City of Winston-Salem may apply for an expansion for the use of additional cells, but will be subject to all rules in effect at that time. This permit is issued to the City of Winston-Salem as the owner and operator of the facility.

Please refer to the Conditions of the Permit, GENERAL section, for the definition of the approved plan and for general terms of the Solid Waste Permit. The CONSTRUCTION AND OPERATION conditions describe permitted fill areas, acceptable waste types, landfill operation, and requirements which must be satisfied prior to operation of the facility as a C&D landfill. Specific requirements for groundwater monitoring and facility record keeping and reporting are described in the MONITORING AND REPORTING conditions.

As stated previously, this permit is for the development of Phase II only and for the operation of areas within Phase II as they are constructed and certified. Portions of the Construction Plan Application for Phase II & III, date April 1999 by HDR Engineering, did not supply all of the information necessary to grant approval for Phase

III construction. The following items corresponding to the appropriate section of the Rules will need to be addressed for the next and future phases of construction.

1. .0503(2)(a and c) are not addressed in the application. Also, for future reference, the 50-foot minimum buffer requirement between property lines and disposal areas (.0503(2)(f)), as stated in section 2.2 of the application, has been increased to 200 feet per a Section Policy Memo.

2. Section 2.3 of the application indicates that a 10 foot separation will be maintained between the potentiometric lines depicted on the drawings and the proposed subgrade. However, the cross-section drawing (Dwg C-4) only shows a 4 to 5 foot separation for most of X-Section B and the low area of X-section A is less than four feet. Please address this discrepancy and show the location of the cross sections on the proposed Excavation Plan (.0503(2)(d)).

3. Existing site conditions shown on drawing C-1 depict site conditions that existed prior to the development of Phase I. Stock Pile areas, access roads, and bench marks to illustrate current site activities are not shown as required by .0504(2).

4. The proposed Excavation Plan drawing C-2 does not show the staged subcell development as described in the text of the application. Please provide a plan showing the planned subcells of each phase, tie-in and removal of the stock pile in relation to subgrade preparation, and temporary diversions related to subcells and overall phase development (.0504(2)(b, d, & g)).

5. The proposed final grades shown on drawing C-3 show contours that tie into proposed excavation grades of future phases. How will the existing stock pile be managed in conjunction with proposed final grades? Also, no slope drains, berms, or other drop structures are shown for removal of stormwater from proposed final grades on drawings C-3 and C-6? How will surface water be managed once final grades are reached for this phase of development (.0504(2)(c))?

6. Please provide a copy of the Sediment and Erosion Control Plan submitted to the Division of Land Quality (DLQ) (.0504(2)(d)). Section 2.7 (p. 9) of the application indicates that an erosion control plan for Phase III is being prepared and will be submitted. Has the plan been submitted? Please provide a copy of DLQ's approval letter with the plan. Also, are temporary control measures shown and is a seeding schedule provided (.0504(2)(d)(I & ii)?

7. According to .0504(2)(e), please provide a copy of pertinent details with the drawing set.

8. The Solid Waste Section normally issues permits based on a five year review cycle according to Section .0201 of the Rules. The anticipated life span of Phase II and III combined is 7.5 years. Please modify the drawings and application to reflect five year phase development based on the anticipated waste disposal of the facility (.0504(2)(g)).

Please address the above comments at your earliest convenience and submit revisions based on the comments with the next application for phase development. Also, please review the Conditions of Permit thoroughly. Some changes have been made that differentiate these conditions from the ones attached to the Phase I permit. If you need further clarification, please contact me at (336) 771-4608 ext. 204 or Mr. Danny Hockett, the Waste Management Specialist for this area, at (336) 771-4608 ext. 208.

Sincerely,

Timothy A. Jewett
Western Area Engineer
Solid Waste Section

cc: Jim Coffey
Julian Foscue
Danny Hockett
Raleigh Central File: Forsyth County, Permit No. 34-12

NCDENR

JAMES B. HUNT JR.
GOVERNOR

WAYNE MCDEVITT
SECRETARY

WILLIAM L. MEYER
DIRECTOR

NORTH CAROLINA DEPARTMENT OF
ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF WASTE MANAGEMENT

PERMIT NUMBER 34-12
ISSUED 09 NOVEMBER 1995
AMENDED 15 OCTOBER 1999

SOLID WASTE PERMIT

THE CITY OF WINSTON-SALEM

is hereby issued a PERMIT TO CONSTRUCT for Phase II of a

CONSTRUCTION AND DEMOLITION LANDFILL

located within the Old Salisbury Road C&D Landfill Facility

located on Old Salisbury Road in Forsyth County, North Carolina based on the site plan submitted to the Section dated April 1995 and referenced as item #1 of the approved documents; in accordance with Article 9, Chapter 130A, of the General Statutes of North Carolina and all rules promulgated thereunder and subject to the conditions set forth in this permit.

James C Coffey

James C. Coffey, Supervisor
Permitting Branch
Solid Waste Section

401 OBERLIN ROAD, SUITE 150, RALEIGH, NC 27605
PHONE 919-733-4996 FAX 919-715-3605

NCDENR

JAMES B. HUNT JR.
GOVERNOR

WAYNE MCDEVITT
SECRETARY

WILLIAM L. MEYER
DIRECTOR

NORTH CAROLINA DEPARTMENT OF
ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF WASTE MANAGEMENT

PERMIT NUMBER 34-12
ISSUED 03 JULY 1996
AMENDED 15 OCTOBER 1999

SOLID WASTE PERMIT

THE CITY OF WINSTON-SALEM

is hereby issued a PERMIT TO OPERATE for Phase II of a

CONSTRUCTION AND DEMOLITION LANDFILL

located within the Old Salisbury Road C&D Landfill Facility

located on Old Salisbury Road in Forsyth County, North Carolina based on the site plan submitted to the Section dated April 1995 and referenced as item #1 of the approved documents; in accordance with Article 9, Chapter 130A, of the General Statutes of North Carolina and all rules promulgated thereunder and subject to the conditions set forth in this permit.

James C. Coffey

James C. Coffey, Supervisor
Permitting Branch
Solid Waste Section

PERMIT NUMBER 34-12
ISSUED 3 JULY 1996
AMENDED 15 OCTOBER 1999

CITY OF WINSTON-SALEM

SOLID WASTE PERMIT
CONSTRUCTION AND DEMOLITION LANDFILL

CONDITIONS OF PERMIT

General:

1. This permit shall not be effective unless the certified copy is filed in the Register of Deeds office and indexed in the grantor index under the name of the owner of the land in the county or counties in which the land is located. The certified copy of the permit, affixed with the Register's seal and the date, book, and page number of recording shall be returned to the Division of Solid Waste Management (the Division).

2. When this property is sold, leased, transferred or conveyed, the deed or other instrument of transfer shall contain in the description section in no smaller type than that used in the body of the deed or instrument, a statement that the property has been used as a sanitary landfill.

3. The approved plan for this facility is described in Attachment 1, "List of Documents for Approved Plan". Where discrepancies exist, the most recent submittal and these Conditions shall govern. Some components of the approved plan may be reiterated in these Conditions.

4. This permit is not transferable.

5. A copy of this permit and the approved plan shall be maintained at the facility.

6. The owner/operator is responsible for obtaining any and all permits and approvals necessary for the development of this project including approval from appropriate agencies for a General or Individual NPDES Stormwater Discharge Permit.

7. This permit is subject to review every five years, on or before 15 October 2004, as per 15A NCAC 13B .0201(c), according to the issuance date of the permit. Modifications may be required in accordance with the rules in effect at the time of review.

Construction and Operation:

8. This permit is for the development of the landfill within the approved facility description, Document 8 of the approved plan. Within the approved facility, development of the landfill unit is approved in Phase II only and operation is approved for the Phase I & II areas according to Certification No. 6 as shown on Drawing CERT-6 of Document 9.

9. All sedimentation and erosion control measures shall be conducted in accordance with the Sedimentation Control Act codified at 15 NCAC 4. Native vegetation shall be established on the completed landfill.

10. The following requirements shall be met prior to operation of this facility:

    a. The City of Winston-Salem or its consultant shall provide documentation to the Division that site preparation (grading, placement of fill if applicable, etc.) has occurred in accordance with the construction plan and the conditions specified herein.
    b. Site inspection shall be made by a representative of the Division.
    c. Signs shall be posted at the facility in accordance with the NC Solid Waste Management Rules.
    d. Groundwater monitoring wells shall be installed in accordance with the approved groundwater monitoring plan, as described in *Appendix E: Groundwater Monitoring Plan* of Document 8, and the modifications described in Document 10. A baseline sampling event for background water quality shall be performed. (See Monitoring and Reporting Conditions 1(d) and 1(e).)
    e. Recordation shall be implemented as described in General Conditions 1 and 2.
    f. The existing monitoring wells that will be replaced with new wells, MW-3 and MW-6, will be properly abandoned in accordance with 15A NCAC 2C .0113(a)(2). The new MW-8 will be constructed according to the plan and added to the semiannual sampling schedule prior to construction of Phase III.
    g. A comprehensive operations plan shall be submitted to the Division.

11. Operation of the facility shall occur in accordance with the NC Solid Waste Management Rules 15A NCAC 13B .0505, "Operational Requirements for Sanitary Landfills", the approved Operations Plan, and the following specific conditions:

    Waste Acceptance and Disposal

    a. This solid waste management facility is approved to receive only the following:
        i. Land-clearing debris as defined in G.S. 130A-290;
        ii. Asphalt in accordance with G.S. 130A-294(m);

iii. Construction and demolition debris defined as solid waste resulting solely from construction, remodeling, repair or demolition operations on pavement, buildings, or other structures;

iv. Inert debris defined as solid waste which is virtually inert, such as brick, concrete, rock and uncontaminated soil.

Note: Yard trash defined as solid waste consisting solely of vegetative matter resulting from landscaping maintenance (see G.S. 130A-290) is banned from disposal in this facility as per NC General Statutes.

b. Waste shall be restricted to the smallest area feasible and compacted as densely as practical into cells.

c. The permittee shall implement a program for detecting and preventing the disposal of unacceptable wastes. The program shall include, at a minimum:
   i. Random inspections of incoming loads or other comparable procedures;
   ii. Record keeping that documents these inspections;
   iii. Training of personnel to recognize hazardous and other unauthorized waste types;
   iv. Development of a contingency plan to properly manage any identified problem wastes; including provisions for removal, storage, and final disposition of these wastes.

Cover Material Requirements

a. Operational soil cover of at least six inches shall be placed at least once per week or when the active area reaches ½ acre in size or more often as necessitated by the nature of the waste so as to prevent the site from becoming a visual nuisance and to prevent fire, windblown materials, vectors or water infiltration.

b. Areas which will not have additional waste placed on them for 12 months or more, but where final elevations have not been reached, shall be covered with one foot of soil cover.

c. Within six months of termination of disposal operations the final cover system shall be installed.

Miscellaneous Operational

a. All pertinent landfill operating personnel shall receive training and supervision necessary to carry out their duties in a safe manner.

b. Upon closure of this facility, the closure and post-closure plan that is included in the approved plan must be implemented. The soils that are to be utilized for the

eighteen inch compacted soil layer must be tested and construction specifications for the placement of this soil be submitted to the Section for approval. All measures necessary shall be taken to close the facility in accordance with all rules in effect at that time.

Monitoring and Reporting

12. Groundwater quality at this facility is subject to the classification and remedial action provisions of 15 NCAC 2L. Water quality monitoring shall occur in accordance with the following specific conditions:

    a. The permittee shall sample the monitoring wells on a semi-annual basis, or as directed by the Section Hydrogeologist.
    b. Sampling methods and equipment shall conform to specifications found in Attachment 2, "North Carolina Water Quality Monitoring Guidance Document for Solid Waste Facilities". Sampling parameters shall conform to those found in Attachment 3, "Sampling and Analysis Requirements".
    c. The permittee shall maintain a record of all monitoring events and analytical data. Reports of the analytical data for each sampling event shall be submitted to the Division in a timely manner.
    d. Prior to the acceptance of waste, a background sampling event shall be performed. The results of this sampling event shall be submitted to the Section Hydrogeologist in a timely manner. (See Construction and Operation Condition 3(d).)
    e. Well completion records and boring logs shall be submitted to the Division at the same time as the results of the initial sampling event. (See Construction and Operation Condition 3(d).)

13. Explosive gas monitoring shall be performed as needed to ensure compliance with the standards in Rule .0503 (2)(a).

14. The permittee shall maintain a record of the amount of waste (in tons) that is received at the facility, compiled on a monthly basis by type and county of origin.

15. On or before 01 August of each year the permittee shall report the amount of waste received at this facility and disposed of in the landfill to the Division and to all counties from which waste was accepted, on forms prescribed by the Division.

16. All pertinent records and reports shall be kept on site and made available to the Division upon request.

PERMIT NUMBER 34-12
ISSUED 3 JULY 1996
AMENDED 15 OCTOBER 1999

ATTACHMENT 1

List of Documents for the Approved Plan

1. Site Plan Application; submitted by HDR Engineering, Inc. April, 1995

2. Construction Plan Application; submitted by HDR Engineering, Inc. June, 1995

3. Legal Description of the Facility

4. Letter dated 17 June 1997 submitted to the Section by HDR Engineering, Inc. certifying the western half of Phase 1A.

5. Letter dated 12 January 1998 submitted to the Section by HDR Engineering, Inc. providing Certification No.3 for Phase I.

6. Letter dated 1 April 1998 submitted to the Section by HDR Engineering, Inc. providing Certification No. 4 for the Phase 1 Area.

7. Letter dated 30 July 1998 submitted to the Section by HDR Engineering, Inc. providing Certification No. 5 for the Phase 1 Area.

8. Construction Plan Application Phase II & III; submitted by HDR Engineering, Inc. April 1999

9. Letter dated 11 May 1999 submitted to the Section by HDR Engineering, Inc. providing Certification No. 6 for Phase I and II Areas.

10. Letter Dated 8 October 1999 submitted to the Section by HDR Engineering, Inc. providing amendments to the Groundwater Monitoring Plan.

March 8, 1999

HDR

Mr. Bobby Lutfy
North Carolina Department of Environment
and Natural Resources
Division of Solid Waste Management
Solid Waste Section
P. O. Box 27687
Raleigh, North Carolina 27611-7687

Re: Modifications to Ground-Water Monitoring Well Network
Winston-Salem Construction and Demolition Landfill (#34-12)
Forsyth County, North Carolina
HDR Project No. 00162-090-018

Dear Mr. Lutfy:

HDR Engineering, Inc. of the Carolinas (HDR) is hereby submitting, on behalf of the City of Winston-Salem Utilities Division, a request to modify the existing ground-water monitoring well network at the C&D Landfill located in Forsyth County, North Carolina. This request is being submitted for the following reasons:

1) The current location of existing ground-water monitoring wells MW-3 and MW-6 (see attached site drawing) are within the footprints of Phase II and III of the proposed landfill expansion plan. Therefore, these wells must be abandoned and replaced.

2) The permitting of Phase III requires the installation of a new ground-water monitoring well to monitor the quality of the ground water downgradient of this phase. The permitting of Phases II and III is ongoing at this time

At this time, there are seven wells in the C&D Landfill monitoring network. Please see attached Drawing D-1. During the most recent semiannual ground-water sampling event performed at the landfill in November 1998, earthwork had begun in the vicinity of monitoring well MW-3 for the preparation of base grades for Phase II. At present, stockpiled soil from the excavation of Phase II is located within the limits of Phase III. However, HDR is currently working on the permit application for both Phase II and Phase III. In addition, HDR has estimated that the life expectancy of Phase II would be 3.2 years and the life expectancy of Phase III would be 4.8 years.

HDR is proposing the following modifications to the existing ground-water monitoring well network at the C&D Landfill:

1) Abandon existing ground-water monitoring well MW-3 and install ground-water monitoring well MW-3R outside the limits of construction, just to the south of sedimentation basin No. 4 (approximately 75 feet from the edge of Phase II).

HDR Engineering, Inc.
of the Carolinas

Employee-owned

Suite 1400
128 S. Tryon Street
Charlotte, North Carolina
28202-5001

Telephone
704 338-6700
Fax
704 338-6760

2) Abandon existing ground-water monitoring well MW-6 and install ground-water monitoring well MW-6R east of its present location at a distance of approximately 75 feet from the edge of Phase II.

3) Install ground-water monitoring well MW-8 outside the limits of construction, just west of sedimentation basin No. 5 at a distance of approximately 75 feet from the edge of Phase III.

4) Modify the existing Ground-Water Monitoring Plan to reflect these changes to the monitoring well network.

All wells installed would be constructed with 15-foot well screens and in accordance with the North Carolina Well Construction Standards, Subchapter 2C, Section .0100 utilizing a North Carolina-certified well driller. Well installation diagrams, abandonment records, soil boring, and survey coordinate data will be submitted to the Solid Waste Section upon completion of the work.

The sampling of the proposed ground-water monitoring well MW-8 would not be implemented until approximately 3 years after initiation of landfilling activities in Phase II. Water level measurements would be collected from this well on a semiannual basis until sampling is initiated. Adjustments to this implementation schedule may be made as airspace monitoring of Phase II is performed.

Please review this submittal and offer any comments you may have. If you have any questions or comments concerning the information summarized in this request, please do not hesitate to contact me at (704) 338-6832.

Sincerely,

HDR Engineering, Inc. of the Carolinas

Curtis M. Wells

for John R. Isham, P.G.
Project Hydrogeologist

JRI/nt

Attachments: Existing and Proposed Ground-Water Monitoring Well Locations

cc: Ed Gibson, Winston-Salem Solid Waste Administrator

NORTH CAROLINA DEPARTMENT OF
ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF WASTE MANAGEMENT

NCDENR

JAMES B. HUNT JR.
GOVERNOR

WAYNE MCDEVITT
SECRETARY

WILLIAM L. MEYER
DIRECTOR

August 13, 1998

Mr. Barry Shearin, Utilities Supervisor
City of Winston-Salem
P.O. Box 2511
Winston-Salem, North Carolina 27102

Re: Solid Waste Permit No. 34-12
City of Winston-Salem Construction and Demolition Landfill located on Old Salisbury Road, Winston-Salem, Forsyth County, North Carolina

Dear Mr. Shearin:

The referenced PERMIT TO OPERATE is issued in accordance with N.C.G.S. 130A-294 and the N.C. Solid Waste Management Rules 15A NCAC 13B. The letter submitted to the Section, dated 30 July 1998 by Joe Readling of HDR, will be listed in Attachment 1, list of documents as item #7 and is included in the Approved Plans for this facility.

This permit is for a five-year period and will be reviewed on 9 November 2000, consistent with Solid Waste Management Rules. At the end of this five-year period, the City of Winston-Salem may apply for an expansion for the use of additional cells, but will be subject to all rules in effect at that time. This permit is issued to the City of Winston-Salem as the owner and operator of the facility.

Please refer to the GENERAL Conditions of the Permit to Construct (PTC), issued 9 November 1995, for the definition of the approved plan and for general terms of the Solid Waste Permit. The CONSTRUCTION AND OPERATION conditions, in the PTC issued 9 November 1995, describe permitted fill areas, acceptable waste types, landfill operation, and requirements which must be satisfied prior to operation of the facility as a C&D landfill. Specific requirements for groundwater monitoring and facility record keeping and reporting are described in the MONITORING AND REPORTING conditions.

401 OBERLIN ROAD, SUITE 150, RALEIGH, NC 27605
PHONE 919-733-4996 FAX 919-715-3605

AN EQUAL OPPORTUNITY / AFFIRMATIVE ACTION EMPLOYER

Please review the Conditions of Permit thoroughly. If you need further clarification, please contact me at (336) 771-4608 ext. 204 or Mr. Brent Rockett, the Waste Management Specialist for this area, at (336) 771-4608 ext. 208.

Sincerely,

Timothy A. Jewett
Western Area Engineer
Solid Waste Section

cc: Jim Coffey
Julian Foscue
Brent Rockett
Central File: Forsyth County; Permit file #34-12

NORTH CAROLINA DEPARTMENT OF
ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF WASTE MANAGEMENT

NCDENR

JAMES B. HUNT JR.
GOVERNOR

WAYNE MCDEVITT
SECRETARY

WILLIAM L. MEYER
DIRECTOR

PERMIT NUMBER 34-12
ISSUED 9 NOVEMBER 1995
MODIFIED 13 AUGUST 1998

SOLID WASTE PERMIT

THE CITY OF WINSTON-SALEM

is hereby issued a PERMIT TO OPERATE a

CONSTRUCTION AND DEMOLITION LANDFILL

Certification No. 5 of the Phase I Area located within the Old Salisbury Road C&D Landfill Facility

located on Old Salisbury Road in Forsyth County, North Carolina based on the site plan submitted to the Section dated April 1995 and referenced as item #1 of the approved documents; in accordance with Article 9, Chapter 130A, of the General Statutes of North Carolina and all rules promulgated thereunder and subject to the conditions set forth in this permit.

James C. Coffey

James C. Coffey, Supervisor
Permitting Branch
Solid Waste Section

401 OBERLIN ROAD, SUITE 150, RALEIGH, NC 27605
PHONE 919-733-4996 FAX 919-715-3605

AN EQUAL OPPORTUNITY / AFFIRMATIVE ACTION EMPLOYER - 50% RECYCLED/10% POST-CONSUMER PAPER

State of North Carolina
Department of Environment,
Health and Natural Resources
Winston-Salem Regional Office

James B. Hunt, Jr., Governor
Jonathan B. Howes, Secretary
Leesha Fuller, Regional Manager

DEHNR

July 3, 1996

RECEIVED
JUL 8 1996
CHARLOTTE, N.C.

Mr. Thomas Griffin
City of Winston-Salem
Utilities Division
P.O. Box 2511
Winston-Salem, NC 27102

Subject: City of Winston-Salem
Solid Waste Permit #34-12
Forsyth County

Dear Mr. Griffin:

Enclosed please find a solid waste permit and the accompanying conditions for the subject facility, issued in accordance with N.C.G.S. 130A-294 and the NC Solid Waste Management Rules, subject to the Conditions of Permit. This permit is issued for a five year period or until the approved capacity of the certified area of Phase 1 (Drawing CERT-1 dated June 28, 1996) is exhausted.

Please review the conditions of permit carefully and contact me if you have questions about them. Please contact Jim Bateson at (919) 733-0692 (extension 342) for assistance with issues concerning the groundwater monitoring plan for the site, or me at (910) 771-4608 (extension 204) for questions about other aspects of the permit.

Sincerely,

Matthew E. Gantt, E.I.T.
Western Area Engineer
Solid Waste Section

cc: Jim Coffey
Julian Foscue
Brent Rockett
Joe Readling

PERMIT #34-12
ISSUED 3 JULY 1996

SOLID WASTE PERMIT

CITY OF WINSTON-SALEM

is hereby issued a permit to operate a

CONSTRUCTION AND DEMOLITION LANDFILL

located on Old Salisbury Road in Forsyth County, North Carolina in accordance with Article 9, Chapter 130A, of the General Statutes of North Carolina and all rules promulgated thereunder and subject to the conditions set forth in this permit.

James C. Coffey
Permitting Branch
Solid Waste Section

Post-it® Fax Note 7671	Date 4/5/99	# of pages ▶ 9
To PHILLIP WESTMORELAND	From TIM JEWETT	
Co./Dept. HDR, ENGINEERING	Co. NC SOLID WASTE SECTION	
Phone # (704) 338-6743	Phone # (336) 771-4600	
Fax # (704) 338-6760	Fax # (336) 771-4631	

PERMIT #34-12
ISSUED 3 JULY 1996
MODIFIED 12 JANUARY 1998

STATE OF NORTH CAROLINA

DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

DIVISION OF SOLID WASTE MANAGEMENT

P.O. BOX 27687RALEIGH, NC 27611

SOLID WASTE PERMIT

THE CITY OF WINSTON-SALEM

is hereby issued a PERMIT TO OPERATE a

CONSTRUCTION AND DEMOLITION LANDFILL
Certification No. 3 Area of Phase I located within the Old Salisbury Road C&D Landfill Facility

located on Old Salisbury Road in Forsyth County, North Carolina based on the site plan submitted to the Section dated April 1995 and referenced as item #1 of the approved documents; in accordance with Article 9, Chapter 130A, of the General Statutes of North Carolina and all rules promulgated thereunder and subject to the conditions set forth in this permit.

James C. Coffey
Permitting Branch
Solid Waste Section

PERMIT #34-12
ISSUED 3 JULY 1996
MODIFIED 12 JANUARY 1998

CITY OF WINSTON-SALEM

SOLID WASTE PERMIT
CONSTRUCTION AND DEMOLITION LANDFILL

CONDITIONS OF PERMIT

General:

1. This permit shall not be effective unless the certified copy is filed in the Register of Deeds office and indexed in the grantor index under the name of the owner of the land in the county or counties in which the land is located. The certified copy of the permit, affixed with the Register's seal and the date, book, and page number of recording shall be returned to the Division of Solid Waste Management (the Division).

2. When this property is sold, leased, transferred or conveyed, the deed or other instrument of transfer shall contain in the description section in no smaller type than that used in the body of the deed or instrument, a statement that the property has been used as a sanitary landfill.

3. The approved plan for this facility is described in Attachment 1, "List of Documents for Approved Plan". Where discrepancies exist, the most recent submittal and these Conditions shall govern. Some components of the approved plan may be reiterated in these Conditions.

4. This permit is not transferable.

5. A copy of this permit and the approved plan shall be maintained at the facility.

6. The owner/operator is responsible for obtaining any and all permits and approvals necessary for the development of this project including approval from appropriate agencies for a General or Individual NPDES Stormwater Discharge Permit.

7. This permit is subject to review every five years, on or before 3 July 2001, as per 15A NCAC 13B .0201(c), according to the issuance date of the permit. Modifications may be required in accordance with the rules in effect at the time of review.

Construction and Operation:

1. This permit is for the development of the landfill within the approved facility description, Document 3 of the approved plan. Within the approved facility, development of the landfill unit is approved in Phase 1 - Certification Area No. 3 as shown on Drawing CERT-3 of Document 5.

2. All sedimentation and erosion control measures shall be conducted in accordance with the Sedimentation Control Act codified at 15 NCAC 4. Native vegetation shall be established on the completed landfill.

3. The following requirements shall be met prior to operation of this facility:

   a. The City of Winston-Salem or its consultant shall provide documentation to the Division that site preparation (grading, placement of fill if applicable, etc.) has occurred in accordance with the construction plan and the conditions specified herein.
   b. Site inspection shall be made by a representative of the Division.
   c. Signs shall be posted at the facility in accordance with the NC Solid Waste Management Rules.
   d. Groundwater monitoring wells shall be installed in accordance with the approved groundwater monitoring plan, as described in *First Attachment of Additions and Modifications to Groundwater Monitoring Plan, October, 1995*, of Document 1, and as shown on Drawing C-6 of Document 1. A baseline sampling event for background water quality shall be performed. (See Monitoring and Reporting Conditions 1(d) and 1(e).)
   e. Recordation shall be implemented as described in General Conditions 1 and 2.
   f. The three existing monitoring wells that will be replaced with new wells, MW-1, MW-4, and MW-5, and the old bored water supply well near the southeast corner of the site, will be properly abandoned in accordance with 15A NCAC 2C .0113(a)(2).
   g. A comprehensive operations plan shall be submitted to the Division.

4. Operation of the facility shall occur in accordance with the NC Solid Waste Management Rules 15A NCAC 13B .0505, "Operational Requirements for Sanitary Landfills", the approved Operations Plan, and the following specific conditions:

   Waste Acceptance and Disposal

   a. This solid waste management facility is approved to receive only the following:
      i. Land-clearing debris as defined in G.S. 130A-290;
      ii. Asphalt in accordance with G.S. 130A-294(m);

iii. Construction and demolition debris defined as solid waste resulting solely from construction, remodeling, repair or demolition operations on pavement, buildings, or other structures;

iv. Inert debris defined as solid waste which is virtually inert, such as brick, concrete, rock and uncontaminated soil.

Note: Yard trash defined as solid waste consisting solely of vegetative matter resulting from landscaping maintenance (see G.S. 130A-290) is banned from disposal in this facility as per NC General Statutes.

b. Waste shall be restricted to the smallest area feasible and compacted as densely as practical into cells.

c. The permittee shall implement a program for detecting and preventing the disposal of unacceptable wastes. The program shall include, at a minimum:

i. Random inspections of incoming loads or other comparable procedures;

ii. Recordkeeping which documents these inspections;

iii. Training of personnel to recognize hazardous and other unauthorized waste types;

iv. Development of a contingency plan to properly manage any identified problem wastes; including provisions for removal, storage, and final disposition of these wastes.

Cover Material Requirements

a. Operational soil cover of at least six inches shall be placed at least once per week or when the active area reaches 1/2 acre in size or more often as necessitated by the nature of the waste so as to prevent the site from becoming a visual nuisance and to prevent fire, windblown materials, vectors or water infiltration.

b. Areas which will not have additional waste placed on them for 12 months or more, but where final elevations have not been reached, shall be covered with one foot of soil cover.

c. Within six months of termination of disposal operations the final cover system shall be installed.

Miscellaneous Operational

a. All pertinent landfill operating personnel shall receive training and supervision necessary to carry out their duties in a safe manner.

b. Upon closure of this facility, the closure and post-closure plan that is included in the approved plan must be implemented. The soils that are to be utilized for the eighteen

inch compacted soil layer must be tested and construction specifications for the placement of this soil be submitted to the Section for approval. All measures necessary shall be taken to close the facility in accordance with all rules in effect at that time.

Monitoring and Reporting

1. Groundwater quality at this facility is subject to the classification and remedial action provisions of 15 NCAC 2L. Water quality monitoring shall occur in accordance with the following specific conditions:

   a. The permittee shall sample the monitoring wells on a semi-annual basis, or as directed by the Section Hydrogeologist.
   b. Sampling methods and equipment shall conform to specifications found in Attachment 2, "North Carolina Water Quality Monitoring Guidance Document for Solid Waste Facilities". Sampling parameters shall conform to those found in Attachment 3, "Sampling and Analysis Requirements".
   c. The permittee shall maintain a record of all monitoring events and analytical data. Reports of the analytical data for each sampling event shall be submitted to the Division in a timely manner.
   d. Prior to the acceptance of waste, a background sampling event shall be performed. The results of this sampling event shall be submitted to the Section Hydrogeologist in a timely manner. (See Construction and Operation Condition 3(d).)
   e. Well completion records and boring logs shall be submitted to the Division at the same time as the results of the initial sampling event. (See Construction and Operation Condition 3(d).)

2. Explosive gas monitoring shall be performed as needed to ensure compliance with the standards in Rule .0503 (2)(a).

3. The permittee shall maintain a record of the amount of waste (in tons) that is received at the facility, compiled on a monthly basis by type and county of origin.

4. On or before 01 August 1997, and each year thereafter, the permittee shall report the amount of waste received at this facility and disposed of in the landfill to the Division and to all counties from which waste was accepted, on forms prescribed by the Division.

5. All pertinent records and reports shall be kept on site and made available to the Division upon request.

PERMIT #34-12
ISSUED 3 JULY 1996
MODIFIED 12 JANUARY 1998

ATTACHMENT 1

List of Documents for the Approved Plan

1. Site Plan Application; submitted by HDR Engineering, Inc. April, 1995
2. Construction Plan Application; submitted by HDR Engineering, Inc. June, 1995
3. Legal Description of the Facility
4. Letter dated 17 June 1997 submitted to the Section by HDR Engineering, Inc. certifying the western half of Phase 1A.
5. Letter dated 12 January 1998 submitted to the Section by HDR Engineering, Inc. providing Certification No.3 for Phase I.

State of North Carolina
Department of Environment,
Health and Natural Resources
Winston-Salem Regional Office

James B. Hunt, Jr., Governor
Jonathan B. Howes, Secretary
Leesha Fuller, Regional Manager

November 9, 1995

Mr. Thomas Griffin
City of Winston-Salem
Utilities Division
P.O. Box 2511
Winston-Salem, NC 27102

Subject: City of Winston-Salem
Solid Waste Permit #34-12
Forsyth County

Dear Mr. Griffin:

Enclosed please find a solid waste permit and the accompanying conditions for the subject facility, issued in accordance with N.C.G.S. 130A-294 and the NC Solid Waste Management Rules, subject to the Conditions of Permit. This permit is issued for a five year period or until the approved capacity of Phase 1 is exhausted.

Please review the conditions of permit carefully and contact me if you have questions about them. Note in particular Construction and Operation Condition No. 3 which establishes the requirements which must be met before the Section can issue approval to operate this landfill. Please contact Jim Bateson at (919) 733-0692 (extension 342) for assistance with issues concerning the groundwater monitoring plan for the site, or me at (910) 771-4608 (extension 204) for questions about other aspects of the permit.

Sincerely,

Janis D. McHargue, PE
Western Area Engineer
Solid Waste Section

cc: Jim Coffey
Julian Foscue

State of North Carolina
Department of Environment,
Health and Natural Resources
Division of Solid Waste Management

James B. Hunt, Jr., Governor
Jonathan B. Howes, Secretary
William L. Meyer, Director

DEHNR

PERMIT #34-12
ISSUED 9 NOVEMBER 1995

SOLID WASTE PERMIT

CITY OF WINSTON-SALEM

is hereby issued a permit to construct and operate a

CONSTRUCTION AND DEMOLITION LANDFILL

located on Old Salisbury Road in Forsyth County, North Carolina in accordance with Article 9, Chapter 130A, of the General Statutes of North Carolina and all rules promulgated thereunder and subject to the conditions set forth in this permit.

James C. Coffey
Permitting Branch
Solid Waste Section

P.O. Box 27687, Raleigh, North Carolina 27611-7687 Telephone 919-733-4996 FAX 919-715-3605
An Equal Opportunity Affirmative Action Employer 50% recycled/ 10% post-consumer paper

Permit #34-12
Issued 9 November 1995

CITY OF WINSTON-SALEM

SOLID WASTE PERMIT
CONSTRUCTION AND DEMOLITION LANDFILL

CONDITIONS OF PERMIT

General:

1. This permit shall not be effective unless the certified copy is filed in the Register of Deeds office and indexed in the grantor index under the name of the owner of the land in the county or counties in which the land is located. The certified copy of the permit, affixed with the Register's seal and the date, book, and page number of recording shall be returned to the Division of Solid Waste Management (the Division).

2. When this property is sold, leased, transferred or conveyed, the deed or other instrument of transfer shall contain in the description section in no smaller type than that used in the body of the deed or instrument, a statement that the property has been used as a sanitary landfill.

3. The approved plan for this facility is described in Attachment 1, "List of Documents for Approved Plan". Where discrepancies exist, the most recent submittal and these Conditions shall govern. Some components of the approved plan may be reiterated in these Conditions.

4. This permit is not transferable.

5. A copy of this permit and the approved plan shall be maintained at the facility.

6. The owner/operator is responsible for obtaining any and all permits and approvals necessary for the development of this project including approval from appropriate agencies for a General or Individual NPDES Stormwater Discharge Permit.

7. This permit is subject to review every five years as per 15A NCAC 13B .0201(c), according to the issuance date of the permit. Modifications may be required in accordance with the rules in effect at the time of review.

Construction and Operation:

1. This permit is for the development of the landfill within the approved facility description, Document 3 of the approved plan. Within the approved facility, development of the landfill unit is approved in Phase 1, as shown on Drawing C-2 of Document 2.

2. All sedimentation and erosion control measures shall be conducted in accordance with the Sedimentation Control Act codified at 15 NCAC 4. Native vegetation shall be established on the completed landfill.

3. The following requirements shall be met prior to operation of this facility:

   a. The City of Winston-Salem or its consultant shall provide documentation to the Division that site preparation (grading, placement of fill if applicable, etc.) has occurred in accordance with the construction plan and the conditions specified herein.
   b. Site inspection shall be made by a representative of the Division.
   c. Signs shall be posted at the facility in accordance with the NC Solid Waste Management Rules.
   d. Groundwater monitoring wells shall be installed in accordance with the approved groundwater monitoring plan, as described in *First Attachment of Additions and Modifications to Groundwater Monitoring Plan, October, 1995,* of Document 1, and as shown on Drawing C-6 of Document 1. A baseline sampling event for background water quality shall be performed. (See Monitoring and Reporting Conditions 1(d) and 1(e).)
   e. Recordation shall be implemented as described in General Conditions 1 and 2.
   f. The three existing monitoring wells that will be replaced with new wells, MW-1, MW-4, and MW-5, and the old bored water supply well near the southeast corner of the site, will be properly abandoned in accordance with 15A NCAC 2C .0113(a)(2).
   g. A comprehensive operations plan shall be submitted to the Division.

4. Operation of the facility shall occur in accordance with the NC Solid Waste Management Rules 15A NCAC 13B .0505, "Operational Requirements for Sanitary Landfills", the approved Operations Plan, and the following specific conditions:

   Waste Acceptance and Disposal

   a. This solid waste management facility is approved to receive only the following:
      i. Land-clearing debris as defined in G.S. 130A-290;
      ii. Asphalt in accordance with G.S. 130A-294(m);
      iii. Construction and demolition debris defined as solid waste resulting solely

from construction, remodeling, repair or demolition operations on pavement, buildings, or other structures;

iv. Inert debris defined as solid waste which is virtually inert, such as brick, concrete, rock and uncontaminated soil.

Note: Yard trash defined as solid waste consisting solely of vegetative matter resulting from landscaping maintenance (see G.S. 130A-290) is banned from disposal in this facility as per NC General Statutes.

b. Waste shall be restricted to the smallest area feasible and compacted as densely as practical into cells.

c. The permittee shall implement a program for detecting and preventing the disposal of unacceptable wastes. The program shall include, at a minimum:
   i. Random inspections of incoming loads or other comparable procedures;
   ii. Recordkeeping which documents these inspections;
   iii. Training of personnel to recognize hazardous and other unauthorized waste types;
   iv. Development of a contingency plan to properly manage any identified problem wastes; including provisions for removal, storage, and final disposition of these wastes.

Cover Material Requirements

a. Waste shall be covered once per week with at least 6 inches of suitable cover, or more frequently if necessary to prevent a public health nuisance.
b. Areas which will not have additional waste placed on them for 12 months or more, but where final elevations have not been reached, shall be covered with one foot of soil cover.
c. Within six months of termination of disposal operations the final cover system shall be installed.

Miscellaneous Operational

a. All pertinent landfill operating personnel shall receive training and supervision necessary to carry out their duties in a safe manner.
b. Upon closure of this facility, the closure and post-closure plan that is included in the approved plan must be implemented. The soils that are to be utilized for the eighteen inch compacted soil layer must be tested and construction specifications for the placement of this soil be submitted to the Section for approval. All measures

necessary shall be taken to close the facility in accordance with all rules in effect at that time.

Monitoring and Reporting

1. Groundwater quality at this facility is subject to the classification and remedial action provisions of 15 NCAC 2L. Water quality monitoring shall occur in accordance with the following specific conditions:

   a. The permittee shall sample the monitoring wells on a semi-annual basis, or as directed by the Section Hydrogeologist.
   b. Sampling methods and equipment shall conform to specifications found in Attachment 2, "North Carolina Water Quality Monitoring Guidance Document for Solid Waste Facilities". Sampling parameters shall conform to those found in Attachment 3, "Sampling and Analysis Requirements".
   c. The permittee shall maintain a record of all monitoring events and analytical data. Reports of the analytical data for each sampling event shall be submitted to the Division in a timely manner.
   d. Prior to the acceptance of waste, a background sampling event shall be performed. The results of this sampling event shall be submitted to the Section Hydrogeologist in a timely manner. (See Construction and Operation Condition 3(d).)
   e. Well completion records and boring logs shall be submitted to the Division at the same time as the results of the initial sampling event. (See Construction and Operation Condition 3(d).)

2. Explosive gas monitoring shall be performed as needed to ensure compliance with the standards in Rule .0503 (2)(a).

3. The permittee shall maintain a record of the amount of waste (in tons) that is received at the facility, compiled on a monthly basis by type and county of origin.

4. On or before 01 August 1997, and each year thereafter, the permittee shall report the amount of waste received at this facility and disposed of in the landfill to the Division and to all counties from which waste was accepted, on forms prescribed by the Division.

5. All pertinent records and reports shall be kept on site and made available to the Division upon request.

Permit #34-12
Issued 9 Nov 1995

ATTACHMENT 1

List of Documents for the Approved Plan

1. Site Plan Application; submitted by HDR Engineering, Inc. April, 1995
2. Construction Plan Application; submitted by HDR Engineering, Inc. June, 1995
3. Legal Description of the Facility

CERTIFIED COPY OF SOLID WASTE PERMIT

I do hereby certify that the attached permit is an exact and true copy of Permit Number 34-12.

James C Coffey

James C. Coffey, Supervisor
Permitting Branch
Solid Waste Section

North Carolina

Wake County

I, Sue S. Hodge, a Notary Public for said County and State, do hereby certify that James C. Coffey, Supervisor, Permitting Branch, personally appeared before me this day and acknowledged the due execution of the foregoing instrument.

Witness my hand and seal, this the 7 day of November, 1995.

Sue S. Hodge

Notary Public

My commission expires October 21, ~~19~~ 2000.

131

[illegible] 10 [illegible] 2071
PRESENTED FOR
REGISTRATION
AND RECORDED

'94 APR -7 P3:59

L.E. SPEAS
REGISTER OF DEEDS
FORSYTH CO. N.C.

$12.00 PD
[illegible]

STATE OF NORTH CAROLINA

$140.00

Real Estate Excise Tax

Excise Tax $140.00

Recording Time, Book and Page

Tax Lot No. 1-7, Block 3872 Parcel Identifier No.

Verified by County on the day of , 19

by

Mail after recording to Drawer of Leslie E. Browder

This instrument was prepared by PARKS ROBERTS, ATTORNEY AT LAW

Brief description for the Index

NORTH CAROLINA GENERAL WARRANTY DEED

THIS DEED made this 29th day of MARCH , 19 94 , by and between

GRANTOR	GRANTEE
GARRIS E. EDWARDS and wife, JUDITH B. EDWARDS	NORTH CAROLINA MUNICIPAL LEASING CORPORATION

Enter in appropriate block for each party: name, address, and, if appropriate, character of entity, e.g. corporation or partnership.

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.

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 that certain lot or parcel of land situated in the City of South Fork Township, Forsyth County, North Carolina and more particularly described as follows:

SEE ATTACHED SHEET MARKED EXHIBIT "A" FOR COMPLETE DESCRIPTION AND INCORPORATED HEREIN BY REFERENCE.

C. Bar Assoc. Form No. 3 © 1976, Revised © 1977 [illegible]

The property hereinabove described was acquired by Grantor by instrument recorded in .....

.....

A map showing the above described property is recorded in Plat Book ..... 10 ..... page ..... 43 .....

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 and restrictive covenants of record, if any. 1994 ad valorem taxes to be prorated.

IN WITNESS WHEREOF, the Grantor has hereunto set his hand and seal, or if corporate, has caused this instrument to be signed in its corporate name by its duly authorized officers and its seal to be hereunto affixed by authority of its Board of Directors, the day and year first above written.

..... (Corporate Name)

By: .....

..... President

ATTEST:

.....

..... Secretary (Corporate Seal)

USE BLACK INK ONLY

Garris E. Edwards (SEAL)
GARRIS E. EDWARDS

Judith B. Edwards (SEAL)
JUDITH B. EDWARDS

..... (SEAL)

..... (SEAL)

SEAL-STAMP

BARBARA S. LOGGINS NOTARY PUBLIC STOKES COUNTY, N.C.

NORTH CAROLINA, Forsyth County.
Stokes

I, a Notary Public of the County and State aforesaid, certify that GARRIS E. EDWARDS and wife, JUDITH B. EDWARDS Grantor, personally appeared before me this day and acknowledged the execution of the foregoing instrument. Witness my hand and official stamp or seal, this 29th day of MARCH, 1994.

My commission expires: 5/6/96 Barbara S. Loggins Notary Public

Use Black Ink

SEAL-STAMP

NORTH CAROLINA, ... County.

I, a Notary Public of the County and State aforesaid, certify that .....

personally came before me this day and acknowledged that ..... he is ..... Secretary of ..... a North Carolina corporation, and that by authority duly given and as the act of the corporation, the foregoing instrument was signed in its name by its ..... President, sealed with its corporate seal and attested by ..... as its ..... Secretary.

Witness my hand and official stamp or seal, this ..... day of ..... 19.....

My commission expires: ..... Notary Public

The foregoing Certificate(s) of BARBARA S. LOGGINS, NOTARY PUBLIC, STOKES COUNTY, NORTH CAROLINA

.....

.....

is/~~are~~ certified to be correct. This instrument and this certificate are duly registered at the date and time and in the Book and Page shown on the first page hereof.

L.E. SPEAS, REGISTER OF DEEDS

..... REGISTER OF DEEDS FOR FORSYTH COUNTY

By ..... Deputy/~~Assistant~~ Register of Deeds

N.C. Bar Assoc. Form No. 3 © 1976, Revised © 1977 ...

EXHIBIT "A"

BEGINNING at an iron located in the West right of way line of Old Salisbury Road, said iron being located at the Northeast corner of James Albert Cox's property; running thence with said Cox property, North 89 degrees 28 minutes 24 seconds West 110.20 feet to an iron located at the Northeast corner of Donald R. Hege's property, North 87 degrees 58 minutes 09 seconds West 236.69 feet to an iron; running thence with the property of Ruby N. Tesh, et al, North 02 degrees 15 minutes 21 seconds East 350.01 feet to an iron located at the Southwest corner of Lot 8, as shown on the plat of C.A. Mendenhall Estate recorded in Plat Book 10, page 43, Forsyth County Registry; running thence with said Lot 8, South 88 degrees 14 minutes 11 seconds East 283.79 feet to an iron located in the West right of way line of Old Salisbury Road; running thence with the West right of way line of Old Salisbury Road, on a curve to the left, a chord distance of South 04 degrees 19 minutes 33 seconds East 190.11 feet to an iron and South 13 degrees 11 minutes 44 seconds East 165.28 feet to the POINT AND PLACE OF BEGINNING. Containing 2.45 acres, more or less, as shown on Map of City of Winston-Salem Utilities Division, dated March 15, 1994, and prepared by W. Max Brady, Registered Land Surveyor, dated March 15, 1994.

Being all of Lots 1 through 7, inclusive, as shown on plat of C.A. Mendenhall Estate property, recorded in Plat Book 10, Page 43, Forsyth County Registry, except the portion that lies within the right of way of Old Salisbury Road.

This conveyance is subject to the rights of others, if any, to use the old farm road running along the West side of subject property.

Forsyth County

STATE OF NORTH CAROLINA

$1733.00

Real Estate Excise Tax

Excise Tax

Book 1820 Page 2074
PRESENTED FOR REGISTRATION AND RECORDED

'94 APR -7 P3:59

L.E. SPEAS
REGISTER OF DEEDS
FORSYTH CO. N.C.

$12.00

Recording Time, Book and Page

Tax Lot No. ..... Parcel Identifier No. .....

Verified by ..... County on the ..... day of ....., 19 .....

by .....

Mail after recording to .....Drawer of Leslie E. Browder.....

This instrument was prepared by .....Leslie E. Browder.....

Brief description for the Index

NORTH CAROLINA GENERAL WARRANTY DEED

THIS DEED made this 7th day of April, 19 94, by and between

GRANTOR	GRANTEE
RUBY N. TESH (Widow)	NORTH CAROLINA MUNICIPAL LEASING CORPORATION, a North Carolina corporation

Enter in appropriate block for each party: name, address, and, if appropriate, character of entity, e.g. corporation or partnership.

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.

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 that certain lot or parcel of land situated in the City of ....., ...South Fork..... Township, Forsyth County, North Carolina and more particularly described as follows:

SEE EXHIBIT "A" ATTACHED HERETO AND INCORPORATED HEREIN BY REFERENCE.

N. C. Bar Assoc. Form No. 3 © 1976, Revised © 1977 – James Williams & Co., Inc., Box 127, Youngsville, N. C. 27596

The property hereinabove described was acquired by Grantor by instrument recorded in .....

.....

A map showing the above described property is recorded in Plat Book ..... page .....

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, rights of way of record and restrictive covenants of record, if any, and 1994 ad valorem taxes which have been prorated to the date of delivery of this deed of conveyance.

IN WITNESS WHEREOF, the Grantor has hereunto set his hand and seal, or if corporate, has caused this instrument to be signed in its corporate name by its duly authorized officers and its seal to be hereunto affixed by authority of its Board of Directors, the day and year first above written.

..... (Corporate Name)

By: .....

..... President

ATTEST:

.....

..... Secretary (Corporate Seal)

USE BLACK INK ONLY

Ruby N. Tesh (SEAL)
Ruby N. Tesh (Widow)

..... (SEAL)

..... (SEAL)

..... (SEAL)

SEAL-STAMP

NORTH CAROLINA, Forsyth County.

I, a Notary Public of the County and State aforesaid, certify that ..... Grantor, personally appeared before me this day and acknowledged the execution of the foregoing instrument. Witness my hand and official stamp or seal, this 7 day of April 19 94.

OFFICIAL SEAL
Notary Public, North Carolina
COUNTY OF FORSYTH
JANET F. DALTON
My Commission Expires May 19, 1997

My commission expires: 5/19/97 Janet F. Dalton Notary Public

SEAL-STAMP

NORTH CAROLINA, ... County.

I, a Notary Public of the County and State aforesaid, certify that .....

personally came before me this day and acknowledged that .... he is ..... Secretary of ..... a North Carolina corporation, and that by authority duly given and as the act of the corporation, the foregoing instrument was signed in its name by its ..... President, sealed with its corporate seal and attested by ..... as its ..... Secretary.

Witness my hand and official stamp or seal, this .....day of ..... 19.....

Use Black Ink

My commission expires: ..... Notary Public

The foregoing Certificate(s) of J. Janet F. Dalton, Notary Public

.....

.....

is/are certified to be correct. This instrument and this certificate are duly registered at the date and time and in the Book and Page shown on the first page hereof.

L.E. SPEAS, REGISTER OF DEEDS REGISTER OF DEEDS FOR FORSYTH COUNTY

By Deputy/~~Assistant~~ - Register of Deeds

N. C. Bar Assoc. Form No. 3 © 1976, Revised © 1977 ... Printed by Agreement with the N. C. Bar Assoc. ...

EXHIBIT "A"

LYING AND BEING in Southfork Township, Forsyth County, State of North Carolina, and beginning at a monument, said monument being located in the common boundary line between the counties of Forsyth and Davidson, and being the southeast corner of Lot No. 16 as set out upon that plat recorded in Plat Book 23 at Page 113 in the Office of the Register of Deeds of Forsyth County, North Carolina; and running thence from said beginning iron monument North 06° 31' 36" West 1,870.84 feet to a monument in the southern boundary line of Emory R. Snyder and wife, Sarah Bell Snyder (see Deed Book 699 at Page 316); thence along the boundary line of Emory R. Snyder, et ux, the two (2) following courses and distances: North 69° 36' 16" East 620.27 feet to an iron stake; and North 34° 37' 13" West 227.37 feet to an iron stake; thence along the boundary line of Jimmie R. Stewart (see Deed Book 1681 at Page 600) the two (2) following courses and distances: North 77° 55' 07" East 722.66 feet to an iron stake; and North 04° 06' 46" West 301.86 feet to an iron stake; thence South 89° 17' 15" East 961.41 feet to an iron stake in the western boundary line of Aren B. Beshears and wife, Ruby S. Beshears (see Deed Book 1228 at Page 1757); thence along the western boundary line of Beshears South 02° 25' 34" West 431.42 feet to an iron stake; thence along the western boundary line of F.C. Mendenhall and wife, Ersley H. Mendenhall (see Deed Book 616 at Page 309) South 02° 57' 26" West 1,185.35 feet to an iron stake; thence along a new line South 02° 57' 26" West 1,122.56 feet to an iron stake in the mutual boundary line between the counties of Forsyth and Davidson; thence along the mutual boundary line between the counties of Forsyth and Davidson the two (2) following courses and distances: North 88° 29' 39" West 199.66 feet to a monument; and North 88° 57' 18" West 1,549.24 feet to the point and place of beginning, same containing 108.24 acres, more or less, being further known as a part of Tax Lot 1, Tax Block 3881 as set out upon the Tax Maps in the Office of the Forsyth County Tax Supervisor as said maps are presently constituted, and being that same property surveyed and platted by W. Max Brady, Jr., R.L.S. on the 15th day of March, 1994.

W #1656m.

APPENDIX B

CALCULATIONS

PAW 10-22-02

TABLE 1

Construction and Demolition Landfill
Projected Operations

Phase	Area (acres)	Volume Excavated (cy)	Gross Capacity (cy)	Estimated Volume		Final Cover Soil (cy)	Excess Soil (cy)	Estimated	
				Waste (cy)	Cover Soil (cy)			Fill Rate (tpy)	Life (years)
IV	11	372,658	517,485	438,000	44,000	35,000	293,658	105,000	2.3
V	4	271,027	225,642	194,000	19,000	13,000	239,027	105,000	1.0
VI	10	457,088	415,033	347,000	35,000	33,000	389,088	105,000	1.8
Total	25	1,100,773	1,158,160	979,000	98,000	81,000	921,773	105,000	5.1

FROM AUTOCAD

NOTES:

Volume Excavated & Gross Capacity are based on computer calculated volumes from the Phase IV, V, and VI cap shown on the Proposed Final Grade Drawing, Drawing C-3 of the Phase IV, V, and VI permit application.

10 :1 waste to cover ratio assumed for both scenarios
Cover Soil includes daily and intermediate soil
2 ft Final Cover (allocated by phase, not area at final grades)
1,000 lb/cy effective waste density (average density over from 8/96 to 9/01)
Volume excavated assumes a 3:1 cut slope at phase line
Gross Capacity assumes 3:1 slopes on all faces
Phase I opened August of 1996
73,015 tons - Average since opening until 12/31/2001
110,400 tpy - 12 month rolling average ending in December 2001
105,000 tpy - Average fill rate to achieve stated life (Based on the City of Winston-Salem's knowledge of their waste stream)

PHASE IV, V, AND VI WASTE AIRSPACE

checked: PAW

4-5-6 PARCEL.txt

Parcel Volume Table: Unadjusted

Cut yards	Fill yards	Net yards	Method

Parcel: 4-5-6 TOTAL
Stratum: 800-el deep-bg 3-5-1 to 800
1155 1158185 cy 1157029 (F) Grid

Parcel: p4 Phase 4
Stratum: 800-el deep-bg 3-5-1 to 800
3 517485 cy 517483 (F) Grid

Parcel: p5 Phase 5
Stratum: 800-el deep-bg 3-5-1 to 800
0 225642 cy 225642 (F) Grid

Parcel: p6 Phase 6
Stratum: 800-el deep-bg 3-5-1 to 800
1153 415033 cy 413880 (F) Grid

* ALL QUANTITIES GENERATED BY AUTOCAD LAND DEVELOPMENT SOFTWARE.

* THESE QUANTITIES ARE BASED ON THE COMPARISON OF THE MAXIMUM DEPTH BASEGRADES ABOVE THE ESTIMATED LONG-TERM SEASONAL HIGH GROUND-WATER CONTOURS AND A 3H:1V CAP WITH 15-FOOT BENCHES EVERY 30 VERTICAL FEET.

Checked: PAW

Phase IV, V and VI Excavation

4-5-6 EARTHWORK.txt

Parcel Volume Table: Unadjusted

	Cut yards	Fill yards	Net yards	Method
Parcel: 4-5-6 TOTAL				
Stratum: p456-earthwork 99-2001 topo deep-bg				
	1100801 cy	2230	1098571	(C) Grid
Parcel: p4 PHASE 4				
Stratum: p456-earthwork 99-2001 topo deep-bg				
	372658 cy	728	371930	(C) Grid
Parcel: p5 PHASE 5				
Stratum: p456-earthwork 99-2001 topo deep-bg				
	271027 cy	0	271027	(C) Grid
Parcel: p6 PHASE 6				
Stratum: p456-earthwork 99-2001 topo deep-bg				
	457088 cy	1504	455584	(C) Grid

* All Quantities Generated By AutoCAD Land Development Software.

* These Quantities are based on the comparison of existing Topographic information and the maximum depth basegrades based on the newest estimated long-term seasonal high Groundwater contours.

APPENDIX C

DESIGN HYDROGEOLOGICAL INVESTIGATION REPORT

(Revised April 2003)
(Revised July 2003)
(Revised December 2003)

December 2, 2003

Mr. Bobby Lufty, Hydrogeologist
North Carolina Department of
Environment and Natural Resources
Division of Solid Waste Management
Solid Waste Section
401 Oberlin Road, Suite 105
Raliegh, NC 27605

Re: Old Salisbury Road C&D Landfill
Construction Permit Application
Phases IV, V, and VI
HDR Project No. 00162-525-018

Dear Mr. Lufty:

On behalf of the Winston-Salem City/County Utility Commission, HDR Engineering, Inc. of the Carolinas is submitting this response letter to the North Carolina Department of Environment and Natural Resources (NCDENR) comment letter dated May 28, 2003. Comments are based on HDR's Design Hydrogeological Investigation Report submitted on September 6, 2002. This package should be incorporated into the Construction Permit Application for the OSR Phase IV, V, and VI expansion, dated October 2002.

The following items are to be placed into or exchanged with existing information:

- **Insert** this letter into the front of the submittal.
- **Replace** part of the Design Hydrogeologic Investigation Report starting after the Appendix C tab divider up through its attached Appendix A "Hydraulic Conductivity Data."
- In Appendix C, **replace** the revised Drawing D-02 – *Ground-Water Potentiometric Map, March 4, 2003, Issue B* with the ***Issue C*** Drawing.
- **Replace** the revised Drawing C-02 – *Excavation Plan, Issue B* with the ***Issue C*** Drawing of the Construction Permit Application after the Appendices.
- **Replace** the revised Drawing C-03 – *Phase IV, V, and VI, Proposed 5 Year Grades, Issue A* with the ***Issue B*** Drawing of the Construction Permit Application after the Appendices.

- **Replace** the revised Drawing C-04 – *Cross Sections*, *Issue A* with the ***Issue B*** Drawing of the Construction Permit Application after the Appendices.
- **Replace** the revised Drawing C-05 – *Existing and Proposed Ground-Water and Methane Monitoring Well Locations*, *Issue C* with the ***Issue D*** Drawing of the Construction Permit Application after the Appendices.

If you have any questions regarding this submittal, please do not hesitate to contact me.

Sincerely,

HDR Engineering, Inc. of the Carolinas

Michael D. Plummer, P.E.
Project Engineer

MDP/det

Enclosures

cc: Tim Jewett, NCDENR
Edward Gibson, P.E., w/enclosures (4 sets)

December 2, 2003

Mr. Bobby Lufty, Hydrogeologist
North Carolina Department of Environment
and Natural Resources (NCDENR)
Solid Waste Section
401 Oberlin Road, Suite 150
Raleigh, NC 27605

RECEIVED
N.C. Dept. of ENR
DEC 0 3 2003
Winston-Salem
Regional Office

Re: Revised Design Hydrogeological Investigation Report
Old Salisbury Road C&D Landfill, Phases IV, V, and VI
Winston-Salem, Forsyth County, North Carolina
Permit No. 34-02
HDR Project No. 00162-525-018

Dear Mr. Lufty:

HDR Engineering, Inc. of the Carolinas (HDR), on behalf of the City/County Utilities Commission of Winston-Salem (City), North Carolina, is pleased to submit the above-referenced document for your review and approval. This document is being submitted in fulfillment of the Section's request dated November 6, 2002, to address the Solid Waste Section's review comments as summarized below. Specific responses to all of the comments have been provided in the order they were presented in the Section's review letter. Revised text has been attached for inclusion into the Design Hydrogeological Investigation Report.

1. **The Solid Waste Section generally defines PWR as beginning at blow counts of 100 bpf. This has been the generally accepted definition among the majority of consultants and has been the definition used by the Solid Waste Section since the early days of the program. In order to "compare apples to apples" this definition should be used. The Solid Waste Section will not require PWR revisions for this report, but in the future the accepted definition of 100 bpf must be used.**

   In the future the Solid Waste Section's definition of PWR will be used for the hydrogeologic evaluation of a landfill site.

2. **Table 2-8: Because of the limited amount of data for the newer piezometers and the fact that the baseline data is from a time of drought of historic proportions, there is still some uncertainty regarding the seasonal high water table estimates. In my last review letter I made several requests for additional water table measurements. The recent revisions did not contain any additional water table data. The Solid Waste Section consistently recommends taking at least monthly water table measurements for all piezometers in the study area from the time of installation until an approval letter is sent. I am not comfortable with only one or two sets of water table measurements for the newer piezometers. If additional water table measurements**

HDR Engineering, Inc. of the Carolinas
128 S Tryon Street
Suite 1400
Charlotte, NC 28202-5004
Phone: (704) 338-6700
Fax: (704) 338-6760
www.hdrinc.com

have been taken, please forward a copy of the data to me immediately. If additional measurements have not been made, then measurements for all the piezometers in the study area should be made as soon as possible. Also, if so much emphasis is to be given to the off-site USGS well in the evaluation of seasonal high water table, then detailed documentation needs to be provided for this well, including location, total depth, screen interval, formation materials, aspects, etc.

Additional measurements were taken on September 5, 2003. This information has been added to Table 2.6 and is included for you review.

In the Design Hydrogeological Investigation Report, Table 2-7 gives the construction and hydrogeologic details of the off-site USGS well.

3. **Table 2-9: I was not able to duplicate the Kh or Vs values for the Transition Zone. How were these values grenerated?**

The Kh value was calculated by taking the average of the Kh values for PZ-18A, PZ-22A, PZ-27, PZ-30, and PZ-31A listed on Table 2-3. The Transition Zone Vs value was calculated using the equation shown on page 25 of the report and using the hydraulic conductivity, hydraulic gradient, and effective porosity values on Table 2-9 for the Transition Zone.

4. **Drawing D-02 Ground-Water Potentionemtric Map – March 4, 2003: The water table elevation for PZ-33 is still incorrect. Additional water table readings may clarify some anomalies, especially for the piezometers having only one or two water table readings.**

Drawing D-02 has been edited to show the correct value for PZ-33 and is attached for reference. The additional water level readings have been added to Table 2-6 for your review.

5. **Drawing D-02A Estimated Long-Term Seasonal High Ground-Water Potentiometric Map: Because of the significant topographic relief, limited boring density, and limited water table data for the newer piezometers, there is still some concern about the seasonal high water table estimates.**

HDR is providing an additional set of water level readings for the onsite piezometers. In addition the base grades have been modified to maintain a minimum 6-foot separation from the estimated long-term seasonal high ground-water potientiometric surface. Drawings C-02 "Excavation Plan" and C-04 "Cross Sections" have been revised to show the new base grades. The new readings and additional separation should provide an added level of confidence for NCDENR in the hydrogeologic investigation.

6. **Drawing C-05 Existing and Proposed Ground-Water and Methane Monitoring Well Locations: Proposed well MW-9 is on the top of a knoll and would not appear to provide meaningful data. There are not enough wells in this area to provide sufficient detail of ground-water flow; however, one would assume with the ridgelines and knoll that there would be some divergence of ground-water flow. Proposed well MW-9 needs to be relocated and/or possibly replaced with two wells in better locations. Although the scale makes it somewhat difficult to interpret, it appears that the locations of proposed wells MW-12 and MW-13 still need to be slightly adjusted to ensure they are in the mouth of the drainage features. Proposed well MW-11 really should be located at the mouth of the large drainage feature. Is it possible to reconfigure the design of the sediment basin to enable the proper location for well MW-11?**

   Based on our meeting on September 9, 2003, with NCDENR, HDR has revised Drawing C-05 to show the well locations agreed upon. HDR has added MW-14 and shifted the locations of MW-9, 10, 11, 12, and 13. The revised drawing is attached for your review.

7. **Drawing C-02 Excavation Plan: There are still some concerns about adequate vertical separation. In a couple of areas there is apparently only 3 to 5 feet of separation from the seasonal high water table. There is a possible problem with rock at the B-19 location. And the outlets for Sedimentation Basins #6 and #7 are still shown to be at or below the seasonal high water table. The piezometer and boring locations need to appear on this drawing.**

   Drawing C-02 "Excavation Plan" has been revised to provide a minimum 6-foot separation from the estimated long-term seasonal high ground-water potientiometric surface and to show the piezometer and boring locations.

   B-19 was a boring installed by S&ME in 1994. This boring like B-18 was terminated at 48.6 feet below groundsurface by S&ME. Both B-18 and B-19 are located in the same knoll. HDR showed that this termination point was not rock in B-18, which is located at the pinnacle of the knoll, by drilling an additional 39.4 feet to top of bedrock. In addition, HDR has generated a top of bedrock map, Drawing D-4, based on the findings in the field, which has shown that the bedrock onsite is not the limiting surface for basegrades.

   Based on our meeting on September 9, 2003, with NCDENR, Sedimentation Basin #6 will remain as originally designed and the base of #7 has been raised 6 feet to Elevation 743 MSL. Drawing C-02 "Excavation Plan" and C-03 "Phase IV, V, and VI Proposed 5 Year Grades" have been revised to show the new sediment basin configuration. These drawings are attached for you review.

Drawing C-02 has been revised to show the piezometer and boring locations.

8. **Figure-1 Wetland Delineation Map: This Map is still confusing. Although I think I was finally able to get oriented for the upper diagram, I have still not been able to figure out the lower diagram. Could some directions or points of reference be added that would help?**

The upper diagram and the lower diagram are of the same drainage feature located along the eastern side of Phases IV and VI. The upper diagram from left to right starts at the northernmost point of the drainage feature at the property line and extends southward to the entrance road. The wetland delineation points are numbered sequentially and match the upper and lower diagrams.

If you have any questions or comments regarding the information in this letter or enclosed document, do not hesitate to call me at (704) 338-6843.

Sincerely,

Michael D. Plummer, PE
Project Engineer

MDP/jvd

Enclosures

cc: Jan McHargue, PE – City of Winston-Salem
Ed Gibson, PE – City of Winston-Salem
Tim Jewett – NCDENR

July 31, 2003

Mr. Bobby Lufty, Hydrogeologist
North Carolina Department of Environment
and Natural Resources (NCDENR)
Solid Waste Section
401 Oberlin Road, Suite 150
Raleigh, NC 27605

Re: Revised Design Hydrogeological Investigation Report
Old Salisbury Road C&D Landfill, Phases IV, V, and VI
Winston-Salem, Forsyth County, North Carolina
Permit No. 34-02
HDR Project No. 00162-525-018

Dear Mr. Lufty:

HDR Engineering, Inc. of the Carolinas (HDR), on behalf of the City/County Utilities Commission of Winston-Salem, North Carolina, is pleased to submit the above-referenced document for your review and approval. This document is being submitted in fulfillment of the Section's request dated November 6, 2002 to address the Solid Waste Section's review comments as summarized below. Specific responses to all of the comments have been provided in the order they were presented in the Section's review letter. Revised text has been attached for inclusion into the Design Hydrogeological Investigation Report.

1. **Page 2, According to Drawing D-01, topography at the site ranges from about 722 to 852 feet.**

   The text for Page 2 has been revised to read "....the site and surrounding area is gently rolling with elevations ranging from approximately 722 to 852 feet above mean sea level (MSL)".

2. **Page 4, the Solid Waste Section generally defines PWR as beginning at blow counts of 100 bpf.**

   For the purpose of this report, HDR has chosen to adopt the definition of Partially Weathered Rock as soil which exhibits standard penetration blow counts (N-values) of greater that 50 blows per foot (bpf) as defined in G. F. Sovers (1963).

3. **Page 5, the Core Location references should be to PZ-32A.**

   The core location reference has been revised to show PZ-32A.

HDR Engineering, Inc. of the Carolinas
128 S Tryon Street
Suite 1400
Charlotte, NC 28202-5004
Phone: (704) 338-6700
Fax: (704) 338-6760
www.hdrinc.com

4. **Page 6, the two deeper sample locations for locations B-26 and B-31 should also be described as saprolite. The "effective porosity" estimations for the finer grained upper soils at location B-31A are actually out of the range that can be quantified on the Textual Classification Triangle but would be estimated at about 2. Since these two samples are from silts with some plasticity that are not representative of the silty sand saprolite unit that characterizes most of the site, these values should not be averaged with the others in calculating an average effective porosity value for this unit. (This would change the Effective Porosity value on Table 2-3.)**

   In keeping with the terminology HDR has adopted for this project, the deep sample location for B-26 has a N-value of 64 blows per foot (bpf), which would classify it as Transition Zone material. The deep sample for B-31 should be classified as saprolite material. Table 2-1 – "Summary of Effective Porosities" has been revised to show the lithologic unit classification changes and the recalculated lithologic averages.

5. **Page 6, there does not appear to be any distinct representative samples for the PWR Transition Zone, as defined by the Solid Waste Section; however, based upon the discussion in the Report, one would assume the PWR to have similar characteristics to that of the predominantly silty sand saprolite. Thus, it would appear the shallow fine-grained silts would have an average effective porosity of about 2. The silty sand saprolite and transition zone materials that are predominant at the site would have an average effective porosity of about 18, and the assumed secondary porosity for the bedrock would be 2.**

   As defined by the report, the deep sample for B-26 classifies as a Transition Zone sample. Table 2-1 was revised to show the average effective porosities for each lithologic unit. The shallow fined-grained samples from B-31A were not included in the average for the Saprolite unit since they were not representative of silty sand layer across the site. The Saprolite unit average is 17 percent, the Transition Zone Unit is 25 percent, and the bedrock unit is 2 percent.

6. **Page 7, the slug test reference should be to Table 2-3. PZ-33 is referenced as Transition Zone in the text, but Saprolite in Table 2-3. Since this boring was done with an air hammer, without testing, there is no way to really know if the screened internal is in Saprolite or PWR. Some of the Aquifer Unit references in Table 2-3 do not match the descriptions in the boring logs. This could make it necessary to recalculate the average hydraulic conductivities for the different aquifer units.**

   The slug test reference on Page 7, Paragraph 2, has been revised to be Table 2-3.

   Any reference to PZ-33 as either Saprolite or Transition Zone has been removed.

The aquifer unit references were revised in Table 2-3 to match the boring logs. The average hydraulic conductivities were recalculated, and the text was revised accordingly.

7. **Page 8, on Table 2-2, the Percent Fines for the last three samples (PZ-31A and PZ-32A) are incorrect. According to the boring log descriptions, all Geologic Units should be Saprolite.**

Table 2-2 has been revised to show the corrected percent fines for samples PZ-31A and PZ-32A. The Geological Unit Classification was revised for PZ-31A on Table 2-2 to Saprolite. PZ-26 will remain classified as Transition zone based on N-values.

8. **Page 9, on Table 2-3, the Aquifer Unit for PZ-22A should be Transition Zone. The upper part of the screened interval for PZ-31A is Saprolite, and the lower part is Transition Zone. Because an air hammer was used for PZ-33, the Aquifer Unit is uncertain. As previously referenced, the Effective Porosity value needs to be recalculated.**

The Aquifer Unit Classifications were revised for PZ-22A, PZ-31A, and PZ-33.

9. **Page 10, it appears that the reference in the last sentence of the first paragraph should be to Table 2-4 on Page 12.**

The reference has been revised.

10. **Page 12, on Table 2-4, it appears the Date Installed is incorrect for Piezometers PZ-18A, PZ-32A, and MW-2R. The Total Depth for Piezometer B-31 is incorrect. The upper Sand Pack Elevation for MW-6R is incorrect.**

The information has been revised.

11. **Page 13, it is not clear how the average sand, silt, and clay contents were calculated. As previously referenced, some of the percent fines on Table 2-2 are incorrect and the values for the three fine-grained samples are not representative of the predominant silty sands that cover most of the site.**

The sand, silt, and clay contents are averages from the laboratory grain-size tests for all eight samples. Refer to the grain-size distribution test reports included in Appendix C to see the percentages of sand, silt, and clay for each specific test. Table 2-2 has been revised to show the correct percent fines.

12. **On Page 14, the references in the first two paragraphs of Page 14 should be to Table 2-2. I was not able to locate the documentation for the Total Porosity values referenced for PZ-29 and PZ-31.**

The text was revised to reference Table 2-2.

The Total porosity values are provided on the corresponding hydraulic conductivity test results.

13. **Page 17, the beginning of paragraph one should reference Table 2-5. The beginning of paragraph two should reference Table 2-6.**

These revisions have been made.

14. **Page 18, the 24-Hour Water Level for PZ-32A in Table 2-5 does not appear to match the level on the Boring Log.**

Table 2-5 has been revised.

15. **Page 20, for Table 2-6, the AVERAGE for B-13 is incorrect. The MAX and DIFF values are incorrect for the following locations: B-15-A, B-15-B, B-16-A, B-16-B, B-21-A, and B-21-B.**

Table 2-6 has been revised.

16. **Page 21, the reference in the last paragraph should be to Table 2-7.**

The reference in the text has been revised.

17. **Page 23, the reference in the last sentence should be to Table 2-8.**

The reference in the text has been revised.

18. **Page 24, Table 2-8: Because of the limited amount of data for the newer piezometers and the fact that the baseline data is from a time of drought of historic proportions, there is still some uncertainty regarding the seasonal high water table estimates. It may help to have another round of measurements taken, since this has been a wet spring.**

Attached is the current USGS well data for the well used to benchmark against in estimating the Long-Term Estimated Seasonal High Ground-Water surface. Even with the historically wet year, the water level readings only reached a maximum elevation that was 3.76 feet below the USGS well high level on March 28, 1993 used in estimating our correction factor.

This information, plus the fact that the greatest on-site individual well fluctuation (since 1994) was 6.84 feet over a period in which this site has experienced historical drought and rainfall, reassures HDR that the 10-foot correction factor on all wells is very conservative.

19. **Page 25, the reference in the second paragraph should be to Table 2-9 on page 25. Table 2-9: As previously referenced, the K_h and P_e values need to be recalculated for each hydrogeologic unit. Why is the Hydraulic Gradient value different from that presented in the previous Table? The headers for the last two columns appear to be reversed.**

The reference in the text is revised to show Table 2-9.

Table 2-9 has been recalculated and edited to show the K_h and P_e values for the revised lithologic unit averages. In addition, the last two columns headers have been corrected.

HDR has revised Table 2-9 to use a site hydraulic gradient as mentioned in NCDENR's previous comments.

20. **Page 26, the reference in the first line of the second paragraph should be to Table 2-10. Table 2-10: According to Table 2-6, the March 2003 Ground-Water Elevation for PZ-21A should be 742.23. According to the boring logs, it appears the Screen Separation should be 14.71 (or 14.70 according to Table 2-4).**

The text has been revised to reference Table 2-10. Table 2-10 has been revised to show the correct ground-water elevation and screen separation. The vertical gradient was recalculated accordingly.

21. **Page 28-30, some of the values referenced in the Summary will need to be modified, based upon the comments and questions raised above.**

The text has been revised to show all changes.

22. **Page 30, the reference at the bottom of the page should be to Drawing D-02A.**

The text has been revised to reference Drawing D-02A.

23. **Drawing D-02 Ground-Water Potentiometric Map – March 4, 2003: The water table elevation for PZ-33 is incorrect. The ground-water contour in the vicinity of PZ-29 is incorrect. Several of the contours need to be adjusted in order to make them more proportional to the data presented. Additional water table readings may clarify some anomalies, especially for the piezometers having only one or two water table readings.**

The water table elevation for PZ-33 was corrected and minor modifications were made to the potientiometric contours around PZ-29 and along the drainage feature on the eastern side of the expansion area.

24. **Drawing D-02A Estimated Long-Term Seasonal High Ground-Water Potentiometric Map: Because of the significant topographic relief and limited boring density, it appears that the ground-water contours are somewhat distorted. Additional water table readings for the newer piezometers may provide some clarification. Perhaps using topography more in the interpretation of the data will help. One would expect the knoll around PZ-18A to have a more significant effect on the water table. The seasonal high readings have been estimated in a way that may exaggerate the apparent anomalies.**

HDR has revisited the shape of the potentiometric contours around PZ-18A and around Sediment Basin No. 7. Contours 730, 735, 740, 745, and 750 have been modified slightly on Drawings D-02 and D-02A to exhibit more influence from the topography.

25. **Drawing C-05 Existing and Proposed Ground-Water and Methane Monitoring Well Locations: Proposed well MW-9 is on the top of a knoll and would not appear to provide meaningful data. The proposed wells, MW-11, MW-12, and MW-13, should each be moved further North into the mouth of the drainage features. For shallow wells, the sand pack should extend no more than one foot above the top of the screen in order to ensure a good seal that will prevent surface water infiltrating the well. (The top of the well screen should be no shallower than five feet below ground surface, and the top of the sand pack should be no shallower than four feet below ground surface.)**

Based on the potientiometric map, Drawing D-02 ground-water flows north from Phase IV; and therefore, MW-9 should provide useful monitoring.

Both MW-12 and MW-13 have been shifted as requested. MW-11 has been kept in place to minimize the impact from Sediment Basin No. 6.

HDR has revised the text in the HDR letter titled "Supplemental Revisions to Revised Ground-Water Monitoring Plan" to show 1 foot of sand above the well screen rather than 2 feet. The revised letter is attached to replace the original April 2003 letter.

26. **Drawing C-02 Excavation Plan: As discussed on numerous previous occasions, because of the relatively sparse boring density inside the proposed expansion footprint and the significant topographic relief, excavation depths should be planned very conservatively. This is further necessary due to some remaining uncertainty regarding representative seasonal high water table conditions. For much of the proposed excavation area, there is apparently only 3 to 5 feet of separation from the**

seasonal high water table. This does not appear very conservative given the conditions at the site. The outlets for Sedimentation Basins #6 and #7 are shown to be significantly below the seasonal high water table.

The Excavation Plan was based on maintaining the regulatory requirement of 4-feet of vertical separation from the long-term estimated seasonal high ground-water surface. With a minor modification to Contour elevation 768, the separation ranges from 4 to 12 feet. In HDR's professional opinion, the seasonal high ground-water contours were estimated very conservatively by adding an additional correction factor for a USGS well rather than relying solely on the nine years of on-site data.

27. **Figure 1 – Wetland Delineation Map: This Map is confusing. It is difficult to get oriented, contour lines do not match, etc.**

The Wetland Delineation Map was provided to show US Corps of Engineers approval of our delineation. The Drawing shows the delineation in two windows with North oriented to the left. The upper window shows the northern end of the wetlands, and the lower window shows the southern end of the wetlands.

If you have any questions or comments regarding the information in this letter or enclosed document, do not hesitate to call me at (704) 338-6843.

Sincerely,

Michael D. Plummer, PE
Project Engineer

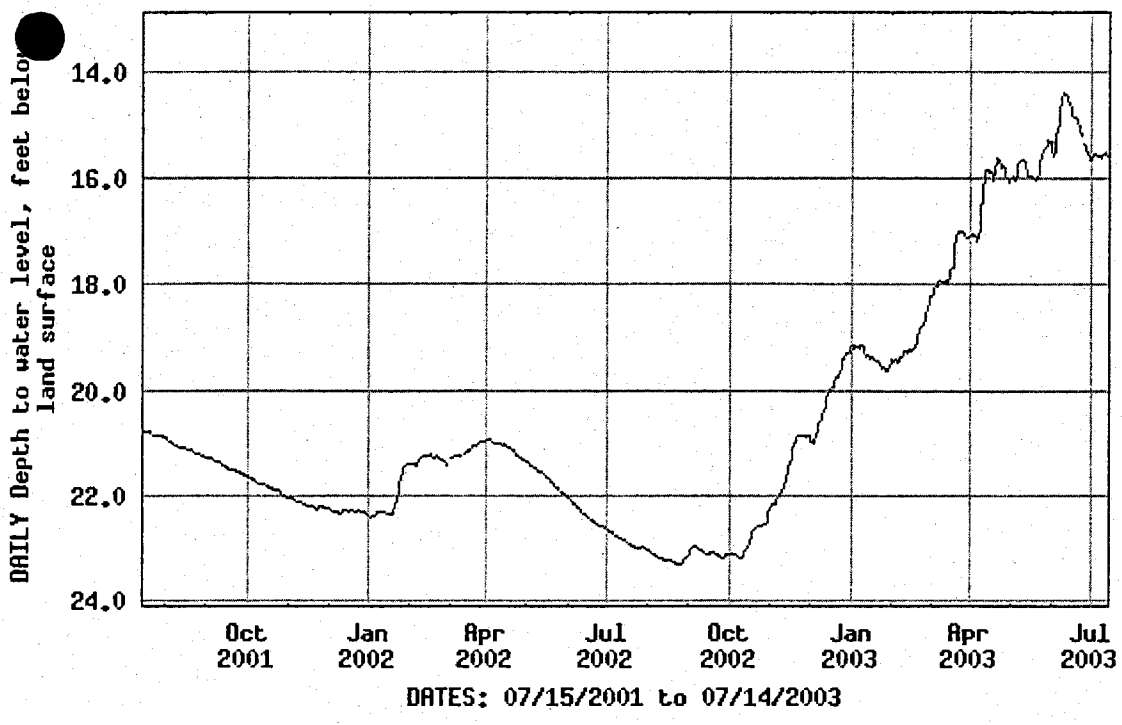
MDP/jvd

Enclosures

cc: Jan McHargue, PE – City of Winston-Salem
Ed Gibson, PE – City of Winston-Salem
Tim Jewett – NCDENR

USGS

USGS 355359080331701 DV-025 (NC-142) NR MOCKSVILLE, NC (SAPROLITE)



DATES: 07/15/2001 to 07/14/2003

Provisional Data Subject to Revision

Depth to water level, feet below land surface (DD 01),
JULY 15 2001 TO JULY 14 2003,
DAILY MEAN VALUES

DATE	Jul 2001	Aug 2001	Sep 2001	Oct 2001	Nov 2001	Dec 2001	Jan 2002	Feb 2002	Mar 2002	Apr 2002	May 2002	Jun 2002	Jul 2002	Aug 2002	Sep 2002	Oct 2002	Nov 2002	Dec 2002	Jan 2003	Feb 2003	Mar 2003	Apr 2003	May 2003	Jun 2003	Jul 2003
1		20.9	21.3	21.6	22	22.3	22.4	---	21.4	20.9	21.4	22	22.7	23.1	23	23.1	22.2	21	19.1	19.4	18.4	17.1	16	15.5	15.6
2		20.9	21.3	21.7	22	22.3	22.4	21.4	---	20.9	21.4	22.1	22.7	23.1	23	23.1	22.2	21	19.2	19.4	18.2	17	15.9	15.6	15.5
3		21	21.3	21.7	22	22.3	22.4	21.4	21.3	20.9	21.4	22.1	22.7	23.1	23	23.1	22.2	20.9	19.1	19.4	18.2	17.1	16	15.5	15.5
4		21	21.3	21.7	22.1	22.3	22.4	21.4	21.3	21	21.4	22.1	22.7	23.1	23	23.1	22.1	21	19.2	19.4	18.2	17.1	16	15.2	15.5
5		21	21.3	21.7	22.1	22.3	22.4	21.4	21.3	21	21.4	22.2	22.8	23.1	23	23.1	22.1	20.9	19.2	19.5	18.1	17.1	15.9	15.1	15.6
6		21	21.3	21.7	22.1	22.3	22.4	21.4	21.3	21	21.5	22.2	22.8	23.1	23	23.2	22.1	20.8	19.2	19.5	18	17.2	15.8	15	15.6
7		21	21.4	21.7	22.1	22.3	22.3	21.4	21.3	21	21.5	22.2	22.8	23.2	23	23.2	22	20.6	19.2	19.4	18	17.1	15.7	14.8	15.6
8		21	21.4	21.8	22.1	22.3	22.3	21.3	21.2	21	21.5	22.2	22.8	23.2	23	23.2	22	20.6	19.1	19.4	17.9	16.9	15.6	14.5	15.6
9		21.1	21.4	21.8	22.1	22.4	22.3	21.3	21.2	21	21.5	22.3	22.8	23.2	23.1	23.2	21.9	20.6	19.1	19.3	17.9	16.7	15.6	14.4	15.6
10		21.1	21.4	21.8	22.1	22.4	22.3	21.3	21.3	21	21.5	22.3	22.8	23.2	23.1	23.2	21.9	20.5	19.2	19.2	17.9	16.3	15.6	14.4	15.5
11		21.1	21.4	21.8	22.1	22.3	22.3	21.2	21.3	21	21.6	22.3	22.8	23.2	23.1	23.2	21.9	20.4	19.3	19.3	17.9	15.9	15.7	14.4	15.5
12		21.1	21.4	21.8	22.2	22.3	22.3	21.2	---	21	21.6	22.4	22.9	23.2	23.1	23.1	21.7	20.3	19.4	19.3	17.9	15.8	15.8	14.4	15.5
13		21.1	21.4	21.8	22.2	22.3	22.3	21.2	---	21	21.6	22.4	22.9	23.2	23.1	23.1	21.6	20.2	19.3	19.3	17.9	15.8	15.9	14.5	15.6
14		21.1	21.4	21.8	22.2	22.3	22.4	21.3	21.2	21	21.6	22.4	22.9	23.3	23.1	23	21.5	20.1	19.3	19.3	18	15.9	15.9	14.6	15.6
15	20.8	21.1	21.5	21.8	22.2	22.3	22.4	21.2	21.2	21.1	21.7	22.4	22.9	23.3	23.1	23	21.4	20	19.4	19.2	18	15.8	15.9	14.7	
16	20.8	21.1	21.5	21.8	22.2	22.3	22.4	21.2	21.2	21.1	21.7	22.4	22.9	23.2	23.1	22.9	21.3	20	19.4	19.2	17.8	15.9	15.9	14.8	
17	20.8	21.1	21.5	21.9	22.2	22.3	22.4	21.2	21.2	21.1	21.7	22.4	22.9	23.3	23.1	22.8	21.1	19.9	19.4	19.2	17.7	15.9	16	14.8	
18	20.8	21.1	21.5	21.9	22.2	22.3	22.4	21.3	21.1	21.1	21.7	22.5	22.9	23.3	23.1	22.7	21.1	19.9	19.4	19.2	17.7	16	16	14.8	
19	20.8	21.1	21.5	21.9	22.2	22.3	22.3	21.3	21.1	21.1	21.7	22.5	23	23.3	23.1	22.7	21	19.9	19.4	19.2	17.7	15.8	16	14.8	
20	20.8	21.1	21.5	21.9	22.2	22.3	22.2	---	21.1	21.1	21.8	22.5	23	23.3	23.1	22.6	20.9	19.8	19.4	19.1	17.3	15.7	16	14.9	
21	20.8	21.2	21.5	21.9	22.3	22.3	22.1	21.3	21.1	21.1	21.8	22.5	23	23.3	23.1	22.6	20.9	19.7	19.4	19	17.1	15.6	16	15	
22	20.9	21.2	21.5	21.9	22.3	22.3	22.1	21.3	21.1	21.2	21.8	22.6	23	23.3	23.1	22.6	20.9	19.7	19.5	18.9	17	15.6	15.9	15.1	
23	20.9	21.2	21.6	21.9	22.3	22.3	22	21.3	21.1	21.2	21.9	22.6	23	23.3	23.2	22.6	20.9	19.7	19.5	18.8	17	15.8	15.7	15.2	
24	20.9	21.2	21.6	21.9	22.2	22.3	21.8	21.3	21	21.3	21.9	22.6	23	23.3	23.2	22.6	20.9	19.6	19.6	18.8	17	15.8	15.6	---	
25	20.9	21.2	21.6	21.9	22.2	22.3	21.7	21.3	21	21.3	21.9	22.6	23	23.3	23.2	22.6	20.9	19.4	19.6	18.7	17	15.8	15.5	15.3	
26	20.9	21.2	21.6	22	22.2	22.3	21.5	21.3	21	21.3	21.9	22.6	23	23.3	23.2	22.6	20.9	19.4	19.6	18.7	17	15.8	15.4	15.4	
27	20.9	21.2	21.6	22	22.2	22.3	21.5	21.4	21	21.3	21.9	22.6	23	23.2	23.1	22.6	20.9	19.3	19.6	18.6	17.1	15.9	15.4	15.4	
28	20.9	21.2	21.6	22	22.2	22.3	21.4	21.4	21	21.3	22	22.6	23	23.2	23.1	22.6	20.9	19.3	19.6	18.5	17.1	16	15.4	15.5	
29	20.9	21.3	21.6	22	22.3	22.3	---		21	21.3	22	22.6	23	23.2	23.1	22.5	20.9	19.3	19.6		17.1	16	15.3	15.6	
30	20.9	21.3	21.6	22	22.3	22.4	21.4		21	21.4	22	22.7	23	23.2	23.1	22.4	20.9	19.3	19.6		17.1	16.1	15.3	15.6	
31	20.9	21.3		22		22.4	21.4		20.9		22		23.1	23.1		22.3		19.2	19.5		17.1		15.3		
COUNT	**17**	**31**	**30**	**31**	**30**	**31**	**30**	**26**	**28**	**30**	**31**	**30**	**31**	**31**	**30**	**31**	**30**	**31**	**31**	**28**	**31**	**30**	**31**	**29**	**14**
MAX	**20.9**	**21.3**	**21.6**	**22**	**22.3**	**22.4**	**22.4**	**21.4**	**21.4**	**21.4**	**22**	**22.7**	**23.1**	**23.3**	**23.2**	**23.2**	**22.2**	**21**	**19.6**	**19.5**	**18.4**	**17.2**	**16**	**15.6**	**15.6**
MIN	**20.8**	**20.9**	**21.3**	**21.6**	**22**	**22.3**	**21.4**	**21.2**	**20.9**	**20.9**	**21.4**	**22**	**22.7**	**23.1**	**23**	**22.3**	**20.9**	**19.2**	**19.1**	**18.5**	**17**	**15.6**	**15.3**	**14.4**	**15.5**

April 3, 2003 (Revised July 2003)

Mr. Bobby Lutfy, Hydrogeologist
North Carolina Department of Environment
and Natural Resources
Division of Solid Waste Management
Solid Waste Section
P. O. Box 27687
Raleigh, North Carolina 27611-7687

Re: Supplemental Revisions to Revised Ground-Water Monitoring Plan
Winston-Salem Construction and Demolition Landfill (No. 34-12)
Forsyth County, North Carolina
HDR Project No. 00162-525-018

Dear Mr. Lutfy:

HDR Engineering, Inc. of the Carolinas (HDR) is hereby submitting, on behalf of the City of Winston-Salem Utilities Division, the enclosed documents to be incorporated into the existing Revised Ground-Water Monitoring Plan (RGWMP), dated January 1996.

In response to the permitting of Phases IV, V, and VI at the Old Salisbury Road Construction and Demolition Landfill (Landfill), the abandonment and installation of ground-water monitoring wells will be conducted in a phased approach. With this phased approach, the abandonment and installations will take place immediately prior to filling of the respective phase, except where wells already exist.

A total of five additional ground-water monitoring wells are needed to adequately monitor the uppermost aquifer for a release from the proposed Phases IV, V, VI area. In keeping with the existing sequence, ground-water monitoring wells MW-9, MW-10, MW-11, MW-12, and 13 are being proposed at the approximate locations shown on the attached Drawing C-05. Ground-water monitoring wells MW-9 and MW-10 are positioned to monitor the downgradient extents of Phase IV. The remaining two Phases (V and VI) will be monitored by the installation of ground-water monitoring wells MW-11, MW-12, and MW-13 as shown on C-05.

With eight ground-water monitoring wells currently making up the monitoring well network, the horizontal distance between existing wells varies between 340 to 860 feet, with an average horizontal spacing of 630 feet. The distance from the edge of waste to each monitoring well also varies (between 75 to 275 feet). The placement of ground-water monitoring wells in the past has been predominantly based on the presence of presumed

HDR Engineering, Inc. of the Carolinas
128 S Tryon Street
Suite 1400
Charlotte, NC 28202-5004
Phone: (704) 338-6700
Fax: (704) 338-6760
www.hdrinc.com

subsurface features with the potential for preferential ground-water flow (i.e., small surface water features onsite being a surficial expression of subsurface fractures). However, ground-water level and water quality data from these wells for the past 6.5 years has not reported any C&D-related compound detections or has suggested that there is any preferential ground-water flow at these areas of the Site. Therefore, the horizontal placement of the proposed ground-water monitoring wells (approximately 500 feet apart and 50 to 100 feet from the edge of waste) is based on the potentiometric data and the estimated annual ground-water seepage velocity for the uppermost aquifer.

The zone of ground-water monitoring around most of the Phases IV, V, VI area is limited, with less than 100 feet available for monitoring well placement (e.g., along eastern stream). Therefore, these wells are expected to be installed at a distance of approximately 100 feet from the edge of waste based on the accessibility and practicality of installing a well that can be effectively monitored year round (i.e., areas prone to flooding). With a reported ground-water flow rate between 28.30 feet per year (ft/year) and 26.34 ft/year for the saprolite and transition zone hydrogeologic units. Assuming a worst-case scenario of a release at the edge of waste, it could potentially take 3.5 years for the proposed monitoring wells to detect this release given the aquifer properties and well spacing above. If one were to assume a release from the center of the waste unit, the distance to the monitoring network would be on the order of 375 feet, with a release detection potential of 13.2 years. Realistically, the scenario is somewhere in the middle (e.g., less than 200 feet). These scenarios assume no lateral dispersion, only particle movement perpendicular to the slope of the potentiometric surface (*i.e.,* dispersion ratio of 1:1). However, ground-water movement is rarely without some component of lateral dispersion. Lateral dispersion in soils containing a significant percentage of fine-gained material can be significant. Without contaminant plume data to directly approximate dispersion at the Landfill, a conservative (estimated) dispersion coefficient or ratio of 1:2 was assumed. For every foot of ground-water movement in the primary direction of flow there is an estimated 2 feet of lateral dispersion. If these values are considered, then a particle released at a distance of approximately 200 feet upgradient of the proposed monitoring well network (125 feet inside the waste unit) could potentially require a horizontal well spacing of 800 feet. This approximation does not have the ability to take into account other factors that could affect the well spacing (i.e., increase spacing) such as the filling sequence and the relationship of the placement of early waste to the nearest ground-water monitoring well.

As shown on the attached Drawing C-05, the horizontal placement of monitoring wells is approximately ~~450~~ 275 to ~~600~~ 700 feet apart, well within the 800-foot spacing calculated above.

Before the construction of Phase VI, monitoring well MW-6R will be permanently abandoned in accordance with North Carolina Department of Environment and Natural Resources (NCDENR) Well Abandonment Regulations. No replacement is currently planned for this well. These monitoring wells will not be sampled until the scheduled sampling event six months prior to their respective phase of the Landfill begins to receive waste. An initial sample will be collected and analyzed in accordance with the existing RGWMP for Appendix I volatile organic compounds (VOCs) and the eight RCRA metals during each sampling event. The enclosed site plan (Drawing C-05) shows the location of all abandoned, existing, and proposed ground-water monitoring wells at the Landfill. The following table summarizes the anticipated well construction details for the proposed detection monitoring wells for the Phases IV, V, VI area.

Summary of Proposed Ground-Water Monitoring Well Construction

Proposed Well	Water Table Elevation (MSL)	Estimated Screened Interval (MSL)	Estimated Total Well Depth
MW-9	731	736 - 721	70
MW-10	725	730 - 715	20
MW-11	725	730 - 715	20
MW-12	730	735 - 720	20
MW-13	730	735 - 720	20

MSL – mean sea level
All data is in feet.

Prior to well construction, each soil boring will be sampled at 5-foot intervals starting from 5 feet below land surface to the total depth of the boring. The samples will be collected using a standard 1.375-inch inside diameter (ID), 2-inch outside diameter (OD), 24-inch long stainless steel split-barrel sampler. In accordance with ASTM practice D1586, the sampler will be driven into the undisturbed soil ahead of the advancing augers using a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final 12 inches will be recorded as the designated penetration resistance value (N-value). The recovered soil samples will be visually inspected in the field by an HDR geologist and classified in general accordance with the Unified Soil Classification System (USCS). Soil boring logs for each location will be prepared.

Once each soil boring is completed to its final depth below the water table, a 2-inch diameter ground-water monitoring well will be constructed in accordance with the North Carolina Well Standards and Regulations. Each well will consist of 2-inch ID Schedule 40 polyvinyl chloride well pipe, which is flush-threaded to factory-slotted well screen with 0.010-inch openings. Each shallow well will be fitted with a 15-foot well screen positioned at the water table interface to allow for seasonal fluctuation (historically less than a foot).

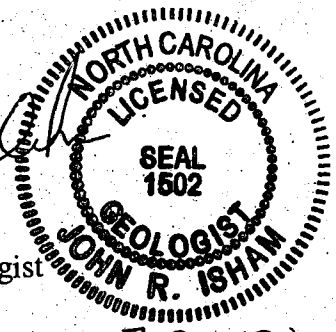
Each monitoring well will be constructed by lowering the well string through the center of the hollow stem augers to the bottom of the borehole. A washed, graded (No. 2) silica sand will be placed through the augers and allowed to settle (by gravity) around the annulus between the well screen and the augers. Upon removal of each 5-foot auger flight, the silica sand will be allowed to settle around the well screen, filling the annulus between the well screen and the wall of the borehole. The sand pack will be placed to a depth of ~~2 feet~~ 1 foot above the top of the well screen. A 2-foot annular seal consisting of 3/8-inch high-yield Wyoming bentonite chips will be placed above the sand pack (by gravity) and allowed to hydrate (swell). The remaining annular space from the top of the bentonite seal to ground surface will be sealed with a Portland Type I cement/3 percent bentonite mixture placed using a tremie pipe.

The wells will be permanently finished above-grade with a stickup of approximately 2.5 feet. The piezometer pipes will be secured against accidental opening or tampering with a locked, steel well box finished with an ID tag and concrete pad. A ground-water monitoring well construction record drawing for each of the proposed monitoring wells will be prepared and submitted upon completion of this task.

In addition to the ground-water monitoring wells, six methane probes (MM-7 through MM-12) will be installed around Phases IV, V, and VI for methane detection monitoring. A North Carolina licensed well driller will bore down to the top of the ground-water table and a Schedule 40 PVC gas probe will be inserted through the center of the borehole. Each probe will be constructed with flush-threaded joints and an appropriate screened interval of 0.020-inch, factory-slotted well screen. A coarse-grained silica gravel will be placed around the screen interval by gravity settling. The gravel pack will extend to a minimum of 6 inches above the top of the screen. A 6-inch minimum bentonite seal will be placed immediately above the gravel pack. The remaining probe annulus will be sealed to surface grade using a Portland Type I cement mixture. Each probe station will be completed above grade and protected by a 4-inch square steel locked well box secured in place with a 3-foot by 3-foot concrete pad. The outside of each station will be fitted with an identification tag indicating the station number, installation date, driller name and registration, completion depth, and, screened interval. A methane probe construction record drawing for each of the proposed probes will be prepared and submitted upon completion of this task. See Drawing C-05 for the approximate locations of the proposed methane monitoring probes.

If you have any questions or comments concerning the information summarized in this letter or on the enclosures, please do not hesitate to contact me or Mike Plummer at (704) 338-6700.

Sincerely,



7-30-03

John R. Isham, PG
Senior Hydrogeologist

Michael D. Plummer, PE
Project Engineer

JRI/MDP/jvd

Enclosures: Existing and Proposed Ground-Water Monitoring Well Locations (C-05)

cc: Edward L. Gibson, City of Winston-Salem (w/attachments)
Larry Rose, NCDENR Solid Waste Section (w/attachments)
Tim Jewett, NCDENR Solid Waste Section (w/attachments)
Brock Turner, Forsyth County Health Department (w/attachments)

April 2, 2003

Mr. Bobby Lufty,
Hydrogeologist
North Carolina Department of Environment
and Natural Resources (NCDENR)
Solid Waste Section
1646 Mail Service Center
Raleigh, North Carolina 27699-1646

Re: Revised Design Hydrogeological Investigation Report
Old Salisbury Road C&D Landfill, Phases IV, V, and VI
Winston-Salem, Forsyth County, NC
Permit No. 34-02
HDR Project No. 00162-525-018

Dear Mr. Lufty:

HDR Engineering, Inc. of the Carolinas (HDR), on behalf of the City/County Utilities Commission of Winston-Salem, NC, is pleased to submit the above-referenced document for your review and approval. This document is being submitted in fulfillment of the Section's request dated November 6, 2002 to address the Solid Waste Section's review comments as summarized below. Specific responses to all of the comments have been provided in the order they were presented in the Section's review letter.

1. **Page 3 There is no support documentation for the "effective porosity" values referenced. Total porosity and effective porosity values should be provided representative of each distinct lithologic unit.**

   Page 3, paragraph 2 of the referenced document gives measured total porosities for the saprolite zone (B-29) and the transition zone (B-31). Effective porosity values are discussed on Page 6, paragraph 3. These were derived using textural grain size distribution data from the geotechnical analysis of split-spoon and Shelby Tube samples from the Site in accordance with A.I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D (1967). A copy of this classification triangle has been included in Appendix C.

2. **Table 2-1 The "Moisture Content" value for the B-31 Shelby Tube sample is different from that values reported on the Permeability Test Report in Appendix C. It is not clear what the source is for the "Moisture Content" values for each of the two B-26 samples and the shallower B-31 sample. The Liquid Limit (LL) values reported in Table 2-1 and the "Plasticity Chart" (Figure No. 1) in**

HDR Engineering, Inc. of the Carolinas
128 S Tryon Street
Suite 1400
Charlotte, NC 28202-5004
Phone (704) 338-6700
Fax (704) 338-6760
www.hdrinc.com

Appendix C, differ from the non-plastic (NP) values reported on the Grain Size Distribution Test Reports.

According to communication with the testing laboratory, the moisture content values between the "Plasticity Charts" and the "Permeability Test Reports" do not necessarily match or should be expected to match even though the same sample interval is referenced. The moisture contents on the Plasticity Charts are part of the primary natural moisture determination for the sample from the portion of the sample in which the Atterberg Limit testing is performed. A sample can have a slightly different moisture content for the permeability testing. Because a different portion of the Shelby tube is used for the test and therefore a different moisture content may be reported for this portion of the tube. In Table 2-1 "Summary of Geotechnical Laboratory Test Data," the B-26 samples and the shallow B-31 sample are split-spoon samples as indicated in the sample type column. These samples would have been returned to the lab in glass jars or plastic Ziploc bags.

The laboratory was contacted and the liquid limits presented on the Plasticity Chart have been recorded on the appropriate Grain Size Distribution Test Report.

3. **Table 2-1 "Aquifer Hydraulic Properties" need to be provided that are representative of each of the distinct lithologic units identified at the site.**

   Table 2-1 has been updated to include the additional geotechnical laboratory data from the additional Shelby Tube and bulk samples collected as part of the recent investigative activities onsite. Representative properties of the saprolite and transition zone are shown in this table. Refer to Page 7 to see aquifer hydraulic properties for bedrock.

4. **Page 5 Boring Logs and Piezometer Construction Records need to be provided for borings installed as part of past hydrogeologic investigations in the vicinity of the Phases currently under investigation.**

   Boring logs and piezometer construction record drawings for all previous test locations have been included in Appendix B.

5. **Page 5 The piezometers and borings done as part of this study are not sufficient to characterize the Phase IV, V, VI area or to provide adequate vertical separation data necessary for designing the base grades. It is not clear if using piezometer data from past hydrogeologic studies will provide adequate coverage.**

   Including the four new ground-water piezometers installed as part of the recent investigations at the Site, data from a total of 24 soil boring/piezometers (20 of which have intersected ground-water and/or bedrock) have been used in the development of the enclosed Design Hydrogeological Investigation Report. This is roughly equivalent to approximately 1.25 boring/piezometer per acre of land studied. HDR strongly believes that this density of study is more than adequate for the design and permitting of the Phase IV, V, VI area.

6. **Page 5 It appears from the limited data presented that in the higher elevations ground water is first encountered in the bedrock. Therefore Top of Rock data is needed to establish the vertical separation in these locations. None of the Boring Logs for the current study indicate Auger Refusal depths used to establish Top of Rock. Since the upper aquifer occurs in bedrock for portions of the site, it is important to provide the hydraulic characteristics of the upper fractured bedrock.**

   Additional investigation has shown that ground-water is encountered first in saprolite across the Expansion area with the exception of a small, localized area near newly installed piezometer PZ-32A. Based on several additional auger refusal encounters during the recent drilling event and some information from the Site Study drilling, HDR was able to produce drawing D-04 "Bedrock Surface Elevation Contour Map," (to provide additional data on the relationship between ground-water and bedrock beneath the proposed landfill footprint). Due to the shallow groundwater depth in bedrock the long-term estimated seasonal high ground-water surface will be the defining surface for defining vertical separation of basegrades.

7. **Page 15 A Table-needs to be provided that clearly illustrates how the Seasonal High Water Table values were determined for each specific piezometer location.**

   Table 2-7 has been added to the Report showing the estimated long-term seasonal high ground-water elevations at the piezometers located around the Phase IV, V, VI area with correction values assigned. The correction values are two-fold. A 5-foot correction was made from the June 2002 readings to the on-site all time high readings in May 1994. A second 5-foot correction was made from the on-site May 1994 readings to a USGS piezometer all time high in March 1993. Therefore, the table shows a 10-foot correction to wells with June 2002 readings and a 5-foot correction to wells; with a May 1994 reading.

8. **Pages 17 and 18 "Ground-Water Flow Components" need to be provided for each distinct lithologic unit.**

   Section 2.3.4 has been revised to include recent data regarding the ground-water flow components of each distinct lithologic unit at the Site.

9. **Table 2-7 Refer to previous comment. How were the "Hydraulic Gradient" values determined? It is not clear what the purpose is of using average "Hydraulic Conductivity" values and average "Effective Porosity" values, and then using variable "Hydraulic Gradient" values in the calculation of "Flow Velocity" values.**

   The gradient value referenced in the Report is an average of the potential minimum and maximum gradients based on piezometer well pairs located within the Phase IV, V, VI area. Hydraulic conductivity values from slug tests should be utilized with caution. They tend to underestimate aquifer potential. Therefore, an average is more appropriate for this data to eliminate any anomalous high or low-end values. Likewise, effective porosity values can be widely variable onsite, depending upon the number of samples taken, the depth of the sample, and the grain size distribution of

the sample. In this case, an average is appropriate to deal with outlying values in the sample population. Averages for hydraulic gradient, hydraulic conductivity, and effective porosity were taken specific to the lithology to make a more accurate representation of flow velocity within the saprolite, transition zone, and bedrock. These values are referenced in Section 2.3.4.

10. **Table 8 Because there are no Piezometer Construction Records for the B-21 Well Pair, it is not clear which well is screened deeper in the aquifer. Please provide support documentation for this table. How does the vertical gradient vary over time?**

Piezometer construction records for B-21A and B-21B have been included in Appendix B. As indicated by the records, piezometer B-21A is the deeper of the two locations, completed within the upper limits of fractured bedrock. Based on the vertical gradient data available from this nested location, the component of ground-water flow has always been in the upwards direction indicating that they are located in a ground-water discharge zone (as previously reported in earlier reports).

11. **Appendix B None of the Boring Logs identify Auger Refusal depths. Ground water was not encountered in borings B-31 or B-32. There was no Standard Penetration Testing done for boring B-32. There was no testing, samples, or logging done for boring PZ-33.**

Several logs in Appendix B signify auger refusal when this condition was encountered and it was confirmed that the refusal was a function of geology not equipment limitations. As evidenced by the advancement of borings B-31A and B-32A utilizing hollow stem augers during a recent drilling event, the previous "refusal" or termination of borings B-31 and B-32 was due to equipment limitations and not geology as was previously expressed by HDR. Additional split-spoon sampling has been provided at each location to supplement previous data. No samples were obtained from B-33 since air drilling was used and the observations made during its installation suggested that the lighology encountered was essentially identical to test locations nearby.

12. **Appendix C Refer to previous comments for Table 2-1, as they also apply to Figure No. 1 in Appendix C. The AASHTO designation for the deeper sample from B-31 should be A-4. Samples are needed for the silty-clay soils.**

The reference to the deeper sample from B-31 has been changed by the testing laboratory to classification of A-4. Samples from the upper limits of the saprolitic unit (0 to 5 feet bgs) have been collected and analyzed in accordance with previous test parameters and have been summarized in Table 2-1 and Section 2.1 of the Report.

13. **Drawings The drawings do not clearly indicate the footprint of the Phase IV, V, VI area.**

The Drawings have been revised to more clearly show the designation of the footprint for the Phase IV, V, VI area.

14. Drawings None of the drawings show the proposed basegrades for the Phase IV, V, VI area. There are no construction drawings showing erosion and sediment control features that could affect the placement of monitoring wells.

All pertinent engineering site features were taken into consideration when the proposed ground-water monitoring wells were planned for the Site. Basegrades were not completed at the time of the previous document submittal and therefore, were not submitted with the subject report. Pertinent site features relating to the construction of the landfill have been included to Drawing C-05A to show their general relationship to the ground-water monitoring wells. Drawing C-02, "Excavation Plan" has since been completed and is attached in Appendix D.

15. Drawings There are no drawings showing "stratigraphic cross-sections identifying hydrogeologic units including lithology".

Two stratigraphic cross sections have been prepared for the Phases IV, V, VI area showing the distinct lithologic units as well as the hydrogeologic data for the Site. The sections are referenced as Drawing D-03.

16. Drawing D-02A The seasonal high water table elevations used to generate this potentiometric drawing are not indicated on the drawing.

The well values used to construct this drawing were unintentionally left off the drawing. The values have been added to the drawing and a revised drawing has been included in the referenced report as Drawing D-02A.

17. "Supplemental Revisions to Revise Ground-Water Monitoring Plan" The Drawing C-05A submitted does not clearly show the locations of the proposed wells for the revised monitoring system. The reasons for the number, location, and design of the new proposed monitoring wells is not clearly discussed in this submittal. Normally fifteen-foot well screens are used for shallow monitoring wells at Solid Waste Management Facilities.

Drawing C-05 has been revised to more clearly reflect the proposed location of future ground-water monitoring wells. A discussion on the number, location, and design of the proposed monitoring wells has been incorporated into a revised "Supplemental Revisions to Revised Ground-Water Monitoring Plan."

If you have any questions or comments regarding the information in this letter or enclosed document, do not hesitate to me at (704) 338-6843.

Sincerely,

Michael D. Plummer, PE

MDP/jvd

Old Salisbury Road C&D Landfill

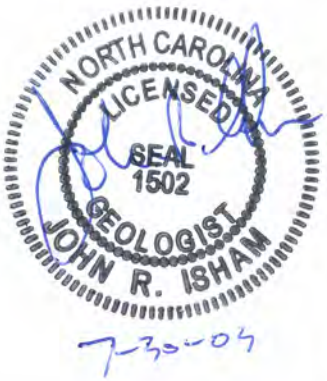
Winston-Salem,
North Carolina

Design Hydrogeological Investigation Report

for Phases IV, V, and VI

August 2002
(REVISED APRIL 2003)
(REVISED JULY 2003)

HDR Project No:
00162-525-018



HDR Engineering, Inc. of the Carolinas
128 South Tryon St., Suite 1400
Charlotte, NC 28202

TABLE OF CONTENTS

SECTION		PAGE
1.0	**INTRODUCTION**	1
1.1	Purpose and Intent	1
1.2	Applicable Regulations	1
1.3	Landfill Facility Location	1
2.0	**DESIGN HYDROGEOLOGIC REPORT**	3
2.1	Hydrogeologic Characteristics of Uppermost Aquifer	3
2.2	Testing Programs for Borings	10
2.2.1	Standard Penetration Testing	12
2.2.2	Particle Size Analysis	13
2.2.3	Soil Classification	14
2.2.4	Subsurface Descriptions	14
2.2.5	Total Porosity and Effective Porosity	15
2.3	Water Table Information	17
2.3.1	24-Hour Water Table Elevations	17
2.3.2	Tabulated Water Table Elevations Over Time	17
2.3.3	Estimation of Long-Term Seasonal High Water Table	17
2.3.4	Ground-Water Flow Components	25
2.4	Hydrogeologic Cross Sections	26
2.5	Boring Abandonment Certification	27
3.0	**SUMMARY AND CONCLUSIONS**	28
3.1	Summary	28
3.2	Conclusions	30
4.0	**REFERENCES**	31

APPENDICES

A	Hydraulic Conductivity Data
B	Boring Logs
C	Geotechnical Laboratory Results
D	Drawings

LIST OF TABLES

TABLE		PAGE
2-1	Summary of Effective Porosities	7
2-2	Summary of Geotechnical Laboratory Test Data	8
2-3	Summary of Aquifer Hydraulic Properties	9
2-4	Summary of Soil Boring and Piezometer Construction	12
2-5	Summary of Available At-Time-of-Boring and 24-Hour Water Levels for Borings and Piezometers	18
2-6	Summary of Historical Ground Water Monitoring Data	19
2-7	Construction and Hydrogeologic Details of USGS Regional Well	22
2-8	Summary of Estimated Long-Term Seasonal High Ground-Water Elevations	24
2-9	Ground-Water Seepage Velocities	25
2-10	Summary of Vertical Components of Ground-Water Flow	26

LIST OF FIGURE

FIGURE		PAGE
2-1	Seismic Map	16

SECTION 1.0
INTRODUCTION

1.1 Purpose and Intent

The North Carolina Solid Waste Management Rules (Rule .0504) require that a design hydrogeologic report be prepared to assess the geologic and hydrogeologic characteristics of the proposed site (the Site) to determine the geologic characteristics within a depth of 50 feet (composition and thickness), general ground-water flow characteristics (gradient and direction), and flow rates for the uppermost aquifer. This information is presented in the sections that follow.

The purpose of this design hydrogeologic evaluation is to collect subsurface soil and ground-water data for base grade determination and ground-water monitoring plan relevant to construction and demolition (C&D) solid waste landfill regulations. Selected soil samples from several on-site locations were also obtained as part of this investigation. Geotechnical testing of the samples was performed to determine the aquifer properties and also to evaluate on-site soils for use as possible landfill construction materials. The depth to ground water was investigated in order to evaluate landfill base grade controls. This site geologic evaluation was structured and performed in general accordance with the North Carolina Solid Waste Management Rules (Rule .0504).

The following sections discuss the methods utilized to conduct this subsurface investigation of the Site.

1.2 Applicable Regulations

This document was prepared in accordance with the guidelines codified under 15A NCAC 13B, Section .0504 entitled "Application Requirements for Sanitary Landfills." A previous report entitled "Geologic and Hydrological Report, Archaeological Survey, Wetlands Delineation" was prepared by S&ME, Inc. in June 1994, which summarized the findings from a preliminary study of the subject property to determine the feasibility of the area. A brief discussion of site and regional geology and hydrogeology was presented in this report to satisfy the requirements under Section .0504 (c).

1.3 Landfill Facility Location

The Old Salisbury Road C&D Landfill (the Site) is located west of Old Salisbury Road and north of Friedberg Church Road in Forsyth County, North Carolina. The Site is accessed via Old Salisbury Road (State Road 3011). Based on the United States Geological Survey

(USGS) Welcome and Winston-Salem-West 7.5-minute Topographic Quadrangle Maps, Forsyth County, North Carolina (1987 and 1994, respectively), the Site and surrounding area is gently rolling with elevations ranging from approximately 722 to 852 feet above mean sea level (MSL). The location of the Site is shown in Drawing D-01 (Appendix D).

The Site is situated within a 140-acre tract north of Friedberg Church Road and west of Old Salisbury Road. The Davidson County line borders the Site to the south. Land use in the Site vicinity is mixed with residential, light commercial, and undeveloped (agricultural) properties.

SECTION 2.0
DESIGN HYDROGEOLOGIC REPORT

2.1 Hydrogeologic Characteristics of Uppermost Aquifer

During soil boring installation conducted from May 28 through 31, 2002, and February 14 through 17, 2003, four undisturbed Shelby tube samples (PZ-29, B-31, PZ-31A, and PZ-32A) were collected and analyzed for undisturbed permeability, porosity, Atterberg Limits, moisture content, and percent fines (grain size analysis). These results are shown in Table 2-1. In addition, a bulk soil sample was collected from drill cuttings representing a depth of ground surface to five feet bgs at boring location PZ-31A for compaction testing, remolded permeability, Atterberg Limits, moisture content, and grain size analysis.

Undisturbed permeabilities ranged from 7.36×10^{-7} centimeters per second (cm/sec) at PZ-31A to 5.45×10^{-5} cm/sec at B-31. A permeability of 4.26×10^{-7} resulted from the remolding of surficial soils at PZ-31A. This value is only slightly less than the undisturbed permeability taken from the same test location. Total porosities reported at PZ-29 and PZ-31 were 7 and 19 percent, respectively. The majority of the soil samples analyzed reported a USCS classification as a silty sand (SM) with Atterberg Limits reporting no plasticity, with the exception of the soil samples collected at PZ-31A and PZ-32A from ground surface to five feet bgs, which classified as sandy silts (ML-MH) with slight plasticities. Field observations and geotechnical analysis of the soil confirmed the relative uniformity of the aquifer material across the permit area .

Based on field and laboratory data collected at the Site, the uppermost aquifer at the expansion site is comprised of three units. Ground water is first encountered in an unconsolidated residual soil unit (termed herein as "saprolite") over the entire study area, with the exception of a small isolated area around piezometer PZ-32A. This unit is distinct and is mapable across the Site (see Section 2.4). From ground surface to approximately 65 feet bgs (west of B-10), a relatively uniform sequence of saprolitic soil, composed predominantly of a silty sand (SM) and sandy silt (ML-MH), is present across the entire Site. This unit is characterized by its standard penetration values or N-values (see Section 2.2) ranging from less than 10 to 50 bpf indicating loose to dense in consistency. At piezometer location PZ-32A, ground water was first encountered just below the residual soil/bedrock interface (at the time of this investigation). In many instances, this saprolitic unit is overlain by a soil that tests under laboratory conditions as a fine-grained material. While there is some evidence of slight plasticity (*e.g.,* plasticity indices of 6% to 14%) and a higher percentage of fines (46 to 48% at PZ-31A) in the surficial soils (between 0 and 5 feet bgs) in the vicinity of soil borings PZ-31A and PZ-32A, the grain size distributions of these soils are similar to the soils encountered at depth; a silty sand to sandy silt. No native (*i.e.,*

undisturbed) soils have been laboratory confirmed as clay, either CL or CH. Those samples with slight plasticities have been classified as inorganic silts (ML and MH), which can typically display certain characteristics of a clay (*i.e.,* slight plasticity). Based on field observations, split-spoon sample evaluation, and laboratory geotechnical testing, the presence of a continuous, mapable "clay" soil horizon overlying the saprolitic soils has not been identified. Only isolated areas of slightly plastic inorganic silt have been confirmed.

The second unit at the Site is compositionally identical to the saprolitic unit and has been termed herein as the "transition zone". This unit lies beneath the saprolitic zone and is texturally similar to the saprolite above. However, based on field and laboratory data, this unit is much denser than the saprolitic unit. This zone is determined based on the gradational change in density generally marked by the first occurrence of N-values greater than 50 blows per foot (bpf). This unit is referred to as partially weathered rock in G.F. Sowers (1963). Engineering applications typically assign residual material as PWR when the standard penetration resistance test values (SPT) or N-values are greater than 50 bpf (very dense consistency). However, the more important issue regarding this unit relates to the ground-water flow characteristics of this unit. Based on all testing performed during this investigation, the flow of ground water through this transition zone is identical to the overlying saprolite, which is porous granular flow. There is no evidence of any bedrock flow characteristics in this unit such as discrete fracture flow. The transition zone onsite is void of features commonly described in the literature on Piedmont geology, such as pegamatite zones, quartz veins, rock lenses, or "float" rock. Literature frequently refers to this zone as partially weathered rock (PWR) when it contains features characteristic of competent rock (*e.g.,* discrete fractures). None of these features have been identified during soil boring sampling. Therefore, the ground water flow characteristics of the transition zone at the Site can be adequately modeled using porous flow models for unconsolidated sediments.

The third unit at the Site is the competent bedrock formation. This unit is hydraulically connected to the saprolitic unit and transition zone above, with these units providing storage of ground water for the bedrock portion of the uppermost aquifer. Ground-water movement within this unit is predominantly through fracture flow with the occurrence and frequency of the fractures diminishing with depth.

Competent bedrock was encountered at piezometer location PZ–32A at a depth of 57 feet bgs prior to reaching the uppermost aquifer. Approximately 18 feet of bedrock was cored at this location for the hydrogeologic evaluation of the bedrock aquifer unit and to determine the depth to ground water (see Section 2.2) at this location. Three core runs were performed between 57 and 75 feet bgs and the recovered core were evaluated for percent recovery, rock quality designation (RQD), fracture occurrence, and general composition. The following is a description of the rock recovered. The log of this core interval is included in Appendix B.

Core Location: PZ-32A
Interval Cored: 57 to 75 feet bgs
Core Designation: NQ

Core Run No. 1: 57 to 60 feet bgs
Percent Recovered: 66%
RQD: 18%
Core Run No. 2: 60 to 65 feet bgs
Percent Recovered: 88%
RQD: 60%

Core Run No. 3: 65 to 70 feet bgs
Percent Recovered: 80%
RQD: 80%

Core Run No. 4: 70 to 75 feet bgs
Percent Recovered: 81%
RQD: 79%

Description: White, gray, and black megacrystic **GRANODIORITE**, massive structure, medium grain size with quartz, plagioclase, potassic feldspar, and biotite evident, microcline feldspar megacrysts (0.5 to 1"), twinned and zoned, weak flow lineation (biotite alignment), highly weathered with multiple stress relief fractures (horizontal to subhorizontal) from 57 to 60 feet bgs, moderate intergranular porosity, feldspars turning to kaolinite. Competent, unweathered with few fractures below 60 feet bgs, 45° water bearing fracture zone at 63.5 to 64.5 feet bgs, iron and manganese oxide staining and weathering along fracture planes, other notable fractures (horizontal to subhorizontal) at 66 and 73.5 feet bgs (not apparently water bearing).

The lack of notable secondary diagenetic features (*e.g.* quartz veins, healed fractures, dikes, foliation) and the uniform texture and composition of the fresh, unweathered portions of the rock supports the conclusion that the saprolitic unit formed from the in-situ weathering of this parent material and should be highly uniform across the Site. Without the presence of preferred regional foliation or variable mineralogic composition, the density and grain size distribution of the resulting soil will reflect this uniformity. This type of parent material quite often results in the absence of a discernable transition zone between the saprolite and featured bedrock. Instead, there is a gradational change in the relative density of the material with depth without the addition of other more rock-like properties such as poorly-sorted gravel zones, rock ledges or boulders ("float"). These features appear to be absent from the Site causing the "transition zone" to be just that, a gradual transition from less dense saprolite to more dense saprolite. The bedrock geology described above is in close agreement to the bedrock geology of Forsyth County as summarized in Section 2.2.4 of this report.

Bedrock was also encountered during the initial siting of the landfill at piezometer B-21A (S&ME, 1994) just outside of the proposed footprint for Phase VI along the eastern unnamed surface water tributary. Based on the well log presented in their report (see Appendix B), the following is a description of the bedrock they recovered at B-21A.

Core Location: B-21A
Interval Cored: 43 to 56.5 feet bgs
Core Designation: NQ

Core Run No. 1: 43 to 48 feet bgs
Percent Recovered: 92%
RQD: 76%

Core Run No. 2: 48 to 53 feet bgs
Percent Recovered: 88%
RQD: 44%

Core Run No. 3: 53 to 56.5 feet bgs
Percent Recovered: 89%
RQD: 71%

Description: Light blue-gray, slightly weathered to unweathered, medium to coarse grained, hard GRANITE SCHIST, with white feldspar, mica.

Effective porosities were derived from the relationship between grain size and specific yield based on the Textural Classification Triangle for unconsolidated materials in A.I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D (1967). The grain size analyses of the split- spoon samples collected during drilling activities from the proposed expansion Site were plotted on the above-referenced textural classification triangle. The following summarizes the results. The classification triangle is included in Appendix C.

Table 2-1

Summary of Effective Porosities

Sample Location	Lithologic Unit	Effective Porosity (%)	Lithologic Average
PZ-31A (1 to 3 feet)	Saprolite	2*	
PZ-31A (0 to 5 feet)	Saprolite	2*	
PZ-32A (1 to 3 feet)	Saprolite	13	
B-26 (8 to 9.5 feet)	Saprolite	23	
B-29 (5 to 7 feet)	Saprolite	24	
B-31 (23.5 to 25 feet)	Saprolite	15	
B-31 (38.5 to 40.5 feet)	Saprolite	10	17
B-26 (28 to 29.5 feet)	Transition Zone	25	25
PZ-32A (60-75 feet)	Bedrock	2	2

*Sample is from silts with some plasticity that are not representative of the silty sand Saprolite Unit and is therefore not included in the Saprolite Lithologic Effective Porosity Average.

These values for effective porosity agree well with published values for an unconsolidated silt between 10% and 39% (McWorter and Sunada, 1977).

Seven slug tests were performed on piezometers located within and in the vicinity of the proposed expansion Site. The results of these tests are summarized in Table 2-3. The calculated hydraulic conductivity (K) for the piezometer completed within the **saprolite** is 0.259 feet per day (ft/day) (9.1 x 10^{-5} cm/sec). The hydraulic conductivities for piezometers screened within **transition zone** ranged from 0.241 ft/day (8.5 x 10^{-5}) to 1.03 ft/day (3.63 x 10^{-4} cm/sec), averaging **0.466 ft/day (1.65 x 10^{-4} cm/sec)**. The hydraulic conductivity of the **bedrock** aquifer was considerably less than either the saprolite or transition zone units with a K value of **0.043 ft/day (1.5 x 10^{-5} cm/sec)**. All values are in close agreement and are suggesting that there is little difference in the ground-water flow potential between the saprolite unit and the transition zone. Due to the lack of appreciable water-bearing fractures within the upper 18 feet of bedrock at PZ-32A, the ground-water flow potential between 60 and 75 feet bgs appears limited at nearly 10 times lower than the transition zone above.

Table 2-2

Summary of Geotechnical Laboratory Test Data
Old Salisbury Road Landfill Expansion

Sample Number	Sample Depth	Sample Type	USCS Classification*	USCS Symbol*	Geologic Unit	Total Porosity	Percent Fines (%)	Moisture Content (%)	Atterberg Limits			Hydraulic Conductivity	
									LL (%)	PL (%)	PI (%)	cm/sec	ft/day
B/PZ-26	8 – 9.5	SS	Silty Sand	SM	Sap	---	24.3	11.5	11	NP	NP	---	---
B/PZ –26	28 - 29.5	SS	Silty Sand	SM	Trans	---	19.4	12.8	11	NP	NP	---	---
B/PZ –29	5 - 7	ST	Silty Sand	SM	Sap	7	22.4	25.9	26	NP	NP	2.73×10^{-6}	0.008
B-31	23.5 – 25	SS	Silty Sand	SM	Sap	---	34.1	12.8	10	NP	NP	---	---
B-31	38.5 – 40	ST	Silty Sand	SM	Sap	19	39.4	12.8	14	NP	NP	5.45×10^{-5}	0.154
B/PZ-31A	1 – 3	ST	Sandy Silt	MH	Sap	---	53	29.8	53	39	14	7.36×10^{-7}	0.002
	0 – 5	Bulk	Sandy Silt	ML	Sap	---	57.5	25.3	48	36	12	4.26×10^{-7}	0.0012
B/PZ-32A	1 – 3	ST	Sandy Silt	SM	Sap	---	22.9	12.7	33	27	6	2.18×10^{-6}	0.006

Sample depths are in feet below land surface.
Sap – Saprolite
Trans – Transition Zone
ST – Shelby Tube.
SS – Split Spoon.
LL – Liquid Limit.
PL – Plasticity Limit.
PI – Plasticity Index.
Shelby tube permeabilities represent undisturbed values, bulk permabilities represent remolded values.
*– Laboratory determined
cm/sec – Centimeters per second
ft/day – Feet per day

Table 2-3

Summary of Aquifer Hydraulic Properties

Piezometer Number	Screen Interval	Test Method*	Aquifer Unit	Aquifer Material	Effective Porosity¥	Hydraulic Conductivity	
						cm/sec	ft/day
PZ-18A	73-88 feet	Slug Test	Transition Zone	Silty Sand	25%	1.2×10^{-4}	0.341
PZ-22A	20-35 feet	Slug Test	Transition Zone	Silty Sand	25%	1.63×10^{-4}	0.461
PZ-27	8-18 feet	Slug Test	Transition Zone	Silty Sand	25%	8.5×10^{-5}	0.241
PZ-30	18-28 feet	Slug Test	Saprolite/Transition Zone	Silty Sand	17%	9.1×10^{-5}	0.259
PZ-31A	55-70 feet	Slug Test	Transition Zone	Silty Sand	25%	3.63×10^{-4}	1.03
PZ-32A	60-75 feet	Slug Test	Bedrock	Granodiorite	2%	1.5×10^{-5}	0.043
PZ-33	40.5-50.5 feet	Slug Test	Unknown	Not Sampled	NA	6.7×10^{-5}	0.190

*All slug tests utilized the rising head slug test method.
Screen interval is in feet below land surface
¥Effective porosities for saprolite and transition zone were calculated from grain size relationships. Bedrock porosity is assumed based on evaluation of core recovered.
cm/sec – centimeters per second
ft/day – feet per day
NA – Not Assigned

Based on field observations (*i.e.,* soil boring records) and laboratory test results, the uppermost aquifer beneath the expansion site predominantly exists within the unconsolidated saprolitic soil and transition zone units, which have been determined to be micaceous silty sands and sandy silts produced by the in-situ weathering of the granodiorite parent rock. Ground-water flow within the uppermost aquifer is predominantly porous flow through the unconsolidated units. There is no evidence of discrete flow patterns within the saprolite and transition zones of the uppermost aquifer resulting from relict quartz veins, dikes, healed fractures, or strong preferential alignment of minerals (*i.e.,* foliation). However, in the vicinity of piezometer PZ-32A, the uppermost aquifer was first encountered (at the time of this study) approximately one and a half feet (1.65 feet) below the transition zone/bedrock interface at a depth of approximately 58 feet bgs. Ground water at this piezometer location is likely controlled by a combination of porous flow as well as some fracture flow. In general, the flow of ground water occurs from higher elevations onsite to lower elevations onsite under unconfined (water table) conditions regardless of the unit in which it resides.

2.2 Testing Programs for Borings

Between May 28 and 31, 2002, ten soil test borings were installed on an approximately 25-acre portion of the proposed landfill expansion property. All but two of the borings (B-31 and B-32) were converted to temporary ground-water piezometers. A work plan indicating the general location and proposed depths of these borings was submitted to the North Carolina Department of Environment and Natural Resources (NCDENR) Division of Solid Waste (DSW) for approval prior to the initiation of field activities. Verbal approval on the proposed boring locations and depths was given by Mr. Bobby Lufty of the NCDENR DSW during a telephone conversation with HDR Engineering, Inc. of the Carolinas (HDR). The final locations of these soil borings and piezometers and ground-water monitoring wells are shown on Drawing D-01 (see Appendix D). Table 2-4 on page 12 summarizes the drilling statistics for each boring location.

On-site drilling and soil sampling activities were performed by Richard Simmons Drilling, PA (NC Registration No. 2209) under the direct supervision of an HDR geologist. General access to the proposed drilling locations was first checked by HDR field personnel to evaluate drill rig accessibility. Landfill personnel assisted with the clearing of access roads to those borings/piezometers located in areas of the property covered by heavy brush or timber.

Ground-water piezometers were constructed in the eight borings that penetrated the uppermost water-bearing unit. Two-inch inside diameter (ID), Schedule 40 polyvinyl chloride (PVC) riser pipe was flush-mounted to 10-foot sections of factory-slotted PVC well screen with 0.010-inch slot openings. The well string was inserted through the center of the hollow stem augers and allowed to rest on the bottom of the borehole. Washed #2 silica sand was placed between the borehole wall and the well screen by pouring the sand through the augers and allowing the sand to fill the well's annulus (by gravity settling) as the augers were removed from the borehole subsurface. In general, the sand pack extended from the bottom of the boring to approximately 2 feet above the top of the well screen. A 2-foot thick bentonite seal was then set in place by pouring bentonite clay chips or pellets into the annulus above the top of the sand pack. The remaining borehole annulus from the top of the bentonite seal was sealed using a Portland Type I cement with three percent bentonite mixture. The top of each piezometer was fitted with a watertight locking well cap. A small vent hole in the well pipe just below the locking cap allows the water level in the piezometer to adjust to changes in atmospheric conditions. All of the piezometers were constructed with a portion of the well casing exposed above land surface. Installation diagrams for each of the piezometers installed were prepared from the geologist's field records and are included in Appendix B.

A follow-up visit to the Site was performed between February 11 and 17, 2003 for the collection of additional geologic and hydrogeologic data from the regions of the Site where auger refusal had been encountered during previous investigations (*i.e.,* vicinity of B-18, B-31, and B-32). Four additional soil borings were converted to ground-water piezometers (PZ-18A, PZ-22A, PZ-31A, and PZ-32A) by Engineering Tectonics, PA of Winston-Salem, NC (NC Registration No. 835) under the supervision of a North Carolina licensed geologist (NC License No. 1502).

Ground-water piezometers were constructed in the four borings that penetrated the uppermost water-bearing unit. Two-inch inside diameter (ID), Schedule 40 polyvinyl chloride (PVC) riser pipe was flush-mounted to 15-foot sections of factory-slotted PVC well screen with 0.010-inch slot openings. The well string was inserted through the center of the hollow stem augers and allowed to rest on the bottom of the borehole. Washed #2 silica sand was placed between the borehole wall and the well screen by pouring the sand through the augers and allowing the sand to fill the well's annulus (by gravity settling) as the augers were removed from the borehole subsurface. In general, the sand pack extended from the bottom of the boring to approximately 2 feet above the top of the well screen. A 2-foot thick bentonite seal was then set in place by pouring bentonite clay chips or pellets into the annulus above the top of the sand pack. The remaining borehole annulus from the top of the bentonite seal was sealed using a Portland Type I cement with three percent bentonite mixture. The top of each piezometer was fitted with a watertight locking well cap. A small vent hole in the well pipe just below the locking cap allows the water level in the piezometer to adjust to changes in atmospheric conditions. All of the piezometers were constructed with a portion of the well casing exposed above land surface. Installation diagrams for each of the piezometers installed were prepared from the geologist's field records and are included in Appendix B.

In addition to the 14 new borings/piezometers installed to characterize the 25-acre expansion area, ten on-site historical borings/piezometers were used to complete the geological/hydrogeological investigation. HDR utilized 8 borings/piezometers from the Site Study investigations (B-6, B-7, B-10, B-18, B-19, B-20, B-21A, and B-21B) installed by S&ME in 1994. Two additional wells (MW-2R AND MW-6R) were used, which were installed for the monitoring network in 1996 and 1999, respectively.

Table 2-4

Summary of Soil Boring and Piezometer Construction

Piezometer No.	Date Installed	Total Depth (bls)	Riser Length (bls)*	Ground Elevation (MSL)	Screen Elevation (ft MSL)	Sand Pack Thickness (ft)	Sand Pack Elevation
PZ-18A	2/14/2003	88.0	73.0	824.15	751.15 - 736.15	17	753.2 - 736.15
PZ-22A	2/11/2003	35.0	20.0	775.17	755.17 - 740.17	17	757.2 - 740.17
PZ-24	5/28/2002	38.0	28.0	767.98	739.98 - 729.98	12	742 - 729.98
PZ-25	5/31/2002	91.0	81.0	790.91	709.91 - 699.91	12	711.9 - 699.91
PZ-26	5/29/2002	33.5	23.5	757.93	734.43 - 724.43	12	736.4 - 724.43
PZ-27	5/29/2002	18.0	8.0	726.51	718.51 - 708.51	12	720.5 - 708.51
PZ-28	5/29/2002	30.0	20.0	744.49	724.49 - 714.49	12	726.5 - 714.49
PZ-29	5/30/2002	14.0	4.0	733.67	729.67 - 719.67	12	731.7 - 719.67
PZ-30	5/30/2002	28.0	18.0	754.04	736.04 - 726.04	12	738 - 726.04
B-31	5/31/2002	55.0	NA	807.64	NA	NA	NA
PZ-31A	2/12/2003	70.0	55.0	808.11	753.11 - 738.11	17	755.1 - 738.11
B-32	5/30/2002	55.5	NA	811.43	NA	NA	NA
PZ-32A	2/13/2003	75.0	60.0	811.78	751.78 - 736.78	17	753.78 - 736.78
PZ-33	5/31/2002	50.5	40.5	784.60	744.10 - 734.10	12	746.10 - 734.10
**B-6	3/24/1994	50.0	40.0	824.46	784.30 - 774.30	13	787.30 - 774.30
**B-7	3/30/1994	50.0	40.0	814.61	775.00 - 765.00	13	778.00 - 765.00
**B-10	4/8/1994	50.0	40.0	785.74	746.00 - 736.00	12	748.00 - 736.00
**B-18	4/7/1994	48.7	38.7	824.27	785.30 - 775.30	11	786.30 - 775.30
**B-19	4/7/1994	48.6	38.6	811.04	772.50 - 762.50	11	773.50 - 762.50
**B-20	4/8/1994	46.5	38.5	757.10	718.60 - 710.60	9	719.60 - 710.60
**B-21A	4/4/1994	56.5	46.5	747.23	700.73 - 690.73	12	702.73 - 690.73
**B-21B	4/4/1994	41.5	31.5	746.94	715.44 - 705.44	12	717.44 - 705.44
MW-2R	12/29/1995	23.0	6.0	781.50	775.50 - 760.50	12	777.50 - 760.50
MW-6R	7/8/1999	60.0	45.0	817.80	773.00 - 758.00	17	775.00 - 758.00

All depths are in feet below land surface (bls).
All elevations are relative to mean sea level (MSL).
NA – Not applicable
*Riser length does not include stick-up.
**Indicates S&ME piezometers from the Site Study.

2.2.1 Standard Penetration Testing

The soil borings were installed utilizing either a track-mounted or all-terrain (AT) drill rig using 4.25-inch ID continuous-flight hollow stem augers and/or a 6-inch diameter air hammer. Starting from approximately 5 feet below land surface (bls), representative samples of the soil immediately ahead of the augers were collected (at 5-foot intervals) using standard 2-inch outside diameter (OD) split-spoon samplers in

general accordance with American Society of Testing and Materials (ASTM) D 1586. The 18-inch long samplers were driven using the rig's mounted cathead-actuated 140-pound hammer into the soil by allowing the hammer to fall a distance of 30 inches. The samplers were initially seated the first 6 inches to penetrate any loose cuttings. The total number of blows required to advance the sampler the last 12 inches was recorded as the N-value (penetration resistance value) for the sample. This value is a relative index of the soils strength and load supporting capability. These N-values were recorded in the field and are shown on the boring logs. In addition, each sample was visually inspected in the field and classified in accordance with the Unified Soil Classification System (USCS). These classifications, along with a general description of each sample, are also provided on the boring logs in Appendix B. Those borings not converted to ground-water piezometers (*i.e.,* B-31 and B-32) were grouted to land surface with Portland Type I cement.

While the subsurface profile at the Site from ground surface to competent bedrock consists predominantly of a silty sand, there is a gradational change in its density with depth. In low-lying areas of the Site, the subsurface soils grade from a medium dense silty sand (N values of 10 to 30) to a dense silty sand (N values 30 to 50). An occasional sandy silt with comparable densities was also encountered. Isolated occurrences of a finer grained (higher percentage of clay) material has been encountered onsite with a medium-stiff density (N values of 4 to 8). However, this material was identified as an engineered fill material used to construct the berm of the Sedimentation Basin No. 5. The main portions of Phases V and VI contain a dominant ridge feature, which is underlain by a dense to very dense silty sand (N values of 30 to 50 or greater) from a depth of approximately three feet bgs to the top of the bedrock encountered at PZ-18A. For reporting purposes, penetration resistance values of 50 blows per foot (bpf) or greater have been given the designation as transition zone. However, this designation is only geotechnically based on field density values and has no bearing or relevance on the hydrogeologic properties of this material. From a hydrogeologic standpoint, the material beneath the Site with N values of 50 bpf or greater resulted from the in-situ weathering of the texturally uniform granodiorite parent rock. As a result, the hydrogeologic properties of this unconsolidated material are essentially equivalent to those of the less dense saprolite soils above.

2.2.2 Particle Size Analysis

Eight grain size distributions were performed as part of the geotechnical laboratory analysis. The samples had an average sand content of 65.3 percent, with the majority of the remaining grain size fraction (11.3 percent) composed of silt-sized particles. Clay sized particles were present in the samples analyzed at an average of 22.8

percent. Table 2-2 summarizes the results of the geotechnical laboratory testing for particle size analysis. Appendix C contains the laboratory particle size analysis reports.

2.2.3 Soil Classification

Based on the evaluation of the grain size analyses performed on the saprolite samples collected from the entire expansion Site, the samples were classified predominantly as a silty sand (SM) of varying composition, with lesser amounts of sandy silt (ML – MH). Table 2-2 summarizes the soil classification results for the samples analyzed. Appendix C contains the geotechnical laboratory reports for these samples.

Natural moisture contents ranged from 11.5 to 29.8 percent.. Maximum dry densities ranging from 80.4 to 110.5 pounds per cubic foot (pcf) were reported for the samples. All of the samples from a depth of approximately five feet bgs were non-plastic. Samples collected from soil boring locations PZ-31A and PZ-32A reported slight plasticities. However, these samples are classified as micaceous sandy silts, which characteristically display a slight plasticity. Copies of the compaction, grain size, and Atterberg testing curves for each sample analyzed are included in Appendix C.

2.2.4 Subsurface Descriptions

Site Geology

Geologic units identified at or adjacent to the Site include the following (Espenshade and others, 1975):

- Pzc, Granitic Rock of the Charlotte Belt – Quartz monzonite and Granodiorite that commonly contain large microcline phenocrysts: generally have biotite and muscovite, epidote, and locally much hornblende. In a few places contain thin layers of mafic rock. Usually nonfoliated Pzcg, gneissic quartz monzonite and Granodiorite mostly along pluton borders.

According to Espenshade and others (1975), the subject site is in the Charlotte belt of the Piedmont Physiographic Province. This area consists of metamorphic and igneous pluton rocks that in some areas have been extensively weathered and eroded forming an undulating and well-dissected topography.

Intrusive granites typically having megacrystic to equigranular textures underlie the area. The bedrock is usually fractured and overlain by highly weathered bedrock (saprolite). The saprolite thickness varies from a few feet (near bedrock outcrops) to over 100 feet and retains some of the original (relict) structures of the parent rock.

Physical and chemical weathering of the saprolite in-situ, which can sometimes retain relict features, forms the near surface residual soils.

Site Ground Water

In the Piedmont Physiographic Province, ground water is present within the pore spaces of the saprolite and the fractures within the bedrock. The aquifers within the saprolite and bedrock are recharged by precipitation that infiltrates the unsaturated zone to the water table. Ground water moves through the saprolite and bedrock fractures toward surface water bodies (discharge areas).

Site Seismicity

The earthquake frequency in the southeastern United States is about one-tenth that of the West Coast. The Southeast United States region is a minor seismic zone, characterized by a low level of seismic release.

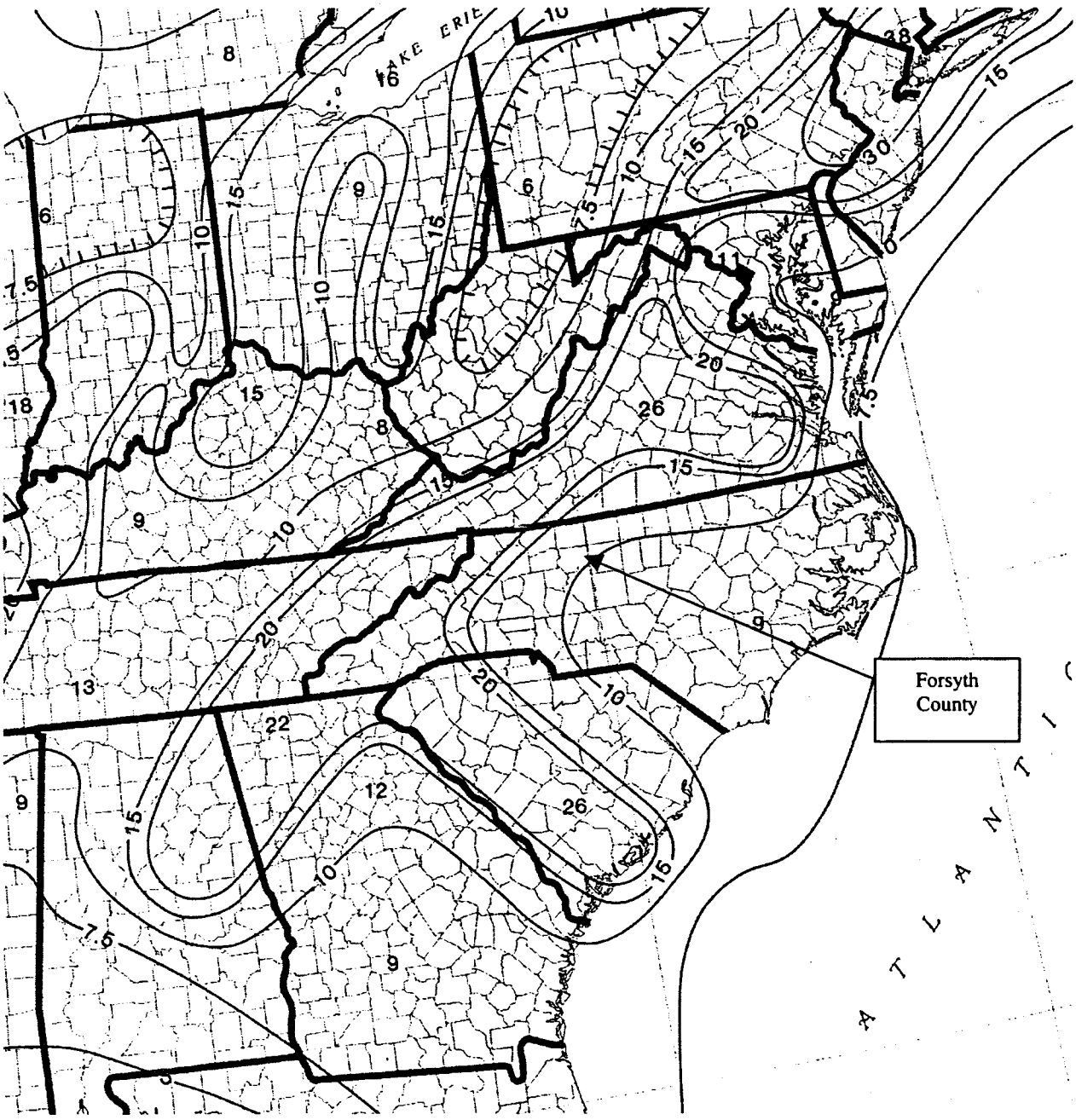
Several earthquakes have taken place in the southeastern United States with intensities over VII on the Modified Mercali Scale. These earthquakes associated to the Central Virginia Seismic Zone, and the South Carolina – Georgia Seismic Zone have concentrated over central Virginia, South Carolina, and northwestern Georgia, for the most part (see Figure 2-1).

2.2.5 Total Porosity and Effective Porosity

Total porosity in the saprolite is usually relatively high, with measured values commonly in the 40 to 50 percent range. However, the total porosity values for the two Shelby tube samples collected during piezometer installation reported saprolite porosity values of 7 and 19 percent for PZ-29 and PZ-31, respectively. "Effective" porosity is typically lower (by as much as half) than total porosity (Daniel and Payne, 1990) so the total porosity values reported from the study area are suspect when compared to the effective porosities derived from their textural classifications and specific yields as previously presented in Section 2.1.

Based on published values in Freeze and Cherry (1979), porosities in dense crystalline rock can range from 0% to 5% with fractured crystalline rock porosities slightly higher between 0% and 10%. Based on the evaluation of the rock encountered within the Phase IV, V, VI area (i.e., RQDs, percent recovery, fracture occurrence), HDR has estimated a porosity of 2% for the bedrock formation onsite.

Figure 2-1
Seismic Map



Horizontal Acceleration (90% Probability of not being exceeded in 250 years)
Scale: 1:7,500,000

Contour--Horizontal acceleration expressed as percent of gravity (g).

Source: USGS Miscellaneous Field Studies Map, MF-2120, Algermissen, et. al., 1990.

2.3 Water Table Information

2.3.1 24-Hour Water Table Elevations

Table 2-5 summarizes all available at-time-of-boring (ATOB) and 24-hour water levels for all piezometers installed. The water table data presented on the boring logs in Appendix B represents the 24-hour water levels in each piezometer.

2.3.2 Tabulated Water Table Elevations Over Time

Table 2-6 presents available water table elevation measurements for the period from April 1994, when the initial 26 ground-water piezometers were installed, to March 4, 2003, after the installation of the final four ground-water piezometers as part of this Design Hydrogeologic Report. The March 4, 2003 water table elevations were used to construct an up-to-date water table potentiometric map (see Appendix D, Drawing D-02). The data shows that the maximum water table fluctuation at the Site during the monitoring period is slightly over six feet, which has occurred in ground-water piezometers PZ-7 and PZ-8 with 6.31 and 6.84 feet of fluctuation, respectively. This can be attributed to these piezometers being in closer proximity to the current waste disposal operations than the other piezometers onsite. In areas not influence by active waste placement (*i.e.,* MW-1R and MW-6R), the maximum ground-water fluctuation measured was slightly less at just over four feet (4.35 and 4.28 feet, respectively). Since these areas are in upland regions of the Site, they represent the maximum Site fluctuation under normal conditions. The normal fluctuation seen at low-lying regions of the Site (*i.e.,* MW-2R and MW-5R) averages around two feet (1.93 and 2.20 feet, respectively).

2.3.3 Estimation of Long-Term Seasonal High Water Table

The estimation of long-term seasonal high ground water at the Site was conducted in two phases. The first phase involved determining which season (12-month period) of the year the water table tends to be the highest. The second phase involved the evaluation of long-term ground-water trends from the Site, as well as from a regional sense.

Seasonal High Water Table

Water level measurements have been periodically collected from the Site since as early as 1994 when the permitting of Phase I began. Earlier work by S&ME document water level measurements collected between April 1994 and February 1995 from 20 temporary ground-water piezometers installed across the Site. HDR has routinely monitored ground-water levels across the Site in up to eight compliance

monitoring wells between January 1996 and March 2003 during semiannual water quality sampling events. In general, the historic water level data from the Site confirms seasonal ground-water level trends seen throughout the Piedmont, *i.e.*, levels are generally at their highest during the spring months of the year (March through May) and lowest in the late summer months between September and October (for example, see hydrographs presented in "Water Resources Data, North Carolina, Water Years 1994 and 1998, Volume 2, Ground-Water Records," USGS

Table 2-5

Summary of Available At-Time-of-Boring (ATOB) and 24-Hour Water Levels for Borings and Piezometers

Well or Piezometer No.	Water Level ATOB	24-Hour Water Level
B-6*	NA	NA
B-7*	44.5	NA
B-10*	40.5	NA
B-11*	28	NA
PZ-15A	NA	NA
PZ-15B	15	NA
PZ-16A	NA	NA
PZ-16B	NA	NA
B-18*	Dry	NA
PZ-18A	79.5	81.9
B-19*	Dry	NA
B-20*	34.5	NA
PZ-21	NA	NA
PZ-21B	NA	NA
B-22*	Dry	NA
PZ-22A	28	17.4
PZ-24	25	29
PZ-25	80	55.6
PZ-26	28	27
PZ-27	3	1.5
PZ-28	20	17.4
PZ-29	5	3.7
PZ-30	15	11.8
PZ-31A	62	61.9
PZ-32A	47	56
PZ-33	65	37.5

All measurements are in feet below land surface.
*Abandoned wells/borings

Table 2-6

Summary of Historical Ground Water Monitoring Data

LOCATION	CASING	DTW	GW ELE	DTW	GW ELE	DTW	GW ELE	DTW	GW ELE	DTW	GW ELE	DTW	GW ELE	DTW	GW ELE	DTW	GW ELE	DTW	GW ELE	DTW	GW ELE	DTW	GW ELE
	ELE	4/14/1994	4/14/1994	5/4/1994	5/4/1994	10/6/1994	10/6/1994	2/20/1995	2/20/1995	1/17/1996	1/17/1996	10/24/1996	10/24/1996	5/13/1997	5/13/1997	10/30/1997	10/30/1997	5/5/1998	5/5/1998	11/5/1998	11/5/1998	6/2/1999	6/2/1999
MW-1R	836.42									38.77	797.65	37.60	798.82	37.94	798.48	38.1	798.32	37.50	798.92	37.50	798.92	37.99	798.43
MW-2R	785.22									11.21	774.01	9.90	775.32	9.97	775.25	10.36	774.86	10.00	775.22	10.30	774.92	9.65	775.57
MW-3	807.00									37.42	769.58	36.65	770.35	34.97	772.03	36.35	770.65	34.45	772.55	36.95	770.05		
MW-3R	776.60																						
MW-4R	767.96									9.90	758.06	9.67	758.29	9.98	757.98	9.85	758.11	9.50	758.46	8.77	759.19	14.15	753.81
MW-5R	784.36									12.26	772.10	12.94	771.42	13.00	771.36	12.73	771.63	12.65	771.71	11.89	772.47	11.50	772.86
MW-6	825.24									50.94	774.30	49.48	775.76	49.98	775.26	50.13	775.11	50.10	775.14	48.62	776.62		
MW-6R	820.40																						
MW-7	803.66									35.88	767.78	35.21	768.45	35.00	768.66	35.36	768.3	34.95	768.71	35.50	768.16	35.15	768.51
MW-8	762.50																						
B-3	835.98	39.08	796.90	38.96	797.02	39.43	796.55	40.07	795.91														
B-5	820.79	43.67	777.12	43.58	777.21	44.12	776.67	45.50	775.29														
B-6	825.42	47.96	777.46	48.00	777.42	48.30	777.12	49.23	776.19														
B-7	816.42	42.92	773.50	42.73	773.69	43.45	772.97	44.67	771.75														
B-8	792.15	30.56	761.59	30.55	761.60	32.39	759.76	33.61	758.54														
B-9	822.68	48.58	774.10	48.53	774.15	49.09	773.59	49.96	772.72														
B-10	787.86	39.38	748.48	39.18	748.68																		
B-11	766.47	23.04	743.43	21.29	745.18																		
B-12	828.75	48.29	780.46	48.19	780.56	48.68	780.07	48.91	779.84														
B-13	816.12	32.17	783.95	32.00	784.12	33.04	783.08	33.90	782.22														
B-14	806.22	18.63	787.59	18.52	787.70	18.62	787.60	19.60	786.62														
B-15-A	782.88	10.75	772.13	10.69	772.19	11.53	771.35	11.18	771.70														
B-15-B	780.96	8.75	772.21	8.80	772.16																		
B-16-A	764.09	12.67	751.42	12.92	751.17	14.96	749.13	14.14	749.95														
B-16-B	762.67	10.33	752.34	10.97	751.70	11.72	750.95	10.60	752.07														
B-17	763.82	6.83	756.99	6.83	756.99	9.70	754.12	10.76	753.06														
PZ-18A	827.15																						
B-20	759.37	28.00	731.37	28.03	731.34																		
B-21-A	749.25	5.12	744.13	5.63	743.62																		
B-21-B	748.80	5.30	743.50	5.46	743.34																		
PZ-22A	778.68																						
B-23	813.42	35.83	777.59	35.48	777.94	36.21	777.21	36.91	776.51														
PZ-24	770.07																						
PZ-25	792.90																						
PZ-26	760.84																						
PZ-27	728.34																						
PZ-28	744.80																						
PZ-29	736.59																						
PZ-30	756.01																						
PZ-31A	810.85																						
PZ-32A	814.67																						
PZ-33	788.09																						

Table 2-6

Summary of Historical Ground Water Monitoring Data

LOCATION	DTW	GW ELE	DTW	GW ELE	DTW	GW ELE	DTW	GW ELE	DTW	GW ELE	DTW	GW ELE	DTW	GW ELE	DTW	GW ELE	DTW	GW ELE	AVERAGE	MAX	MIN	DIFF
	11/19/1999	11/19/1999	5/6/2000	5/6/2000	12/14/2000	12/14/2000	7/31/2001	7/31/2001	11/20/2001	11/20/2001	4/17/2002	4/17/2002	6/20/2002	6/20/2002	3/4/2003	3/4/2003	9/5/2003	9/6/2003				
MW-1R	38.95	797.47	38.53	797.89	39.75	796.67	40.45	795.97	41.80	794.62	41.53	794.89	41.85	794.57	41.62	794.80	37.86	798.56	797.19	798.92	794.57	4.35
MW-2R	10.55	774.67	9.93	775.29	11.21	774.01	10.82	774.40	11.16	774.06	10.80	774.42	11.45	773.77	9.52	775.70	9.03	776.19	774.85	776.19	773.77	2.42
MW-3																			770.87	772.55	769.58	2.97
MW-3R	23.37	753.23	22.76	753.84	23.95	752.65	25.13	751.47	26.18	750.42	26.5	750.10	27.04	749.56	23.15	753.45	22.20	754.40	752.12	754.40	749.56	4.84
MW-4R	9.17	758.79	8.62	759.34	10.12	757.84	10.87	757.09	11.95	756.01	11.88	756.08	12.49	755.47	11.16	756.80	8.29	759.67	757.56	759.67	753.81	5.86
MW-5R	12.07	772.29	11.62	772.74	12.50	771.86	12.98	771.38	13.70	770.66	12.80	771.56	13.68	770.68	11.66	772.70	9.70	774.66	772.01	774.66	770.66	4.00
MW-6																			775.37	776.62	774.30	2.32
MW-6R	49.42	770.98	48.75	771.65	51.05	769.35	51.17	769.23	52.17	768.23	52.56	767.84	52.95	767.45	52.80	767.60	48.89	771.51	769.32	771.65	767.45	4.20
MW-7	36.00	767.66	35.66	768.00	36.90	766.76	38.49	765.17	39.29	764.37	40.15	763.51	40.52	763.14	41.26	762.40	38.42	765.24	766.55	768.71	762.40	6.31
MW-8					17.20	745.30	22.20	740.30	23.72	738.78	23.08	739.42	24.04	738.46	21.7	740.80	17.30	745.20	741.18	745.30	738.46	6.84
B-3																			796.60	797.02	795.91	1.11
B-5																			776.57	777.21	775.29	1.92
B-6																			777.05	777.46	776.19	1.27
B-7																			772.98	773.69	771.75	1.94
B-8																			760.37	761.60	758.54	3.06
B-9																			773.64	774.15	772.72	1.43
B-10																			748.58	748.68	748.48	0.20
B-11																			744.31	745.18	743.43	1.75
B-12																			780.23	780.56	779.84	0.72
B-13																			783.34	784.12	782.22	1.90
B-14																			787.38	787.70	786.62	1.08
B-15-A													12.87	770.01	11.15	771.73			771.52	772.19	770.01	2.18
B-15-B													11.00	769.96	9.43	771.53			771.47	772.21	769.96	2.25
B-16-A													17.17	746.92	14.72	749.37			749.66	751.42	746.92	4.50
B-16-B													14.34	748.33	11.30	751.37			751.13	752.34	748.33	4.01
B-17																			755.29	756.99	753.06	3.93
PZ-18A															81.75	745.40	76.9	750.25	747.83	750.25	745.40	4.85
B-20																			731.36	731.37	731.34	0.03
B-21-A													9.13	740.12	7.02	742.23			742.53	744.13	740.12	4.01
B-21-B													9.05	739.75	6.96	741.84			742.11	743.50	739.75	3.75
PZ-22A															19.51	759.17	15.46	763.22	761.20	763.22	759.17	4.05
B-23																			777.31	777.94	776.51	1.43
PZ-24													30.99	739.08	29.39	740.68	28.31	741.76	740.51	741.76	739.08	2.68
PZ-25													57.69	735.21	60.59	732.31	55.45	737.45	734.99	737.45	732.31	5.14
PZ-26													30.03	730.81	29.16	731.68	27.61	733.23	731.91	733.23	730.81	2.42
PZ-27													3.77	724.57	2.53	725.81	2.17	726.17	725.52	726.17	724.57	1.60
PZ-28													17.99	726.81	14.76	730.04	14.3	730.50	729.12	730.50	726.81	3.69
PZ-29													6.64	729.95	4.77	731.82	4.4	732.19	731.32	732.19	729.95	2.24
PZ-30													14.33	741.68	10.87	745.14	9.69	746.32	744.38	746.32	741.68	4.64
PZ-31A															64.34	746.51	59.79	751.06	748.79	751.06	746.51	4.55
PZ-32A															61.54	753.13	55.84	758.83	755.98	758.83	753.13	5.70
PZ-33													40.97	747.12	38.44	749.65	33.45	754.64	750.47	754.64	747.12	7.52

Water Data Report NC-94-2 and NC-98-2, respectively). Based on the historical ground-water data from the Site (1994 to 2003), the highest recorded levels routinely occurred during the spring months of April and May.

In addition, HDR has determined through the repeated monitoring of ground-water levels at the Site (and other landfills in the region) that seasonal variations in ground-water level vary depending upon the piezometer's topographic position (*i.e.,* ridge, slope, draw). For example, piezometers located in upland regions (*i.e.,* areas of recharge) tend to fluctuate more between seasons than piezometers located in low-lying areas (*i.e.,* discharge regions). A maximum fluctuation of 6.84 feet has occurred at monitoring well location MW-8. However, this well has experienced a consistent reduction in water level since being installed (possibly due to a reduction in ground-water recharge resulting from the expansion of waste disposal activities into nearby Phase III) and, therefore, this is not a valid measure of true ground-water fluctuation at the Site. The maximum average fluctuation observed across the Site between 1996 and 2003 was approximately 5 feet, observed in monitoring wells MW-3R (4.28 feet) and MW-7 (6.31 feet). On the average, monitoring wells in upland areas (e.g., MW-1R and MW-6R) experienced a fluctuation of a little over 4 feet during this period, while wells located near drainage features or discharge areas experienced slightly less fluctuation (*e.g.,* MW-2R and MW-5R with 1.93 and 2.20 feet of change, respectively). Between 1996 and 2003, the average annual fluctuation of ground water at the Site measured slightly less than one foot at 0.98 feet. However, single yearly fluctuations have been as much as 1.7 feet (1999) and as little as 0.4 feet (1997). Finally, the overall trend in water levels on-site is one of reduction or lowering. Since 1999, the water levels in all of the compliance monitoring wells have been decreasing with levels measured in June 2002 being the lowest reported to-date. Recent levels recorded in March 2003 have shown an increase since June 2002 between 0.15 and 3.89 feet. A correction for the B-18A, B-22A, B-31A, and B-32A March 2003 readings was made based on a 2.5-foot increase in ground-water elevation in PZ-33 over this period. This can be attributed to the higher precipitation levels for the area during the first quarter of 2003.

Long-Term Seasonal High Water Table

In order to determine "long-term" seasonal high trends, the historical ground-water records for a USGS piezometer located within the Piedmont physiographic province were evaluated. Table 2-7 summarizes the construction and long-term monitoring results for this well between 1981 and 1998.

Table 2-7

Construction and Hydrogeologic Details of USGS Regional Well

Piezometer No.	Piedmont County	Total Depth (feet bls)	Formation Monitored	Interval Monitored (feet bls)	Highest Recorded Depth (feet bls)	Lowest Recorded Depth (feet bls)	Difference (feet)
NC-142	Davie	30.8	Saprolite	20 to 30.8	10.64	20.98	10.34

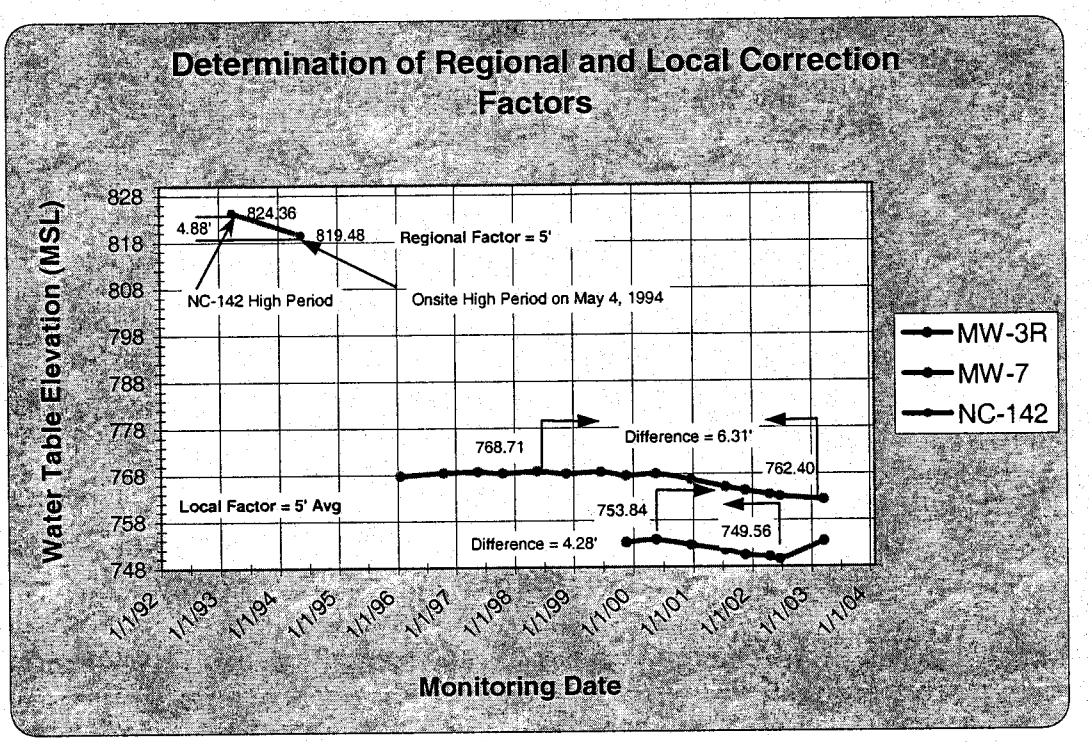
Note: Highest recorded depth occurred during the spring on March 28, 1993.
Lowest recorded depth occurred during the fall in October 1981.

The highest water table reading at this well between October 1981 to September 1998 (17-year span) occurred on March 28, 1993, this measurement was considered as the regional "benchmark" for determining the long-term seasonal high for the Site. Over a 17-year period, this well experienced a 10.34-foot variation in static water level. However, water table data from the expansion site is not available during this regional "benchmark" period to make a direct comparison with current water table data from the Site. Therefore, several comparisons were made between the regional well and earlier ground-water data from the expansion Site until a direct comparison could be made with current piezometer data from the expansion area.

The earliest ground-water data from the Site was collected between April 1994 and February 1995. During this period, the data from the May 4, 1994, event consistently recorded the highest on-site levels. A comparison was made between the measured water level on May 4, 1994, in this regional benchmark well against the highest recorded water level reported in the same well measured on March 28, 1993, to determine the potential level of "regional" correction to be applied to the on-site data. The recorded level in this well on March 28, 1993, was 10.64 feet bls (824.36 feet MSL) with the level recorded on May 4, 1994, measuring at 15.52 feet bls (819.48 feet MSL). This calculates to a drop in water level of approximately 5 feet (4.88 feet). Therefore, it can be presumed that the on-site high ground-water measurements collected on May 4, 1994, would need to be increased by as much as **5 feet** to meet the NC-142 historical high.

The final step involved determining the change in the static water table between the May 4, 1994, event and the current Site readings. The current monitoring event for the Landfill is represented by static ground-water measurements collected on March 4, 2003, from all ground-water piezometers and compliance monitoring wells located on-site. Drawing D-02 depicts the water table potentiometric contours from the water table elevations representing the June 20, 2002, data. However, none of the piezometers installed during the permitting of Phase I remain on-site, with the exception of three paired piezometer locations (*i.e.*, B-15-A, B-15-B; B-16-A,

B-16-B; and B-21-A, and B-21-B). All of these locations are positioned near drainage features or potential discharge areas. Therefore, the level of potential fluctuation at these locations will be less than the average for the Site based on previous determinations (see discussion in previous section). As stated above, the maximum Site fluctuation observed between 1996 and 2003 was approximately 5 feet and most of this fluctuation was in the downward direction due to the drought conditions experienced over the past several years. Water table conditions remained fairly consistent between 1994 and 1996 when routine monitoring of the Site began. It was not until the latter part of 1999 when water table conditions consistently began to drop across the Site. With the June 20, 2002 water table measurements being the lowest recorded to date, these measurements would need to be adjusted (increased) by approximately **5 feet** to equal the highest readings reported for the Site on May 4, 1994. The following graph illustrates the relationship between the local and regional correction factors and how they apply to the existing ground-water data.



In conclusion, an estimated long-term seasonal high adjustment factor of 10 feet (5-foot regional factor plus 5-foot local factor) would be required to correct the June 20, 2002 water table elevations to more accurately reflect the potential long-term seasonal high water table conditions at the Site. The diagram above illustrates how these correction factors were determined. This correction value seems to closely approximate the total historical fluctuation reported in the regional USGS well located in Davie County (approximately 10 feet since 1981). Table 2-8 summarizes the estimated long-term seasonal high ground water elevations at the piezometers installed within and in close proximity to the Phase IV, V, VI area.

Table 2-8

Summary of Estimated Long-Term Seasonal High Ground-Water Elevations

Well or Piezometer No.	Water Level on 5/4/1994 (5-Foot Correction)	Water Level on 6/20/2002 (10-Foot Correction)	Estimated Seasonal High Elevation
MW-2R		773.77	783.77
MW-6R		767.45	777.45
B-6	777.42		782.42
B-7	773.69		778.69
B-10	748.68		753.68
B-20	731.34		736.34
B-21B		739.75	749.75
PZ-18A		742.90*	752.90
PZ-22A		756.67*	766.67
PZ-24		739.08	749.08
PZ-25		735.21	745.21
PZ-26		730.81	740.81
PZ-27		724.57	734.57
PZ-28		726.81	736.81
PZ-29		729.95	739.95
PZ-30		741.68	751.68
PZ-31A		744.01*	754.01
PZ-32A		750.63*	760.63
PZ-33		747.12	757.12

All measurements are in feet above mean sea level (MSL).
*Values are estimates based on March 4, 2003 elevations minus average change in water table between June 20, 2002 and March 4, 2003 of 2.5 feet.

Prior to calculating final base grades for Phases IV through VI of the proposed expansion Site, an additional 4 feet (the required distance between the base of the debris and the long-term seasonal high water table or bedrock) of separation was added to the "corrected" water table elevations from the June 20, 2002, monitoring event. Drawing D-2a represents the estimated long-term seasonal high water table based on corrected water table elevations from static measurements obtained on June 20, 2002 from the ground-water piezometers located within and around the proposed landfill expansion Site. It should be noted that the Piedmont region has experienced moderate to severe drought conditions since the latter part of 1999. With precipitation (and ultimately recharge) rates being less than normal during this time, water table elevations collected from the Site (and from other sites in the region) have declined over the past few years, causing lower than normal water table conditions across the Site. At the time of this report, water table elevations were the lowest experienced in the past 7 years.

2.3.4 Ground-Water Flow Components

As previously noted, Drawing D-02 (see Appendix D) depicts the water table at the proposed Site. This map is based upon water levels measured in March 2003, at the piezometers shown on this potentiometric surface map. As shown on this drawing, ground-water flow is generally to the north. Flow occurs from areas of recharge, represented by the highest areas of natural topography, and moves toward the discharge areas found along streams or creeks. Discharge on-site takes place locally along the unnamed stream to the north.

The following variation of Darcy's Equation was used to calculate the ground-water seepage velocities for the geologic units referenced in Table 2-9 below.

$$V_s = \frac{(K_h)(i)}{(P_e)}$$

Where: V_s = Seepage Velocity (feet/day)
i = Hydraulic Gradient (feet/foot)
K_h = Hydraulic Conductivity (feet/day)
P_e = Effective Porosity

Table 2-9

Ground-Water Seepage Velocities

	K_h	Pe	i	Vs (ft/d)	Vs (ft/yr)
Saprolite	0.259	17%	0.028	.043	15.57
Transition Zone	0.466	25%	0.028	0.052	18.98
Rock	0.043	2%	0.028	.060	21.97

Hydraulic gradients within the Phase IV, V, VI area (saprolite and transition zones) taken from Figure D-02 (see Appendix D) range from 0.009 (PZ-33 to PZ-31A) to 0.046 feet/foot (ft/ft) (PZ-32A to PZ-28) with a Site average of 0.028 ft/ft. Using the average of the hydraulic conductivities for the piezometers within the study area (0.259 feet/foot for the saprolite, 0.466 feet/foot for the transition zone, and 0.043 feet/foot for bedrock), the average hydraulic gradient from Figure D-02, an average effective porosity of 17 percent for wells screened within the saprolite, 25 percent for wells within the transition zone, and 2 percent for the bedrock, an average ground-water seepage rate (velocity) was calculated for each hydrogeologic unit.

The calculated horizontal ground-water flow velocity for the saprolite unit is .043 feet per day (15.57 feet/year). The transition zone beneath the saprolite unit calculated with a ground-water flow velocity of .052 feet/day (18.98 feet/year), while the bedrock aquifer unit resulted in a slightly lower ground-water flow velocity of 0.060 feet/day (21.97 feet/year). Overall, the calculated ground-water flow velocities for each of the hydrogeologic units are very similar suggesting a general degree of

uniformity between the units. There appears to be no preferential ground-water flow in any one unit beneath the Phase IV, V, VI area.

A vertical component of ground-water flow is presented in Table 2-10 below for the existing Site Study piezometer pair within the study area. This piezometer pair shows an upward vertical gradient of 0.025 ft/ft during a June 2002 monitoring event with an upward vertical gradient of 0.027 ft/ft again in March 2003. Historically, these wells have been measured in show an upward vertical gradient. Downward vertical gradients indicate recharge conditions; upward gradients indicate discharge; and horizontal gradients indicate a neutral/lateral ground-water flow regime. Since this piezometer pair is located within an expected ground-water discharge zone, the resulting upward gradients confirm this condition.

Table 2-10

Summary of Vertical Components of Ground-Water Flow

Well Pair	Ground-Water Elevation*	Elevation Difference (feet)	Screen Separation (feet)	Vertical Gradient (feet/foot)
PZ-21A / 21B	740.12 / 739.75	0.37	14.71	0.025
	742.23 / 741.84	0.39		0.027

*Elevations are in feet relative to MSL.
A – denotes deep piezometer
B – denotes shallow piezometer
Water levels from June 2002 (top) and March 2003 (bottom).
Positive vertical gradient indicates an upward flow gradient.

2.4 Hydrogeologic Cross Sections

Two geologic cross sections can be seen on Drawing D-03 (see Appendix D). Geologic Cross Section A-A′ is oriented north to south across the Site, with the southern portion of the section running essentially parallel to the dominant horizontal component of ground-water flow at the Site (west to east). Geologic Cross Section B-B′ is oriented roughly west to east across the central portion of the Site, essentially perpendicular to ground-water flow.

Based on the data presented in this section, the Site is shown to consist of a continuous layer of residual soil, which is present across the entire Site. As previously discussed in Sections 2.1 and 2.2.1, this residual soil unit grades vertically from a material (termed herein as saprolite) that has a relative density ranging from medium dense to dense (N values less than 50 bpf) to a material that is characteristically dense to very dense (N values greater than or equal to 50 bpf), which has been termed the transition zone. The relative thicknesses of these two units is highly variable across the Site. The low-density saprolite unit varies in thickness from approximately three feet on the ridge top (at B-18) to as much as 65 feet near boring B-10 in Phase IV. The more dense transition zone is also highly variable in thickness across the Site and seems to be the more dominant of the two units. It ranges in thickness of

only a few feet near boring B-10 to as much as 85 feet on the ridge near B-18. It also appears that the relative density change between these to residual soil units has played a large role in the surficial geomorphology of the Site, in particular, the two large erosional scarps near PZ-26 and PZ-32A. Also tied to the geomorphology of the Site is the occurrence of the granodiorite encountered beneath the dominant ridge near B-18 and B-19. The relative surface topography of the bedrock/residual soil interface beneath the ridge appears to have been carried through to the surface topography of the ridge. Based on the hydrogeologic data obtained through this study, the first occurrence of ground water beneath the Site is encountered in the residual soil with only a single occurrence of ground water at or just below the bedrock interface at piezometer PZ-32A (1.65 feet below the top of rock on March 4, 2003). This condition has caused a slight elevation (mounding) in the ground-water table in the vicinity of PZ-32A and PZ-22A (see Drawing D-02). However, due to drought conditions, this condition is probably only temporary and under normal ground water conditions prior to the drought, the ground water at PZ-32A would likely be above the bedrock interface, as it appears to be everywhere else across the Site. Drawing D-04 (see Appendix D) depicts the inferred structure on top of the bedrock beneath the central portion of the Phase IV, V, VI area based on the occurrence of confirmed auger refusal or cored rock locations. Based on the data, it appears that a structural high ("ridge") in the bedrock formation is present beneath the main ridge near soil borings B-18 and B-19. As expected, the strike of this feature appears to be northeast to southwest in the same general orientation as other regional tectonic features of the Piedmont.

The horizontal components of ground-water flow are also presented on the cross sections. In general, ground-water flows from the ridge tops to the surface water streams on site with no hydrologic differences observable between the saprolite, transition zone, or bedrock. Vertical components of ground-water flow in the upward direction are measured at low-lying areas of the Site, specifically at the surface water streams.

2.5 Boring Abandonment Certification

All borings and/or piezometers that were not converted to permanent ground-water monitoring wells were abandoned in accordance with the procedures for permanent abandonment of wells, as delineated in 15A NCAC 2C Rule .0113(a)(2). In addition, all study piezometers will be abandoned in accordance with these procedures prior to commencement of construction activities on site.

SECTION 3.0
SUMMARY AND CONCLUSIONS

3.1 Summary

The following is a summary of the findings from the performance of the subsurface investigation at the proposed lateral expansion area of the Old Salisbury Road C&D Landfill.

Geology

- A saprolite unit (density between 10 and 50 bpf) consisting predominantly of a tan to reddish-brown and gray silty sand (SM), with lesser amounts of a sandy silt (ML) is present from ground surface to a depth of at least 65 feet bgs.

- A transition zone (density of 50 or greater bpf) consisting of a reddish-brown to tan silty sand (SM), with lesser amounts of a silty/sandy gravel is present from a depth of three feet bgs to at least 88 feet bgs.

- A bedrock formation consisting of a relatively unweathered, slightly fractured Granodiorite is present at a depth ranging from 43 feet bgs to 88 feet bgs and is orientated in a northeast to southwest ridge beneath the proposed landfill area.

- All soil samples collected from a depth greater than five feet bgs during drilling were reported as non-plastic. Samples collected from ground surface to a depth of five feet bgs reported a sandy silt (ML-MH) slight plasticity with plasticity indices between 6 and 14%. No soil classifications resulted in the determination of a "clay" soil (CL or CH).

- Natural soil moisture contents reported for the saprolite (and transition zone) unit ranged from 11.5 to 29.8 percent with an average moisture content of 17.95 percent.

- Based on the results of the grain size analysis of the saprolite (and transition zone), the predominant soil classification for this unit was determined to be a silty sand (SM) with lesser amounts of a sandy silt (MH to ML). There is no readily apparent distinction in the grain size distribution between the saprolite unit and the transition zone.

Hydrogeology

- The uppermost water-bearing zone predominantly occurs within the saprolite unit and transition zone at a depth that varies from approximately 1.5 feet bls at low-lying areas to 78.8 feet bls at higher topographic areas. An isolated occurrence of ground water first encountered within fractured bedrock occurs in the vicinity of piezometer PZ-32A (Phase V) with the ground water level approximately 1.65 feet below the top of bedrock at the time of this investigation.

- The water table appears to vary as much as 41 feet across the proposed expansion Site between the highest elevation (767.60 feet) and the lowest elevation (725.81 feet), averaging 743 feet above MSL.

- Potentiometric surface contours of static water level data indicate that ground-water flow is generally away from areas of recharge (the southern region in general), represented by the highest areas of natural and manmade topography, towards the discharge areas found along the northeastern bounding stream.

- Hydraulic gradients (horizontal) calculated at selected wells within the Phase IV, V, VI area ranged from 0.009 to 0.046 ft/ft with a vertical gradient (in an upward direction) of 0.025 to 0.027 ft/ft reported along the northern stream at piezometers B-21-A/21-B.

- Hydraulic conductivity value calculated at the well screened within the saprolite unit is 0.259 feet/day.

- Hydraulic conductivity values calculated at selected wells screened within the transition zone ranged from 0.241 feet/day to 1.03 feet/day, with an average of 0.466 feet/day.

- The hydraulic conductivity of the fractured bedrock formation resulting from slug testing efforts is 0.043 feet/day.

- Laboratory-measured intrinsic permeability values for the saprolite unit reported from Shelby tube samples taken during drilling activities was 2.73×10^{-6} cm/sec (0.008 feet/day). Surficial soil intrinsic permeability values for the saprolite unit ranged from 4.26×10^{-7} (0.0012 feet/day) to 2.18×10^{-6} cm/sec (0.006 feet/day)

- A laboratory-measured intrinsic permeability value for the transition zone reported from Shelby tube samples taken during drilling activities was 5.45×10^{-5} cm/sec (0.154 feet/day).

- Laboratory-measured porosity values were reported at 7 percent for the saprolite unit and 19 percent for the transition zone. Effective porosities derived from textural (grain size distribution) and specific yield relationships averaged 13 percent for the saprolite unit, 17.5 percent for the transition zone, and 2 percent for bedrock.

- A seepage (pore water) velocity of 0.043 feet/day (15.57 feet/year) was calculated for the saprolitic portion of the uppermost aquifer.

- A seepage (pore water) velocity of 0.052 feet/day (18.98 feet/year) was calculated for the transition zone of the uppermost aquifer.

- A seepage velocity of 0.060 feet/day (21.97 feet/year) was calculated for the upper limits of fractured bedrock.

- A review of historic water table potentiometric evaluations showed greater fluctuations over time in wells located in ground-water recharge areas than in wells located in ground-water discharge areas.

- Based on a review of historical static water level data, the shallow water table appears to be the highest (i.e., shallowest) during the spring months and the lowest (i.e., deeper) during the late summer months.

3.2 Conclusions

Based upon data synthesized for this report, the proposed area of expansion appears geologically and hydrologically well-suited for C&D landfilling activities. The depth to the water table and the depth to bedrock appear great enough over most of the area proposed for expansion to not pose any major restrictions. The ground-water flow regime in the uppermost aquifer is uncomplicated and readily allows effective monitoring of the proposed waste unit(s). In the uppermost aquifer, silty sand soil textures create relatively slow ground-water flow velocities, allowing time to deal with any detected impairment of ground-water quality before it has traveled very far. The hydraulic properties of the upper limits of fractured bedrock are slightly less than the porous soils and therefore this formation does not appear to be a preferential pathway for ground-water (or contaminant) movement.

The uppermost aquifer occurs almost entirely within the saprolite (and transition zone) in the expansion area. Therefore, depth to the water table is the primary limiting factor for excavation depths. In order to ensure adequate separation, a potentiometric contour map was generated utilizing water table elevations (June 20, 2002) at each piezometer (see Appendix D, Drawing D-02A). This potentiometric contour map was then used to develop the base grade for the bottom of the Landfill. The base grades were drawn using the June 20, 2002,

water table elevations, plus 10 feet (10 feet long-term seasonal high correction factor plus required 4 feet of vertical separation from long-term seasonal high ground water or bedrock). The required separation between the high water table (and bedrock) and C&D debris will be maintained given the specified base grades.

In summary, based upon the geologic and hydrologic conditions of the proposed expansion, it appears that the location is suitable for C&D landfilling activities.

SECTION 4.0
REFERENCES

Daniel, Charles C., III, and R. A. Payne, Hydrogeologic Unit Map of the Piedmont and Blue Ridge Provinces of North Carolina, USGS Water-Resources Investigations Report 90-4035, 1990.

Department of Environment and Natural Resources, 1992, "Well Constructed Standards, Criteria, and Standards Applicable to Water Supply and Certain Other Wells", Title 15A NCAC, Subchapter 2C, Section .0100, Division of Environment and Management, Raleigh, North Carolina, 26p.

Department of Environment and Natural Resources, 1997, "North Carolina Solid Waste Management Rules", the 15A NCAC 13B, Division of Waste Management, Raleigh, North Carolina, 230p.

Espenshade, G. H., D. W. Rankin, K. W. Shaw, and R. B. Neuman, "Geologic Map of the East Half of Winston-Salem Quadrangle, North Carolina-Virginia," USGS Miscellaneous Investigations Map I-709-B, 1975.

S&ME, Inc, "Geologic and Hydrological Report, Archaeological Survey, Wetlands Delineation", June 1994.

United States Department of Agriculture, 1976, "Soil Summary of Forsyth County", Soil Conservation Service, Washington, D.C.

United States Environmental Protection Agency, 1987, "RCRA Facility Investigation Guidance Document", Volume II of IV, EPA 530/SW-87-001.

United States Geological Survey, "Welcome Quadrangle, North Carolina"; 7.5 Minute Series (Topographic), Department of the Interior, scale 1:24,000, 1987.

United States Geological Survey, "Winston-Salem - West Quadrangle, North Carolina"; 7.5 Minute Series (Topographic), Department of the Interior, scale 1:24,000, 1994.

Freeze, R. Allan and Cherry, John A. 1979, "Groundwater", Prentice Hall, Inc, New Jersey, 604p

Sowers, G.F., 1963, "Engineering Properties of Residual Soils Derived from Igneous and Metamorphic Rocks": Proc., 2nd Panamerican Conference on Soil Mechanics and Foundation Engineering, Sao Paulo, Brazil, p 39-62.

APPENDIX A

HYDRAULIC CONDUCTIVITY DATA

Rising Head Method

Reference: Bouwer, 1989

Hydraulic Conductivity

$$K = (R_{eq}^2 \ln(R_e/R_w)/2L_e)*(1/T)*\ln(Y_o/Y_t)$$

Where:

$$\ln(R_e/R_w)=[1.1/\ln(L_w/R_w)+(A+B\ln[(H-L_w)/R_w])/L_e/R_w]^{-1}$$

$$R_{eq} = [(1-n)(R_c^2) + n(R_w^2)]^{1/2}$$

Well	*27*	*30*	*33*
L_w = Ht. of Water Column in Well (ft) =	14.23	13.67	9.53
L_e = Screen Interval Open to Aquifer (ft) =	10	10	10
R_w = Radius of Well Including Sand Pack (ft) =	0.33	0.33	0.33
R_c = Radius of Casing (ft) =	0.083	0.083	0.083
H = Aquifer Thickness to First Aquitard (ft) =	50	50	50
Y_0 = Relative Ht. of Water at Time Zero (ft) =	1.5	3	0.33
Y_t = Relative Ht. of Water at Time t (ft) =	0.37	1.54	0.03
n = Porosity =	0.186	0.186	0.186
T = Time (minutes) =	25	11	50
Correct for Sand Pack in screened interval	Yes	Yes	Yes
R_{eq} =	0.16	0.16	0.16
Evaluation of A & B L_e/R_w =	30.30	30.30	30.30

A & B are Constants. Determined graph by Bouwer & Rice

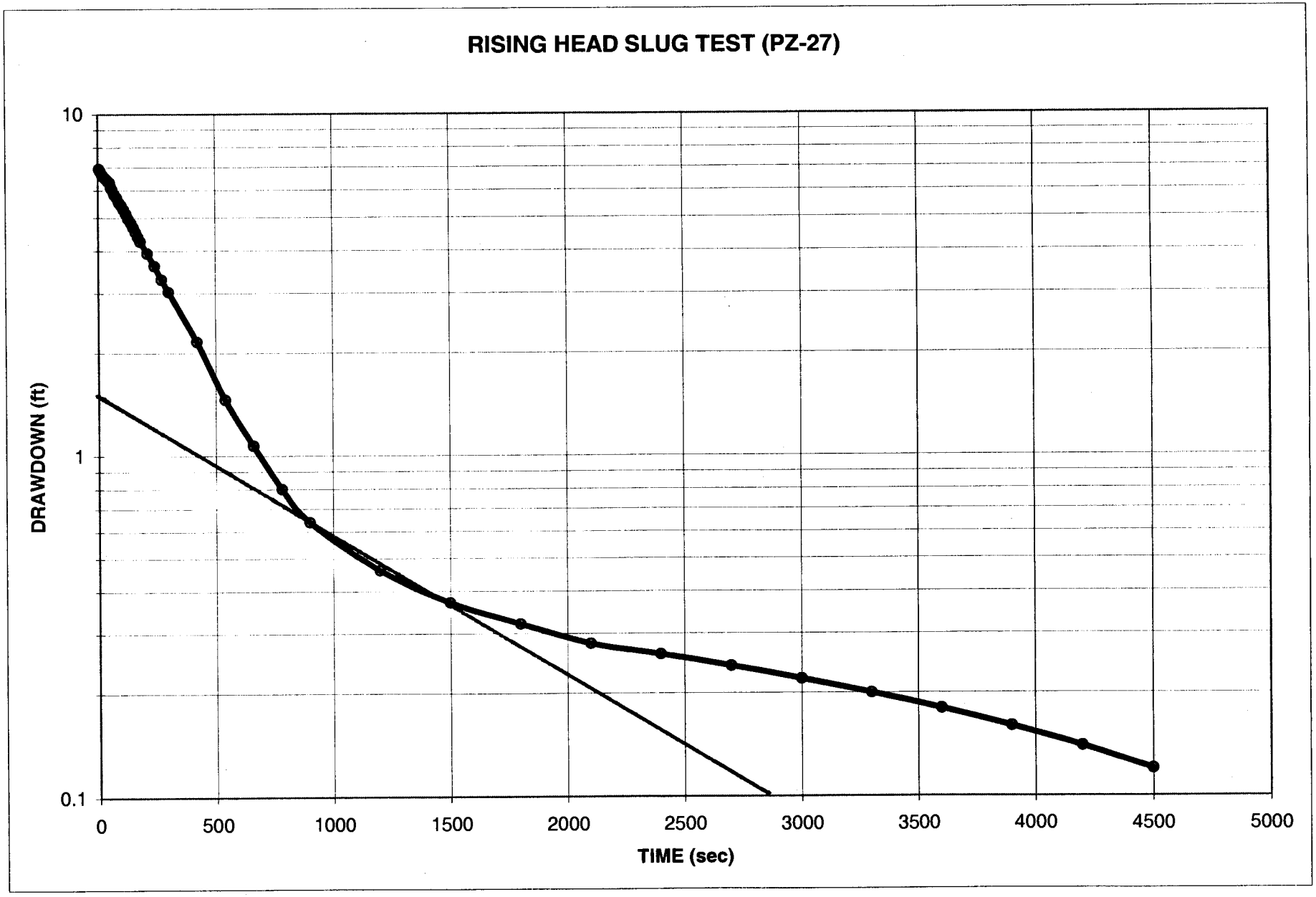
A =	2.4	2.4	2.4
B =	0.4	0.4	0.4
ln (R_e/R_w) =	2.31	2.29	2.13

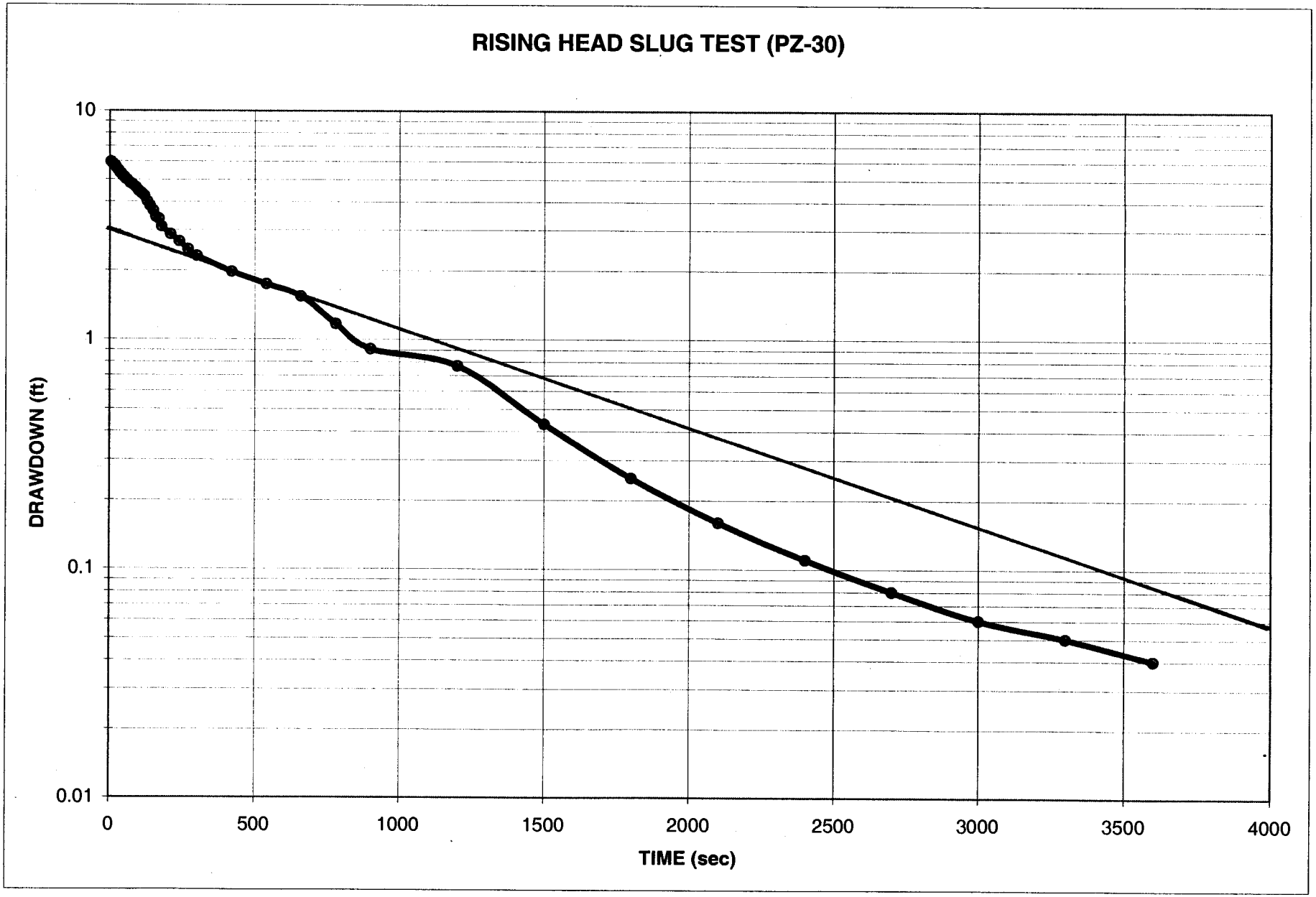
Determination of Hydraulic Conductivity

K (ft/day) =	**0.241**	**0.259**	**0.190**
K (cm/sec) =	**8.5E-05**	**9.1E-05**	**6.7E-05**

Average Hydraulic Conductivity

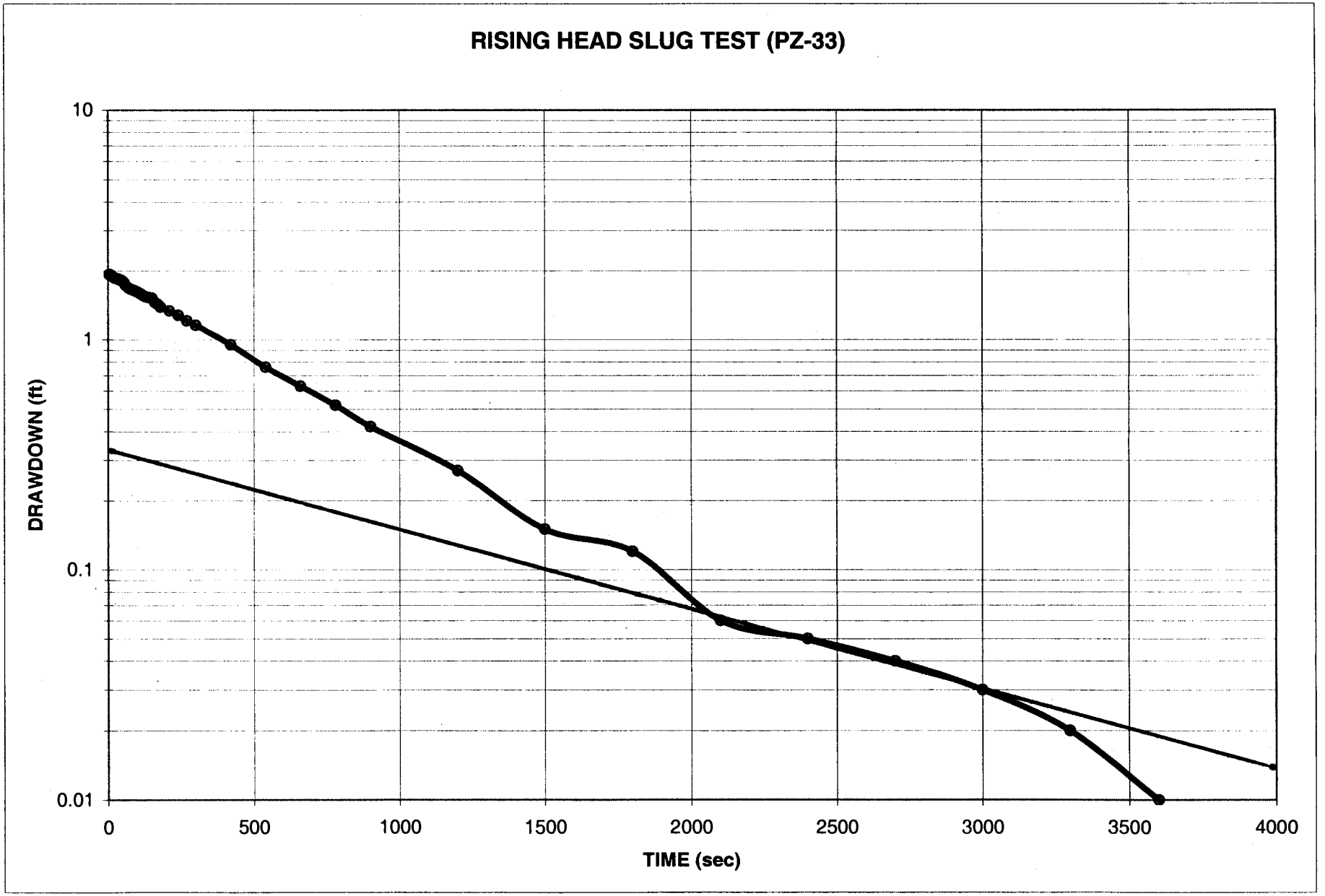
Ave K (ft/day) =	**0.230**
Ave K (cm/sec) =	**8.11E-05**


RISING HEAD SLUG TEST (PZ-27)
DRAWDOWN (ft)
10
1
0.1
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
TIME (sec)



Old Salisbury Road Landfill

PZ-30 graph


RISING HEAD SLUG TEST (PZ-33)
DRAWDOWN (ft)
10
1
0.1
0.01
0
500
1000
1500
2000
2500
3000
3500
4000
TIME (sec)

HDR

Piezometer No.: PZ-27 OSR
Initial Depth to Ground Water: 3.77' BTOC
Start Test:
Stop Test:

Time (sec)	Depth to Water Table (feet below TOC)	Drawdown
5	10.70'	6.93'
10	10.60'	6.83'
15	10.50'	6.73'
20	10.43'	6.66'
25	10.35'	6.58'
30	10.30'	6.53'
35	10.25'	6.48'
40	10.20'	6.43'
45	10.15'	6.38'
50	10.10'	6.33'
55	9.90'	6.13
60 (1 min)	9.82'	6.05'
70	9.62'	5.85'
80	9.50'	5.73'
90	9.31'	5.54'
100	9.20'	5.43'
110	9.05'	5.28'
120 (2 min)	8.90'	5.13'
130	8.72'	4.95'
140	8.60'	4.83'
150	8.45'	4.68'

HDR

Piezometer No.: PZ-27
Initial Depth to Ground Water: 3.77' BTOC
Start Test:
Stop Test:

Time (sec)	Depth to Water Table	Drawdown
160	8.30'	4.53'
170	8.16'	4.39'
180 (3 min)	8.02'	4.25'
210	7.70'	3.93'
240 (4 min)	7.38'	3.61'
270	7.06'	3.29'
300 (5 min)	6.80'	3.03'
420 (7 min)	5.93'	2.16'
540 (9 min)	5.23'	1.46'
660 (11 min)	4.84'	1.07'
780 (13 min)	4.57'	0.80'
900 (15 min)	4.41'	0.64'
1200 (20 min)	4.23'	0.46'
1500 (25 min)	4.14'	0.37'
1800 (30 min)	4.09'	0.32'
2100 (35 min)	4.05'	0.28'
2400 (40 min)	4.03'	0.26'
2700 (45 min)	4.01'	0.24
3000 (50 min)	3.99'	0.22
3300 (55 min)	3.97'	0.20
3600 (1 hr)	3.95'	0.18
3900	3.93'	0.16
4200	3.91'	0.14
4500	3.89'	0.12

HDR

Piezometer No.: PZ-30 OSR
Initial Depth to Ground Water: 14.33' BTOC
Start Test:
Stop Test:

Time (sec)	Depth to Water Table (feet below TOC)	Drawdown
5	20.30	5.97'
10	20.20	5.87'
15	20.12	5.79'
20	20.05	5.72'
25	19.90	5.57'
30	19.80	5.47'
35	19.68	5.35'
40	19.63	5.30'
45	19.51	5.18'
50	19.46	5.13'
55	19.35	5.02'
60 (1 min)	19.30	4.97'
70	19.15	4.82'
80	19.07	4.74'
90	18.95	4.62'
100	18.79	4.46'
110	18.68	4.35'
120 (2 min)	18.57	4.24'
130	18.33	4.00'
140	18.15	3.82'
150	17.95	3.62'

HDR

Piezometer No.: PZ - 30
Initial Depth to Ground Water: 14.33' BTOC
Start Test:
Stop Test:

Time (sec)	Depth to Water Table	Drawdown
160	17.75	3.42'
170	17.64	3.36'
180 (3 min)	17.43	3.10'
210	17.20	2.87'
240 (4 min)	17.00	2.67'
270	16.80	2.47'
300 (5 min)	16.64	2.31'
420 (7 min)	16.33	2.00'
540 (9 min)	16.07	1.74'
660 (11 min)	15.87	1.54'
780 (13 min)	15.50	1.17'
900 (15 min)	15.24	0.91'
1200 (20 min)	15.10	0.77'
1500 (25 min)	14.76	0.43'
1800 (30 min)	14.58	0.25'
2100 (35 min)	14.49	0.16'
2400 (40 min)	14.44	0.11'
2700 (45 min)	14.41	0.08'
3000 (50 min)	14.39	0.06'
3300 (55 min)	14.38	0.05'
3600 (1 hr)	14.37	0.04'

HDR

Piezometer No.: PZ-33 OSR
Initial Depth to Ground Water: 40.97' BTOC
Start Test:
Stop Test:

Time (sec)	Depth to Water Table (feet below TOC)	Drawdown
5	42.90	1.93
10	42.88	1.91
15	42.86	1.89
20	42.84	1.87
25	42.83	1.86
30	42.82	1.85
35	42.81	1.84
40	42.80	1.83
45	42.79	1.82
50	42.77	1.80
55	42.74	1.77
60 (1 min)	42.70	1.73
70	42.65	1.68
80	42.63'	1.66
90	42.61'	1.64
100	42.59'	1.62
110	42.56'	1.59
120 (2 min)	42.53'	1.56
130	42.51'	1.54
140	42.50'	1.53
150	42.49	1.52

HDR

Piezometer No.: PZ-33
Initial Depth to Ground Water: 40.97' BTOC
Start Test:
Stop Test:

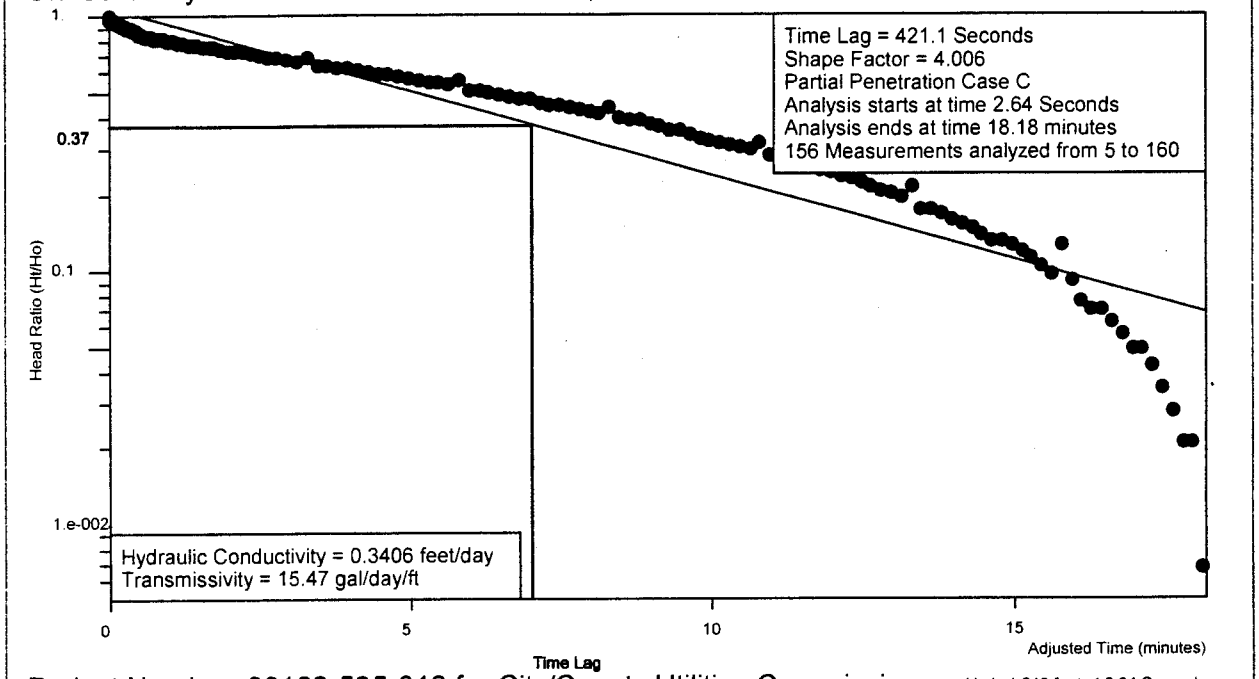
Time (sec)	Depth to Water Table	Drawdown
160	42.43	1.46'
170	42.40	1.43'
180 (3 min)	42.36	1.39'
210	42.31	1.34'
240 (4 min)	42.25	1.28'
270	42.18	1.21'
300 (5 min)	42.13	1.16'
420 (7 min)	41.92	0.95'
540 (9 min)	41.73	0.76'
660 (11 min)	41.60	0.63'
780 (13 min)	41.49	0.52'
900 (15 min)	41.39	0.47'
1200 (20 min)	41.24	0.27'
1500 (25 min)	41.12	0.15'
1800 (30 min)	41.09	0.17'
2100 (35 min)	41.03	0.06'
2400 (40 min)	41.02	0.05'
2700 (45 min)	41.01	0.04'
3000 (50 min)	41.00	0.03
3300 (55 min)	40.99	0.02
3600 (1 hr)	40.98	0.01'
3900	40.97	0.00'

Slug Test Evaluation February 26, 2003

Hvorslev Graph

Old Salisbury Road Landfill Winston-Salem, North Carolina

PZ-18A



Project Number: 00162-525-018 for City/County Utilities Commission

Ho is 1.049 feet at 2.64 Seconds

Analysis by Starpoint Software

Slug Test Evaluation

Site Name:	Old Salisbury Road Landfill
Location:	Winston-Salem, North Carolina
Test Date:	February 26, 2003
Client:	City/County Utilities Commission
Project Number:	00162-525-018

Well Label:	PZ-18A
Aquifer Thickness:	6.07 feet
Screen Length:	15. feet
Casing Radius:	8.333e-002 feet
Effective Radius:	0.3333 feet
Gravel Pack Porosity:	30. %
Corrected Casing Radius:	0.1954 feet
Static Water Level:	0. feet
Water Table to Screen Bottom:	6.07 feet
Anisotropy Ratio:	0.5
Time Adjustment:	2.64 Seconds

Test starts with trial 4
There are 160 time and drawdown measurements
Maximum head is 1.049 feet
Minimum head is 0. feet

Trial	Time (minutes)	Adjusted Time (minutes)	Drawdown (feet)	Head (feet)	Head Ratio
1	0.	-4.4e-002	0.	0.	0.
2	1.1e-002	-3.3e-002	1.5e-002	1.5e-002	1.43e-002
3	2.2e-002	-2.2e-002	0.211	0.211	0.2011
4	3.3e-002	-1.1e-002	0.67	0.67	0.6387
5	4.4e-002	0.	1.049	1.049	1.
6	5.5e-002	1.1e-002	1.041	1.041	0.9924
7	6.6e-002	2.2e-002	1.034	1.034	0.9857
8	7.7e-002	3.3e-002	1.027	1.027	0.979
9	8.8e-002	4.4e-002	1.027	1.027	0.979
10	9.9e-002	5.5e-002	1.019	1.019	0.9714
11	0.11	6.6e-002	1.019	1.019	0.9714
12	0.121	7.7e-002	1.012	1.012	0.9647
13	0.132	8.8e-002	1.012	1.012	0.9647
14	0.143	9.9e-002	1.005	1.005	0.9581
15	0.154	0.11	0.998	0.998	0.9514
16	0.165	0.121	0.998	0.998	0.9514
17	0.176	0.132	0.998	0.998	0.9514
18	0.187	0.143	0.99	0.99	0.9438
19	0.198	0.154	0.99	0.99	0.9438
20	0.209	0.165	0.99	0.99	0.9438
21	0.22	0.176	0.983	0.983	0.9371
22	0.231	0.187	0.983	0.983	0.9371
23	0.2427	0.1987	0.976	0.976	0.9304
24	0.2552	0.2112	0.976	0.976	0.9304
25	0.2683	0.2243	0.976	0.976	0.9304
26	0.2823	0.2383	0.969	0.969	0.9237
27	0.2972	0.2532	0.969	0.969	0.9237
28	0.3128	0.2688	0.961	0.961	0.9161
29	0.3295	0.2855	0.961	0.961	0.9161
30	0.3472	0.3032	0.954	0.954	0.9094
31	0.3658	0.3218	0.954	0.954	0.9094
32	0.3857	0.3417	0.947	0.947	0.9028

33	0.4067	0.3627	0.939	0.939	0.8951
34	0.4288	0.3848	0.932	0.932	0.8885
35	0.4523	0.4083	0.939	0.939	0.8951
36	0.4772	0.4332	0.932	0.932	0.8885
37	0.5035	0.4595	0.932	0.932	0.8885
38	0.5315	0.4875	0.896	0.896	0.8541
39	0.5612	0.5172	0.903	0.903	0.8608
40	0.5925	0.5485	0.896	0.896	0.8541
41	0.6257	0.5817	0.888	0.888	0.8465
42	0.6608	0.6168	0.881	0.881	0.8398
43	0.6982	0.6542	0.881	0.881	0.8398
44	0.7377	0.6937	0.874	0.874	0.8332
45	0.7795	0.7355	0.867	0.867	0.8265
46	0.8238	0.7798	0.867	0.867	0.8265
47	0.8708	0.8268	0.859	0.859	0.8189
48	0.9207	0.8767	0.852	0.852	0.8122
49	0.9733	0.9293	0.852	0.852	0.8122
50	1.029	0.9852	0.845	0.845	0.8055
51	1.088	1.044	0.845	0.845	0.8055
52	1.151	1.107	0.837	0.837	0.7979
53	1.217	1.173	0.83	0.83	0.7912
54	1.288	1.244	0.83	0.83	0.7912
55	1.362	1.318	0.816	0.816	0.7779
56	1.441	1.397	0.816	0.816	0.7779
57	1.525	1.481	0.808	0.808	0.7703
58	1.613	1.569	0.801	0.801	0.7636
59	1.707	1.663	0.794	0.794	0.7569
60	1.806	1.762	0.794	0.794	0.7569
61	1.912	1.868	0.786	0.786	0.7493
62	2.023	1.979	0.772	0.772	0.7359
63	2.142	2.098	0.772	0.772	0.7359
64	2.267	2.223	0.765	0.765	0.7293
65	2.399	2.355	0.75	0.75	0.715
66	2.54	2.496	0.743	0.743	0.7083
67	2.688	2.644	0.728	0.728	0.694
68	2.846	2.802	0.721	0.721	0.6873
69	3.013	2.969	0.714	0.714	0.6806
70	3.179	3.135	0.699	0.699	0.6663
71	3.346	3.302	0.721	0.721	0.6873
72	3.513	3.469	0.677	0.677	0.6454
73	3.679	3.635	0.67	0.67	0.6387
74	3.846	3.802	0.663	0.663	0.632
75	4.013	3.969	0.655	0.655	0.6244
76	4.179	4.135	0.648	0.648	0.6177
77	4.346	4.302	0.634	0.634	0.6044
78	4.513	4.469	0.626	0.626	0.5968
79	4.679	4.635	0.619	0.619	0.5901
80	4.846	4.802	0.612	0.612	0.5834
81	5.013	4.969	0.604	0.604	0.5758
82	5.179	5.135	0.59	0.59	0.5624
83	5.346	5.302	0.583	0.583	0.5558
84	5.513	5.469	0.575	0.575	0.5481
85	5.679	5.635	0.568	0.568	0.5415
86	5.846	5.802	0.59	0.59	0.5624
87	6.013	5.969	0.539	0.539	0.5138
88	6.179	6.135	0.532	0.532	0.5071
89	6.346	6.302	0.524	0.524	0.4995

90	6.513	6.469	0.517	0.517	0.4929
91	6.679	6.635	0.51	0.51	0.4862
92	6.846	6.802	0.495	0.495	0.4719
93	7.013	6.969	0.495	0.495	0.4719
94	7.179	7.135	0.481	0.481	0.4585
95	7.346	7.302	0.473	0.473	0.4509
96	7.513	7.469	0.466	0.466	0.4442
97	7.679	7.635	0.459	0.459	0.4376
98	7.846	7.802	0.451	0.451	0.4299
99	8.013	7.969	0.444	0.444	0.4233
100	8.179	8.135	0.437	0.437	0.4166
101	8.346	8.302	0.459	0.459	0.4376
102	8.513	8.469	0.422	0.422	0.4023
103	8.679	8.635	0.415	0.415	0.3956
104	8.846	8.802	0.408	0.408	0.3889
105	9.013	8.969	0.393	0.393	0.3746
106	9.179	9.135	0.386	0.386	0.368
107	9.346	9.302	0.371	0.371	0.3537
108	9.513	9.469	0.371	0.371	0.3537
109	9.679	9.635	0.357	0.357	0.3403
110	9.846	9.802	0.35	0.35	0.3337
111	10.01	9.969	0.342	0.342	0.326
112	10.18	10.14	0.335	0.335	0.3194
113	10.35	10.3	0.328	0.328	0.3127
114	10.51	10.47	0.32	0.32	0.3051
115	10.68	10.64	0.313	0.313	0.2984
116	10.85	10.8	0.335	0.335	0.3194
117	11.01	10.97	0.299	0.299	0.285
118	11.18	11.14	0.291	0.291	0.2774
119	11.35	11.3	0.284	0.284	0.2707
120	11.51	11.47	0.277	0.277	0.2641
121	11.68	11.64	0.269	0.269	0.2564
122	11.85	11.8	0.262	0.262	0.2498
123	12.01	11.97	0.255	0.255	0.2431
124	12.18	12.14	0.248	0.248	0.2364
125	12.35	12.3	0.24	0.24	0.2288
126	12.51	12.47	0.233	0.233	0.2221
127	12.68	12.64	0.226	0.226	0.2154
128	12.85	12.8	0.218	0.218	0.2078
129	13.01	12.97	0.211	0.211	0.2011
130	13.18	13.14	0.204	0.204	0.1945
131	13.35	13.3	0.226	0.226	0.2154
132	13.51	13.47	0.182	0.182	0.1735
133	13.68	13.64	0.182	0.182	0.1735
134	13.85	13.8	0.175	0.175	0.1668
135	14.01	13.97	0.167	0.167	0.1592
136	14.18	14.14	0.16	0.16	0.1525
137	14.35	14.3	0.153	0.153	0.1459
138	14.51	14.47	0.146	0.146	0.1392
139	14.68	14.64	0.138	0.138	0.1316
140	14.85	14.8	0.138	0.138	0.1316
141	15.01	14.97	0.131	0.131	0.1249
142	15.18	15.14	0.124	0.124	0.1182
143	15.35	15.3	0.117	0.117	0.1115
144	15.51	15.47	0.109	0.109	0.1039
145	15.68	15.64	0.102	0.102	9.724e-002
146	15.85	15.8	0.131	0.131	0.1249

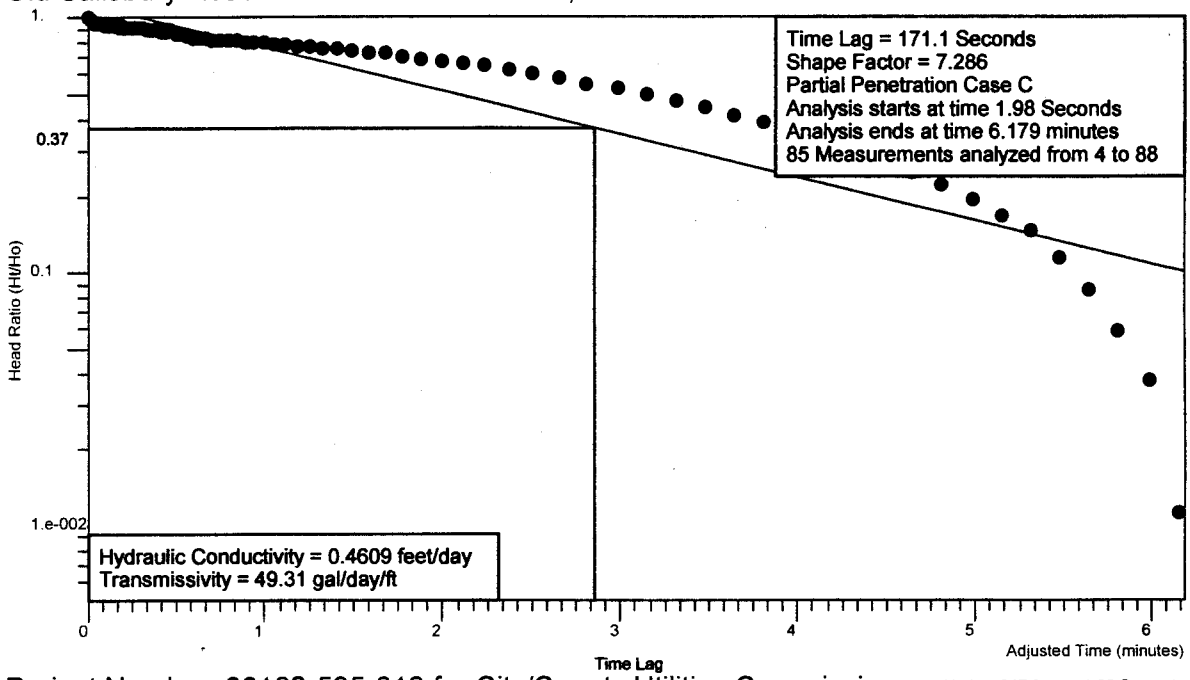
147	16.01	15.97	9.5e-002	9.5e-002	9.056e-002
148	16.18	16.14	8.e-002	8.e-002	7.626e-002
149	16.35	16.3	7.3e-002	7.3e-002	6.959e-002
150	16.51	16.47	7.3e-002	7.3e-002	6.959e-002
151	16.68	16.64	6.6e-002	6.6e-002	6.292e-002
152	16.85	16.8	5.8e-002	5.8e-002	5.529e-002
153	17.01	16.97	5.1e-002	5.1e-002	4.862e-002
154	17.18	17.14	5.1e-002	5.1e-002	4.862e-002
155	17.35	17.3	4.4e-002	4.4e-002	4.194e-002
156	17.51	17.47	3.6e-002	3.6e-002	3.432e-002
157	17.68	17.64	2.9e-002	2.9e-002	2.765e-002
158	17.85	17.8	2.2e-002	2.2e-002	2.097e-002
159	18.01	17.97	2.2e-002	2.2e-002	2.097e-002
160	18.18	18.14	7.e-003	7.e-003	6.673e-003

Slug Test Evaluation February 26, 2003

Hvorslev Graph

Old Salisbury Road Landfill Winston-Salem, North Carolina

PZ-22A



Project Number: 00162-525-018 for City/County Utilities Commission

Ho is 1.347 feet at 1.98 Seconds

Analysis by Starpoint Software

Slug Test Evaluation

Site Name:	Old Salisbury Road Landfill
Location:	Winston-Salem, North Carolina
Test Date:	February 26, 2003
Client:	City/County Utilities Commission
Project Number:	00162-525-018

Well Label:	PZ-22A
Aquifer Thickness:	14.3 feet
Screen Length:	15. feet
Casing Radius:	8.333e-002 feet
Effective Radius:	0.3333 feet
Gravel Pack Porosity:	30. %
Corrected Casing Radius:	0.1954 feet
Static Water Level:	0. feet
Water Table to Screen Bottom:	14.3 feet
Anisotropy Ratio:	0.5
Time Adjustment:	1.98 Seconds

Test starts with trial 3
There are 88 time and drawdown measurements
Maximum head is 1.347 feet
Minimum head is 0. feet

Trial	Time (minutes)	Adjusted Time (minutes)	Drawdown (feet)	Head (feet)	Head Ratio
1	0.	-3.3e-002	0.	0.	0.
2	1.1e-002	-2.2e-002	7.e-003	7.e-003	5.197e-003
3	2.2e-002	-1.1e-002	8.7e-002	8.7e-002	6.459e-002
4	3.3e-002	0.	1.347	1.347	1.
5	4.4e-002	1.1e-002	1.347	1.347	1.
6	5.5e-002	2.2e-002	1.326	1.326	0.9844
7	6.6e-002	3.3e-002	1.311	1.311	0.9733
8	7.7e-002	4.4e-002	1.296	1.296	0.9621
9	8.8e-002	5.5e-002	1.289	1.289	0.9569
10	9.9e-002	6.6e-002	1.282	1.282	0.9517
11	0.11	7.7e-002	1.275	1.275	0.9465
12	0.121	8.8e-002	1.275	1.275	0.9465
13	0.132	9.9e-002	1.267	1.267	0.9406
14	0.143	0.11	1.267	1.267	0.9406
15	0.154	0.121	1.26	1.26	0.9354
16	0.165	0.132	1.26	1.26	0.9354
17	0.176	0.143	1.253	1.253	0.9302
18	0.187	0.154	1.253	1.253	0.9302
19	0.198	0.165	1.253	1.253	0.9302
20	0.209	0.176	1.253	1.253	0.9302
21	0.22	0.187	1.245	1.245	0.9243
22	0.231	0.198	1.253	1.253	0.9302
23	0.2427	0.2097	1.245	1.245	0.9243
24	0.2552	0.2222	1.245	1.245	0.9243
25	0.2683	0.2353	1.245	1.245	0.9243
26	0.2823	0.2493	1.245	1.245	0.9243
27	0.2972	0.2642	1.238	1.238	0.9191
28	0.3128	0.2798	1.238	1.238	0.9191
29	0.3295	0.2965	1.231	1.231	0.9139
30	0.3472	0.3142	1.231	1.231	0.9139
31	0.3658	0.3328	1.224	1.224	0.9087
32	0.3857	0.3527	1.224	1.224	0.9087

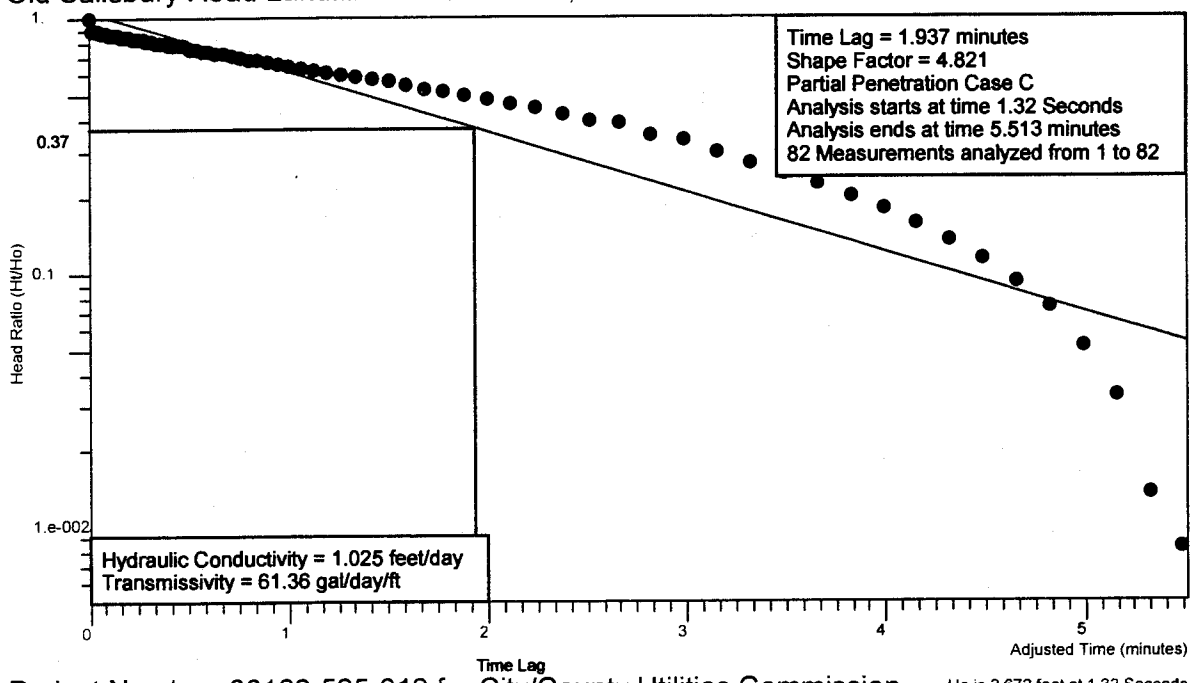
33	0.4067	0.3737	1.209	1.209	0.8976
34	0.4288	0.3958	1.209	1.209	0.8976
35	0.4523	0.4193	1.202	1.202	0.8924
36	0.4772	0.4442	1.202	1.202	0.8924
37	0.5035	0.4705	1.209	1.209	0.8976
38	0.5315	0.4985	1.158	1.158	0.8597
39	0.5612	0.5282	1.165	1.165	0.8649
40	0.5925	0.5595	1.151	1.151	0.8545
41	0.6257	0.5927	1.136	1.136	0.8434
42	0.6608	0.6278	1.129	1.129	0.8382
43	0.6982	0.6652	1.122	1.122	0.833
44	0.7377	0.7047	1.114	1.114	0.827
45	0.7795	0.7465	1.114	1.114	0.827
46	0.8238	0.7908	1.107	1.107	0.8218
47	0.8708	0.8378	1.1	1.1	0.8166
48	0.9207	0.8877	1.085	1.085	0.8055
49	0.9733	0.9403	1.085	1.085	0.8055
50	1.029	0.9962	1.078	1.078	0.8003
51	1.088	1.055	1.071	1.071	0.7951
52	1.151	1.118	1.063	1.063	0.7892
53	1.217	1.184	1.049	1.049	0.7788
54	1.288	1.255	1.034	1.034	0.7676
55	1.362	1.329	1.027	1.027	0.7624
56	1.441	1.408	1.027	1.027	0.7624
57	1.525	1.492	1.005	1.005	0.7461
58	1.613	1.58	0.991	0.991	0.7357
59	1.707	1.674	0.983	0.983	0.7298
60	1.806	1.773	0.947	0.947	0.703
61	1.912	1.879	0.94	0.94	0.6978
62	2.023	1.99	0.918	0.918	0.6815
63	2.142	2.109	0.896	0.896	0.6652
64	2.267	2.234	0.874	0.874	0.6488
65	2.399	2.366	0.845	0.845	0.6273
66	2.54	2.507	0.816	0.816	0.6058
67	2.688	2.655	0.787	0.787	0.5843
68	2.846	2.813	0.743	0.743	0.5516
69	3.013	2.98	0.714	0.714	0.5301
70	3.179	3.146	0.677	0.677	0.5026
71	3.346	3.313	0.641	0.641	0.4759
72	3.513	3.48	0.605	0.605	0.4491
73	3.679	3.646	0.561	0.561	0.4165
74	3.846	3.813	0.524	0.524	0.389
75	4.013	3.98	0.495	0.495	0.3675
76	4.179	4.146	0.459	0.459	0.3408
77	4.346	4.313	0.415	0.415	0.3081
78	4.513	4.48	0.371	0.371	0.2754
79	4.679	4.646	0.335	0.335	0.2487
80	4.846	4.813	0.299	0.299	0.222
81	5.013	4.98	0.262	0.262	0.1945
82	5.179	5.146	0.226	0.226	0.1678
83	5.346	5.313	0.197	0.197	0.1463
84	5.513	5.48	0.153	0.153	0.1136
85	5.679	5.646	0.117	0.117	8.686e-002
86	5.846	5.813	8.e-002	8.e-002	5.939e-002
87	6.013	5.98	5.1e-002	5.1e-002	3.786e-002
88	6.179	6.146	1.5e-002	1.5e-002	1.114e-002

Slug Test Evaluation February 26, 2003

Hvorslev Graph

Old Salisbury Road Landfill Winston-Salem, North Carolina

PZ-31A



Project Number: 00162-525-018 for City/County Utilities Commission

Ho is 2.672 feet at 1.32 Seconds

Analysis by Starpoint Software

Slug Test Evaluation

Site Name:	Old Salisbury Road Landfill
Location:	Winston-Salem, North Carolina
Test Date:	February 26, 2003
Client:	City/County Utilities Commission
Project Number:	00162-525-018

Well Label:	PZ-31A
Aquifer Thickness:	8. feet
Screen Length:	15. feet
Casing Radius:	8.333e-002 feet
Effective Radius:	0.3333 feet
Gravel Pack Porosity:	30. %
Corrected Casing Radius:	0.1954 feet
Static Water Level:	0. feet
Water Table to Screen Bottom:	8. feet
Anisotropy Ratio:	0.5
Time Adjustment:	1.32 Seconds

Test starts with trial 0
There are 82 time and drawdown measurements
Maximum head is 2.672 feet
Minimum head is 0. feet

Trial	Time (minutes)	Adjusted Time (minutes)	Drawdown (feet)	Head (feet)	Head Ratio
1	2.2e-002	0.	2.672	2.672	1.
2	3.3e-002	1.1e-002	2.41	2.41	0.9019
3	4.4e-002	2.2e-002	2.403	2.403	0.8993
4	5.5e-002	3.3e-002	2.396	2.396	0.8967
5	6.6e-002	4.4e-002	2.388	2.388	0.8937
6	7.7e-002	5.5e-002	2.374	2.374	0.8885
7	8.8e-002	6.6e-002	2.367	2.367	0.8859
8	9.9e-002	7.7e-002	2.359	2.359	0.8829
9	0.11	8.8e-002	2.345	2.345	0.8776
10	0.121	9.9e-002	2.337	2.337	0.8746
11	0.132	0.11	2.337	2.337	0.8746
12	0.143	0.121	2.33	2.33	0.872
13	0.154	0.132	2.323	2.323	0.8694
14	0.165	0.143	2.308	2.308	0.8638
15	0.176	0.154	2.301	2.301	0.8612
16	0.187	0.165	2.294	2.294	0.8585
17	0.198	0.176	2.286	2.286	0.8555
18	0.209	0.187	2.272	2.272	0.8503
19	0.22	0.198	2.265	2.265	0.8477
20	0.231	0.209	2.257	2.257	0.8447
21	0.2427	0.2207	2.25	2.25	0.8421
22	0.2552	0.2332	2.243	2.243	0.8394
23	0.2683	0.2463	2.235	2.235	0.8365
24	0.2823	0.2603	2.221	2.221	0.8312
25	0.2972	0.2752	2.214	2.214	0.8286
26	0.3128	0.2908	2.206	2.206	0.8256
27	0.3295	0.3075	2.185	2.185	0.8177
28	0.3472	0.3252	2.177	2.177	0.8147
29	0.3658	0.3438	2.163	2.163	0.8095
30	0.3857	0.3637	2.155	2.155	0.8065
31	0.4067	0.3847	2.134	2.134	0.7987
32	0.4288	0.4068	2.126	2.126	0.7957

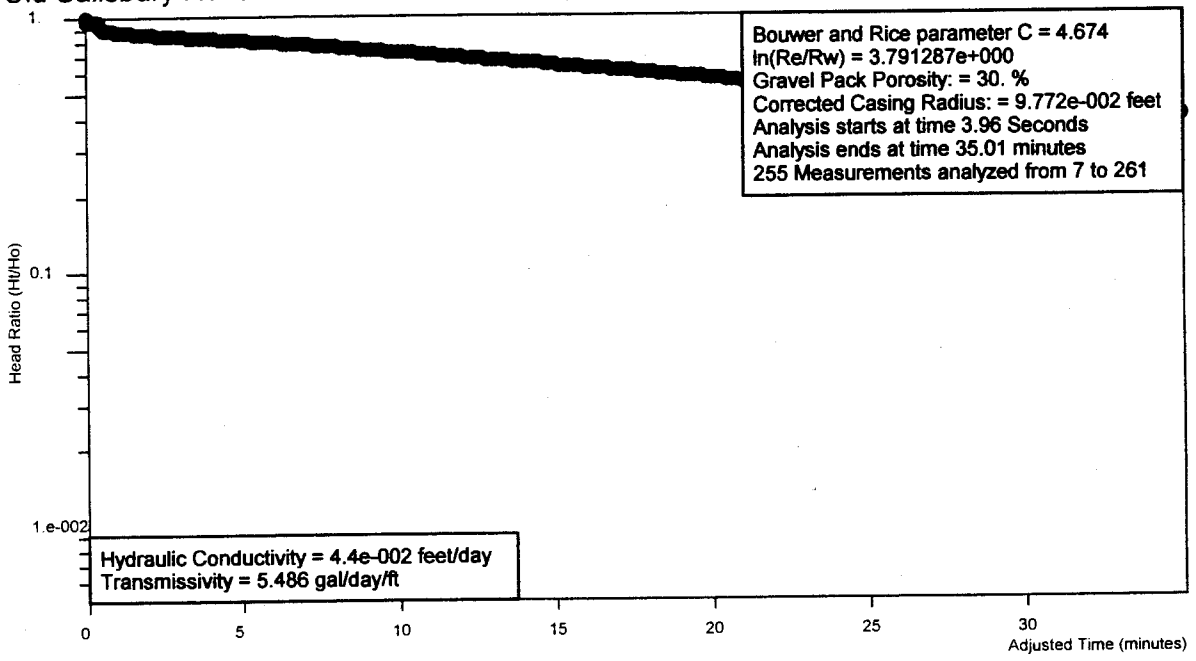
33	0.4523	0.4303	2.112	2.112	0.7904
34	0.4772	0.4552	2.097	2.097	0.7848
35	0.5035	0.4815	2.097	2.097	0.7848
36	0.5315	0.5095	2.032	2.032	0.7605
37	0.5612	0.5392	2.024	2.024	0.7575
38	0.5925	0.5705	2.01	2.01	0.7522
39	0.6257	0.6037	1.988	1.988	0.744
40	0.6608	0.6388	1.966	1.966	0.7358
41	0.6982	0.6762	1.944	1.944	0.7275
42	0.7377	0.7157	1.922	1.922	0.7193
43	0.7795	0.7575	1.886	1.886	0.7058
44	0.8238	0.8018	1.864	1.864	0.6976
45	0.8708	0.8488	1.842	1.842	0.6894
46	0.9207	0.8987	1.813	1.813	0.6785
47	0.9733	0.9513	1.784	1.784	0.6677
48	1.029	1.007	1.762	1.762	0.6594
49	1.088	1.066	1.726	1.726	0.646
50	1.151	1.129	1.689	1.689	0.6321
51	1.217	1.195	1.66	1.66	0.6213
52	1.288	1.266	1.624	1.624	0.6078
53	1.362	1.34	1.595	1.595	0.5969
54	1.441	1.419	1.558	1.558	0.5831
55	1.525	1.503	1.522	1.522	0.5696
56	1.613	1.591	1.471	1.471	0.5505
57	1.707	1.685	1.427	1.427	0.5341
58	1.806	1.784	1.391	1.391	0.5206
59	1.912	1.89	1.34	1.34	0.5015
60	2.023	2.001	1.289	1.289	0.4824
61	2.142	2.12	1.238	1.238	0.4633
62	2.267	2.245	1.187	1.187	0.4442
63	2.399	2.377	1.121	1.121	0.4195
64	2.54	2.518	1.07	1.07	0.4004
65	2.688	2.666	1.041	1.041	0.3896
66	2.846	2.824	0.939	0.939	0.3514
67	3.013	2.991	0.903	0.903	0.3379
68	3.179	3.157	0.801	0.801	0.2998
69	3.346	3.324	0.728	0.728	0.2725
70	3.513	3.491	0.67	0.67	0.2507
71	3.679	3.657	0.604	0.604	0.226
72	3.846	3.824	0.539	0.539	0.2017
73	4.013	3.991	0.481	0.481	0.18
74	4.179	4.157	0.422	0.422	0.1579
75	4.346	4.324	0.364	0.364	0.1362
76	4.513	4.491	0.306	0.306	0.1145
77	4.679	4.657	0.248	0.248	9.281e-002
78	4.846	4.824	0.197	0.197	7.373e-002
79	5.013	4.991	0.138	0.138	5.165e-002
80	5.179	5.157	8.7e-002	8.7e-002	3.256e-002
81	5.346	5.324	3.6e-002	3.6e-002	1.347e-002
82	5.513	5.491	2.2e-002	2.2e-002	8.234e-003

Slug Test Evaluation February 26, 2003

Bouwer and Rice Graph

Old Salisbury Road Landfill Winston-Salem, North Carolina

PZ-32A



Project Number: 00162-525-018 for City/County Utilities Commission

Ho is 4.953 feet at 3.96 Seconds

Analysis by Starpoint Software

Slug Test Evaluation

Site Name:	Old Salisbury Road Landfill
Location:	Winston-Salem, North Carolina
Test Date:	February 26, 2003
Client:	City/County Utilities Commission
Project Number:	00162-525-018

Well Label:	PZ-32A
Aquifer Thickness:	16.67 feet
Screen Length:	15. feet
Casing Radius:	8.333e-002 feet
Effective Radius:	0.125 feet
Gravel Pack Porosity:	30. %
Corrected Casing Radius:	9.772e-002 feet
Static Water Level:	0. feet
Water Table to Screen Bottom:	16.67 feet
Anisotropy Ratio:	0.5
Time Adjustment:	3.96 Seconds

Test starts with trial 6
There are 261 time and drawdown measurements
Maximum head is 4.953 feet
Minimum head is 0. feet

Trial	Time (minutes)	Adjusted Time (minutes)	Drawdown (feet)	Head (feet)	Head Ratio
1	0.	-6.6e-002	0.	0.	0.
2	1.1e-002	-5.5e-002	7.e-003	7.e-003	1.413e-003
3	2.2e-002	-4.4e-002	1.464	1.464	0.2956
4	3.3e-002	-3.3e-002	4.021	4.021	0.8118
5	4.4e-002	-2.2e-002	4.523	4.523	0.9132
6	5.5e-002	-1.1e-002	4.931	4.931	0.9956
7	6.6e-002	0.	4.953	4.953	1.
8	7.7e-002	1.1e-002	4.938	4.938	0.997
9	8.8e-002	2.2e-002	4.931	4.931	0.9956
10	9.9e-002	3.3e-002	4.916	4.916	0.9925
11	0.11	4.4e-002	4.916	4.916	0.9925
12	0.121	5.5e-002	4.88	4.88	0.9853
13	0.132	6.6e-002	4.858	4.858	0.9808
14	0.143	7.7e-002	4.851	4.851	0.9794
15	0.154	8.8e-002	4.858	4.858	0.9808
16	0.165	9.9e-002	4.851	4.851	0.9794
17	0.176	0.11	4.851	4.851	0.9794
18	0.187	0.121	4.851	4.851	0.9794
19	0.198	0.132	4.851	4.851	0.9794
20	0.209	0.143	4.851	4.851	0.9794
21	0.22	0.154	4.836	4.836	0.9764
22	0.231	0.165	4.836	4.836	0.9764
23	0.2427	0.1767	4.836	4.836	0.9764
24	0.2552	0.1892	4.836	4.836	0.9764
25	0.2683	0.2023	4.822	4.822	0.9736
26	0.2823	0.2163	4.822	4.822	0.9736
27	0.2972	0.2312	4.822	4.822	0.9736
28	0.3128	0.2468	4.822	4.822	0.9736
29	0.3295	0.2635	4.814	4.814	0.9719
30	0.3472	0.2812	4.807	4.807	0.9705
31	0.3658	0.2998	4.822	4.822	0.9736
32	0.3857	0.3197	4.807	4.807	0.9705

33	0.4067	0.3407	4.807	4.807	0.9705
34	0.4288	0.3628	4.793	4.793	0.9677
35	0.4523	0.3863	4.771	4.771	0.9633
36	0.4772	0.4112	4.785	4.785	0.9661
37	0.5035	0.4375	4.771	4.771	0.9633
38	0.5315	0.4655	4.64	4.64	0.9368
39	0.5612	0.4952	4.559	4.559	0.9205
40	0.5925	0.5265	4.538	4.538	0.9162
41	0.6257	0.5597	4.523	4.523	0.9132
42	0.6608	0.5948	4.494	4.494	0.9073
43	0.6982	0.6322	4.487	4.487	0.9059
44	0.7377	0.6717	4.479	4.479	0.9043
45	0.7795	0.7135	4.465	4.465	0.9015
46	0.8238	0.7578	4.457	4.457	0.8999
47	0.8708	0.8048	4.443	4.443	0.897
48	0.9207	0.8547	4.436	4.436	0.8956
49	0.9733	0.9073	4.428	4.428	0.894
50	1.029	0.9632	4.414	4.414	0.8912
51	1.088	1.022	4.407	4.407	0.8898
52	1.151	1.085	4.392	4.392	0.8867
53	1.217	1.151	4.385	4.385	0.8853
54	1.288	1.222	4.377	4.377	0.8837
55	1.362	1.296	4.363	4.363	0.8809
56	1.441	1.375	4.356	4.356	0.8795
57	1.525	1.459	4.348	4.348	0.8779
58	1.613	1.547	4.334	4.334	0.875
59	1.707	1.641	4.326	4.326	0.8734
60	1.806	1.74	4.319	4.319	0.872
61	1.912	1.846	4.297	4.297	0.8676
62	2.023	1.957	4.29	4.29	0.8661
63	2.142	2.076	4.275	4.275	0.8631
64	2.267	2.201	4.268	4.268	0.8617
65	2.399	2.333	4.254	4.254	0.8589
66	2.54	2.474	4.246	4.246	0.8573
67	2.688	2.623	4.224	4.224	0.8528
68	2.846	2.78	4.21	4.21	0.85
69	3.013	2.947	4.195	4.195	0.847
70	3.179	3.113	4.181	4.181	0.8441
71	3.346	3.28	4.166	4.166	0.8411
72	3.513	3.447	4.152	4.152	0.8383
73	3.679	3.613	4.144	4.144	0.8367
74	3.846	3.78	4.13	4.13	0.8338
75	4.013	3.947	4.115	4.115	0.8308
76	4.179	4.113	4.101	4.101	0.828
77	4.346	4.28	4.086	4.086	0.825
78	4.513	4.447	4.071	4.071	0.8219
79	4.679	4.613	4.057	4.057	0.8191
80	4.846	4.78	4.05	4.05	0.8177
81	5.013	4.947	4.035	4.035	0.8147
82	5.179	5.113	4.028	4.028	0.8132
83	5.346	5.28	4.013	4.013	0.8102
84	5.513	5.447	4.006	4.006	0.8088
85	5.679	5.613	3.991	3.991	0.8058
86	5.846	5.78	3.977	3.977	0.8029
87	6.013	5.947	3.962	3.962	0.7999
88	6.179	6.113	3.948	3.948	0.7971
89	6.346	6.28	3.94	3.94	0.7955

90	6.513	6.447	3.919	3.919	0.7912
91	6.679	6.613	3.904	3.904	0.7882
92	6.846	6.78	3.897	3.897	0.7868
93	7.013	6.947	3.882	3.882	0.7838
94	7.179	7.113	3.875	3.875	0.7824
95	7.346	7.28	3.853	3.853	0.7779
96	7.513	7.447	3.838	3.838	0.7749
97	7.679	7.613	3.831	3.831	0.7735
98	7.846	7.78	3.817	3.817	0.7706
99	8.013	7.947	3.802	3.802	0.7676
100	8.179	8.113	3.787	3.787	0.7646
101	8.346	8.28	3.773	3.773	0.7618
102	8.513	8.447	3.766	3.766	0.7603
103	8.679	8.613	3.736	3.736	0.7543
104	8.846	8.78	3.729	3.729	0.7529
105	9.013	8.947	3.715	3.715	0.7501
106	9.179	9.113	3.7	3.7	0.747
107	9.346	9.28	3.678	3.678	0.7426
108	9.513	9.447	3.671	3.671	0.7412
109	9.679	9.613	3.656	3.656	0.7381
110	9.846	9.78	3.642	3.642	0.7353
111	10.01	9.947	3.627	3.627	0.7323
112	10.18	10.11	3.613	3.613	0.7295
113	10.35	10.28	3.605	3.605	0.7278
114	10.51	10.45	3.591	3.591	0.725
115	10.68	10.61	3.576	3.576	0.722
116	10.85	10.78	3.562	3.562	0.7192
117	11.01	10.95	3.54	3.54	0.7147
118	11.18	11.11	3.525	3.525	0.7117
119	11.35	11.28	3.511	3.511	0.7089
120	11.51	11.45	3.496	3.496	0.7058
121	11.68	11.61	3.489	3.489	0.7044
122	11.85	11.78	3.474	3.474	0.7014
123	12.01	11.95	3.46	3.46	0.6986
124	12.18	12.11	3.445	3.445	0.6955
125	12.35	12.28	3.438	3.438	0.6941
126	12.51	12.45	3.423	3.423	0.6911
127	12.68	12.61	3.409	3.409	0.6883
128	12.85	12.78	3.387	3.387	0.6838
129	13.01	12.95	3.372	3.372	0.6808
130	13.18	13.11	3.35	3.35	0.6764
131	13.35	13.28	3.343	3.343	0.6749
132	13.51	13.45	3.329	3.329	0.6721
133	13.68	13.61	3.321	3.321	0.6705
134	13.85	13.78	3.307	3.307	0.6677
135	14.01	13.95	3.307	3.307	0.6677
136	14.18	14.11	3.292	3.292	0.6646
137	14.35	14.28	3.285	3.285	0.6632
138	14.51	14.45	3.27	3.27	0.6602
139	14.68	14.61	3.263	3.263	0.6588
140	14.85	14.78	3.234	3.234	0.6529
141	15.01	14.95	3.219	3.219	0.6499
142	15.18	15.11	3.205	3.205	0.6471
143	15.35	15.28	3.19	3.19	0.6441
144	15.51	15.45	3.183	3.183	0.6426
145	15.68	15.61	3.168	3.168	0.6396
146	15.85	15.78	3.147	3.147	0.6354

147	16.01	15.95	3.132	3.132	0.6323
148	16.18	16.11	3.125	3.125	0.6309
149	16.35	16.28	3.11	3.11	0.6279
150	16.51	16.45	3.096	3.096	0.6251
151	16.68	16.61	3.088	3.088	0.6235
152	16.85	16.78	3.074	3.074	0.6206
153	17.01	16.95	3.066	3.066	0.619
154	17.18	17.11	3.052	3.052	0.6162
155	17.35	17.28	3.037	3.037	0.6132
156	17.51	17.45	3.03	3.03	0.6118
157	17.68	17.61	3.023	3.023	0.6103
158	17.85	17.78	3.001	3.001	0.6059
159	18.01	17.95	2.994	2.994	0.6045
160	18.18	18.11	2.979	2.979	0.6015
161	18.35	18.28	2.964	2.964	0.5984
162	18.51	18.45	2.95	2.95	0.5956
163	18.68	18.61	2.928	2.928	0.5912
164	18.85	18.78	2.921	2.921	0.5897
165	19.01	18.95	2.913	2.913	0.5881
166	19.18	19.11	2.899	2.899	0.5853
167	19.35	19.28	2.892	2.892	0.5839
168	19.51	19.45	2.877	2.877	0.5809
169	19.68	19.61	2.862	2.862	0.5778
170	19.85	19.78	2.848	2.848	0.575
171	20.01	19.95	2.833	2.833	0.572
172	20.18	20.11	2.826	2.826	0.5706
173	20.35	20.28	2.811	2.811	0.5675
174	20.51	20.45	2.797	2.797	0.5647
175	20.68	20.61	2.79	2.79	0.5633
176	20.85	20.78	2.761	2.761	0.5574
177	21.01	20.95	2.753	2.753	0.5558
178	21.18	21.11	2.739	2.739	0.553
179	21.35	21.28	2.731	2.731	0.5514
180	21.51	21.45	2.717	2.717	0.5486
181	21.68	21.61	2.702	2.702	0.5455
182	21.85	21.78	2.695	2.695	0.5441
183	22.01	21.95	2.68	2.68	0.5411
184	22.18	22.11	2.673	2.673	0.5397
185	22.35	22.28	2.659	2.659	0.5368
186	22.51	22.45	2.651	2.651	0.5352
187	22.68	22.61	2.637	2.637	0.5324
188	22.85	22.78	2.629	2.629	0.5308
189	23.01	22.95	2.615	2.615	0.528
190	23.18	23.11	2.608	2.608	0.5265
191	23.35	23.28	2.6	2.6	0.5249
192	23.51	23.45	2.578	2.578	0.5205
193	23.68	23.61	2.571	2.571	0.5191
194	23.85	23.78	2.557	2.557	0.5163
195	24.01	23.95	2.549	2.549	0.5146
196	24.18	24.11	2.542	2.542	0.5132
197	24.35	24.28	2.527	2.527	0.5102
198	24.51	24.45	2.52	2.52	0.5088
199	24.68	24.61	2.506	2.506	0.506
200	24.85	24.78	2.498	2.498	0.5043
201	25.01	24.95	2.491	2.491	0.5029
202	25.18	25.11	2.476	2.476	0.4999
203	25.35	25.28	2.462	2.462	0.4971

204	25.51	25.45	2.462	2.462	0.4971
205	25.68	25.61	2.447	2.447	0.494
206	25.85	25.78	2.44	2.44	0.4926
207	26.01	25.95	2.425	2.425	0.4896
208	26.18	26.11	2.418	2.418	0.4882
209	26.35	26.28	2.404	2.404	0.4854
210	26.51	26.45	2.396	2.396	0.4837
211	26.68	26.61	2.382	2.382	0.4809
212	26.85	26.78	2.367	2.367	0.4779
213	27.01	26.95	2.36	2.36	0.4765
214	27.18	27.11	2.345	2.345	0.4735
215	27.35	27.28	2.338	2.338	0.472
216	27.51	27.45	2.331	2.331	0.4706
217	27.68	27.61	2.323	2.323	0.469
218	27.85	27.78	2.316	2.316	0.4676
219	28.01	27.95	2.302	2.302	0.4648
220	28.18	28.11	2.294	2.294	0.4632
221	28.35	28.28	2.287	2.287	0.4617
222	28.51	28.45	2.273	2.273	0.4589
223	28.68	28.61	2.265	2.265	0.4573
224	28.85	28.78	2.258	2.258	0.4559
225	29.01	28.95	2.243	2.243	0.4529
226	29.18	29.11	2.236	2.236	0.4514
227	29.35	29.28	2.229	2.229	0.45
228	29.51	29.45	2.214	2.214	0.447
229	29.68	29.61	2.214	2.214	0.447
230	29.85	29.78	2.207	2.207	0.4456
231	30.01	29.95	2.192	2.192	0.4426
232	30.18	30.11	2.178	2.178	0.4397
233	30.35	30.28	2.171	2.171	0.4383
234	30.51	30.45	2.163	2.163	0.4367
235	30.68	30.61	2.156	2.156	0.4353
236	30.85	30.78	2.149	2.149	0.4339
237	31.01	30.95	2.141	2.141	0.4323
238	31.18	31.11	2.134	2.134	0.4308
239	31.35	31.28	2.134	2.134	0.4308
240	31.51	31.45	2.127	2.127	0.4294
241	31.68	31.61	2.12	2.12	0.428
242	31.85	31.78	2.112	2.112	0.4264
243	32.01	31.95	2.105	2.105	0.425
244	32.18	32.11	2.098	2.098	0.4236
245	32.35	32.28	2.09	2.09	0.422
246	32.51	32.45	2.083	2.083	0.4206
247	32.68	32.61	2.076	2.076	0.4191
248	32.85	32.78	2.09	2.09	0.422
249	33.01	32.95	2.09	2.09	0.422
250	33.18	33.11	2.083	2.083	0.4206
251	33.35	33.28	2.076	2.076	0.4191
252	33.51	33.45	2.069	2.069	0.4177
253	33.68	33.61	2.054	2.054	0.4147
254	33.85	33.78	2.039	2.039	0.4117
255	34.01	33.95	2.025	2.025	0.4088
256	34.18	34.11	2.025	2.025	0.4088
257	34.35	34.28	2.025	2.025	0.4088
258	34.51	34.45	2.018	2.018	0.4074
259	34.68	34.61	2.01	2.01	0.4058
260	34.85	34.78	1.988	1.988	0.4014

261	35.01	34.95	1.988	1.988	0.4014

APPENDIX B

BORING LOGS

LEGEND TO SOIL CLASSIFICATION AND SYMBOLS

SOIL TYPES

(Shown in Graphic Log)

Asphalt/Concrete

Topsoil

Gravel

Sand

Silt

Clay

Organic

Sandy

Silty

Clayey

Silty Sand

Clayey Sand

Sandy Silt

Clayey Silt

Sandy Clay

Silty Clay

Partially Weathered Rock

Cored Rock

WATER LEVELS

(Shown in Water Level Column)

▽ = Water Level At Termination Of Boring

▾ = Water Level Taken After 24 Hours

◂ = Loss Of Drilling Water

HC = Hole Cave

CONSISTENCY OF COHESIVE SOILS

CONSISTENCY	STD. PENETRATION RESISTANCE BLOWS/FOOT
Very Soft	0 to 2
Soft	3 to 4
Firm	5 to 8
Stiff	9 to 15
Very Stiff	16 to 30
Hard	31 to 50
Very Hard	Over 50

RELATIVE DENSITY OF COHESIONLESS SOILS

RELATIVE DENSITY	STD. PENETRATION RESISTANCE BLOWS/FOOT
Very Loose	0 to 4
Loose	5 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	Over 50

SAMPLER TYPES

(Shown in Samples Column)

▮ Shelby Tube

⊠ Split Spoon

I Rock Core

▯ No Recovery

TERMS

Standard Penetration Resistance - The Number of Blows of 140 lb. Hammer Falling 30 in. Required to Drive 1.4 in. I.D. Split Spoon Sampler 1 Foot. As Specified in ASTM D-1586

REC - Total Length of Rock Recovered in the Core Barrel Divided by the Total Length of the Core Run Times 100%.

RQD - Total Length of Sound Rock Segments Recovered that are Longer Than or Equal to 4" (mechanical breaks exluded) Divided by the Total Length of the Core Run Times 100%.

S&ME
Environmental Services
Engineering * Testing

PROJECT:	Proposed C&D Landfill Winston Salem, N.C.	WELL LOG	B-8

PROJECT NO. : 1581-93-052	ELEVATION: 824.46	NOTES: North Carolina State Coordinates N 820,983.724 E 1,622,253.039 Top of Casing Elev. 825.42 feet
LOGGED BY: JRS	BORING DEPTH: 50.0 FEET	
DATE DRILLED: 3-24-94	WATER LEVEL:	
DRILLING METHOD: 3-1/4" HSA	DRILL RIG: Diedrich D-50	

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.	WELL DIAGRAM
0		Residuum: Very Stiff Red Slightly Clayey Fine to Medium Sandy SILT				20		
5		Medium Dense to Loose Orange Tan Silty Fine to Medium SAND				14	820	
10						15	814	
15						17	810	
20						18	804	
25		Medium Dense to Dense Gray White Slightly Silty Coarse to Fine SAND				24	800	
30						28	794	
35						44	790	

Soil Cuttings

2" Dia. PVC Casing

S&ME
Environmental Services
Engineering * Testing

PROJECT:	Proposed CGO Landfill Winston Salem, N.C.	WELL LOG	B-6

PROJECT NO.: 1581-93-052	ELEVATION: 824.46	NOTES: North Carolina State Coordinates N 820,983.724 E 1,622,253.039 Top of Casing Elev. 825.42 feet
LOGGED BY: JRS	BORING DEPTH: 50.0 FEET	
DATE DRILLED: 3-24-94	WATER LEVEL:	
DRILLING METHOD: 3-1/4" HSA	DRILL RIG: Diedrich D-50	

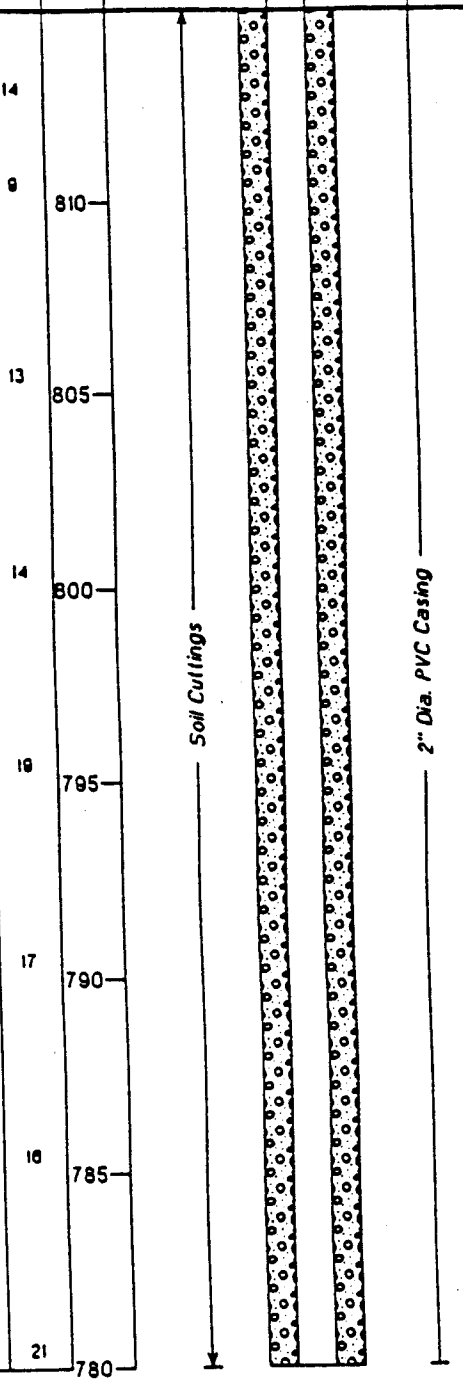
DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.	WELL DIAGRAM
40		Medium Dense to Dense Gray White Slightly Silty Coarse to Fine **SAND**				50	784	Bentonite Seal; Fine Filter Sand; 2" Dia. 0.010" Slotted Screen; 2" Dia. PVC Casing
45		Very Dense White Tan Silty Coarse to Medium **SAND**				47	780	
50		*Boring Terminated at 50.0 feet*				84	774	
55							770	
60							764	
65							760	
70							754	

S&ME
Environmental Services
Engineering * Testing

PROJECT:	Proposed C&D Landfill Winston Salem, N.C.	WELL LOG	B-7

PROJECT NO. : 1581-93-052	ELEVATION: 814.61	NOTES: North Carolina State Coordinates N 821,215.929 E 1,622,268.398 Top of Casing Elev. 816.42 feet
LOGGED BY: JRS	BORING DEPTH: 50.0 FEET	
DATE DRILLED: 3-30-94	WATER LEVEL: 44.5 @ T.O.B.	
DRILLING METHOD: 3-1/4" HSA	DRILL RIG: Diedrich D-50	

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.	WELL DIAGRAM
		Residuum: Stiff Red Clayey **SILT**				14		
5		Loose to Medium Dense Orange Pink White Silty Fine to Medium **SAND**, micaceous				9	810	
10						13	805	
15						14	800	
20		Medium Dense Orange White Silty Fine to Medium **SAND**				19	795	
25						17	790	
30		Medium Dense to Very Dense White Gray Silty Fine to Medium **SAND**				16	785	
35						21	780	



S&ME
Environmental Services
Engineering * Testing

PROJECT:	Proposed C&D Landfill Winston Salem, N.C.	WELL LOG	B-7

PROJECT NO.: 1581-93-052	ELEVATION: 814.61	NOTES: North Carolina State Coordinates N 821,215.929 E 1,622,268.398 Top of Casing Elev. 816.42 feet
LOGGED BY: JRS	BORING DEPTH: 50.0 FEET	
DATE DRILLED: 3-30-94	WATER LEVEL: 44.5 @ T.O.B.	
DRILLING METHOD: 3-1/4" HSA	DRILL RIG: Diedrich D-50	

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.	WELL DIAGRAM
40		Medium Dense to Very Dense White Gray Silty Fine to Medium SAND				23	775	Bentonite Seal; Fine Filter Sand; 2" Dia. 0.010" Slotted Screen; 2" Dia. PVC Casing
45						25	770	
50		Boring Terminated at 50.0 feet				58	765	
55							760	
60							755	
65							750	
70							745	

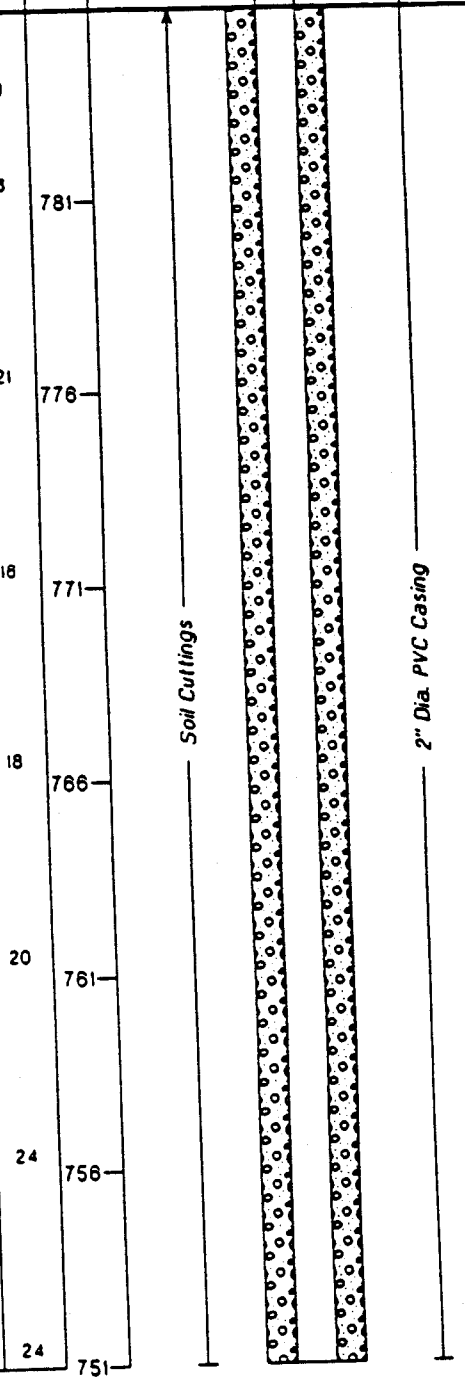
S&ME
Environmental Services
Engineering * Testing

PROJECT:	Proposed C&D Landfill Winston Salem, N.C.	WELL LOG	B-10

PROJECT NO.: 1581-93-052	ELEVATION: 785.74	NOTES: North Carolina State Coordinates N 822,005.638 E 1,622,174.174 Top of Casing Elev. 787.86 feet
LOGGED BY: JRS	BORING DEPTH: 50.0 FEET	
DATE DRILLED: 4-8-94	WATER LEVEL: 40.5 @ T.O.B.	
DRILLING METHOD: 3-1/4" HSA	DRILL RIG: Diedrich D-50	

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.
		Residuum: Very Stiff Red Tan Firm Sandy Clayey **SILT**				19	
5		Very Stiff Orange White Slightly Clayey Coarse to Fine Sandy **SILT**				16	781
10		Medium Dense White Pink Silty Fine to Medium **SAND**				21	776
15		Medium Dense White Gray Silty Medium to Fine **SAND**, micaceous				18	771
20						18	766
25						20	761
30		Medium Dense White Gray Silty Coarse to Medium **SAND**				24	756
35						24	751

WELL DIAGRAM



S&ME
Environmental Services
Engineering * Testing

PROJECT:	Proposed C&D Landfill Winston Salem, N.C.	WELL LOG	B-10

PROJECT NO. : 1581-93-052	ELEVATION: 785.74	NOTES: North Carolina State Coordinates N 822,005.638 E 1,622,174.174 Top of Casing Elev. 787.86 feet
LOGGED BY: JRS	BORING DEPTH: 50.0 FEET	
DATE DRILLED: 4-8-94	WATER LEVEL: 40.5 @ T.O.B.	
DRILLING METHOD: 3-1/4" HSA	DRILL RIG: Diedrich D-50	

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.	WELL DIAGRAM
40		Medium Dense White Gray Silty Coarse to Medium SAND				25	746	Soil Cuttings; Bentonite Seal; Fine Filter Sand; 2" Dia. 0.010" Slotted Screen; 2" Dia. PVC Casing
45						26	741	
		Very Dense White Tan Silty Fine to Medium SAND				87	736	
50		*Boring Terminated at 50.0 feet*						
55							731	
60							726	
65							721	
70							716	

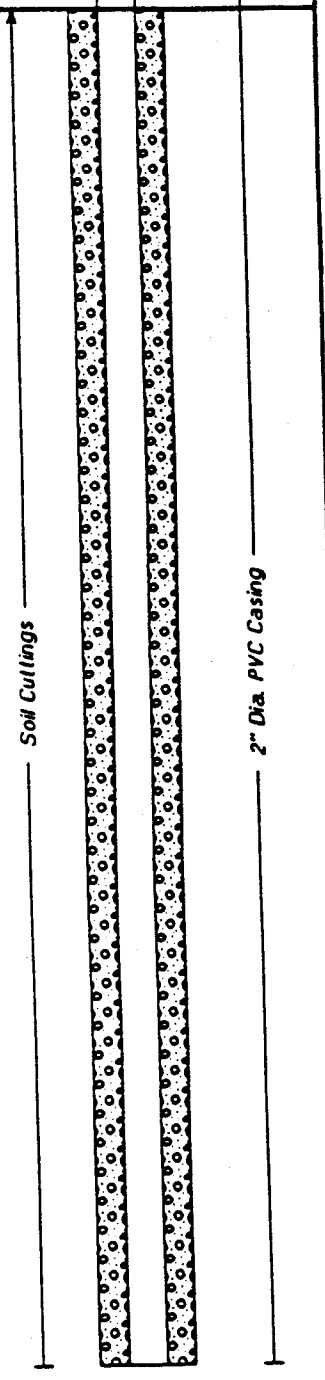
S&ME
Environmental Services
Engineering * Testing

PROJECT:	Proposed CSO Landfill Winston Salem, N.C.	WELL LOG	B-18

PROJECT NO.: 1581-93-052	ELEVATION: 824.27	NOTES: North Carolina State Coordinates N 821,705.626 E 1,622,590.008 Top of Casing Elev. 826.29
LOGGED BY: JRS	BORING DEPTH: 48.7 FEET	
DATE DRILLED: 4-7-94	WATER LEVEL: DRY @ T.O.B.	
DRILLING METHOD: 3-1/4" HSA	DRILL RIG: Diedrich D-50	

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.
0		Topsoil					
		Residuum: Medium Dense Orange White Silty Medium to Coarse **SAND**, with rock fragments				21	
5		Very Dense White Pink Medium to Coarse **SAND**, with rock fragments				61	819
10		Partially Weathered Rock: Sampled as White Pink Coarse **SAND**, with rock fragments				50/0.3	814
15		Partially Weathered Rock: Sampled as Gray White Coarse to Medium **SAND**, with rock fragments				50/0.5	809
20						50/0.5	804
25						50/0.5	799
30						50/0.3	794
35		Partially Weathered Rock: Sampled as White Brown Fine to Coarse **SAND**, with quartz fragments				50/0.3	789

WELL DIAGRAM



S&ME
Environmental Services
Engineering * Testing

PROJECT:	Proposed CGD Landfill Winston Salem, N.C.	WELL LOG	B-18

PROJECT NO.: 1581-93-052	ELEVATION: 824.27	NOTES: North Carolina State Coordinates N 821,705.626 E 1,622,590.008 Top of Casing Elev. 826.29
LOGGED BY: JRS	BORING DEPTH: 48.7 FEET	
DATE DRILLED: 4-7-94	WATER LEVEL: DRY @ T.O.B.	
DRILLING METHOD: 3-1/4" HSA	DRILL RIG: Diedrich D-50	

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.	WELL DIAGRAM
40		Partially Weathered Rock: Sampled as White Brown Fine to Coarse SAND, with quartz fragments				50/0.4	784	Soil Cuttings Bentonite Seal Fine Filter Sand 2" Dia. 0.010" Slotted Screen 2" Dia. PVC Casing
45						50/0.2	779	
50		Boring Terminated at 48.7 feet				50/0.2	774	
55							769	
60							764	
65							759	
70							754	

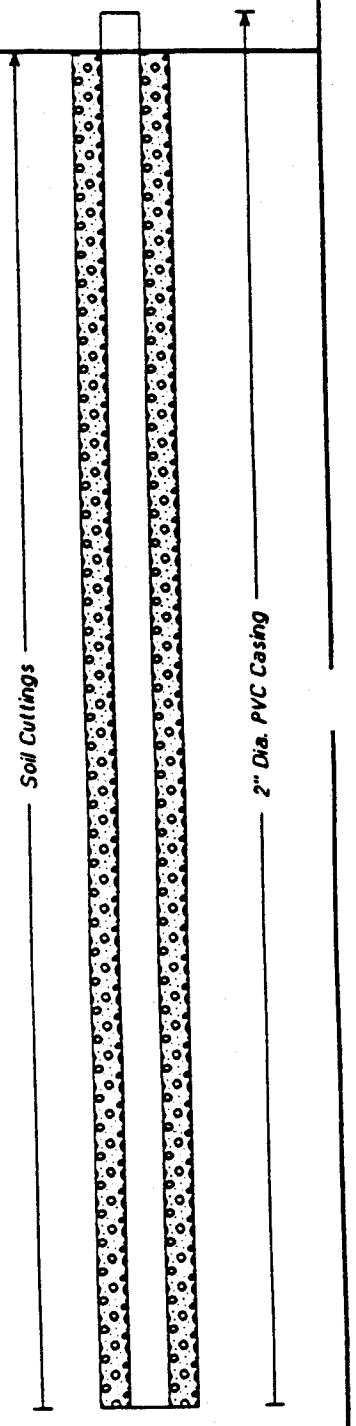
S&ME
Environmental Services
Engineering * Testing

PROJECT:	Proposed C&D Landfill Winston Salem, N.C.	WELL LOG	B-19

PROJECT NO.: 1581-93-052	ELEVATION: 811.04	NOTES: North Carolina State Coordinates N 821,916.209 E 1,622,589.337 Top of Casing Elev. 813.19
LOGGED BY: JRS	BORING DEPTH: 48.6 FEET	
DATE DRILLED: 4-7-94	WATER LEVEL: DRY @ T.O.B.	
DRILLING METHOD: 3-1/4" HSA	DRILL RIG: Diedrich D-50	

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.
		Topsoil					
		Residuum: Stiff Brown Orange Slightly Clayey Fine to Medium Sandy **SILT**				12	
5		Medium Dense Orange Brown Slightly Silty Medium **SAND**				22	806
10		Dense White Gray Orange Coarse to Medium **SAND**, with rock fragments				51	801
15		Partially Weathered Rock: Sampled as Gray Tan Medium **SAND**				90/0.8	796
20		Partially Weathered Rock: Sampled as Gray White Coarse **SAND**, with rock fragments				50/0.4	791
25						50/0.3	786
30						50/0.2	781
35		Partially Weathered Rock: Sampled as White Fragmented rock				50/0.2	776

WELL DIAGRAM



S&ME
Environmental Services
Engineering * Testing

PROJECT:	Proposed C&D Landfill Winston Salem, N.C.	WELL LOG	B-19

PROJECT NO.: 1581-93-052	ELEVATION: 811.04	NOTES: North Carolina State Coordinates N 821,916.209 E 1,622,589.337 Top of Casing Elev. 813.19
LOGGED BY: JRS	BORING DEPTH: 48.6 FEET	
DATE DRILLED: 4-7-94	WATER LEVEL: DRY @ T.O.B.	
DRILLING METHOD: 3-1/4" HSA	DRILL RIG: Diedrich D-50	

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.	WELL DIAGRAM
40		Partially Weathered Rock: Sampled as White Fragmented rock				50/0.1	771	Soil Cuttings; Bentonite Seal; Fine Filler Sand; 2" Dia. 0.010" Slotted Screen; 2" Dia. PVC Casing
45						50/0.1	766	
50		Boring Terminated at 48.6 feet				50/0.1	761	
55							756	
60							751	
65							746	
70							741	

S&ME
Environmental Services
Engineering * Testing

PROJECT:	Proposed C&D Landfill Winston Salem, N.C.	WELL LOG	B-20

PROJECT NO. : 1581-93-052	ELEVATION: 757.10	NOTES: North Carolina State Coordinates N 822,435.253 E 1,622,613.470 Top of Casing Elev. 759.37
LOGGED BY: JRS	BORING DEPTH: 46.5 FEET	
DATE DRILLED: 4-8-94	WATER LEVEL: 34.5' @ T.O.B.	
DRILLING METHOD: 3-1/4" HSA	DRILL RIG: Diedrich D-50	

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.	WELL DIAGRAM
0		Topsoil				15		
		Residuum: Stiff Orange Clayey Fine Sandy SILT, micaceous				11	752	
5		Medium Dense White Brown Orange Silty Fine to Medium SAND, micaceous				15	747	
10						17	742	
15						24	737	
20						18	732	
25						43	727	
30		Dense to Very Dense Orange White Gray Silty Coarse to Medium SAND, with rock fragments				84	722	
35								

Soil Cuttings

2" Dia. PVC Casing

S&ME
Environmental Services
Engineering * Testing

PROJECT:	Proposed C&D Landfill Winston Salem, N.C.	WELL LOG	B-20

PROJECT NO.: 1581-93-052	ELEVATION: 757.10	NOTES:
LOGGED BY: JRS	BORING DEPTH: 46.5 FEET	North Carolina State Coordinates
DATE DRILLED: 4-8-94	WATER LEVEL: 34.5' @ T.O.B.	N 822,435.253
DRILLING METHOD: 3-1/4" HSA	DRILL RIG: Diedrich D-50	E 1,622,613.470
		Top of Casing Elev. 759.37

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.	WELL DIAGRAM
40		Dense to Very Dense Orange White Gray Silty Coarse to Medium **SAND**, with rock fragments				50/0.3	717	Soil Cuttings
		Partially Weathered Rock: Sampled as Tan Gray Coarse to Medium **SAND**, with rock fragments				50/0.5	712	Bentonite Seal Fine Filler Sand 2" Dia. 0.010" Slotted Screen 2" Dia. PVC Casing
45						50/0.0		
		Auger Refusal at 46.5 feet						
50							707	
55							702	
60							697	
65							692	
70							687	

S&ME
Environmental Services
Engineering * Testing

PROJECT:	Proposed C&D Landfill Winston Salem, N.C.	WELL LOG	B-21A

PROJECT NO.: 1581-93-052	ELEVATION: 747.23	NOTES: North Carolina State Coordinates N 821,529.384 E 1,622,928.829 Top of Casing Elev. 749.25
LOGGED BY: JRS	BORING DEPTH: 56.5 FEET	
DATE DRILLED: 4-4-94	WATER LEVEL:	
DRILLING METHOD: 3-1/4" HSA	DRILL RIG: Diedrich D-50	

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.	WELL DIAGRAM
0		Topsoil						
		Residuum: Firm Brown Gray Streaked Orange Slightly Clayey Medium Sandy **SILT**				6		
5		Stiff Blue Gray Streaked Red Medium Sandy Clayey **SILT**				13	742	
10		Medium Dense White Gray Slightly Silty Medium to Fine **SAND**				19	737	
15		Medium Dense Brown White Silty Fine to Medium **SAND**, micaceous				29	732	
20						14	727	
25		Partially Weathered Rock: Sampled as Brown White Silty Fine to Medium **SAND**, micaceous				90/0.8	722	
30						50/0.3	717	
35						50/0.2	712	

Concrete Grout

2" Dia. PVC Casing

S&ME
Environmental Services
Engineering * Testing

PROJECT:	Proposed C&D Landfill Winston Salem, N.C.	WELL LOG	B-21A

PROJECT NO.: 1581-93-052	ELEVATION: 747.23	NOTES: North Carolina State Coordinates N 821,529.384 E 1,622,928.829 Top of Casing Elev. 749.25
LOGGED BY: JRS	BORING DEPTH: 56.5 FEET	
DATE DRILLED: 4-4-94	WATER LEVEL:	
DRILLING METHOD: 3-1/4" HSA	DRILL RIG: Diedrich D-50	

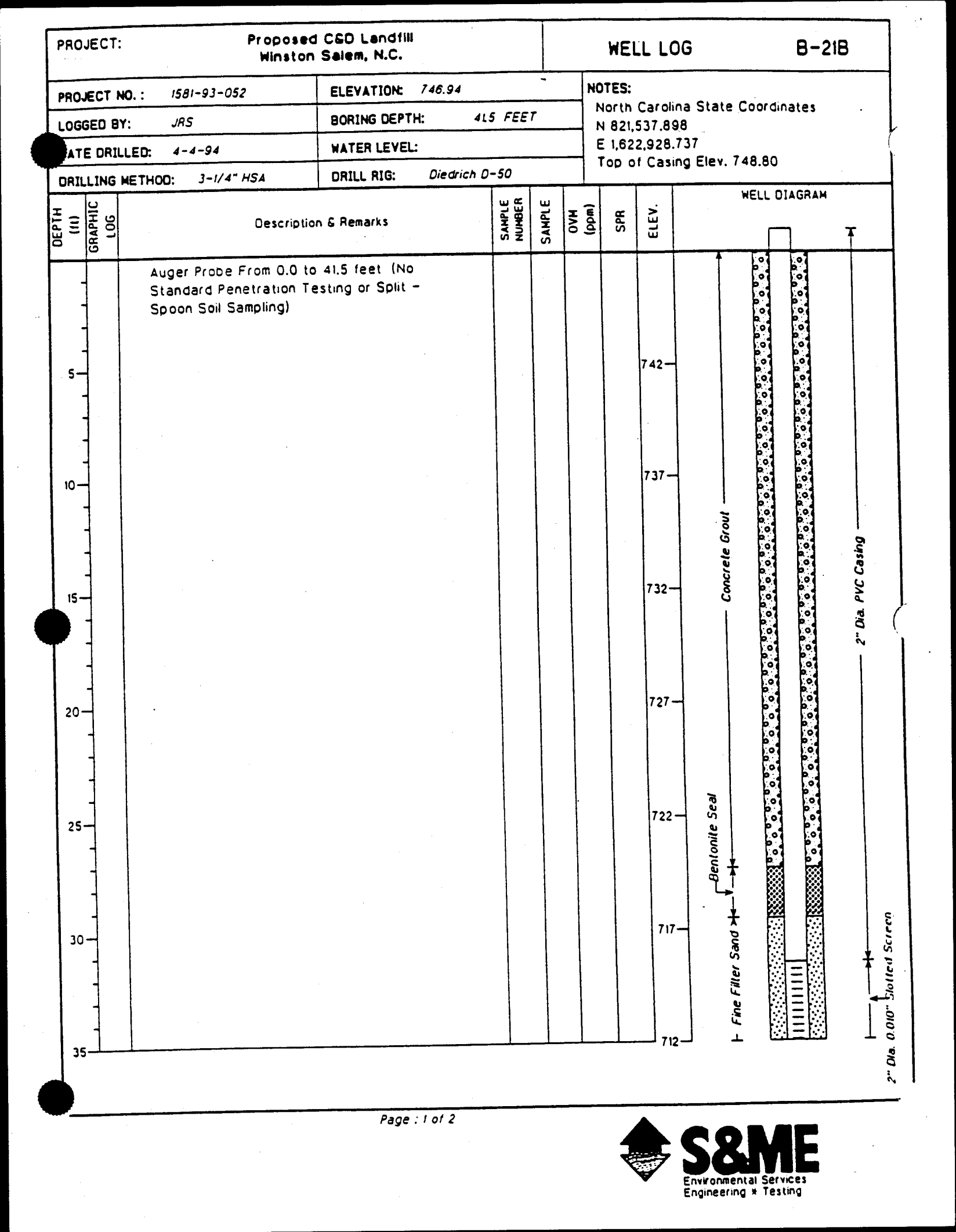
DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.	WELL DIAGRAM
40						50/0.2	707	Bentonite Seal Concrete Grout
		Gray Blue Slightly Weathered Rock (difficult drilling) Auger Refusal at 43.0 ft						
45		Rock: Light Blue Gray, Slightly Weathered to Unweathered, Medium to Coarse Grained, Hard **GRANITE SCHIST**, with white feldspar, mica Core Run 1: 43.0 ft to 48.0 ft REC = 92% RQD = 76%					702	Fine Filter Sand
50		Core Run 2: 48.0 ft to 53.0 ft REC = 88% RQD = 44%					697	
55		Core Run 3: 53.0 ft to 56.5 ft REC = 89% RQD = 71%					692	2" Dia. 0.010" Slotted Screen 2" Dia PVC Casing
		Boring Terminated at 56.5 feet					687	
60							682	
65							677	
70								

S&ME
Environmental Services
Engineering * Testing

PROJECT:	Proposed C&D Landfill Winston Salem, N.C.	WELL LOG	B-21B

PROJECT NO. : 1581-93-052	ELEVATION: 746.94	NOTES:
LOGGED BY: JRS	BORING DEPTH: 41.5 FEET	North Carolina State Coordinates
DATE DRILLED: 4-4-94	WATER LEVEL:	N 821,537.898
DRILLING METHOD: 3-1/4" HSA	DRILL RIG: Diedrich D-50	E 1,622,928.737
		Top of Casing Elev. 748.80

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.	WELL DIAGRAM
		Auger Probe From 0.0 to 41.5 feet (No Standard Penetration Testing or Split - Spoon Soil Sampling)						



S&ME
Environmental Services
Engineering * Testing

PROJECT:	Proposed C&D Landfill Winston Salem, N.C.	WELL LOG	B-21B

PROJECT NO.: 1581-93-052	ELEVATION: 746.94	NOTES:
LOGGED BY: JRS	BORING DEPTH: 41.5 FEET	North Carolina State Coordinates
DATE DRILLED: 4-4-94	WATER LEVEL:	N 821,537.898
DRILLING METHOD: 3-1/4" HSA	DRILL RIG: Diedrich D-50	E 1,622,928.737
		Top of Casing Elev. 748.80

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.	WELL DIAGRAM
40							707	Fine Filler Sand
		Boring Terminated at 41.5 feet						2" Dia. 0.010" Slotted Screen
45							702	
50							697	
55							692	
60							687	
65							682	
70							677	

S&ME
Environmental Services
Engineering * Testing

Symbol Legend

USCS Symbols

[GW-GP] Gravels, Gravel-Sand Mixtures, Little or No Fines

[GM] Silty Gravels, Gravel-Sand-Silt Mixtures

[GC] Clayey Gravels, Gravel-Sand-Clay Mixtures

[SW-SP] Sands, Gravely Sands, Little or No Fines

[SM] Silty Sands, Sand-Silt Mixtures

[SC] Clayey Sands, Sand-Clay Mixtures

[ML] Silts and Very Fine Sands, Silty or Clayey Fine Sands, or Clayey Silts

[CL] Clays, Gravely Clays, Sandy Clays, Silty Clays

[OL] Organic Silts and Silty Clays

[MH] Silts, Fine Sandy or Silty Soils

[CH] Inorganic Clays and Fat Clays

[OH] Organic Clays and Silts

[PT] Peat, Highly Organic Soils

Competent Rock

Incompetent Rock

Well Symbols

Pipe with cement packing

Pipe with bentonite packing

Screen with sand packing

Ground Water Level 24 hours after drilling

Sample Type Symbols

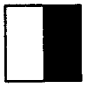
Split Spoon

Auger

Core

Grab / Bulk

Shelby Tube


No Recovery

Geologist Log: PZ-18A

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-02

Ground Elevation: 824.15' MSL

Geologist: J.Isham PG & C.Randazzo

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
-3										
-2										
-1										
0		Ground Surface	824.1							
		(NOTE: SEE WELL LOG B-18 DRILLED BY S&ME FOR 0' TO 50' DATA)	0.0							
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										Portland Type I Cement with 3% Bentonite
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										

Drilled By: Engineering Tectonics

Drill Method: HSA

Drill Date: February 14, 2003

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: 827.15' MSL

Sheet: 1 of 4

Geologist Log: PZ-18A

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-02

Ground Elevation: 824.15' MSL

Geologist: J.Isham PG & C.Randazzo

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										
31										Portland Type I Cement with 3% Bentonite
32										
33										
34										
35										
36										
37										
38										
39										
40										
41										
42										
43										

Drilled By: Engineering Tectonics

Drill Method: HSA

Drill Date: February 14, 2003

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: 827.15' MSL

Geologist Log: PZ-18A

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-02

Ground Elevation: 824.15' MSL

Geologist: J.Isham PG & C.Randazzo

HDR

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft (20 40 60 80)	Well Data	Remarks
44										
45										
46										
47										
48										
49										
50			774.1							
51		***SAND AND GRAVEL*** White and gray, medium to very coarse grained, micaceous (PWR), kaolinitic feldspars, quartz grains, powdery, brittle, dry	50.1	1		50 1"	<1%			
52										
53										
54										Portland Type I Cement with 3% Bentonite
55			769.0							
56		Brown, tan, white, fine to coarse grained, silty, micaceous, (PWR), dry	55.1	2		50 2"	2%			
57										
58										
59										
60			764.1							
61		Same as above	60.0	3		50 2"	2%			
62										
63										
64										
65			759.1							
66		Same with less fines, crumbly	65.0	4		50 3"	2%			

Drilled By: Engineering Tectonics

Drill Method: HSA

Drill Date: February 14, 2003

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: 827.15' MSL

Geologist Log: PZ-18A

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-02

Ground Elevation: 824.15' MSL

Geologist: J.Isham PG & C.Randazzo

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
67										
68										
69										
70		Same with more orange and rust, less gravel	754.1 70.0	5		50 3"	2%			3/8 inch Bentonite Chips
71										
72										
73										
74			749.1							
75		Same but moist	75.0	6		50 1"	2%			
76										
77										#2 Silica Sand Pack
78										
79										
80			744.1 80.0	7		50 1"	2%			
81										
82										
83										
84										
85										
86				8		50 0.5"	<1%			N= 821690.00 E= 1622572.85
87		AUGER REFUSAL (TOP OF BEDROCK)	736.1							
88		End of Borehole	88.0							
89										

Drilled By: Engineering Tectonics

Drill Method: HSA

Drill Date: February 14, 2003

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: 827.15' MSL

Geologist Log: PZ-22A

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-02

Ground Elevation: 775.17' MSL

Geologist: J. Isham PG

SUBSURFACE PROFILE

Depth	Symbol	Description	Elevation
-3 to 0		Ground Surface	775.2
0		***SILTY SAND*** Tan, white, gray, fine to medium grained, silty, micaceous, relict horizontal foliation of mica, quartz and feldspar abundant, PWR, dry.	0.0
10		***SANDY GRAVEL*** Black, white, gray, medium to coarse grained sandy, micaceous, granitic texture, poorly sorted, dry, PWR.	765.2 10.0
15		***SILTY SAND*** Tan to brown and white, fine to medium grained, silty, micaceous, faint relict foliation, slightly moist, PWR.	760.2 15.0
20			755.2 20.0

SAMPLE

Number	Type	Blows/ft	Recovery
1		50 4"	1%
2		50 5"	1%
3		50 5"	1%

Shear Strength blows/ft (20 40 60 80)

Well Data

Remarks: Portland Type I Cement with 3% Bentonite; 3/8-inch Bentonite Chips; #2 Silica Sand Pack

Drilled By: Engineering Tectonics

Drill Method: HSA

Drill Date: February, 11, 2003

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: 778.68' MSL

Geologist Log: PZ-22A

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-02

Ground Elevation: 775.17' MSL

Geologist: J. Isham PG

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
21		Tan to brown, silty, fine to medium grained, micaceous, manganese oxide staining, faint relict foliation, slightly damp, dense saprolite to PWR.		4		50 3"	5%			
22										
23										
24										
25			750.2 25.0							
26		Dark brown to tan, fine grained, silty, micaceous, moist, very dense saprolite.		5		50 0"	0%			
27										
28										2-inch Diameter SCH 40 PVC 0.010-inch Slots
29										
30			745.2 30.0							
31		Same with relict foliation and sticky.		6		50 1"	1%			
32										
33										
34			741.2 34.0							
35		AUGER REFUSAL (TOP OF BEDROCK)	740.2 35.0							
36		End of Borehole								
37										N= 821649.94
38										E=1622040.39
39										
40										
41										
42										
43										

Drilled By: Engineering Tectonics

Drill Method: HSA

Drill Date: February, 11, 2003

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: 778.68' MSL

Sheet: 2 of 2

Geologist Log: PZ-24

Project: Old Salisbury Road

Project No: 00162-525-018-01

Client: Winston Salem

Ground Elevation: 767.98

Location: Winston Salem

Geologist: J. Isham

HDR

Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft (20 40 60 80)	Well Data	Remarks
-2										
-1										
0		Ground Surface	768.0							
0		***SILT*** Gray, tan to light brown, micaceous, slightly clayey, sandy, slightly plastic, moist	0.0							
1										
2										
3										
4				1		6	20%			
5										
6										
7										
8			760.0							
8		***CLAY*** Tan to light brown, sandy, sticky, very moist, plastic, medium to coarse grained quartz, no structure	8.0							
9				2		7	45%			
10										Portland Type I Cement with 3% Bentonite
11										
12										
13			755.0							
13		***SAND*** Reddish brown to tan, slightly micaceous, clayey, sticky, mottled, iron staining weakly foliated, medium to coarse grained quartz, slightly moist, saprolite	13.0							
14				3		17	50%			
15										
16										
17										
18										
19			748.7	4		21	50%			
19		White to light gray, clayey, medium to very coarse grained, sticky, dense, slightly plastic, no structure, lightly kaolinitic, moist	19.3							
20										
21										

Drilled By: Richard Simmons Drilling

Drill Method: HSA

Drill Date: May 28, 2002

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: 770.07

Geologist Log: PZ-24

Project: Old Salisbury Road
Project No: 00162-525-018-01
Client: Winston Salem
Ground Elevation: 767.98
Location: Winston Salem
Geologist: J. Isham

HDR

SUBSURFACE PROFILE / SAMPLE

Depth	Description	Elevation	Number	Type	Blows/ft	Recovery	Remarks
23	White, tan yellow to brown, granitic saprolite, slightly micaceous, silty sand, medium to coarse grained, very moist to wet, kaolinitic, granite host rock, quartz, feldspar, mica	745.0 / 23.0	5		11	50%	3/8-inch Bentonite Chips; #2 Silica Sand Pack
28	White, gray, black, silty, medium to very coarse grained, (gneissic saprolite), weak foliation, (heavy mafic/biotite), slightly moist to dry, crumbles to touch	740.0 / 28.0	6		36	45%	2-inch Diameter SCH 40 PVC 0.010-inch Slots
33	White and pink silty, PWR, dry, brittle, abundant pink potassic feldspar and quartz, manganese oxide healed fractures and veins, very weak foliation, minor biotite, medium to coarse grained	735.0 / 33.0	7		75	45%	
38	End of Borehole	730.0 / 38.0					

Shear Strength blows/ft: 20 40 60 80

Well Data

Drilled By: Richard Simmons Drilling
Drill Method: HSA
Drill Date: May 28, 2002

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"
Top of Casing: 770.07
Sheet: 2 of 2

Geologist Log: PZ-25

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-01

Ground Elevation: 790.91

Geologist: J. Isham

HDR

SUBSURFACE PROFILE / SAMPLE

Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft (20 40 60 80)	Well Data	Remarks
-1										
0		Ground Surface	790.9							
0		***SAND*** Pink to reddish brown to tan, micaceous, silty, fine to medium grained, abundant pink potassic feldspar, quartz and feldspar dominant, weak horizontal foliation, dry	0.0							
3				1		20	50%			
8			782.9							
8		***SILT*** Light tan to white and brown, micaceous, slightly sandy, medium to fine grained quartz, abundant biotite, soft, dry, weakly foliated	8.0	2		9	50%			Portland Type I Cement with 3% Bentonite
13		White, light gray to tan micaceous, sandy, medium to fine grained quartz, abundant biotite, very weak foliation, dry, brittle, kaolinite	13.0	3		13	50%			
18		Dry, powdery, no foliation	772.9 18.0	4		12	40%			
22										

Drilled By: Richard Simmons Drilling

Drill Method: HSA/Air Hammer

Drill Date: May, 31, 2002

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: 792.90

Geologist Log: PZ-25

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-01

Ground Elevation: 790.91

Geologist: J. Isham

HDR

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
23										
24				5		20	50%			
25										
26										
27			762.9							
28		***SAND*** White to light gray, silty to sandy silt, micaceous, very weak foliation, granitic quartz feldspar dominant, medium to fine grained, dry, powdery	28.0	6		26	50%			
29										
30										
31										
32										Portland Type I Cement with 3% Bentonite
33		White to light gray, micaceous, silty, medium to fine grained, dry, kaolinitic, powder, no relict foliation, quartz feldspar dominant	33.0	7		27	50%			
34										
35										
36										
37			752.9							
38		Weak foliation	38.0	8		30	50%			
39										
40										
41										
42			747.9							
43		Gray to white silty sand, fine grained, micaceous, weak foliation, quartz - feldspar dominant, dry, brittle	43.0	9		50	50%			
44										
45										
46										

Drilled By: Richard Simmons Drilling

Drill Method: HSA/Air Hammer

Drill Date: May, 31, 2002

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: 792.90

Geologist Log: PZ-25

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-01

Ground Elevation: 790.91

Geologist: J. Isham

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft (20 40 60 80)	Well Data	Remarks
47										
48		White, gray to tan, micaceous, silty, medium to fine grained, granite composition, dry, brittle, hard (PWR), no relict foliation	742.9 48.0	10		100	30%			
49										
50										
51										
52										
53		Air Drill PWR	737.9 53.0							
54										
55										Portland Type I Cement with 3% Bentonite
56										
57										
58										
59										
60										
61										
62										
63										
64										
65										
66										
67										
68										
69										
70										

Drilled By: Richard Simmons Drilling

Drill Method: HSA/Air Hammer

Drill Date: May, 31, 2002

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: 792.90

Sheet: 3 of 4

Geologist Log: PZ-25

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-01

Ground Elevation: 790.91

Geologist: J. Isham

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
71										
72										
73										
74										
75										
76										
77										3/8-inch Bentonite Chips
78										
79										#2 Silica Sand Pack
80										
81										
82										
83										2-inch Diameter SCH 40 PVC 0.010-inch Slots
84										
85										
86										
87										
88										
89										
90										
91		End of Borehole	699.9 91.0							
92										
93										
94										

Drilled By: Richard Simmons Drilling

Drill Method: HSA/Air Hammer

Drill Date: May, 31, 2002

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: 792.90

Geologist Log: PZ-26

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-01

Ground Elevation: 757.93

Geologist: J. Isham

HDR

SUBSURFACE PROFILE

SAMPLE

Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft (20 40 60 80)	Well Data	Remarks
-2 -1 0		Ground Surface	757.9							
0–8		***SILT*** Reddish brown to pink and tan, highly micaceous, sandy, weak foliation, dry, powdery, biotite heavy, pink potassic feldspar, fine to coarse grained quartz	0.0	1		16	15%			
			749.9							
8–13		***SAND [SM]*** Light brown to tan and white, silty sand to sandy, micaceous, dry, abundant biotite, powdery, kaolinitic, no relict structure	8.0	2		14	50%			Portland Type I Cement with 3% Bentonite
			744.9							
13–18		Light brown, tan and white, micaceous, silty sandy, dry, powdery, kaolinitic, no relict foliation, abundant biotite, medium to fine grained quartz (saprolite)	13.0	3		27				
			739.9							
18–20		White to tan, micaceous, sandy, dry, powdery, abundant biotite, no relict foliation, fin grained quartz, kaolinitic	18.0	4		24	40%			3/8-inch Bentonite Chips

Drilled By: Richard Simmons Drilling

Drill Method: HSA

Drill Date: May 29, 2002

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: 760.84

Geologist Log: PZ-26

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-01

Ground Elevation: 757.93

Geologist: J. Isham

HDR

SUBSURFACE PROFILE / SAMPLE

Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft (20 40 60 80)	Well Data	Remarks
21										
22										#2 Silica Sand Pack
23			734.9							
24		White to tan, micaceous, silty, fine to medium grained quartz, weak relict foliation, damp, brittle, kaolinitic	23.0	5		25	50%			
25										
26										
27			729.9							2-inch Diameter SCH 40 PVC 0.010-inch Slots
28		***SAND [SM]*** Medium to coarse grained, damp to wet, relict foliation, granite PWR	28.0	6		64	50%			
29										
30										
31										
32										
33			724.4							
34		End of Borehole	33.5							
35										
36										
37										
38										
39										
40										
41										
42										
43										

Drilled By: Richard Simmons Drilling

Drill Method: HSA

Drill Date: May 29, 2002

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: 760.84

Geologist Log: PZ-27

Project: Old Salisbury Road | *Project No:* 00162-525-018-01

Client: Winston Salem | *Ground Elevation:* 726.51

Location: Winston Salem | *Geologist:* J. Isham

HDR

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
0		Ground Surface	726.5							
0		***SAND*** Reddish brown to tan, clayey, sticky, slightly plastic, medium to fine grained, no relict structure, biotite grains mottled, slightly moist to moist	0.0							Portland Type I Cement with 3% Bentonite
4				1		19	50%			3/8-inch Bentonite Chips
8		Tan to pink and brown, micaceous, silty, medium to fine grained, quartz, pink feldspar, biotite (granite), PWR zone, dry, brittle	718.5 8.0	2		100	20%			#2 Silica Sand Pack
13		White and gray, micaceous, silty, medium to coarse grained, granite PWR, abundant biotite, wet, no relict structure	713.5 13.0	3		100	1%			2-inch Diameter SCH 40 PVC 0.010-inch Slots
18		End of Borehole	708.5 18.0							

Drilled By: Richard Simmons Drilling

Drill Method: HSA

Drill Date: May 29, 2002

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: 728.34

Sheet: 1 of 1

Geologist Log: PZ-28

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-01

Ground Elevation: 744.49

Geologist: J. Isham

HDR

SUBSURFACE PROFILE

Depth	Symbol	Description	Elevation
0		Ground Surface	744.5
0		***SAND*** White and tan, micaceous, silty, medium to fine grained, no relict foliation, abundant biotite, dry, brittle, kaolinitic	0.0
8		Tan and white, micaceous, silty, dry, brittle, medium to fine grained quartz, granitic composition, relict vertical foliation	736.5 / 8.0
13		White and gray to tan, micaceous, silty, medium to coarse grained, top of PWR, dry, brittle, feldspars to kaolinite	731.5 / 13.0
18		White, silty, sandy silt, micaceous, sticky, moist, kaolinitic, holds structure when pressed, granitic composition	726.5 / 18.0
23			721.5

SAMPLE

Number	Type	Blows/ft	Recovery
1		16	40%
2		24	40%
3		61	40%
4		14	40%

Shear Strength
blows/ft
20 40 60 80

Well Data

Remarks

Portland Type I Cement with 3% Bentonite

3/8-inch Bentonite Chips

#2 Silica Sand Pack

2-inch Diameter SCH 40 PVC 0.010-inch Slots

Drilled By: Richard Simmons Drilling

Drill Method: HSA

Drill Date: May 29, 2002

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: 744.80

Geologist Log: PZ-28

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-01

Ground Elevation: 744.49

Geologist: J. Isham

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
23		White to tan, micaceous, silty, medium to fine grained quartz, abundant biotite, brittle, moist, granitic composition, PWR		5		83	10%			
24										
25										
26										
27										
28										
29			714.5							
30		End of Borehole	30.0							
31										
32										
33										
34										
35										
36										
37										
38										
39										
40										
41										
42										
43										
44										
45										

Drilled By: Richard Simmons Drilling

Drill Method: HSA

Drill Date: May 29, 2002

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: 744.80

Geologist Log: PZ-29

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-01

Ground Elevation: 733.67

Geologist: J. Isham

Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft (20 40 60 80)	Well Data	Remarks
-2										
-1										
0		Ground Surface	733.7							
0		***SAND*** Gray, fine grained, slightly clayey, wet, sticky, well sorted, no relict structure, creek overbank deposits	0.0							Portland Type I Cement with 3% Bentonite
1										
2										3/8-inch Bentonite Chips
3										
4				1		2				#2 Silica Sand Pack
5			728.7							
5		***SAND [SM]*** Shelby Tube	5.0	2			5%			
6										
7										
8			725.7							
8		Brown, tan and white, micaceous, silty, medium, to fine grained, weak foliation, brittle, wet, PWR	8.0	3		87				2-inch Diameter SCH 40 PVC 0.010-inch Slots
9										
10										
11										
12										
13			719.7							
14		End of Borehole	14.0							
15										
16										
17										
18										
19										
20										

Drilled By: Richard Simmons Drilling

Drill Method: HSA

Drill Date: May 30, 2002

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: 736.59

Sheet: 1 of 1

Geologist Log: PZ-30

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-01

Ground Elevation: 754.04

Geologist: J. Isham

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
-1										
0		Ground Surface	754.0							
1		***SAND*** Reddish brown, to tan, slightly micaceous, clayey, medium to fine grained quartz, mottled, slightly plastic, sticky, no relict foliation, garnet bearing	0.0							
2										
3										
4				1		12	50%			
5										
6										
7										
8			746.0							
9		Tan, reddish maroon, purple, white and brown, micaceous, fine to medium grained, clayey, very moist, sticky, plastic, abundant potassic feldspar as kaolinite (chalky), strong relict vertical foliation, heavy iron staining, garnet bearing	8.0	2		15	60%			Portland Type I Cement with 3% Bentonite
10										
11										
12										
13			741.0							
14		Strong relict isoclinal folding, heavy garnet ghosts and residual grains, medium to fine grained	13.0	3		39	50%			3/8-inch Bentonite Chips
15										
16										#2 Silica Sand Pack
17										
18			736.0							
19		Reddish brown to orange brown and white, micaceous, silty, medium to fine grained, dry, dense, vertical relict foliation, heavy iron staining	18.0	4		55	50%			2-inch Diameter SCH 40 PVC 0.010-inch Slots
20										
21										

Drilled By: Richard Simmons Drilling

Drill Method: HSA

Drill Date: May 30, 2002

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: 756.01

Geologist Log: PZ-30

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-01

Ground Elevation: 754.04

Geologist: J. Isham

HDR

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
22			731.0							
23		Wet, brittle	23.0	5		47	30%			
24										
25										
26										
27			726.0							
28		End of Borehole	28.0							
29										
30										
31										
32										
33										
34										
35										
36										
37										
38										
39										
40										
41										
42										
43										
44										

Drilled By: Richard Simmons Drilling

Drill Method: HSA

Drill Date: May 30, 2002

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: 756.01

Geologist Log: B-31

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-01

Ground Elevation: 807.64

Geologist: J. Isham

HDR

SUBSURFACE PROFILE

Depth	Symbol	Description	Elevation
		Ground Surface	807.6
0		***SILT*** Yellow red to orange and brown, micaceous, sandy, silty sand, medium to fine grained, slightly moist, sticky, no relict foliation, quartz, feldspar slightly kaolinitic, biotite	0.0
8		Yellow brown to tan, dry, powdery.	799.6 8.0
13		White to tan, quartz is fine grained, dry, powdery	794.6 13.0
18		Light gray to white, abundant kaolinite, weak relict foliation	789.6 18.0
23			784.6 23.0

SAMPLE

Number	Type	Blows/ft	Recovery
1	G		0'-5'
2			
3		27	50%
4		21	40%
5		17	50%
6		20	50%

Shear Strength
blows/ft
20 40 60 80

Well Data

Remarks

Portland Type I Cement with 3% Bentonite

Drilled By: Richard Simmons Drilling

Drill Method: HSA

Drill Date: May 31, 2002

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: NA

Geologist Log: B-31

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-01

Ground Elevation: 807.64

Geologist: J. Isham

HDR

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft (20 40 60 80)	Well Data	Remarks
24		***SAND [SM]***		7		19	50%			
25										
26										
27										
28				8		21	50%			
29										
30										
31										
32										
33				9		28	50%			
34										
35										
36										
37										
38		***SAND [SM]*** Shelby tube	769.6 38.0	10						
39										
40										
41										
42										
43		***SAND*** Yellow brown, tan and white, micaceous, silty, medium to coarse grained, relict foliation, kaolinitic, biotite stained due to some moisture	764.6 43.0	11		26	50%			
44										
45										
46										

Drilled By: Richard Simmons Drilling

Drill Method: HSA

Drill Date: May 31, 2002

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: NA

Geologist Log: B-31

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-01

Ground Elevation: 807.64

Geologist: J. Isham

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
47										
48			759.6							
49		White and tan, micaceous, silty, coarse to very coarse grained, dry, powder, brittle, iron oxide stained PWR	48.0	12		100				
50										
51										
52										
53										
54										
55			752.6							
56		End of Borehole	55.0							
57										
58										
59										
60										
61										
62										
63										
64										
65										
66										
67										
68										
69										

Drilled By: Richard Simmons Drilling

Drill Method: HSA

Drill Date: May 31, 2002

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: NA

Geologist Log: PZ-31A

Project: Old Salisbury Road | *Project No:* 00162-525-018-02

Client: Winston Salem | *Ground Elevation:* 808.11' MSL

Location: Winston Salem | *Geologist:* J. Isham PG

Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft (20 40 60 80)	Well Data	Remarks
0		Ground Surface	808.1							
0		***SILT [MH]*** Yellow red to orange and brown, micaceous, sandy, silty, medium to fine grained, slightly moist, sticky, no relict foliation, quartz, feldspar slightly kaolinitic, biotite	0.0	1	G		0'-5'			
2				2						
4			804.1	3		27	50%			
4		***SILT [ML]***	4.0							
8		Yellow brown to tan, dry, powdery.	800.1 8.0	4		21	40%			Portland Type I Cement with 3% Bentonite
13		White to tan, quartz is fine grained, dry, powdery	795.1 13.0	5		17	50%			
18		Light gray to white, abundant kaolinite, weak relict foliation	790.1 18.0	6		20	50%			

Drilled By: Engineering Tectonics

Drill Method: HSA

Drill Date: February 12, 2003

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: 810.85' MSL

Geologist Log: PZ-31A

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-02

Ground Elevation: 808.11' MSL

Geologist: J. Isham PG

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
21										
22										
23										
24				7		19	50%			
25										
26										
27										
28										
29				8		21	50%			
30										Portland Type I Cement with 3% Bentonite
31										
32										
33										
34				9		28	50%			
35										
36										
37										
38		Shelby tube	770.1 38.0							
39				10						
40										
41										
42										
43			765.1 43.0							

Drilled By: Engineering Tectonics

Drill Method: HSA

Drill Date: February 12, 2003

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: 810.85' MSL

Geologist Log: PZ-31A

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-02

Ground Elevation: 808.11' MSL

Geologist: J. Isham PG

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
44		***SILTY SAND*** Yellow brown, tan and white, micaceous, silty, medium to coarse grained, relict foliation, kaolinitic, biotite stained due to some moisture		11		26	50%			
45										
46										
47			760.1							
48		***SILTY SAND*** White and tan, micaceous, silty, coarse to very coarse grained, dry, powder, brittle, iron oxide stained PWR	48.0	12		100				
49										
50										
51										3/8 inch Bentonite Chips
52										
53										
54			753.1							
55		***SILTY SAND*** White, tan, light gray, medium to coarse grained, micaceous, granitic texture, faint horizontal mica fabric, dense, quartz graines large in places, feldspar abundant, minor epidote, dry.	55.0	13		72	50%			
56										
57										#2 Silica Sand Pack
58										
59										
60				14		97	50%			
61										
62										
63										
64			743.1							
65			65.0	15		50 6"	30%			
66										

Drilled By: Engineering Tectonics

Drill Method: HSA

Drill Date: February 12, 2003

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: 810.85' MSL

Geologist Log: PZ-31A

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-02

Ground Elevation: 808.11' MSL

Geologist: J. Isham PG

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
67		***SILTY SAND AND GRAVEL*** White, gray and tan, medium to coarse grained, silty, biotite micaceous, quartz, feldspar, granitic texture, saprolite								
68										
69										
70										N= 821531.81 E= 1622440.82
71				16		50 4"	10%			
72			736.1							
		End of Borehole	72.0							
73										
74										
75										
76										
77										
78										
79										
80										
81										
82										
83										
84										
85										
86										
87										
88										
89										

Drilled By: Engineering Tectonics

Drill Method: HSA

Drill Date: February 12, 2003

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: 810.85' MSL

Sheet: 4 of 4

Project No: 00162-525-018-01

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Geologist Log: B-32

Ground Elevation: 811.43

Geologist: J. Isham

HDR

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
		Ground Surface	811.4							
0		***SAND*** Tan to yellow brown and white, micaceous, silty, dry, brittle, no relict foiliation, granitic looking, no garnets	0.0							
8		***SILT*** Tan to green, micaceous, weak vertical grain alignment, chorite abundant from biotite alteration, fine grained, dry, powdery, possible altered hornblende grains(?)	803.4 8.0							
13		***SAND*** White, tan and gray, micaceous silty, medium to coarse grained, granite PWR, kaolinitic, brittle, dry	798.4 13.0							Portland Type I Cement with 3% Bentonite
18		Tan and white, micaceous, silty, gravel, PWR, coarse to very coarse grained quartz, feldspar as kaolitnite, dry	793.4 18.0							
23			788.4 23.0							

Drilled By: Richard Simmons Drilling

Drill Method: HSA

Drill Date: May 30, 2002

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: NA

Project No: 00162-525-018-01

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Geologist Log: B-32

Ground Elevation: 811.43

Geologist: J. Isham

HDR

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
24		No sample, hard PWR								
25										
26										
27										
28										
29										
30										
31										
32										
33										
34										
35										
36										
37										
38										
39										
40										
41										
42										
43										
44										
45										
46										

Drilled By: Richard Simmons Drilling

Drill Method: HSA

Drill Date: May 30, 2002

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: NA

Project No: 00162-525-018-01

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Geologist Log: B-32

Ground Elevation: 811.43

Geologist: J. Isham

HDR

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
47										
48										
49										
50										
51										
52										
53										
54										
55			755.9							
56		End of Borehole	55.5							
57										
58										
59										
60										
61										
62										
63										
64										
65										
66										
67										
68										
69										

Drilled By: Richard Simmons Drilling

Drill Method: HSA

Drill Date: May 30, 2002

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8"

Top of Casing: NA

Geologist Log: PZ-32A

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-01

Ground Elevation: 811.78' MSL

Geologist: J. Isham PG

HDR

SUBSURFACE PROFILE

Depth	Symbol	Description	Elevation
0		Ground Surface	811.8
0		***SILTY SAND (SM)*** Tan to yellow brown and white, micaceous, dry, brittle, no relict foiliation, granitic looking, no garnets	0.0
8		***SILT*** Tan to green, micaceous, weak vertical grain alignment, chorite abundant from biotite alteration, fine grained, dry, powdery, possible altered hornblende grains(?)	803.8 8.0
13		***SILTY SAND*** White, tan and gray, micaceous silty, medium to coarse grained, granite PWR, kaolinitic, brittle, dry	798.8 13.0
18		***SILTY GRAVEL*** Tan and white, micaceous, PWR, coarse to very coarse grained quartz, feldspar as kaolitnite, dry	793.8 18.0

SAMPLE

Number	Type	Blows/ft	Recovery
1			

Shear Strength blows/ft: 20 40 60 80

Well Data: Portland Type I Cement with 3% Bentonite

Remarks

Drilled By: Engineering Tectonics

Drill Method: HSA/Core Barrel

Drill Date: February 13, 2003

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8" & 2.5"

Top of Casing: 814.67' MSL

Geologist Log: PZ-32A

Project: Old Salisbury Road | *Project No:* 00162-525-018-01

Client: Winston Salem | *Ground Elevation:* 811.78' MSL

Location: Winston Salem | *Geologist:* J. Isham PG

Depth	Description	Elevation	Number	Type	Blows/ft	Recovery	Remarks
21–25							
		786.6					
25.2	***SILTY SAND*** White, light, gray, tan, silty, medium to coarse grained, quartz, feldspar, biotite (granitic composition), some weathered rock fragments, dry		2		50 2"	1%	
		781.8					
30.0	Tan, brown and white, silty, medium to coarse grained, micaceous, faint relict horizontal foliation, quartz and feldspar rock fragments, dense, dry		3		50 2"	1%	
		776.8					Portland Type I Cement with 3% Bentonite
35.0	White, tan and reddish brown, silty, medium to coarse grained, micaceous, relict horizontal foliation, granitic composition, very dense saprolite, dry		4		50 3"	2%	
		771.8					
40.0	Tan to light brown and white, silty, medium to coarse grained, micaceous, relict horizontal foliation, granitic texture, very dense saprolite, dry		5		50 1"	<1%	
42–43							

Shear Strength blows/ft: 20 40 60 80

Well Data

Drilled By: Engineering Tectonics

Drill Method: HSA/Core Barrel

Drill Date: February 13, 2003

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8" & 2.5"

Top of Casing: 814.67' MSL

Geologist Log: PZ-32A

Project: Old Salisbury Road | *Project No:* 00162-525-018-01

Client: Winston Salem | *Ground Elevation:* 811.78' MSL

Location: Winston Salem | *Geologist:* J. Isham PG

Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft (20 40 60 80)	Well Data	Remarks
44			766.8							
45		White and gray, silty, medium to coarse grained, micaceous, rock fragments, quartz and biotite abundant, very dense unconsolidated saprolite, dry	45.0	6		50 0.5"	<1%			
46										
47										
48										Portland Type I Cement with 3% Bentonite
49										
50		Tan to light brown, silty, fine to medium grained, granitic rock fragments, very dense saprolite, dry	761.8 50.0	7		50 1"	<1%			
51										
52										
53										
54										
55			756.4							55' - 75': 4 inch Borehole
56		***SAND AND GRAVEL*** Tan, white and gray, silty, medium to coarse grained, micaceous, quartz and feldspar (kaolinite) abundant, granitic texture, very dense saprolite to PWR, some rock fragments, slightly moist	55.4 755.3	8		50 1"	<1%			3/8 inch Bentonite Chips
57		AUGER REFUSAL (TOP OF BEDROCK)	784.8 57.0	1		RQD 18%	66%			
58										
59		***GRANODIORITE*** White, gray, black, mega crystic (1/2"-1") feldspar megacrysts, hard, mesocratic color, very weakly foliated (preferrential biotite), flow lineations, moderate intergranular porosity, feldspars turning to kaolintie	751.8							
60			60.0							
61										
62		Same with few horizontal to sub-horizontal fractures, weathered zone (water bearing?)		2		RQD 60%	88%			
63										
64										#2 Silica Sand Pack
65			746.8							
66			65.0							

Drilled By: Engineering Tectonics

Drill Method: HSA/Core Barrel

Drill Date: February 13, 2003

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8" & 2.5"

Top of Casing: 814.67' MSL

Geologist Log: PZ-32A

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-01

Ground Elevation: 811.78' MSL

Geologist: J. Isham PG

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
67		Same but 3 sub-horizontal fractures, no weathering zone, very large feldspar megacrysts, slightly foliated, quartz, potassic feldspar, microcline		3		RQD 80%	80%			
68										
69										
70			741.8 70.0							
71		Same as above, competent, quartz granodiorite, sub-horizontal fracute zone								
72				4		RQD 79%	81%			
73										
74										N= 821813.12 E= 1622461.36
75			736.8 75.0							
		End of Borehole								
76										
77										
78										
79										
80										
81										
82										
83										
84										
85										
86										
87										
88										
89										

Drilled By: Engineering Tectonics

Drill Method: HSA/Core Barrel

Drill Date: February 13, 2003

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 8" & 2.5"

Top of Casing: 814.67' MSL

Sheet: 4 of 4

Geologist Log: PZ-33

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-01

Ground Elevation: 784.60

Geologist: J. Isham

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
-2										
-1										
0		Ground Surface	784.6							
0		***SAPROLITE***	0.0							
1		(No samples taken, see other boring logs for details.								
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										Portland Type I Cement with 3% Bentonite
13										
14										
15										
16										
17										
18										
19										
20										

Drilled By: Richard Simmons Drilling

Drill Method: Air Hammer

Drill Date: May 31, 2002

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 6"

Top of Casing: 788.09

Geologist Log: PZ-33

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-01

Ground Elevation: 784.60

Geologist: J. Isham

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										
31										
32										
33										
34										
35										
36										
37										3/8-inch Bentonite Chips
38										
39										#2 Silica Sand Pack
40										
41										
42										2-inch Diameter SCH 40 PVC 0.010-inch Slots
43										

Drilled By: Richard Simmons Drilling

Drill Method: Air Hammer

Drill Date: May 31, 2002

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 6"

Top of Casing: 788.09

Geologist Log: PZ-33

Project: Old Salisbury Road

Project No: 00162-525-018-01

Client: Winston Salem

Ground Elevation: 784.60

Location: Winston Salem

Geologist: J. Isham

HDR

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
44										
45										
46										
47										
48										
49										
50										
51										
52										
53										
54										
55										
56										
57										Portland Type I Cement with 3% Bentonite
58										
59										
60										
61										
62										
63										
64										
65										
66										

Drilled By: Richard Simmons Drilling

Drill Method: Air Hammer

Drill Date: May 31, 2002

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 6"

Top of Casing: 788.09

Geologist Log: PZ-33

Project: Old Salisbury Road

Client: Winston Salem

Location: Winston Salem

Project No: 00162-525-018-01

Ground Elevation: 784.60

Geologist: J. Isham

HDR

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Elevation	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
67										
68										
69										
70										
71										
72										
73										
74										
75		End of Borehole	709.6 75.0							
76										
77										
78										
79										
80										
81										
82										
83										
84										
85										
86										
87										
88										
89										

Drilled By: Richard Simmons Drilling

Drill Method: Air Hammer

Drill Date: May 31, 2002

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size: 6"

Top of Casing: 788.09

Sheet: 4 of 4

PROJECT: WINSTON-SALEM C & D LANDFILL PROJECT NO: 00162-082-018

LOCATION: OLD SALISBURY ROAD BORING NUMBER: MW-2R PAGE: 1 OF 1

BORING LOG

DATE: 12/29/95

NUMBER	DEPTH	SPT	T	WL	SI	DESCRIPTION (USCS)	COMMENTS
						RED, VERY SOFT, MICACEOUS CLAY (CL) WITH SAND, PLASTIC, VERY MOIST	FILL MATERIAL
SS-1	4'	2	SS			LIGHT BROWN TO TAN, VERY LOOSE, SLIGHTLY CLAYEY SAND (SC), MEDIUM TO FINE GRAINED QUARTZ, STRUCTURELESS, VERY MOIST, ORGANIC MATTER	ALLUVIAL DEPOSITS (?)
	8'			▽			
SS-2	---	50+	SS			LIGHT GRAY TO DARK BROWN/BLACK, VERY DENSE, SILTY SAND (SM) MEDIUM TO FINE GRAINED, HEAVY IRON AND MANGANESE OXIDE STAINING, MICACEOUS, QUARTZ, FELDSPAR, BRITTLE, DRY	GRANITIC SAPROLITE
	12'						
SS-3		50+	SS	▽		PARTIALLY WEATHERED ROCK AND SAPROLITE (SILTY SAND), QUARTZ, FELDSPAR, BIOTITE, BRITTLE, HARD, DRY	
	16'						
	20'					PARTIALLY WEATHERED ROCK	AUGAR REFUSAL
	24'					TD = 23 FT.	
	28'						
	32'						
	36'						
	40'						

▽ AT DRILLING

▼ 24 HR

BOREHOLE COMPLETION: 23 FT. BELOW LAND SURFACE

WATER DEPTH: 11.41 FT. BELOW TOC DATE: 1/3/96

DRILLING METHOD: 4 1/4-INCH HOLLOW STEM AUGER

LOGGED BY: J. ISHAM

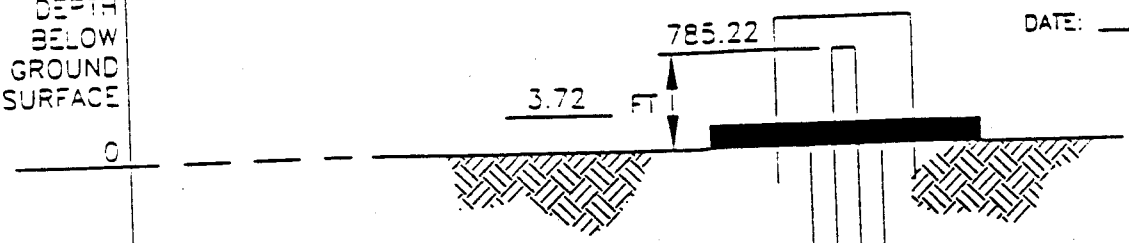
KEY:

SI - SCREEN
SS - SPLITSPOON
SPT - SOIL PENETRATION TEST-N NUMBER
ST - SHELBY TUBE
T - TYPE
WL - WATER LEVEL

HDR

MONITORING WELL INSTALLATION DIAGRAM

LOCATION: WINSTON-SALEM C&D
WELL NO.: MW-2R
BORING NO.:
JOB NO.: 00162-082-015
PREPARED BY: J. ISHAM
CHECKED BY:
DATE: 12/29/95



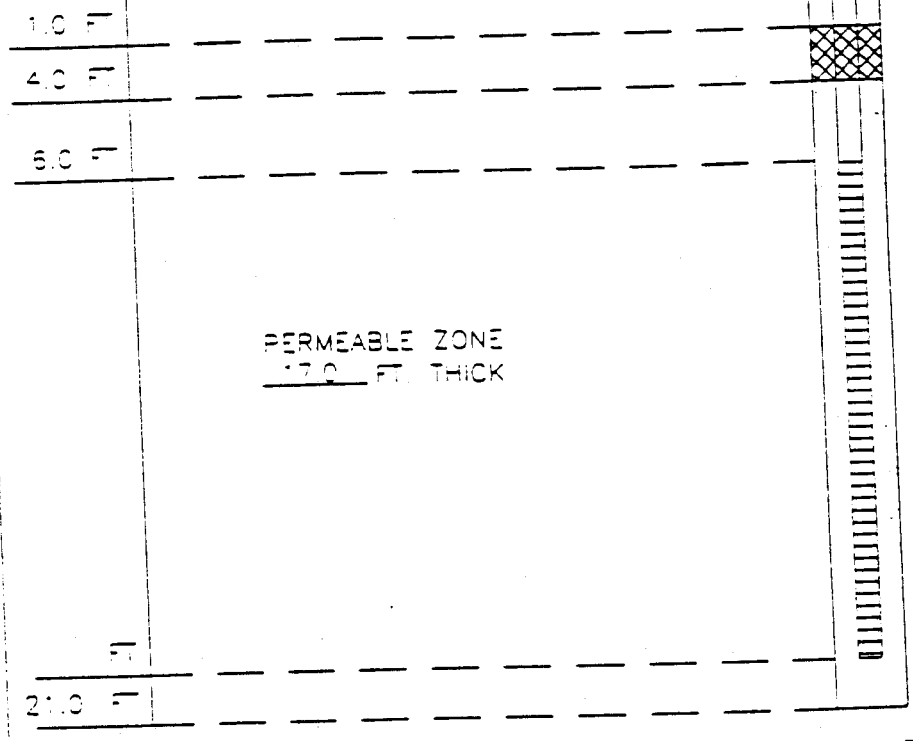
ANNULAR SEAL:
PORTLAND TYPE I CEMENT

PROTECTIVE METAL CASING
4-INCH SQUARE BLACK STEEL BOX WITH LOCKING LID

BENTONITE SEAL:
3/8-INCH BENTONITE CHIPS

IMPERVIOUS ZONE
4.0 FT. THICK

RISER PIPE: SCHEDULE 40
ID: 2" OD:
COUPLINGS: THREADED
PIPE IN 10.0 FT. LENGTHS
PIPE FT
PIPE 1-9.0 FT
SCREEN 15.0 FT
SLOT SIZE 0.010 IN
TOTAL: 24.0 FT



THICKNESS OF UPPER SEAL 3.0 FT

LENGTH OF SCREEN 15.0 FT

PERMEABLE ZONE
17.0 FT. THICK

SAND 17.0 FT

BOTTOM OF BORING

REMARKS: ALL MEASUREMENTS TO THE NEAREST 0.1 FT.

HDR

HDR Engineering, Inc.

MONITOR WELL INSTALLATION DIAGRAM

Project No: 00162-090-018

Project: Winston-Salem C&D Landfill

Client: City of Winston-Salem

Location: Old Salisbury Road

Geologist Log B-6R (MW-6R)

Ground Elevation: 817.8' MSL

Geologist: John R. Isham, PG.

HDR

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Depth/Elev.	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
0		Ground Surface	0							
		RESIDUUM Tan to light brown sandy loam.	818							
2		*SANDY SILT (ML)* Orange-brown, micaceous, fine-grained quartz grains, dry.	3.5							
			814							
5				1		8	60%			
10				2		7	75%			Portland Type I Cement with 3% Bentonite
12		*SILTY SAND (SM)* Tan to yellow-brown, micaceous, fine to coarse-grained quartz grains, weak mineral alignment (horizontal), iron oxide staining, mottled, dry								
15				3		8	75%			
20										

Drilled By: Engineering Tectonics, PA.

Drill Method: 4.25-inch ID HSA

Drill Date: July 8, 1999

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size 8-inch Diameter

Top-of-Casing 820.4' MSL

Project No: 00162-090-018

Project: Winston-Salem C&D Landfill

Client: City of Winston-Salem

Location: Old Salisbury Road

Geologist Log B-6R (MW-6R)

Ground Elevation: 817.8' MSL

Geologist: John R. Isham, PG.

HDR

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Depth/Elev.	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
21		***SILTY SAND (SM)*** Tan to yellow-brown, micaceous, fine to coarse-grained quartz grains, weak mineral alignment (horizontal), iron oxide staining, mottled, dry.		4		12	80%			
22										
23			23 / 795							
24										Granitic Saprolite
25				5		15	75%			
26										
27										
28		***SILTY SAND (SM)*** Same as above, becoming mixed with partially weathered rock lenses, dry.								
29										
30										Portland Type I Cement with 3% Bentonite
31				6		27	75%			
32										
33										
34			34 / 784							
35		***SILTY SAND w/ GRAVEL*** White, to light gray and tan, micaceous, mottled with iron oxide staining, fine to coarse-grained quartz, feldspar, mica, weak foliation as mineral alignment, dry.		7		48	85%			
36										
37										
38										
39										
40										

Drilled By: Engineering Tectonics, PA.

Drill Method: 4.25-inch ID HSA

Drill Date: July 8, 1999

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

Hole Size 8-inch Diameter

Top-of-Casing 820.4' MSL

Project No: 00162-090-018

Project: Winston-Salem C&D Landfill

Client: City of Winston-Salem

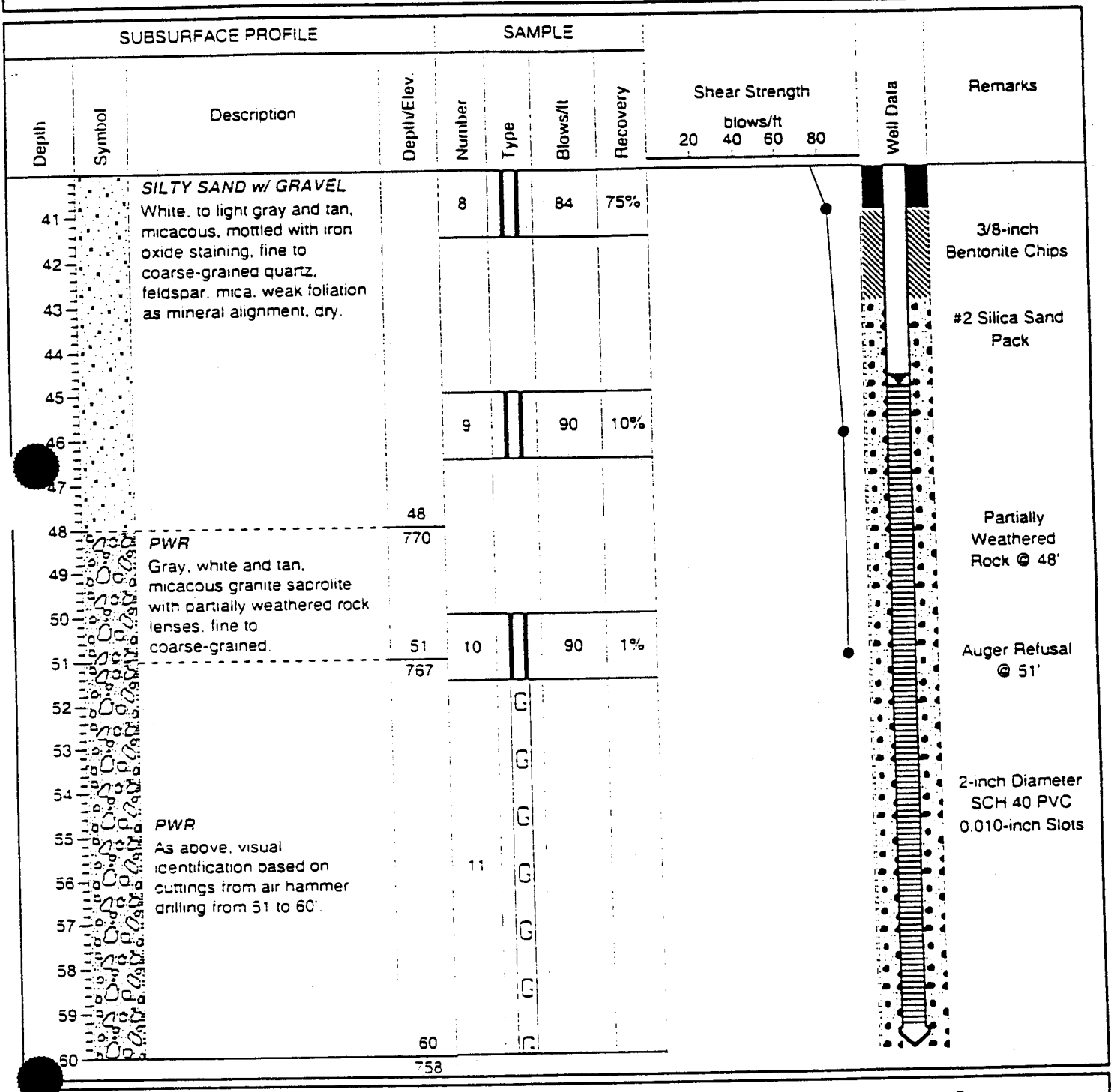
Location: Old Salisbury Road

Geologist Log B-6R (MW-6R)

Ground Elevation: 817.8' MSL

Geologist: John R. Isham, PG

HDR



Drilled By: Engineering Tectonics, PA.

Drill Method: 4.25-inch ID HSA

Drill Date: July 8, 1999

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC 28202

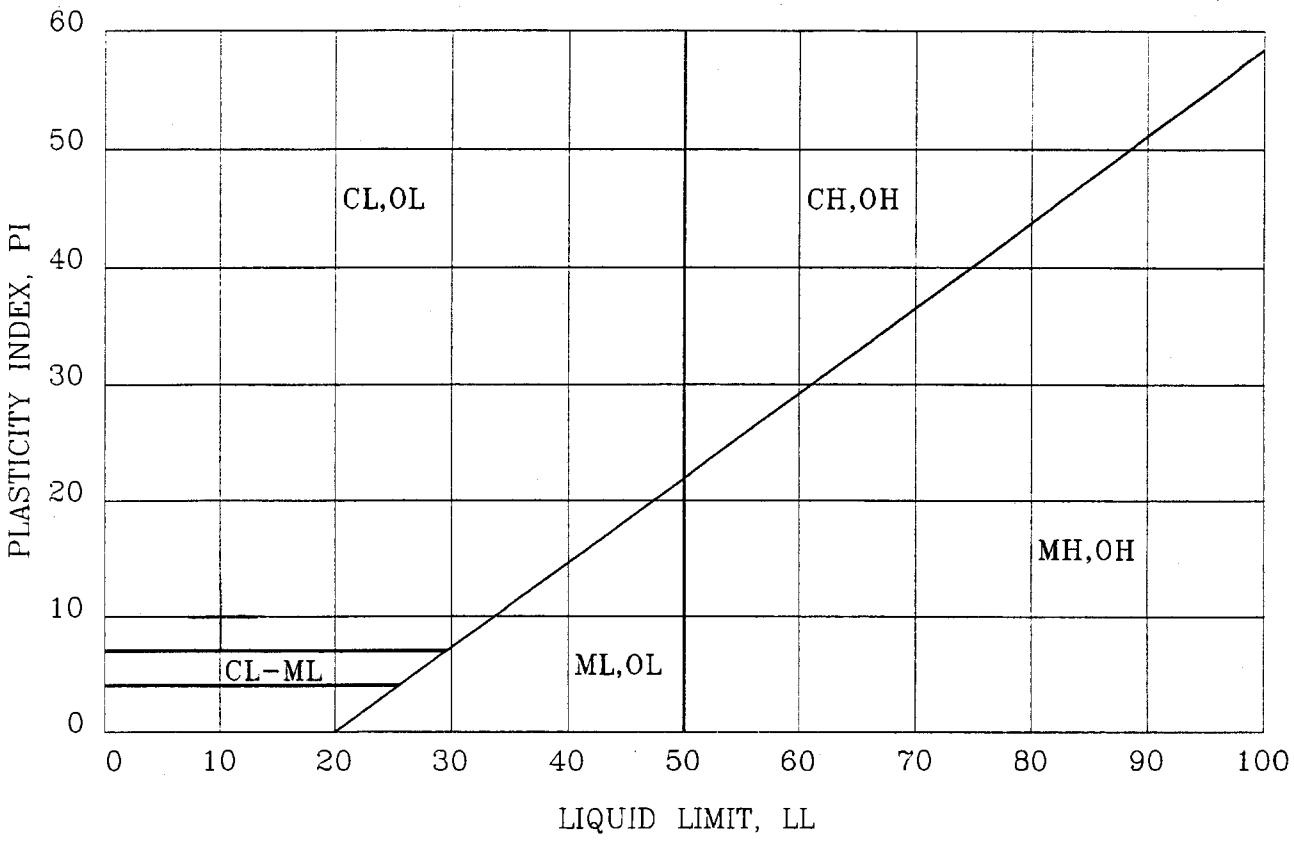
Hole Size 8-inch Diameter

Top-of-Casing 820.4' MSL

Sheet: 3 of 3

APPENDIX C

GEOTECHNICAL LABORATORY RESULTS

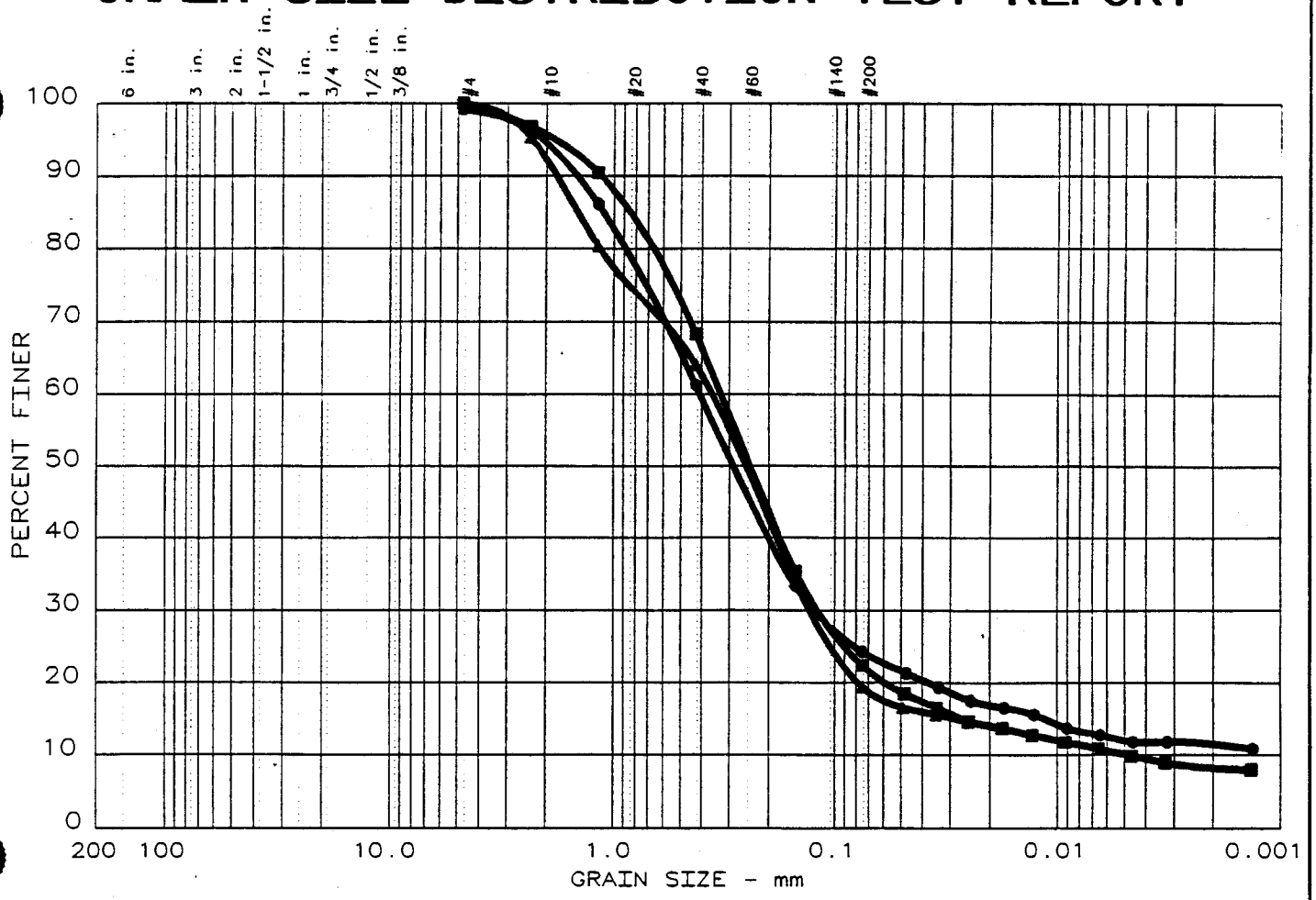


SYMBOL	SAMPLE	DEPTH (ft)	MC (%)	LL (%)	PL (%)	PI (%)	LI (-)	DESCRIPTION
○	B26	8-9.5	11.5	11	NP	NP	1.08	Gray/White Mic Silty Sand
□	B26	28-29.5	12.8	11	NP	NP	1.13	Tan/White Mic Silty Sand
△	B29	5-7.0	25.9	26	NP	NP	1.00	Mic Sandy Top Soil/large organic
◇	B31	23.5-25	12.8	10	NP	NP	1.23	Tan/White Mic Silty Sand
☆	B31	39-41	12.8	14	NP	NP	.91	Gray Silty Sand

Remark :

Project No.02-447	W-S C D Landfill
Engineering Tectonics	PLASTICITY CHART Figure No.1

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	1	0.0	0.8	74.9	12.4	11.9
▲	2	0.0	0.0	80.6	9.3	10.1
■	3	0.0	0.0	77.6	12.3	10.1

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	11	NP	1.11	0.406	0.288	0.123	0.0113			
▲	11	NP	1.45	0.355	0.251	0.129	0.0275	0.0048	9.77	74.1
■	26	NP	0.840	0.327	0.242	0.119	0.0265	0.0048	8.91	67.6

MATERIAL DESCRIPTION	USCS	AASHTO
● Gray/White Mic Silty Sand	SM	A-2-4(0.0)
▲ Tan/White Mic Silty Sand	SM	A-2-4(0.0)
■ Gray Mic Silty Sand	SM	A-2-4(0.0)

Project No.: 02-447B
Project: W-S C&D Lanfill
● Location: B26 @ 8.0 to 9.5 ft.
▲ Location: B26 @ 28.0 to 29.5 ft.
■ Location: B29 @ 5.0 to 7.0 ft.
Date: 06-06-02

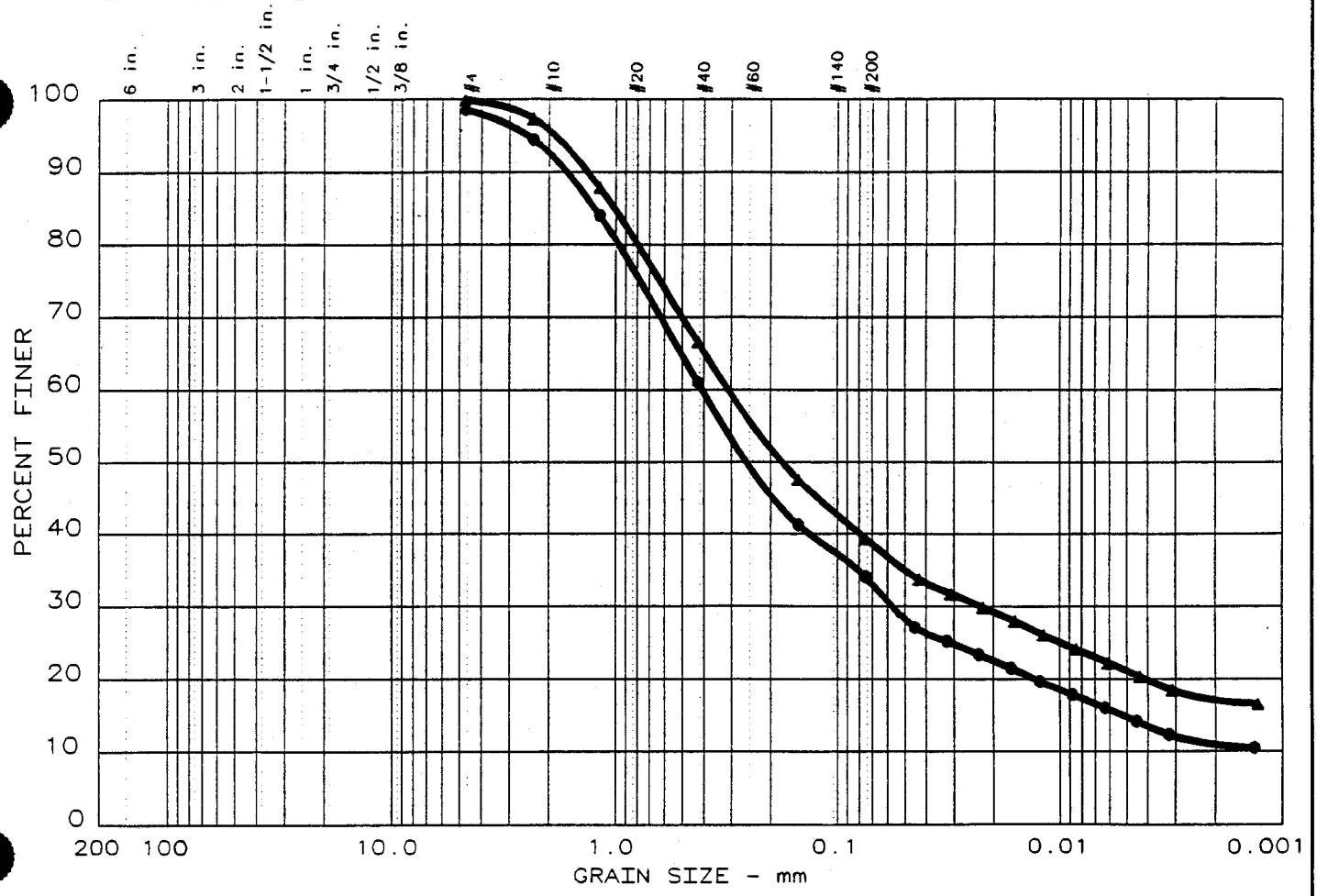
Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT

ENGINEERING TECTONICS

Fig. No.: 2

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	4	0.0	1.4	64.5	19.3	14.8
▲	5	0.0	0.1	60.5	18.2	21.2

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	10	NP	1.23	0.406	0.256	0.0568	0.0052			
▲	14	NP	1.01	0.309	0.176	0.0229				

MATERIAL DESCRIPTION	USCS	AASHTO
● Tan/White Mic Silty Sand	SM	A-2-4(0.0)
▲ Gray Silty Sand	SM	A-4(0.0)

Project No.: 02-447B
Project: W-S C&D Lanfill
● Location: B31 @ 23.5 to 25.0 ft.
▲ Location: B31 @ 38.5 to 40.5 ft.

Date: 06-06-02

Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT

ENGINEERING TECTONICS

Fig. No.: 3

ENGINEERING TECTONICS, P.A.
PERMEABILITY TEST REPORT
ASTM D5084

Project No. 02-447B
Sample No. B31 @ 38.5-40.0 ft.

Project: W-S C&D Landfill
Client: HDR

Test Summary

Permeability	5.45E-05	cm/sec
% Moisture	12.8%	%
Dry Density	92.3	pcf

Sample Information

Specimen Type:
Remolded
Tube X

Date Sampled
Location B31 @ 38.5-40.5 ft.

Specimen Data

Length (in.):	5.60
Diameter (in.):	2.85
Area (sq.in.):	6.38
Volume (cu.in.):	35.71
Wet Weight (grms.):	976
Dry Weight (grms.):	804
Dry Density (pcf):	92.3

Moisture Content Test Data

Wet Weight	185.26
Dry Weight	164.23
Tare Weight	0
% Moisture	12.8%

Test Data

Confining Pressure 5 psi

T	H	Inflow (B)	Outflow (C)	B/C ratio	Q	k
5	3	10.00	10.00	1.000	10.000	5.45E-05
5	3	10.00	10.00	1.000	10.000	5.45E-05

T: Change In Time (minutes)
H: Driving Head (PSI)
Inflow (B): Flow In (cubic centimeters)
Inflow (C) :Flow Out (cubic centimeters)
Q: Flow (cubic centimeters)

Permeability (k) 5.45E-05 cm/sec

Total Porosity = 19

ENGINEERING TECTONICS, P.A.
PERMEABILITY TEST REPORT
ASTM D5084

Project No. 02-447B
Sample No. B29 @ 5-7 ft.

Project: W-S C&D Landfill
Client: HDR

Test Summary

Permeability	2.73E-06	cm/sec
% Moisture	25.9%	%
Dry Density	80.4	pcf

Sample Information

Specimen Type:
Remolded
Tube X

Date Sampled
Location B29 @ 5-7 ft.

Specimen Data

Length (in.):	5.60
Diameter (in.):	2.85
Area (sq.in.):	6.38
Volume (cu.in.):	35.71
Wet Weight (grms.):	949
Dry Weight (grms.):	646
Dry Density (pcf):	80.4

Moisture Content Test Data

Wet Weight	154.53
Dry Weight	122.75
Tare Weight	0
% Moisture	25.9%

Test Data

Confining Pressure 5 psi

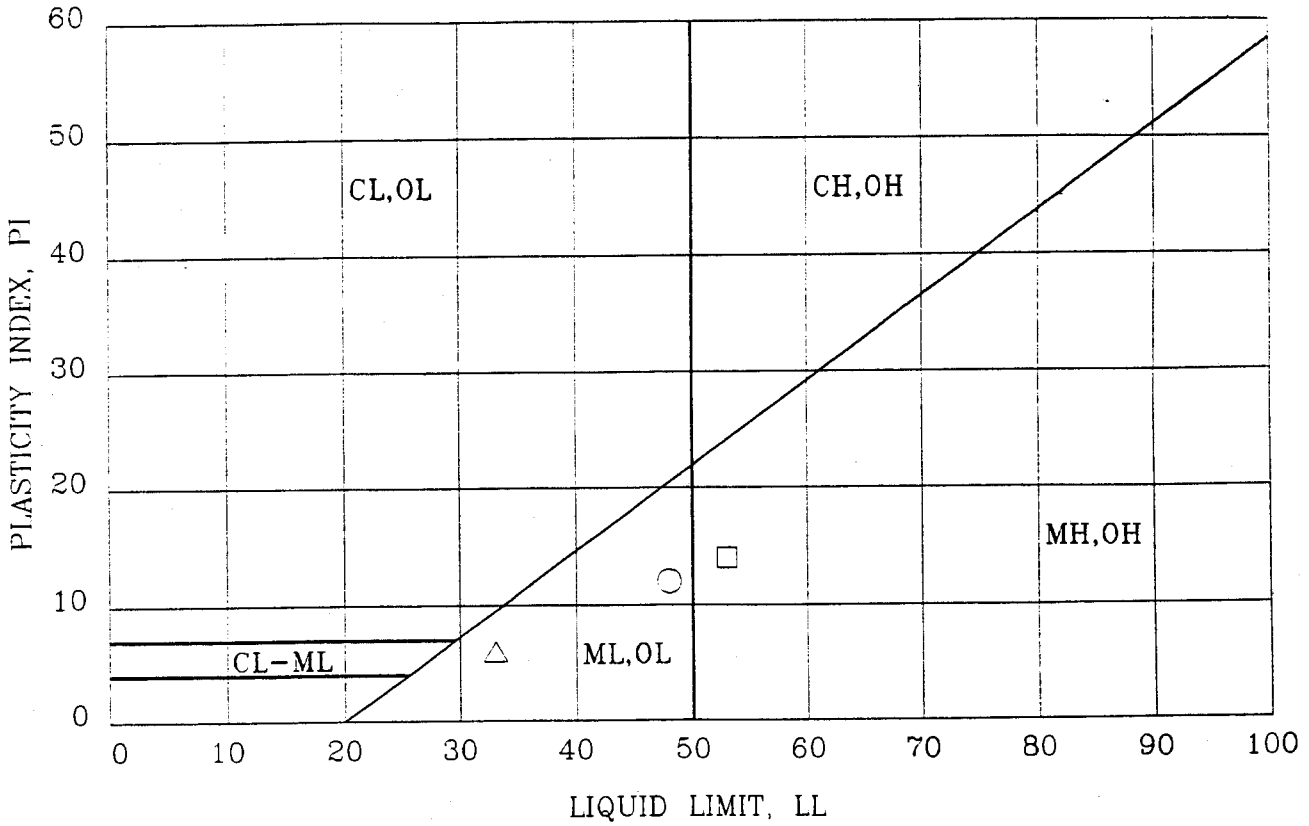
T	H	Inflow (B)	Outflow (C)	B/C ratio	Q	k
60	3	6.00	6.00	1.000	6.000	2.73E-06
60	3	6.00	6.00	1.000	6.000	2.73E-06

T: Change In Time (minutes)
H: Driving Head (PSI)
Inflow (B): Flow In (cubic centimeters)
Inflow (C) :Flow Out (cubic centimeters)
Q: Flow (cubic centimeters)

Permeability (k) 2.73E-06 cm/sec

Total Porosity = 7

Comment:
Sample was high organic enriched with large pieces of organics.

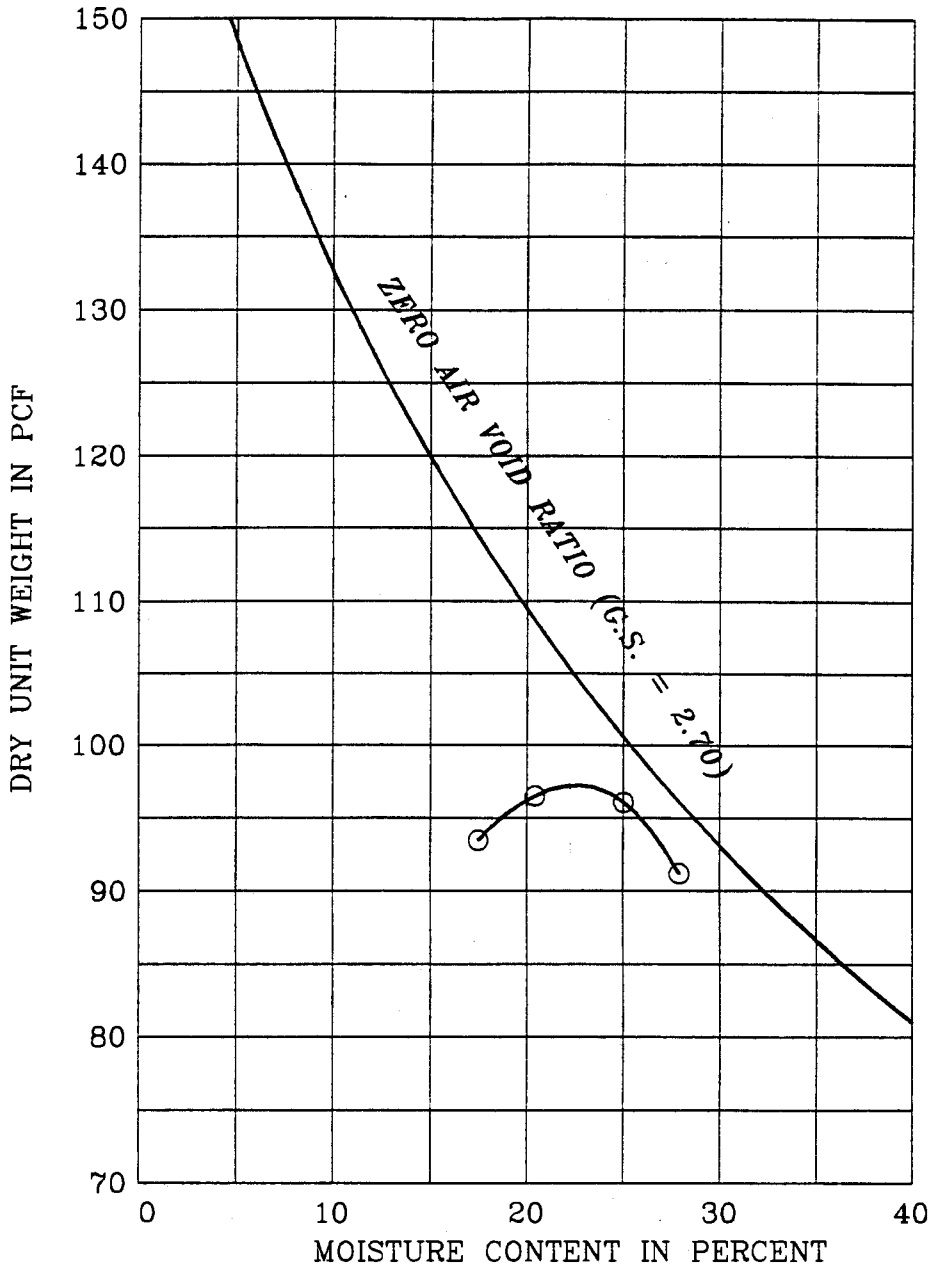


SYMBOL	SAMPLE	DEPTH (ft)	MC * (%)	LL (%)	PL (%)	PI (%)	LI (-)	DESCRIPTION
○	B-31A	Bulk0-5	25.3	48	36	12	-.88	Brown Sandy Silt
□	B-31A	JDS 1-3	29.8	53	39	14	-.69	Red/Tan Mic Sandy Silt
△	B-32A	JDS 1-3	12.7	33	27	6	-2.30	Tan/Gray Mic Silty Sand

* MOISTURE CONTENT FOR THE SAMPLE. MOISTURE CONTENTS MAY VARY WITHIN A SHELBY TUBE SAMPLE BETWEEN TESTS.

Remark :

Project No.03-159A	Salisbury Road Landfill
Engineering Tectonics	PLASTICITY CHART Figure No.1

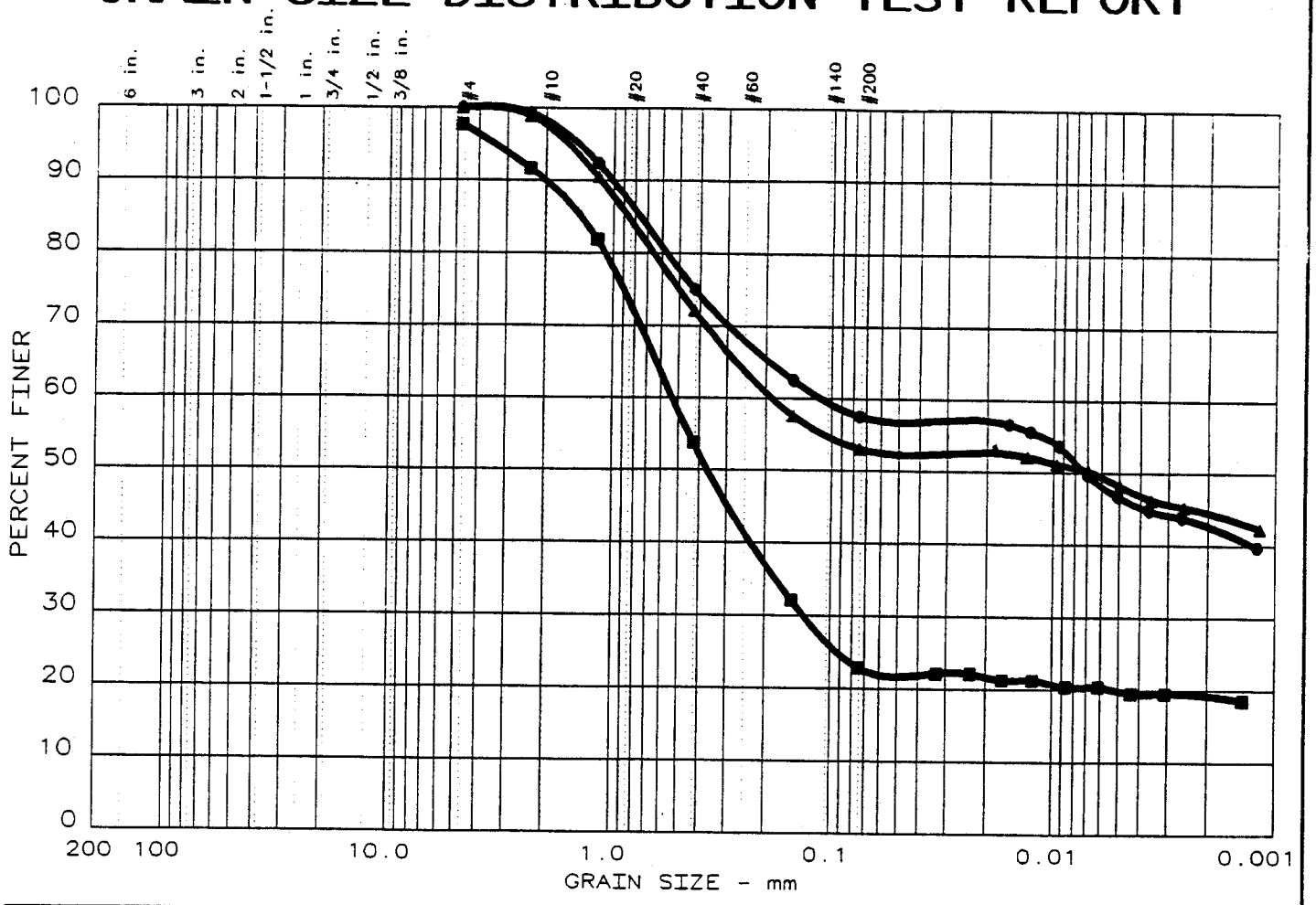


SYMBOL	SAMPLE LOCATION	DEPTH (ft)	DESCRIPTION	TEST METHOD	OPTIMUM MOISTURE (%)	MAXIMUM DRY DENSITY (pcf)
O	B-31A	0-5	Brown Sandy Silt	D-698	22.7	97.2

Remark : Bulk Sample

Project No.03-159A	Salisbury Road Landfill
Engineering Tectonics	COMPACTION TEST — Figure No.A

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	8	0.0	0.0	42.5	11.0	46.5
▲	9	0.0	0.0	47.0	4.8	48.2
■	10	0.0	2.3	74.8	3.0	19.9

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	48	12	0.750	0.111	0.0072					
▲	53	14	0.851	0.186	0.0067					
■	33	6	1.38	0.531	0.367	0.132				

MATERIAL DESCRIPTION	USCS	AASHTO
● Brown Sandy Silt	ML	A-7-5(6.4)
▲ Red/Tan Mic Sandy Silt	MH	A-7-5(6.3)
■ Tan/Gray Mic Silty Sand	SM	A-2-4(0.0)

Project No.: 03-159A
Project: Salisbury Road Landfill
● Location: B-31A @ 0-5 ft. (Bulk Sample)
▲ Location: B-31A @ 1-3 ft.(UDS)
■ Location: B-32A @ 1-3 ft.(UDS)
Date: 02-21-03

GRAIN SIZE DISTRIBUTION TEST REPORT

ENGINEERING TECTONICS

Remarks:

Fig. No.: 2

ENGINEERING TECTONICS, P.A.
PERMEABILITY TEST REPORT
ASTM D5084

Project No. 03-159A
Boring B-31A

Project: Salisbury Road Landfill
Client: HDR

Test Summary

Permeability	4.26E-07	cm/sec
% Moisture	25.3%	%
Dry Density	92.8	pcf

Sample Information

Specimen Type:
Remolded X
Tube

Date Sampled
Type Sample (Bulk)
Depth Sample 0-5 ft.

Specimen Data

Length (in.):	4.60
Diameter (in.):	4.00
Area (sq.in.):	12.56
Volume (cu.in.):	57.78
Wet Weight (grms.):	1764
Dry Weight (grms.):	1387
Dry Density (pcf):	92.8

Moisture Content Test Data

Wet Weight	99.67
Dry Weight	79.54
Tare Weight	0
% Moisture	25.3%
% Compaction	95.5%
Proctor No.	A

Test Data

Confining Pressure 10 psi

T	H	Inflow (B)	Outflow (C)	B/C ratio	Q	k
60	8	6.00	6.00	1.00	6.00	4.26E-07
60	8	6.00	6.00	1.00	6.00	4.26E-07

T: Change In Time (minutes)
H: Driving Head (PSI)
Inflow (B): Flow In (cubic centimeters)
Inflow (C) :Flow Out (cubic centimeters)
Q: Flow (cubic centimeters)

Permeability (k) 4.26E-07 cm/sec

Proctors:	Opt.Moist.	Max. DD
A	22.7	97.2

ENGINEERING TECTONICS, P.A.
PERMEABILITY TEST REPORT
ASTM D5084

Project No. 03-159A
Boring B-31A

Project: Salisbury Road Landfill
Client: HDR

Test Summary

Permeability	7.36E-07	cm/sec
% Moisture	24.0%	%
Dry Density	93.8	pcf

Sample Information

Specimen Type:
Remoided
Tube X

Date Sampled
Type Sample (UDS)
Depth Sample 1-3 ft.

Specimen Data

Length (in.):	5.60
Diameter (in.):	2.85
Area (sq.in.):	6.38
Volume (cu.in.):	35.71
Wet Weight (grms.):	1090
Dry Weight (grms.):	860
Dry Density (pcf):	93.8

Moisture Content Test Data

Wet Weight	99.72
Dry Weight	80.41
Tare Weight	0
% Moisture	24.0%

Test Data

Confining Pressure 10 psi

T	H	Inflow (B)	Outflow (C)	B/C ratio	Q	k
60	8	4.32	4.32	1.00	4.32	7.36E-07
60	8	4.32	4.32	1.00	4.32	7.36E-07

T: Change In Time (minutes)
H: Driving Head (PSI)
Inflow (B): Flow In (cubic centimeters)
Inflow (C) :Flow Out (cubic centimeters)
Q: Flow (cubic centimeters)

Permeability (k) 7.36E-07 cm/sec

ENGINEERING TECTONICS, P.A.
PERMEABILITY TEST REPORT
ASTM D5084

Project No. 03-159A
Boring B-32A

Project: Salisbury Road Landfill
Client: HDR

Test Summary

Permeability	2.18E-06	cm/sec
% Moisture	15.1%	%
Dry Density	110.5	pcf

Sample Information

Specimen Type:
Remolded
Tube X

Date Sampled
Type Sample (UDS)
Depth Sample 1-3 ft.

Specimen Data

Length (in.):	5.60
Diameter (in.):	2.85
Area (sq.in.):	6.38
Volume (cu.in.):	35.71
Wet Weight (grms.):	1192
Dry Weight (grms.):	1069
Dry Density (pcf):	110.5

Moisture Content Test Data

Wet Weight	97.32
Dry Weight	84.58
Tare Weight	0
% Moisture	15.1%

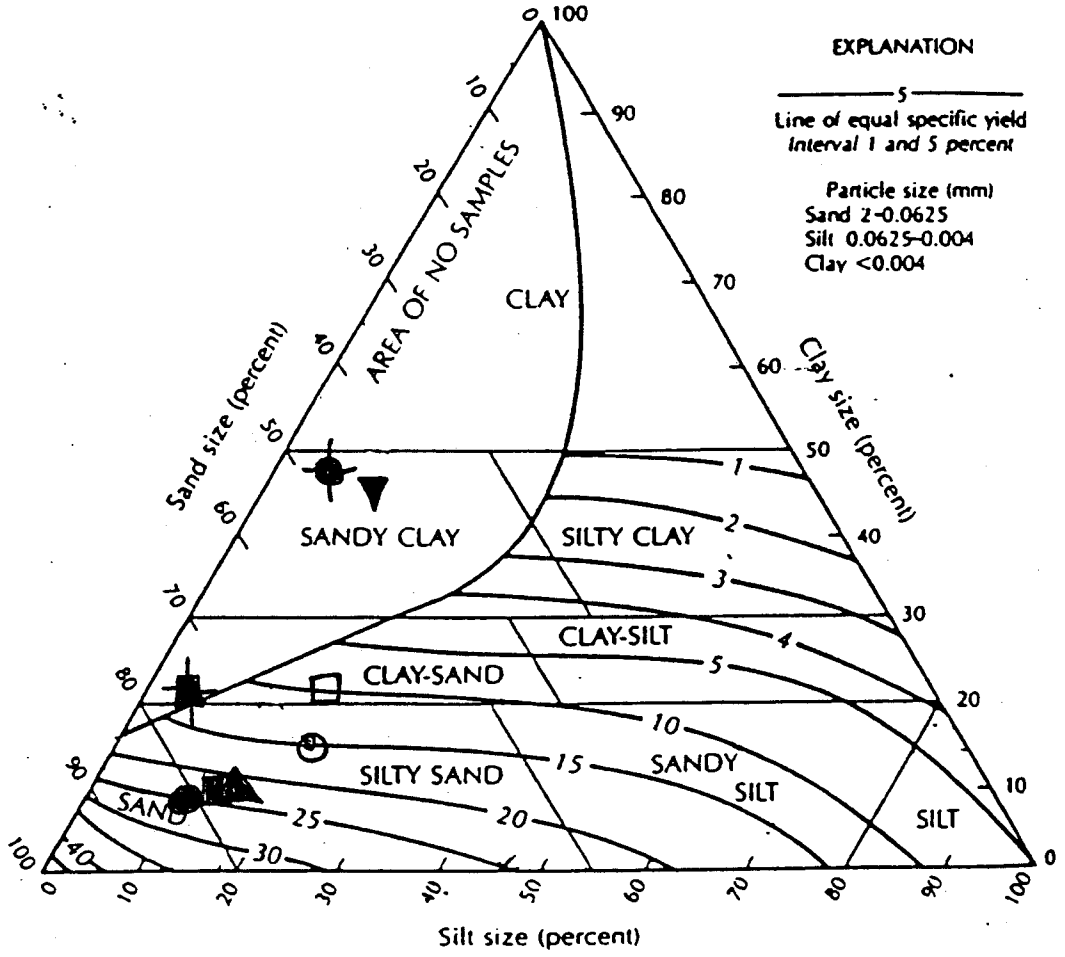
Test Data

Confining Pressure 10 psi

T	H	Inflow (B)	Outflow (C)	B/C ratio	Q	k
30	8	6.40	6.40	1.00	6.40	2.18E-06
30	8	6.40	6.40	1.00	6.40	2.18E-06

T: Change In Time (minutes)
H: Driving Head (PSI)
Inflow (B): Flow In (cubic centimeters)
Inflow (C) :Flow Out (cubic centimeters)
Q: Flow (cubic centimeters)

Permeability (k) 2.18E-06 cm/sec



Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A.I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.

		EFFECTIVE POROSITIES
▲	B-26 (8-9.5)	23
●	B-26 (28-29.5)	25
■	B-29 (5-7)	24
✦	B-31A (1-3)	1.5
▼	B-31A (0-5)	2
○	B-31 (23.5-25)	15
□	B-31 (38.5-40.5)	10
✦	B-32A (1-3)	13

APPENDIX D

DRAWINGS

End of File

APPENDIX D

EROSION CONTROL

North Carolina
Department of Environment and Natural

Michael F. Easley, Governor
William G. Ross Jr., Secretary

James D. Simons, P.G., P.E., Acting Director and State Geologist

RECEIVED
AUG 23 2002
HDR ENGINEERING, INC. OF THE CAROLINAS

NCDENR
WINSTON-SALEM REGIONAL OFFICE
DIVISION OF LAND RESOURCES
LAND QUALITY SECTION

August 22, 2002

LETTER OF APPROVAL WITH MODIFICATIONS

City of Winston-Salem
City/County Utilities Commission
P.O. Box 2511
Winston-Salem, NC 27102

Dear Sir or Madam:

This office has reviewed the subject erosion and sedimentation control plan. We find the plan to be acceptable with modifications and hereby issue this Letter of Approval with Modifications. The Modifications Required for Approval are listed on the attached page. This plan approval shall expire three (3) years following the date of approval, if no land-disturbing activity has been undertaken, as is required by Title 15A NCAC 4B .0029.

Please be advised that Title 15 NCAC 4B.0018 (a) requires that a copy of the approved erosion control plan be on file at the job site. Also, you should consider this letter to give the notice required by G.S. 113A-61.1 (a) of our right of periodic inspection to insure compliance with the approved plan.

North Carolina's Sedimentation Pollution Control Program is performance-oriented, requiring protection of existing natural resources and adjoining properties. If, following the commencement of this project, it is determined that the erosion and sedimentation control plan is inadequate to meet the requirements of the Sedimentation and Pollution Control Act of 1973 (North Carolina General Statute 113A-51 through 66), this office may require revisions to the plan and implementation of the revisions to insure compliance with the Act.

Acceptance and approval of this plan is conditioned upon your compliance with Federal and State water quality laws, regulations, and rules. In addition, local city or county ordinances or rules may also apply to this land-disturbing activity. This approval does not supersede any other permit or approval.

Please be aware that if five acres are to be disturbed by this project, you will be covered by the enclosed general stormwater permit NCGO1000 (Construction Activities). You should first become familiar with all of the requirements for compliance with the enclosed general permit.

Please note that this approval is based in part on the accuracy of the information provided in the Financial Responsibility Form, which you have provided. You are requested to file an amended form if there is any change in the information included on the form. In addition, it would be helpful if you notify this office of the proposed starting date for this project. Please notify us if you plan to have a preconstruction conference, and we will plan to attend.

Your cooperation is appreciated, and we look forward to working with you on this project.

Sincerely,

Brooks Cole, CPESC
Assistant Regional Engineer

BC/ls
Enclosure: Certificate of Plan Approval with Modifications
NPDES

cc: HDR Engineering, Inc.
WSRO File

PROJECT NAME:	Old Salisbury Road Landfill Ph. 4, 5 & 6
COUNTY:	FORSYTH
RIVER BASIN:	Yadkin
WATER CLASSIFICATION:	Other
FACILITY NUMBER:	FORSY-2003-007
SUBMITTED BY:	HDR Engineering, Inc.
RECEIVED BY L.Q.S.:	July 30, 2002

NEW SUBMITTAL (x)

MODIFICATIONS REQUIRED FOR APPROVAL

This plan is approved with the following modification:

1. In the absence of soil tests fertility results lime must be applied at a minimum rate of two (2) tons per acre and a balanced formulation of fertilizer applied at a rate of 1000 pounds per acre.

CERTIFICATE OF PLAN APPROVAL

The posting of this certificate certifies that an erosion and sedimentation control plan has been approved for this project by the North Carolina Department of Environment and Natural Resources in accordance with North Carolina General Statute 113A - 57 (4) and 113A - 54 (d) (4) and North Carolina Administrative Code, Title 15A, Chapter 4B.0007 (c). This certificate must be posted at the primary entrance of the job site before construction begins and until establishment of permanent groundcover as required by North Carolina Administrative Code, Title 15A, Chapter 4B.0027 (b).

Old Salisbury Road Landfill Ph. 4, 5 + 6

Project Name and Location

8-22-02

Date of Plan Approval

w/ mod.

NCDENR

Assist.

Regional Engineer
Land Quality Section

DIVISION OF LAND RESOURCES

EROSION CONTROL PLAN

FOR THE

OLD SALISBURY ROAD C&D LANDFILL
PHASE IV, V, AND VI EXPANSION

WINSTON-SALEM, NORTH CAROLINA

JULY 2002

HDR Engineering, Inc.
of the Carolinas

July 19, 2002

Mr. Brooks Cole, CPESC
Assistant Regional Engineer
North Carolina Department of Environment
and Natural Resources
Land Quality Section
585 Waughtown Street
Winston-Salem, NC 27107

Re: Old Salisbury Road C&D Landfill Phases IV, V, and VI
Winston-Salem, NC
Erosion and Sediment Control Plan
HDR Project No. 00162-525-018

Dear Mr. Cole:

Enclosed is the Erosion Control Plan submittal for the above referenced project. This plan addresses the proposed disturbance of approximately 29 acres of land located at the northern end of the existing C&D landfill. The City of Winston Salem is planning on developing Phases IV, V and VI of the C&D landfill.

The City of Winston-Salem (City) is submitting a check in the amount of $1,160 for the 29 acres of disturbance along with an executed Financial Responsibility and Ownership Form under separate cover. In addition, the City is currently pursuing a Mining Permit to allow removal of the excavated material off-site.

If you have any questions regarding this submittal, please do not hesitate to contact me.

Sincerely,

HDR Engineering, Inc. of the Carolinas

Michael D. Plummer, PE
Project Engineer

MDP/mdp

Enclosure

cc: Edward Gibson, w/attachments
Danny Hockett, w/attachments

HDR Engineering, Inc. of the Carolinas
Employee Owned

Suite 1400
128 S. Tryon Street
Charlotte, North Carolina
28202-5001

Telephone
704 338-6700
Fax
704 338-6760

EROSION CONTROL PLAN

FOR THE OLD SALISBURY ROAD C&D LANDFILL

PHASE IV, V, AND VI EXPANSION

WINSTON-SALEM, NORTH CAROLINA

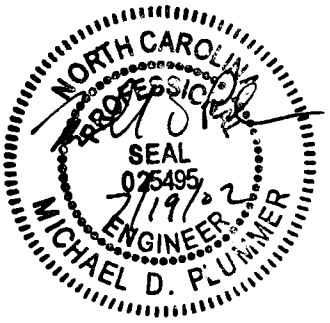
Prepared for:

City/County Utility Commission
City of Winston-Salem
P.O. Box 2511
Winston-Salem, NC 27102

Prepared by:

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street, Suite 1400
Charlotte, NC 28202-5001

HDR Engineering, Inc.
of the Carolinas



JULY 2002

Table of Contents

SECTION		PAGE
1.0	Purpose	1
2.0	Background	1
3.0	Contact Information	1
4.0	Project Description	2
5.0	Existing Conditions	2
6.0	Design Guideline and Procedures	2
7.0	Erosion and Sedimentation Control Measures	3
8.0	Sediment Basins	3
9.0	Drainage Channels	3
10.0	Temporary Diversion Berms	4
11.0	Slope Drains	4
12.0	Vegetative Stabilization	4
13.0	Silt Fence	4
14.0	Maintenance and Sediment Disposal	4
15.0	Construction Sequence	5
16.0	Phase Development	5

Appendices

Appendix A – Calculations

Sediment Basins Numbers 6 and 7 (Design)
Sediment Basin Number 5 (Check)
Perimeter Channels
Sideslope Swales
Slope Drain

Appendix B – Technical Specifications

02110 Site Clearing
02220 Earthwork
02270 Soil and Erosion Control
02271 Stone Revetment (Rip Rap)
02485 Seeding
02511 Aggregate Course
02720 Erosion Control Blankets

Appendix C – Drawings

ES-01 Existing Conditions
ES-02 Proposed Excavation Plan
ES-03 Proposed Final Grading Plan
ES-04 Erosion Control Details (1 of 2)
ES-05 Erosion Control Details (2 of 2)

1.0 PURPOSE

The purpose of this Erosion and Sediment Control Plan (Plan) is to obtain a Certificate of Plan Approval form the North Carolina Department of Environment and Natural Resources (NCDENR) to expand the existing soil borrow area at the Old Salisbury Road Landfill (Landfill). This Plan describes the erosion and sedimentation control features for the proposed landfill expansion (Phase IV, V, and VI Expansion), the operational procedures for the area, and potential development of the site as a Construction and Demolition Debris (C&D) landfill. This Plan addresses disturbance for approximately 29 acres and has been prepared in accordance with the *North Carolina Erosion and Sediment Control Planning and Design Manual Guidelines*.

2.0 BACKGROUND

The City of Winston-Salem, North Carolina (City) owns the existing Landfill located west of Old Salisbury Road (SR 3001) and north of Friedberg Road (SR 3132) at the Forsyth/Davidson County Line. The existing landfill is used for the disposal of C&D generated within the City and Forsyth County. The landfill property is comprised of approximately 140 acres, in which three landfill phases have been constructed comprising 31 acres of the property. Phase I was permitted for construction by NCDENR on July 3, 1996; Phase II was permitted October 15, 1999; and Phase III was permitted on August 2, 2000. It is anticipated that landfill activities in the current landfill unit will cease in August 2003.

The City purchased 55 acres adjacent to the northwest boundary of the landfill property. This property is a stockpile area for the excavation from the landfill phases. An erosion and sedimentation control plan was approved for stockpiling the excavation material from Phase III construction. The City is currently pursuing a Mining Permit to handle the excess soil in Phases IV, V, and VI.

3.0 CONTACT INFORMATION

Owner: The owner of the site and the person to contact should sediment control issues arise during the land-disturbing activity is as follows:

City/County Utilities Commission
Attn.: Edward Gibson, P.E., Solid Waste Administrator
City of Winston-Salem
100 East First Street, Suite 131
Winston-Salem, NC 27102
Telephone: (336) 727-8418 Fax: (336) 727-8432

Engineer: For questions regarding this Plan, please contact the following:

HDR Engineering, Inc. of the Carolinas
Attn.: Michael D. Plummer, P.E.
128 South Tryon Street, Suite 1400
Charlotte, NC 28202-5001
Telephone: (704) 338-6700 Fax: (704) 338-6760

4.0 PROJECT DESCRIPTION

The City plans to expand its current landfill into Phases IV, V, and VI. The City will use soil from the landfill excavation for on-site operations; however there will be more excavated material than can be used. Therefore, the City is applying for a Mining Permit to allow removal of excess material from the property. In addition to the landfill, there will be an access road constructed around the landfill perimeter. The total disturbed area within the clearing limits is 29 acres. The work consists of clearing and grubbing, installing erosion and sediment control features, construction of the access road, and excavation of soils.

5.0 EXISTING CONDITIONS

The Phase IV, V, and VI Expansion area expands the existing landfill north and northeast and will expand the landfill footprint by approximately 25 acres. The expansion area is comprised of heavily, wooded forest. Existing ground surface elevations vary from Elevation 824 (feet) at the top of the hill to Elevation 728 (feet) along the drainage feature on the eastern side of the landfill. The borrow material will be used as weekly, intermediate, and final cover for the active Landfill.

6.0 DESIGN GUIDELINES AND PROCEDURES

This Plan for the Phase IV, V, and VI Expansion was conducted based on guidelines and procedures as set forth in the *North Carolina Erosion and Sediment Control Planning and Design Manual* and *Elements of Urban Stormwater Design* by H. Rooney Malcom, P.E. Design calculations are provided as an attachment to this Plan.

Stormwater runoff flows were calculated using the Rational Method based on the maximum rate of runoff from a 25-year storm event for the sediment basins and drainage channels. Runoff coefficients for various groundcover conditions are referenced in the above-mentioned documents. Rainfall intensities used in the concentration were calculated with the Kirpirch Equation. Drainage areas were determined using a planimeter and/or AutoCAD on topographic sheets of the project area.

7.0 EROSION AND SEDIMENTATION CONTROL MEASURES

The following erosion and sedimentation control measures are to be used in construction of the Phase IV, V, and VI Expansion: Sediment Basins, Drainage Channels, Diversion Berms, Silt Fence, and Seeding. Attachments A, B, and C to this Plan include technical specifications, calculations, plans, and details for each of these measures.

8.0 SEDIMENT BASINS

There are two proposed permanent sediment basins (Sediment Basins numbers 6 and 7), which will serve the Phase IV, V, and VI Expansion. Sediment basin design is subject to several requirements. The sediment basin must provide a basin volume of 1,800 ft^3/acre of disturbed area and a minimum surface area of 1 percent of the peak flow runoff. The crest of the emergency spillway is set one foot above the invert of the riser and must pass the peak runoff from the ten-year storm event with one foot of freeboard to crest of berm. The principal and emergency spillways were designed using a spreadsheet based on methods provided in *Elements of Urban Stormwater Design.* These methods provide a more detailed design than provided in the *North Carolina Design Manual* while meeting the above requirements. The riser/barrel assembly must be provided with an anchor displacing a buoyant weight of at least 1.1 times the weight of water displaced by the riser. The riser must also be provided with a method of dewatering the basin. This design was performed in accordance with criteria from the *North Carolina Design Manual.*

9.0 DRAINAGE CHANNELS

Drainage channel calculations were conducted using a reformulation of Manning's Equation to calculate normal depth of flow, as set forth in *Elements of Urban Stormwater Design*, for given conditions to establish ditch capacity and flow velocity. For conservatism, the channel calculations assume peak flow over maximum slope of channel reach in determining velocity. Channels were first checked assuming bare earth as the initial condition. The maximum allowable velocity for bare earth was assumed to be 2.5 feet per second (*North Carolina Design Manual*, Table 8.05d). If the velocity exceeded this value, a temporary liner was chosen if appropriate. Normal depth and velocity was then calculated assuming grass lining as a minimum constructed condition. The allowable velocity for grass lining was assumed to be 4.5 feet per second (*North Carolina Design Manual,* Table 8.05a). If velocity exceeded 4.5 feet, a permanent liner was designed.

10.0 TEMPORARY DIVERSION BERMS

Temporary diversion berms are to be installed on disturbed slopes and above cut slopes to prevent runoff from flowing over the slope. The temporary diversion berms will divert stormwater runoff into the appropriate sediment basins. No more than half (14.5 acres) of the disturbed area may be diverted to Sediment Basin No. 7. Temporary diversion berm slopes are designed to minimize the erosive velocity of the stormwater within the diversion channel. Drainage areas will be minimized as necessary. Diversion berm capacity, velocity, and ridge design were designed in accordance the *North Carolina Design Manual*, Section 6.20.

11.0 SLOPE DRAINS

Slope drains are to be installed on the disturbed slopes of the landfill cap to collect runoff from the sideslope channels and direct it into either a perimeter channel or sediment basin. The pipes were sized to handle the amount of drainage area directed to them and in accordance with the *North Carolina Design Manual*, Section 6.20.

12.0 VEGETATIVE STABILIZATION

Vegetative stabilization will be in accordance with the seeding schedule in the project specifications and on the plans. The seeding schedule was prepared with reference to the *North Carolina Design Manual*, Sections 6.10 and 6.11, and seeding regimes used in the geographic location.

13.0 SILT FENCE

Silt fence will be installed at or outside the clearing limits as shown on the plans prior to land-disturbing activity. Silt fence is an adequate runoff control measure provided that less than one-fourth an acre per 100 linear feet drains to it according to the North Carolina Design Manual Section 6.62.1.

14.0 MAINTENANCE AND SEDIMENT DISPOSAL

All erosion and sedimentation control devices will be inspected at regular intervals and immediately following any major storm event. Repairs will be made as needed and accumulated sediment removed when one half of the holding capacity is depleted.

All sediments which are removed from erosion and sedimentation control measures will be disposed of in a manner such that further erosion and sedimentation will not occur.

15.0 CONSTRUCTION SEQUENCE

Prior to any land disturbing activity, silt fence will be installed outside the construction limits. Clearing and grubbing will initially begin in the areas of the proposed Sediment Basins 6 and 7. After the basins are constructed and operational, clearing and grubbing of the areas within the construction limits will continue. Drainage channels and diversion berms will be constructed to promote drainage to either sediment basin. The locations of these drainage channels and diversion berms will change throughout development of the landfill.

The clearing and grubbing debris will be stockpiled within the disturbed area limits and hauled to an appropriate disposal site. After clearing and grubbing is complete, all disturbed areas are to be seeded and mulched as per the specifications.

Excavation is anticipated to occur in phases and will initially begin in Phase IV. After excavation reaches the proposed grades as shown on the plans, excavation will proceed to the east to Phase V and VI.

16.0 PHASE DEVELOPMENT

Initially, a 50-foot section along the tree line between Phase IV and V will be cleared and grubbed so soil may be borrowed for on-site operations. This area will be excavated in a manner to maintain drainage to Sediment Basin No. 5. Calculations are attached showing that this basin can handle the additional drainage area. Borrow activities will continue in Phase IV until the proposed grades are reached. Excavation will then continue eastward into Phase V and VI.

Appendix A

CALCULATIONS

HDR Computation | Job No. 00162-525-018 |

Project:	Old Salisbury Road Landfill	Computed: PAW	Date: 7-17-02
Subject:	Drainage	Checked MDP	Date 7-17-02
Task:	Sediment Basins	Sheet 1	Of 1

Objective: Design the sediment basins based on the largest drainage area to each feature during each phase of site development.

Total Disturbed Area (ac): **29**

References:

1. NC Erosion and Sediment Control Planning and Design Manual
2. Elements of Urban Stormwater Design, H. Rooney Malcom, P.E.
3. VA Erosion and Sediment Control Handbook

Given:

Calculate Time of Concentration (t_c)

$$t_c = [L^3/H]^{0.385}/128 \qquad \text{Ref 2}$$

SB #6

Development Phase	Pre	During	Post
Drainage Area (ac) =	10.2	17.4	9.9
Hydraulic length of watershed L (ft) =	1,100	1,238	900
Elevation change along length H (ft) =	90	44	144
t_c (min) =	4.5	6.8	3.0

use t_c (min) = 7.0

Drainage Area (ac) = 17.4

SB #7

Development Phase	Pre	During	Post
Drainage Area (ac) =	8.5	9.5	13.3
Hydraulic length of watershed L (ft) =	550	1050	1,180
Elevation change along length H (ft) =	58	58	136
t_c (min) =	2.4	5.1	4.2

Assume that no more than 1/2 of the total disturbed area will be diverted to SB #7.

Drainage Area (ac) = 14.5

t_c (min) = 5

Project:	Old Salisbury Road Landfill	Computed: PAW	Date: 7-17-02
Subject:	Drainage	Checked MDP	Date 7-17-02
Task:	Sediment Basin 6	Sheet 1	Of 8

Objective: Design sediment basins for 25-Year Storm per C&D Solid Waste Regulations

Drainage Area

Area Type = Newly Graded Area

Drainage Area (ac) =	17.4		
CN =	93	Newly Graded Area	Ref 1, Table 8.03b
Runoff Coeff =	0.4	Ag land, smooth	Ref 3
Soil Group =	C	Class C Soils having a moderately high runoff potential due to slow infiltration rates. These soils consist primarily of soils in which a layer exists near the surface that impede the downward movement of water or soils with moderately fine to fine texture.	

Inflow Data

Calculate Peak Flow using the Rational Method (Q_p):

25-yr, 5-min Design Storm

Rainfall, P (inches) =	5.5	Ref 1, Figure 8.03k
I (in/hr) =	7.0	
Q_P (cfs) = CIA =	48.7	

Estimate Depth of Runoff for design storm @ location:

Ref 2, page III-4

Determine Ultimate Storage Capacity (S):

$S = (1000/CN) - 10 =$ 0.75

Determine Runoff Depth (Q*):

Q^* (inches) $= (P-0.2S)^2/(P+0.8S) =$ 4.69

Determine Time to Peak (Tp):

T_P (min) $= 60.5(Q^*)A/Q_P/1.39 =$ 73 minutes

Ref 2, page III-4

Determine Shape of Basin:

Find the area of the Basin using AutoCADD .

Calculate Volume of the Basin using Truncated Pyramid Method.

Elevation (ft)	Depth (ft)	Area (sf)	Volume (cf)	Cumulative Vol (cf)
735	0	0	0	0
736	1	5,069	1,690	1,690
738	3	16,988	20,891	22,581
740	5	20,314	37,252	59,833
742	7	24,034	44,296	104,129
743	8	26,043	25,032	129,161

Calculate the Sediment Storage Volume (V_c):

Clean Out Internal (T), days = 180 or as needed

Ref 1 pg 8.07.17

V_C (cf) $= 18 * T * A^{0.84} =$ 35,695

Project:	Old Salisbury Road Landfill	Computed: DAW	Date: 7-17-02
Subject:	Drainage	Checked MDP	Date 7-17-02
Task:	Sediment Basin 6	Sheet 2	Of 8

Determine Sediment Storage Elevation (Z_{sed}):

Z_{Sed} (ft) = $(V_C/K_S)^{1/b}$ Ref 2 pg III-8

Pick one point near max expected water surface and the other at the mid depth.

Z_1 (ft) = 5 S_1 (cf)= 59,833

Z_2 (ft) = 8 S_2 (cf) = 129,161

b = $\ln(S_2/S_1)/\ln(Z_2/Z_1)$ = 1.6

$K_S = S_2/Z_2^b$ = 4,291

Z_{Sed} (ft) = 3.6 set riser a minimum of this height measured from bottom of pond

Determine the remaining volume for wet Storage (V_{rem}):

V_{rem} (cf) = S_2-V_C = 93,466

Route the Storm through the Basin using the Hydrograph Model

see attached calculations

Set Height of Emergency Spillway at (ft) = 8

Set Top of Dam at (ft) = 9

Emergency Spillway

Q_E (cfs) = 9.87 Peak "Weir Flow" from Hydrograph

Use Normal Depth Procedure (Manning's Eqn.)

$A * R^{2/3} = Q * n / 1.49\ s^{0.5}$ Area (A)= bd+z(d^2)

$Z_{req} = Q*n/1.49s^{0.5}$ R=Area/(b+2d((z^2)+1)^.5) $Z_{av} = A*R^{2/3}$

n =	0.048	Class B Phase 3 (Fully vegetated) TRM (NAG C350)
Vp (ft/sec) =	18.0	Class B Phase 3 (Fully vegetated) TRM (NAG C350)
z (enter X for X:1) =	5	Side Slope of channel
s (ft/ft) =	2	Slope down the dam
Bottom Width (ft) =	25	Length of Emergency Spillway (from Hydrograph)

Z_{req}	Flow Depth d (ft)	A (sf)	R (ft)	Z_{av}	V (ft/sec)
0.22	0.06	1.5	0.06	0.22	6.7

Project:	Old Salisbury Road Landfill	Computed: PAN	Date: 7-17-02
Subject:	Drainage	Checked MSP	Date 7-17-02
Task:	Sediment Basin 6	Sheet 3	Of 8

Anti-Seep Collar:

Anti-Seep Collar Size = 2 * Barrel Dia

Anti-Seep Collar Size (ft) = 3.0

Use Anti-Seep Collar Size (ft) = 3 x 3

Width of access road (ft) = 15

Length of base of dam (ft) = 51 Toe to toe

Locations for Collars:

Space collars at 15 intervals.

Minimum Concrete Base for Riser:

Diameter of Riser (in) = 24 From Hydrograph

Avg Density of Concrete (lbs/cf) = 87.6

Density of Water (cf/lb) = 62.4

Riser Displacement (cf) = 18.85 Pi * D_R/24 * Total Ht of Riser

Convert cf to cy = 27^{-1}

Min Concrete Needed (cy) = 0.50

Anti-Vortex Device: Ref 3, Table 3.14-D

Diameter of Riser (in) = 24

Cylinder Diameter (in) = 36

Cylinder Thickness (gage) = 16

Cylinder Height (in) = 13

Support Bars = #6 Rebar

Top Thickness = 16 gage corrugated , 14 gage flat

Stiffener = none required

Project:	Old Salisbury Road Landfill	Computed: PRW	Date: 7-17-02
Subject:	Drainage	Checked MDP	Date 7-17-02
Task:	Sediment Basin 6	Sheet 4	Of 8

Outlet Apron

Determine Tailwater conditions to size apron
Use Normal Depth Procedure (Manning's Eqn.)

$A*R^{2/3} = Q*n/1.49\ s^{0.5}$ Area (A)= bd+z(d^2)

$Z_{req} = Q*n/1.49s^{0.5}$ R=Area/(b+2d((z^2)+1)^.5) $Z_{av} = A*R^{2/3}$

n =	0.032	9" Rip Rap Lined Channel	Ref 2
Vp (ft/sec) =	10.8	Permissible Velocity for 9" Rip Rap @ 12:1	Ref 2
Side Slope (z) =	5	enter X for X:1	
s (ft/ft) =	0.05	Outlet Slope (assumed)	
Bottom Width (ft) =	4.5	3 * Barrel Diameter	

Q_B (cfs)	Z_{req}	Depth d (ft)	A (sf)	R (ft)	Z_{av}	V (ft/sec)
32	3.09	0.66	5.2	0.46	3.09	6.2

Flow Depth = Tailwater (d) = 0.66 0.5* Barrel Diameter = 0.75
Minimum Tailwater Conditions: d<0.5*Diameter of Outlet Pipe
Maximum Tailwater Conditions: d>0.5*Diameter of Outlet Pipe
Since the Tailwater is less than half of the diameter of the outlet, use Minimum Tailwater conditions.

Barrel Diameter (ft)	Entrance (ft)	Length (ft)	Outlet Width (ft)	Median Rip Rap Size d_{50}	Selected Rip Rap Size (in)	
1.5	4.5	22	27	1	Class B	Ref 3 p. 8.06.4

Computed By: PMW Date: 7-17-02

Checked By: MDP Date: 7-17-02

Sheet: 5 of 8

Old Salisbury Road C&D Landfill

Sediment Basin #6

25-Year Storm

HDR Project No. 162-525-018

Qp = 48.72 cfs

Tp = 73 min.

dT = 2

				Bottom	at 5' deep
Diameter of Barrel =	18	(in)	Length of Basin (ft) =	25	110
Height of Riser =	6.0	(ft)	Width of Basin (ft) =	180	260
Emergency Spillway =	8	(ft)	Slope of side & front walls =	2	(enter "X" for X:1)
Total Height of Dam =	9	(ft)	Slope of back wall =	7.50	(enter "X" for X:1)
Length of Emergency Spillway =	25	(ft)	b =	1.64	
Diameter of Riser =	24	(in)	Ks =	4,291	

Notes:

1. Length of emergency spillway is the bottom width of the emergency spillway.

TIME [min]	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	RISER CAPACITY [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	BOUND DISCHG [cfs]	SETTLING EFF. [%]
0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A
2	0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A
4	0.4	11	0.03	0.00	0.00	0.00	0.00	1.51	N/A
6	0.8	54	0.07	0.00	0.00	0.00	0.00	2.82	N/A
8	1.4	151	0.13	0.00	0.00	0.00	0.00	4.20	N/A
10	2.2	323	0.21	0.00	0.00	0.00	0.00	5.65	N/A
12	3.2	591	0.30	0.00	0.00	0.00	0.00	7.14	N/A
14	4.3	973	0.40	0.00	0.00	0.00	0.00	8.67	N/A
16	5.6	1,489	0.52	0.00	0.00	0.00	0.00	10.24	N/A
18	7.0	2,157	0.66	0.00	0.00	0.00	0.00	11.83	N/A
20	8.5	2,993	0.80	0.00	0.00	0.00	0.00	13.43	N/A
22	10.2	4,013	0.96	0.00	0.00	0.00	0.00	15.06	N/A
24	11.9	5,232	1.13	0.00	0.00	0.00	0.00	16.70	N/A
26	13.8	6,661	1.31	0.00	0.00	0.00	0.00	18.34	N/A
28	15.7	8,312	1.50	0.00	0.00	0.00	0.00	19.99	N/A
30	17.7	10,194	1.70	0.00	0.00	0.00	0.00	21.64	N/A
32	19.7	12,315	1.90	0.00	0.00	0.00	0.00	23.30	N/A
34	21.8	14,681	2.12	0.00	0.00	0.00	0.00	24.95	N/A
36	23.9	17,296	2.34	0.00	0.00	0.00	0.00	26.59	N/A
38	26.0	20,163	2.57	0.00	0.00	0.00	0.00	28.23	N/A
40	28.1	23,281	2.81	0.00	0.00	0.00	0.00	29.85	N/A
42	30.1	26,650	3.05	0.00	0.00	0.00	0.00	31.46	N/A
44	32.1	30,266	3.30	0.00	0.00	0.00	0.00	33.06	N/A
46	34.1	34,123	3.55	0.00	0.00	0.00	0.00	34.64	N/A
48	36.0	38,216	3.80	0.00	0.00	0.00	0.00	36.20	N/A
50	37.8	42,535	4.06	0.00	0.00	0.00	0.00	37.74	N/A
52	39.5	47,070	4.32	0.00	0.00	0.00	0.00	39.26	N/A
54	41.1	51,809	4.58	0.00	0.00	0.00	0.00	40.75	N/A
56	42.5	56,738	4.84	0.00	0.00	0.00	0.00	42.22	N/A
58	43.9	61,843	5.10	0.00	0.00	0.00	0.00	43.66	N/A
60	45.1	67,107	5.36	0.00	0.00	0.00	0.00	45.07	N/A
62	46.1	72,513	5.62	0.00	0.00	0.00	0.00	46.45	N/A
64	47.0	78,043	5.88	0.00	0.00	0.00	0.00	47.80	N/A

66	47.7	83,677	6.14	1.05	0.00	19.72	1.05	49.11	100.0
68	48.2	89,270	6.38	4.94	0.00	20.16	4.94	50.37	99.7
70	48.5	94,459	6.61	9.84	0.00	20.56	9.84	51.49	99.0
72	48.7	99,102	6.80	14.97	0.00	20.90	14.97	52.46	98.0
74	48.7	103,150	6.97	19.91	0.00	21.19	19.91	53.28	96.8
76	48.5	106,604	7.11	24.41	0.00	21.43	21.43	53.97	96.4
78	48.1	109,852	7.25	28.86	0.00	21.65	21.65	54.60	96.4
80	47.6	113,030	7.37	33.39	0.00	21.86	21.86	55.21	96.4
82	46.9	116,116	7.50	37.95	0.00	22.07	22.07	55.79	96.4
84	46.0	119,093	7.61	42.48	0.00	22.26	22.26	56.34	96.4
86	44.9	121,941	7.72	46.93	0.00	22.43	22.43	56.87	96.4
88	43.7	124,641	7.83	51.24	0.00	22.60	22.60	57.35	96.4
90	42.4	127,178	7.92	55.37	0.00	22.76	22.76	57.80	96.4
92	41.0	129,535	8.01	59.27	0.13	22.90	23.02	58.22	96.4
94	39.6	131,691	8.10	62.89	2.21	23.02	25.23	58.59	95.8
96	38.2	133,410	8.16	65.81	4.79	23.12	27.91	58.89	95.1
98	36.8	134,640	8.21	67.92	6.99	23.20	30.19	59.10	94.5
100	35.5	135,437	8.24	69.29	8.56	23.24	31.80	59.24	94.1
102	34.3	135,886	8.25	70.07	9.48	23.27	32.75	59.31	93.9
104	33.1	136,072	8.26	70.39	9.87	23.28	33.15	59.34	93.7
106	31.9	136,064	8.26	70.38	9.86	23.28	33.14	59.34	93.7
108	30.8	135,920	8.25	70.13	9.55	23.27	32.82	59.32	93.8
110	29.7	135,679	8.24	69.71	9.05	23.26	32.31	59.28	94.0
112	28.7	135,370	8.23	69.18	8.42	23.24	31.66	59.23	94.1
114	27.7	135,014	8.22	68.56	7.71	23.22	30.93	59.16	94.3
116	26.7	134,625	8.21	67.89	6.96	23.20	30.16	59.10	94.6
118	25.8	134,212	8.19	67.18	6.19	23.17	29.37	59.03	94.8
120	24.9	133,782	8.17	66.45	5.43	23.15	28.57	58.95	95.0
122	24.0	133,339	8.16	65.69	4.67	23.12	27.79	58.88	95.2
124	23.2	132,885	8.14	64.91	3.93	23.09	27.03	58.80	95.4
126	22.4	132,421	8.12	64.13	3.23	23.07	26.29	58.72	95.6
128	21.6	131,949	8.11	63.33	2.55	23.04	25.59	58.64	95.7
130	20.8	131,466	8.09	62.51	1.92	23.01	24.93	58.55	95.9
132	20.1	130,972	8.07	61.68	1.34	22.98	24.32	58.47	96.1
134	19.4	130,464	8.05	60.82	0.82	22.95	23.77	58.38	96.2
136	18.7	129,937	8.03	59.94	0.38	22.92	23.30	58.29	96.3
138	18.0	129,386	8.01	59.02	0.06	22.89	22.95	58.19	96.4
140	17.4	128,798	7.99	58.04	0.00	22.85	22.85	58.09	96.4
142	16.8	128,146	7.96	56.96	0.00	22.81	22.81	57.97	96.4
144	16.2	127,425	7.93	55.77	0.00	22.77	22.77	57.85	96.4
146	15.6	126,638	7.90	54.48	0.00	22.72	22.72	57.71	96.4
148	15.1	125,789	7.87	53.10	0.00	22.67	22.67	57.56	96.4
150	14.6	124,881	7.84	51.63	0.00	22.62	22.62	57.39	96.4
152	14.1	123,915	7.80	50.07	0.00	22.56	22.56	57.22	96.4
154	13.6	122,896	7.76	48.44	0.00	22.49	22.49	57.04	96.4
156	13.1	121,825	7.72	46.74	0.00	22.43	22.43	56.84	96.4
158	12.6	120,704	7.68	44.98	0.00	22.36	22.36	56.64	96.4
160	12.2	119,538	7.63	43.17	0.00	22.28	22.28	56.43	96.4
162	11.8	118,327	7.58	41.30	0.00	22.21	22.21	56.20	96.4
164	11.4	117,073	7.53	39.39	0.00	22.13	22.13	55.97	96.4
166	11.0	115,780	7.48	37.45	0.00	22.04	22.04	55.73	96.4
168	10.6	114,450	7.43	35.47	0.00	21.96	21.96	55.48	96.4

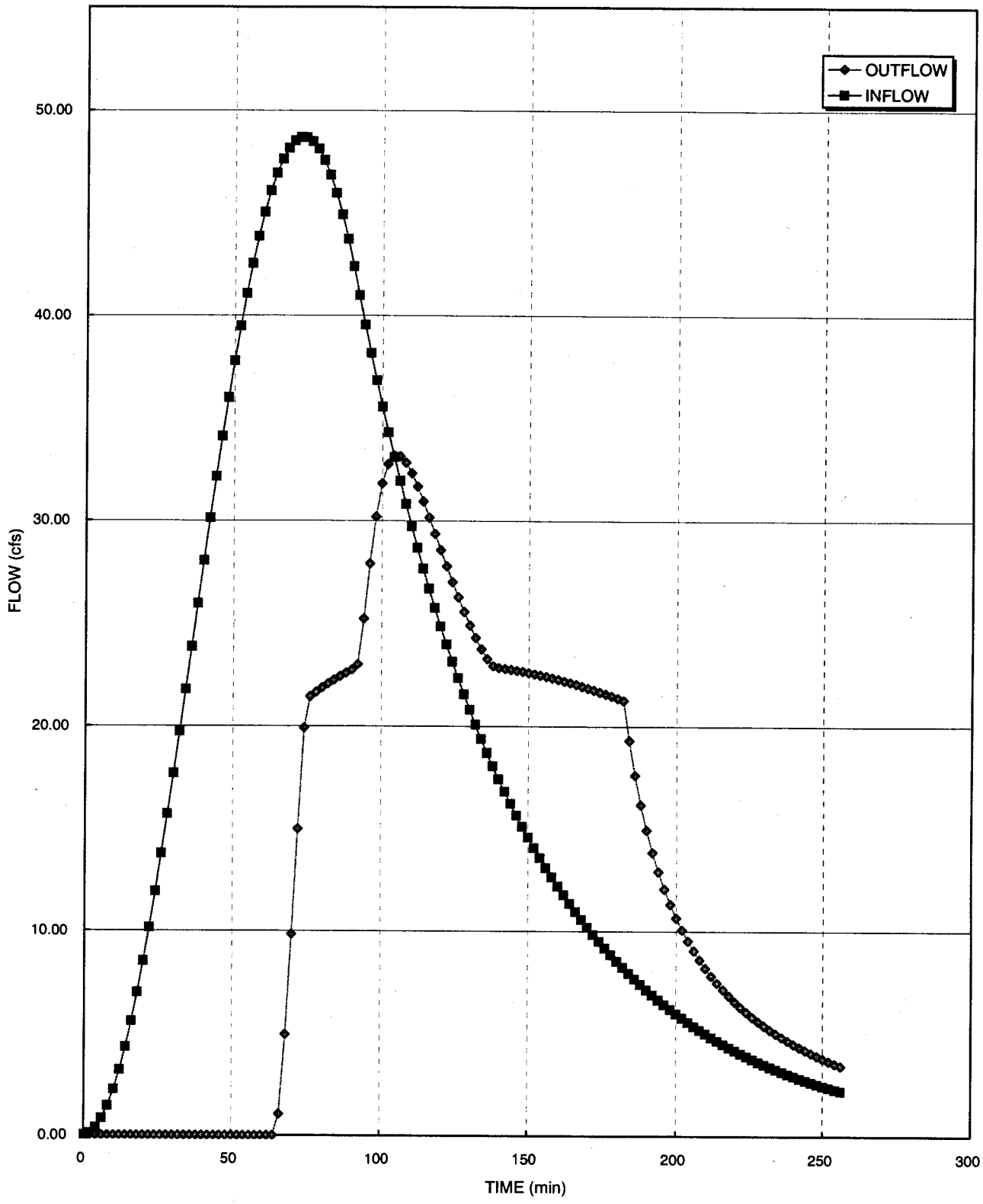
170	10.2	113,083	7.38	33.47	0.00	21.87	21.87	55.22	96.4
172	9.8	111,683	7.32	31.45	0.00	21.78	21.78	54.95	96.4
174	9.5	110,251	7.26	29.42	0.00	21.68	21.68	54.68	96.4
176	9.2	108,789	7.20	27.38	0.00	21.58	21.58	54.39	96.4
178	8.8	107,299	7.14	25.35	0.00	21.48	21.48	54.10	96.4
180	8.5	105,783	7.08	23.32	0.00	21.38	21.38	53.80	96.4
182	8.2	104,242	7.02	21.31	0.00	21.27	21.27	53.50	96.4
184	7.9	102,677	6.95	19.31	0.00	21.16	19.31	53.18	96.9
186	7.7	101,313	6.90	17.62	0.00	21.06	17.62	52.91	97.4
188	7.4	100,119	6.85	16.17	0.00	20.98	16.17	52.66	97.7
190	7.1	99,066	6.80	14.93	0.00	20.90	14.93	52.45	98.0
192	6.9	98,131	6.76	13.85	0.00	20.83	13.85	52.26	98.2
194	6.6	97,296	6.73	12.90	0.00	20.77	12.90	52.08	98.4
196	6.4	96,546	6.70	12.07	0.00	20.72	12.07	51.92	98.6
198	6.2	95,867	6.67	11.33	0.00	20.67	11.33	51.78	98.7
200	6.0	95,251	6.64	10.67	0.00	20.62	10.67	51.65	98.9
202	5.8	94,687	6.62	10.08	0.00	20.58	10.08	51.53	99.0
204	5.6	94,170	6.60	9.54	0.00	20.54	9.54	51.42	99.1
206	5.4	93,693	6.58	9.05	0.00	20.50	9.05	51.32	99.1
208	5.2	93,251	6.56	8.61	0.00	20.47	8.61	51.23	99.2
210	5.0	92,839	6.54	8.20	0.00	20.44	8.20	51.14	99.3
212	4.8	92,455	6.52	7.83	0.00	20.41	7.83	51.06	99.3
214	4.7	92,094	6.51	7.48	0.00	20.38	7.48	50.98	99.4
216	4.5	91,755	6.49	7.16	0.00	20.36	7.16	50.91	99.4
218	4.3	91,435	6.48	6.86	0.00	20.33	6.86	50.84	99.5
220	4.2	91,132	6.47	6.58	0.00	20.31	6.58	50.77	99.5
222	4.0	90,844	6.45	6.32	0.00	20.29	6.32	50.71	99.6
224	3.9	90,571	6.44	6.07	0.00	20.27	6.07	50.65	99.6
226	3.8	90,310	6.43	5.84	0.00	20.25	5.84	50.59	99.6
228	3.6	90,060	6.42	5.62	0.00	20.23	5.62	50.54	99.6
230	3.5	89,822	6.41	5.41	0.00	20.21	5.41	50.49	99.7
232	3.4	89,593	6.40	5.21	0.00	20.19	5.21	50.44	99.7
234	3.3	89,372	6.39	5.02	0.00	20.17	5.02	50.39	99.7
236	3.1	89,161	6.38	4.84	0.00	20.16	4.84	50.34	99.7
238	3.0	88,956	6.37	4.67	0.00	20.14	4.67	50.30	99.7
240	2.9	88,759	6.36	4.51	0.00	20.12	4.51	50.25	99.8
242	2.8	88,569	6.35	4.36	0.00	20.11	4.36	50.21	99.8
244	2.7	88,385	6.35	4.21	0.00	20.10	4.21	50.17	99.8
246	2.6	88,207	6.34	4.07	0.00	20.08	4.07	50.13	99.8
248	2.5	88,035	6.33	3.93	0.00	20.07	3.93	50.09	99.8
250	2.4	87,867	6.32	3.80	0.00	20.05	3.80	50.06	99.8
252	2.4	87,705	6.32	3.68	0.00	20.04	3.68	50.02	99.8
254	2.3	87,548	6.31	3.56	0.00	20.03	3.56	49.98	99.8
256	2.2	87,395	6.30	3.44	0.00	20.02	3.44	49.95	99.9

Computed By: PAW Date: 7-17-02

Checked By: MJP Date: 7-17-02

Sheet: 05 of 06

Sediment Basin #6 Hydrograph
25-Yr Storm



Conclusion: The basin can pass the design storm without overtopping the dam and provide a settling efficiency greater than 75%.

Project:	Old Salisbury Road Landfill	Computed: JPW	Date: 7-17-02
Subject:	Drainage	Checked MDP	Date 7-17-02
Task:	Sediment Basin 7	Sheet 1	Of 8

Objective: Design sediment basins for 25-Year Storm per C&D Solid Waste Regulations

Drainage Area

Area Type = Newly Graded Area

Drainage Area (ac) =	14.5		
CN =	93	Newly Graded Area	Ref 1, Table 8.03b
Runoff Coeff =	0.4	Ag land, smooth	Ref 3
Soil Group =	C	Class C Soils having a moderately high runoff potential due to slow infiltration rates. These soils consist primarily of soils in which a layer exists near the surface that impede the downward movement of water or soils with moderately fine to fine texture.	

Inflow Data

Calculate Peak Flow using the Rational Method (Q_p):

25-yr, 5-min Design Storm

Rainfall, P (inches) =	5.5	Ref 1, Figure 8.03k
I (in/hr) =	7.2	
Q_P (cfs) = CIA =	41.8	

Estimate Depth of Runoff for design storm @ location: Ref 2, page III-4

Determine Ultimate Storage Capacity (S):

$S = (1000/CN) - 10 =$ 0.75

Determine Runoff Depth (Q*):

Q^* (inches) $= (P-0.2S)^2/(P+0.8S) =$ 4.69

Determine Time to Peak (Tp):

T_P (min) $= 60.5(Q^*)A/Q_P/1.39 =$ 71 minutes Ref 2, page III-4

Determine Shape of Basin:

Find the area of the Basin using AutoCADD .

Calculate Volume of the Basin using Truncated Pyramid Method

Elevation (ft)	Depth (ft)	Area (sf)	Volume (cf)	Cumulative Vol (cf)
737	0	0	0	0
738	1	6,284	2,095	2,095
740	3	13,108	18,979	21,073
742	5	16,908	29,935	51,009
743	6	19,247	18,065	69,074

Calculate the Sediment Storage Volume (V_c):

Clean Out Internal (T), days = 150 or as needed Ref 1 pg 8.07.17

V_C (cf) $= 18 * T * A^{0.84} =$ 25,522

Project:	Old Salisbury Road Landfill	Computed: PMD	Date: 7-17-02
Subject:	Drainage	Checked MDP	Date 7-17-02
Task:	Sediment Basin 7	Sheet 2	Of 8

Determine Sediment Storage Elevation (Z_{sed}):

Z_{Sed} (ft) = $(V_C/K_S)^{1/b}$ Ref 2 pg III-8

Pick one point near max expected water surface and the other at the mid depth.

Z_1 (ft) = 3 S_1 (cf)= 21,073

Z_2 (ft) = 6 S_2 (cf) = 69,074

b = $\ln(S_2/S_1)/\ln(Z_2/Z_1)$ = 1.7

$K_S = S_2/Z_2^b$ = 3,210

Z_{Sed} (ft) = 3.4 set riser a minimum of this height measured from bottom of pond

Determine the remaining volume for wet Storage (V_{rem}):

V_{rem} (cf) = S_2-V_C = 43,552

Route the Storm through the Basin using the Hydrograph Model

see attached calculations

Set Height of Emergency Spillway at (ft) = 6

Set Top of Dam at (ft) = 7

Emergency Spillway

Q_E (cfs) = 20.91 Peak "Weir Flow" from Hydrograph

Use Normal Depth Procedure (Manning's Eqn.)

$A * R^{2/3} = Q * n / 1.49\ s^{0.5}$ Area (A)= bd+z(d^2)

$Z_{req} = Q*n/1.49s^{0.5}$ R=Area/(b+2d((z^2)+1)^.5) $Z_{av} = A*R^{2/3}$

n =	0.048	Class B Phase 3 (Fully vegetated) TRM (NAG C350)
Vp (ft/sec) =	18.0	Class B Phase 3 (Fully vegetated) TRM (NAG C350)
Side Slope (z) =	5	enter X for X:1
s (ft/ft) =	2	Slope down the dam
Bottom Width (ft) =	25.0	Length of Emergency Spillway (from Hydrograph)

Z_{req}	Flow Depth d (ft)	A (sf)	R (ft)	Z_{av}	V (ft/sec)
0.48	0.09	2.4	0.09	0.48	8.8

Project:	Old Salisbury Road Landfill	Computed: PMD	Date: 7-17-02
Subject:	Drainage	Checked MDP	Date 7-17-02
Task:	Sediment Basin 7	Sheet 3	Of 8

Anti-Seep Collar:

Anti-Seep Collar Size = 2 * Barrel Dia

Anti-Seep Collar Size (ft) = 3.0

Use Anti-Seep Collar Size (ft) = 3 x 3

Width of access road (ft) = 15

Length of base of dam (ft) = 43 Toe to toe

Locations for Collars:

Space collars at 15 intervals.

Minimum Concrete Base for Riser:

Diameter of Riser (in) = 24 From Hydrograph

Avg Density of Concrete (lbs/cf) = 87.6

Density of Water (cf/lb) = 62.4

Riser Displacement (cf) = 0.65 Pi * D_R/24 * Total Ht of Riser

Convert cf to cy = 27^{-1}

Min Concrete Needed (cy) = 0.02

Anti-Vortex Device: Ref 3, Table 3.14-D

Diameter of Riser (in) = 24

Cylinder Diameter (in) = 36

Cylinder Thickness (gage) = 16

Cylinder Height (in) = 13

Support Bars = #6 Rebar

Top Thickness = 16 gage corrugated , 14 gage flat

Stiffener = none required

Project:	Old Salisbury Road Landfill	Computed: BMW	Date: 7-17-02
Subject:	Drainage	Checked MDP	Date 7-17-02
Task:	Sediment Basin 7	Sheet 4	Of 8

Outlet Apron

Determine Tailwater conditions to size apron
Use Normal Depth Procedure (Manning's Eqn.)

$A*R^{2/3} = Q*n/1.49\ s^{0.5}$ Area (A)= bd+z(d^2)

$Z_{req} = Q*n/1.49s^{0.5}$ R=Area/(b+2d((z^2)+1)^.5) $Z_{av} = A*R^{2/3}$

n =	0.032	9" Rip Rap Lined Channel	Ref 2
Vp (ft/sec) =	10.8	Permissible Velocity for 9" Rip Rap @ 12:1	Ref 2
Side Slope (z) =	5	enter X for X:1	
s (ft/ft) =	0.05	Outlet Slope (assumed)	
Bottom Width (ft) =	4.5	3 * Barrel Diameter	

Q_B (cfs)	Z_{req}	Depth d (ft)	A (sf)	R (ft)	Z_{av}	V (ft/sec)
40	3.88	0.74	6.1	0.51	3.88	6.6

Flow Depth = Tailwater (d) = 0.74 0.5* Barrel Diameter = 0.75
Minimum Tailwater Conditions: d<0.5*Diameter of Outlet Pipe
Maximum Tailwater Conditions: d>0.5*Diameter of Outlet Pipe
Since the Tailwater is <u>less</u> than half of the diameter of the outlet, use <u>Minimum</u> Tailwater conditions.

Barrel Diameter (ft)	Entrance (ft)	Length (ft)	Outlet Width (ft)	Median Rip Rap Size d_{50}	Selected Rip Rap Size (in)	
1.5	4.5	24	26	1.1	Class 1	Ref 3 p. 8.06.4

Old Salisbury Road C&D Landfill

Sediment Basin #7

25-Year Storm

HDR Project No. 162-525-018

Qp =	41.76	cfs
Tp =	71	min.
dT =	4	

				Bottom	at 4' deep
Diameter of Barrel =	18	(in)	Length of Basin (ft) =	40	60
Height of Riser =	5.00	(ft)	Width of Basin (ft) =	290	360
Emergency Spillway =	6	(ft)	Slope of side & front walls =	2	(enter "X" for X:1)
Total Height of Dam =	7	(ft)	Slope of back wall =	2.00	(enter "X" for X:1)
Length of Overflow Weir =	25	(ft)	b =	1.71	
Diameter of Riser =	24	(in)	Ks =	3,210	

Notes:

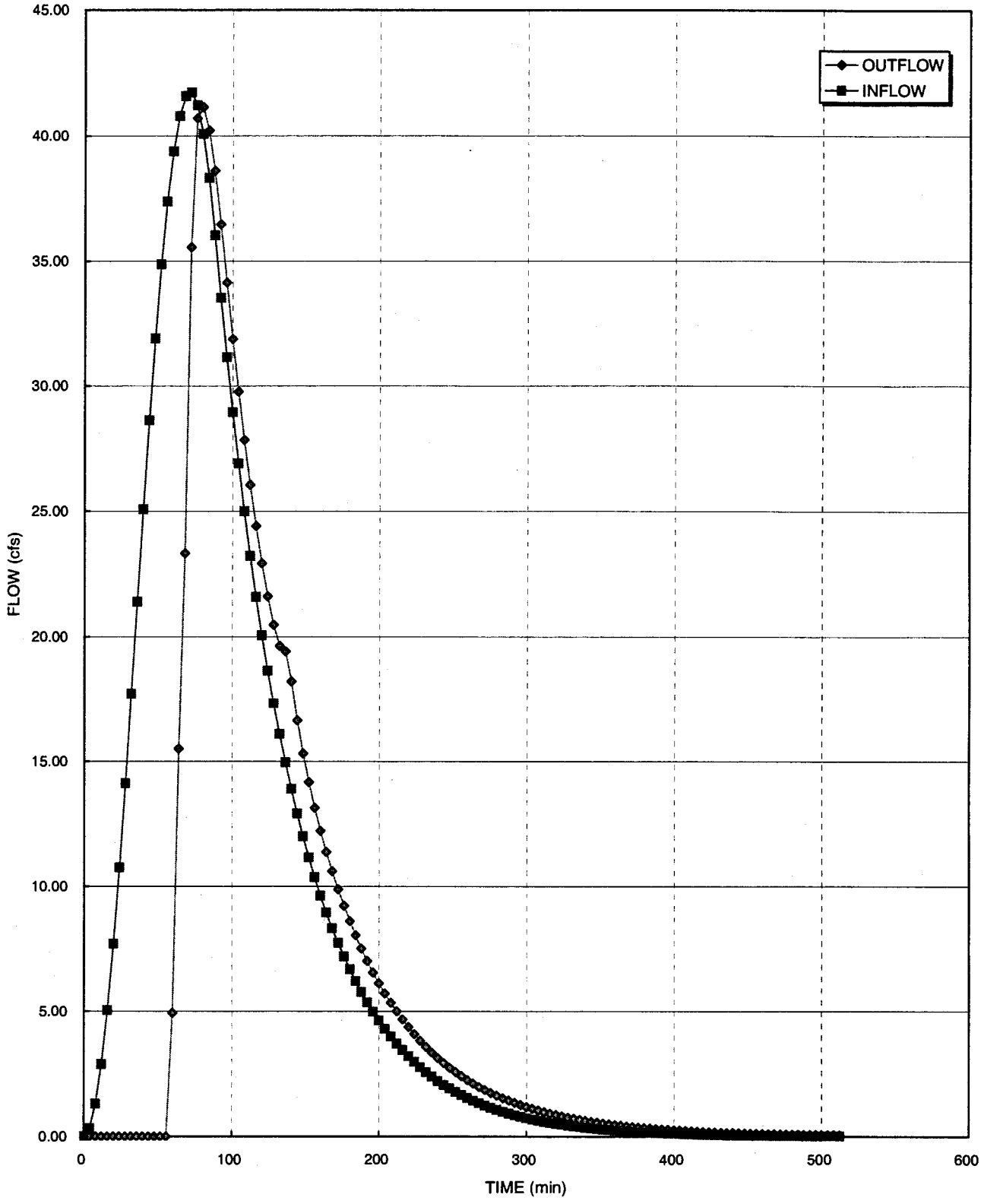
1. Length of overflow weir is the width of the dam.

TIME [min]	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	RISER CAPACITY [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	BOUND DISCHG [cfs]	SETTLING EFF. [%]
0	0.0	0.00	0.00	0.0	0.00	0.00	0.00	0.0	N/A
4	0.3	0.00	0.00	0.0	0.00	0.00	0.00	0.0	N/A
8	1.3	79	0.11	0.0	0.00	0.00	0.00	2.6	N/A
12	2.9	390	0.29	0.0	0.00	0.00	0.00	5.0	N/A
16	5.0	1,083	0.53	0.0	0.00	0.00	0.00	7.7	N/A
20	7.7	2,291	0.82	0.0	0.00	0.00	0.00	10.5	N/A
24	10.7	4,135	1.16	0.0	0.00	0.00	0.00	13.4	N/A
28	14.1	6,713	1.54	0.0	0.00	0.00	0.00	16.4	N/A
32	17.7	10,102	1.95	0.0	0.00	0.00	0.00	19.5	N/A
36	21.4	14,353	2.40	0.0	0.00	0.00	0.00	22.6	N/A
40	25.1	19,489	2.87	0.0	0.00	0.00	0.00	25.6	N/A
44	28.6	25,507	3.35	0.0	0.00	0.00	0.00	28.7	N/A
48	31.9	32,375	3.85	0.0	0.00	0.00	0.00	31.6	N/A
52	34.9	40,035	4.36	0.0	0.00	0.00	0.00	34.6	N/A
56	37.4	48,403	4.88	0.0	0.00	0.00	0.00	37.4	N/A
60	39.4	57,375	5.38	4.9	0.00	18.29	4.93	40.2	99.3
64	40.8	65,643	5.82	15.5	0.00	19.14	15.51	42.5	95.5
68	41.6	71,711	6.13	25.0	3.63	19.71	23.34	44.1	91.9
72	41.7	76,092	6.35	32.5	15.45	20.10	35.55	45.2	85.9
76	41.2	77,576	6.42	35.1	20.47	20.23	40.70	45.5	83.5
80	40.1	77,702	6.43	35.3	20.91	20.24	41.16	45.6	83.3
84	38.3	77,442	6.41	34.9	20.00	20.22	40.22	45.5	83.7
88	36.0	76,987	6.39	34.1	18.43	20.18	38.61	45.4	84.5
92	33.5	76,368	6.36	33.0	16.35	20.13	36.48	45.2	85.5
96	31.2	75,660	6.33	31.7	14.07	20.06	34.13	45.1	86.6
100	28.9	74,945	6.29	30.5	11.88	20.00	31.88	44.9	87.7
104	26.9	74,242	6.26	29.3	9.84	19.94	29.78	44.7	88.7
108	25.0	73,552	6.22	28.1	7.96	19.88	27.84	44.5	89.7
112	23.2	72,871	6.19	26.9	6.23	19.82	26.05	44.4	90.6
116	21.6	72,195	6.16	25.8	4.66	19.75	24.41	44.2	91.3
120	20.1	71,517	6.12	24.7	3.24	19.69	22.93	44.0	92.1
124	18.6	70,828	6.09	23.5	1.98	19.63	21.60	43.8	92.7
128	17.3	70,117	6.05	22.4	0.91	19.56	20.47	43.6	93.2

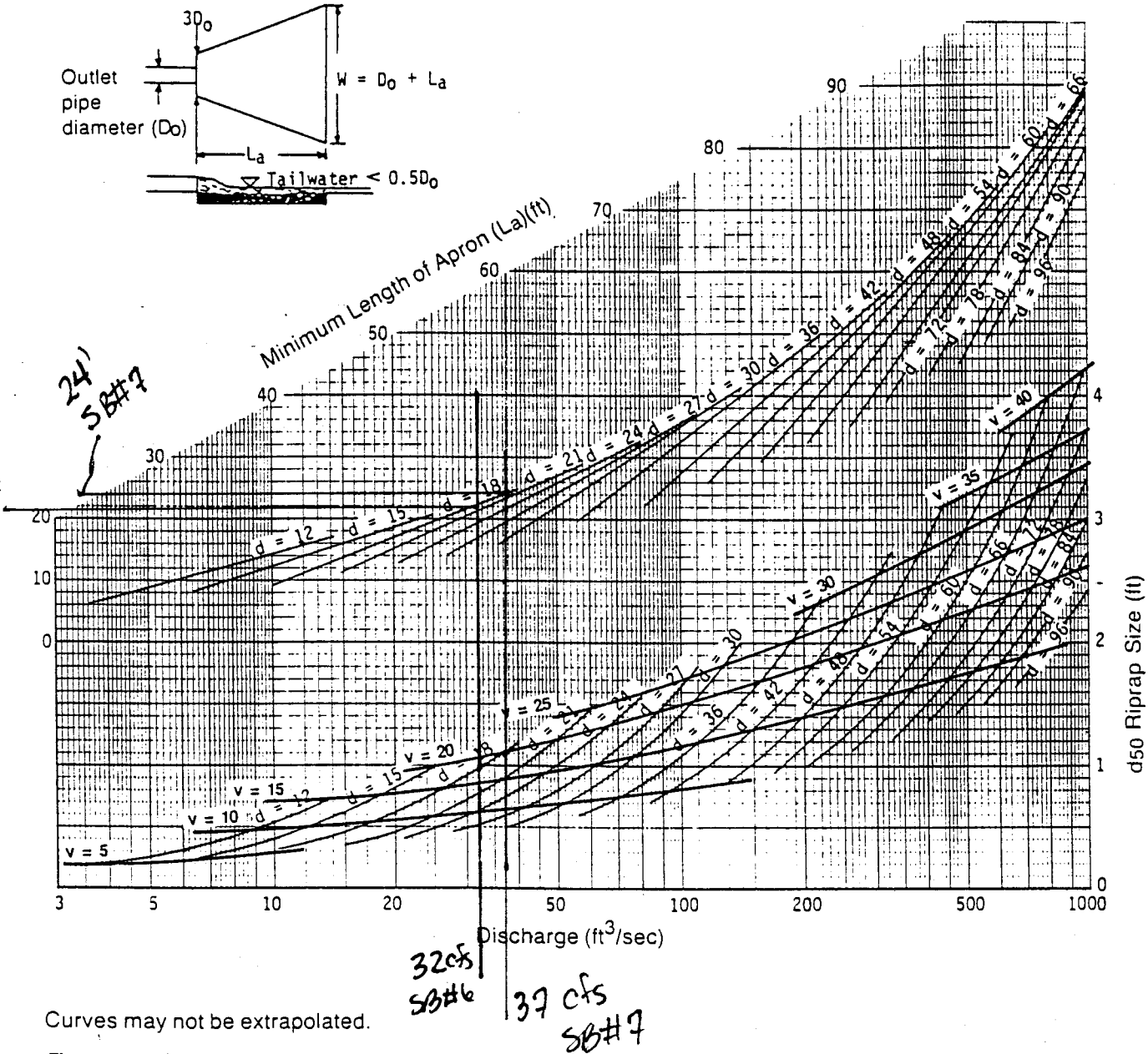
132	16.1	69,361	6.01	21.2	0.13	19.49	19.62	43.5	93.6
136	15.0	68,515	5.97	19.9	0.00	19.41	19.41	43.2	93.7
140	13.9	67,446	5.92	18.2	0.00	19.31	18.21	42.9	94.3
144	12.9	66,412	5.86	16.6	0.00	19.21	16.65	42.7	95.0
148	12.0	65,516	5.82	15.3	0.00	19.12	15.33	42.4	95.6
152	11.2	64,718	5.78	14.2	0.00	19.05	14.18	42.2	96.1
156	10.4	63,992	5.74	13.2	0.00	18.97	13.15	42.0	96.5
160	9.6	63,323	5.70	12.2	0.00	18.91	12.22	41.8	96.9
164	8.9	62,701	5.67	11.4	0.00	18.84	11.38	41.7	97.2
168	8.3	62,118	5.64	10.6	0.00	18.78	10.60	41.5	97.5
172	7.7	61,569	5.61	9.9	0.00	18.73	9.89	41.4	97.8
176	7.2	61,051	5.58	9.2	0.00	18.68	9.22	41.2	98.0
180	6.7	60,561	5.56	8.6	0.00	18.62	8.61	41.1	98.3
184	6.2	60,097	5.53	8.0	0.00	18.58	8.04	40.9	98.4
188	5.8	59,657	5.51	7.5	0.00	18.53	7.51	40.8	98.6
192	5.4	59,238	5.49	7.0	0.00	18.49	7.01	40.7	98.8
196	5.0	58,841	5.46	6.5	0.00	18.44	6.55	40.6	98.9
200	4.6	58,464	5.44	6.1	0.00	18.40	6.12	40.5	99.0
204	4.3	58,105	5.42	5.7	0.00	18.37	5.72	40.4	99.1
208	4.0	57,763	5.41	5.3	0.00	18.33	5.35	40.3	99.2
212	3.7	57,438	5.39	5.0	0.00	18.29	5.00	40.2	99.3
216	3.4	57,129	5.37	4.7	0.00	18.26	4.67	40.1	99.4
220	3.2	56,835	5.35	4.4	0.00	18.23	4.37	40.0	99.5
224	3.0	56,554	5.34	4.1	0.00	18.20	4.09	39.9	99.5
228	2.8	56,288	5.32	3.8	0.00	18.17	3.83	39.8	99.6
232	2.6	56,034	5.31	3.6	0.00	18.14	3.58	39.8	99.6
236	2.4	55,791	5.30	3.4	0.00	18.11	3.35	39.7	99.7
240	2.2	55,561	5.28	3.1	0.00	18.09	3.14	39.6	99.7
244	2.1	55,341	5.27	2.9	0.00	18.06	2.94	39.6	99.7
248	1.9	55,132	5.26	2.7	0.00	18.04	2.75	39.5	99.8
252	1.8	54,932	5.25	2.6	0.00	18.02	2.57	39.4	99.8
256	1.7	54,742	5.24	2.4	0.00	18.00	2.41	39.4	99.8
260	1.5	54,561	5.23	2.3	0.00	17.98	2.26	39.3	99.8
264	1.4	54,388	5.22	2.1	0.00	17.96	2.12	39.3	99.9
268	1.3	54,223	5.21	2.0	0.00	17.94	1.98	39.2	99.9
272	1.2	54,066	5.20	1.9	0.00	17.92	1.86	39.2	99.9
276	1.1	53,916	5.19	1.7	0.00	17.90	1.74	39.1	99.9
280	1.1	53,772	5.18	1.6	0.00	17.89	1.63	39.1	99.9
284	1.0	53,636	5.18	1.5	0.00	17.87	1.53	39.0	99.9
288	0.9	53,506	5.17	1.4	0.00	17.86	1.44	39.0	99.9
292	0.9	53,381	5.16	1.3	0.00	17.84	1.35	39.0	99.9
296	0.8	53,263	5.16	1.3	0.00	17.83	1.27	38.9	99.9
300	0.7	53,149	5.15	1.2	0.00	17.82	1.19	38.9	100.0
304	0.7	53,041	5.14	1.1	0.00	17.80	1.12	38.9	100.0
308	0.6	52,938	5.14	1.0	0.00	17.79	1.05	38.8	100.0
312	0.6	52,839	5.13	1.0	0.00	17.78	0.99	38.8	100.0
316	0.6	52,745	5.13	0.9	0.00	17.77	0.93	38.8	100.0
320	0.5	52,655	5.12	0.9	0.00	17.76	0.87	38.7	100.0
324	0.5	52,569	5.12	0.8	0.00	17.75	0.82	38.7	100.0
328	0.4	52,487	5.11	0.8	0.00	17.74	0.77	38.7	100.0
332	0.4	52,409	5.11	0.7	0.00	17.73	0.72	38.7	100.0
336	0.4	52,334	5.10	0.7	0.00	17.72	0.68	38.6	100.0

340	0.4	52,262	5.10	0.6	0.00	17.72	0.64	38.6	100.0
344	0.3	52,194	5.09	0.6	0.00	17.71	0.60	38.6	100.0
348	0.3	52,129	5.09	0.6	0.00	17.70	0.57	38.6	100.0
352	0.3	52,066	5.09	0.5	0.00	17.69	0.53	38.6	100.0
356	0.3	52,006	5.08	0.5	0.00	17.69	0.50	38.5	100.0
360	0.2	51,949	5.08	0.5	0.00	17.68	0.47	38.5	100.0
364	0.2	51,894	5.08	0.4	0.00	17.67	0.45	38.5	100.0
368	0.2	51,842	5.07	0.4	0.00	17.67	0.42	38.5	100.0
372	0.2	51,792	5.07	0.4	0.00	17.66	0.40	38.5	100.0
376	0.2	51,744	5.07	0.4	0.00	17.65	0.37	38.5	100.0
380	0.2	51,698	5.07	0.4	0.00	17.65	0.35	38.5	100.0
384	0.2	51,654	5.06	0.3	0.00	17.64	0.33	38.4	100.0
388	0.1	51,613	5.06	0.3	0.00	17.64	0.31	38.4	100.0
392	0.1	51,572	5.06	0.3	0.00	17.63	0.30	38.4	100.0
396	0.1	51,534	5.06	0.3	0.00	17.63	0.28	38.4	100.0
400	0.1	51,497	5.05	0.3	0.00	17.63	0.26	38.4	100.0
404	0.1	51,462	5.05	0.3	0.00	17.62	0.25	38.4	100.0
408	0.1	51,428	5.05	0.2	0.00	17.62	0.24	38.4	100.0
412	0.1	51,396	5.05	0.2	0.00	17.61	0.22	38.4	100.0
416	0.1	51,365	5.05	0.2	0.00	17.61	0.21	38.3	100.0
420	0.1	51,335	5.05	0.2	0.00	17.61	0.20	38.3	100.0
424	0.1	51,307	5.04	0.2	0.00	17.60	0.19	38.3	100.0
428	0.1	51,279	5.04	0.2	0.00	17.60	0.18	38.3	100.0
432	0.1	51,253	5.04	0.2	0.00	17.60	0.17	38.3	100.0
436	0.1	51,228	5.04	0.2	0.00	17.59	0.16	38.3	100.0
440	0.1	51,204	5.04	0.2	0.00	17.59	0.15	38.3	100.0
444	0.1	51,181	5.04	0.1	0.00	17.59	0.14	38.3	100.0
448	0.0	51,159	5.04	0.1	0.00	17.59	0.14	38.3	100.0
452	0.0	51,138	5.03	0.1	0.00	17.58	0.13	38.3	100.0
456	0.0	51,117	5.03	0.1	0.00	17.58	0.12	38.3	100.0
460	0.0	51,098	5.03	0.1	0.00	17.58	0.12	38.3	100.0
464	0.0	51,079	5.03	0.1	0.00	17.58	0.11	38.3	100.0
468	0.0	51,061	5.03	0.1	0.00	17.57	0.11	38.3	100.0
472	0.0	51,044	5.03	0.1	0.00	17.57	0.10	38.2	100.0
476	0.0	51,027	5.03	0.1	0.00	17.57	0.10	38.2	100.0
480	0.0	51,012	5.03	0.1	0.00	17.57	0.09	38.2	100.0
484	0.0	50,996	5.03	0.1	0.00	17.57	0.09	38.2	100.0
488	0.0	50,982	5.03	0.1	0.00	17.57	0.08	38.2	100.0
492	0.0	50,968	5.02	0.1	0.00	17.56	0.08	38.2	100.0
496	0.0	50,954	5.02	0.1	0.00	17.56	0.07	38.2	100.0
500	0.0	50,941	5.02	0.1	0.00	17.56	0.07	38.2	100.0
504	0.0	50,928	5.02	0.1	0.00	17.56	0.07	38.2	100.0
508	0.0	50,916	5.02	0.1	0.00	17.56	0.06	38.2	100.0
512	0.0	50,905	5.02	0.1	0.00	17.56	0.06	38.2	100.0

Sediment Basin #7 Hydrograph
25-Yr Storm



Conclusion: The basin can pass the design storm without overtopping the dam and provide a settling efficiency greater than 75%.



Curves may not be extrapolated.

Figure 8.06a Design of outlet protection protection from a round pipe flowing full, minimum tailwater condition (T_w < 0.5 diameter).

TABLE 3.14-D

CONCENTRIC TRASH RACK AND ANTI-VORTEX DEVICE DESIGN TABLE

Riser Diam., in.	Cylinder		Height, inches	Minimum Size Support Bar	Minimum Top	
	Diameter, inches	Thickness, gage			Thickness	Stiffener
12	18	16	6	#6 Rebar or 1½ x 1½ x 3/16 angle	16 ga. (F&C)	-
15	21	16	7	" "	" "	-
18	27	16	8	" "	" "	-
21	30	16	11	" "	16 ga.(C), 14 ga.(F)	-
24	36	16	13	" "	" "	-
27	42	16	15	" "	" "	-
36	54	14	17	#8 Rebar	14 ga.(C), 12 ga.(F)	-
42	60	16	19	" "	" "	-
48	72	16	21	1¼" pipe or 1¼ x 1¼ x ¼ angle	14 ga.(C), 10 ga.(F)	-
54	78	16	25	" "	" "	-
60	90	14	29	1½" pipe or 1½ x 1½ x ¼ angle	12 ga.(C), 8 ga.(F)	-
66	96	14	33	2" pipe or 2 x 2 x 3/16 angle	12 ga.(C), 8 ga.(F) w/stiffener	2 x 2 x ¼ angle
72	102	14	36	" "	" "	2½ x 2½ x ¼ angle
78	114	14	39	2½" pipe or 2 x 2 x ¼ angle	" "	" "
84	120	12	42	2½" pipe or 2½ x 2½ x ¼ angle	" "	2½ x 2½ x 5/16 angle

Note$_1$: The criterion for sizing the cylinder is that the area between the inside of the cylinder and the outside of the riser is equal to or greater than the area inside the riser. Therefore, the above table is invalid for use with concrete pipe risers.

Note$_2$: Corrugation for 12"-36" pipe measures 2⅔" x ½"; for 42" -84" the corrugation measures 5" x 1" or 8" x 1".

Note$_3$: C = corrugated; F = flat.

Source: Adapted from USDA-SCS and Carl M. Henshaw Drainage Products Information.

Project: Old Salisbury Road Landfill	Computed: PAW	Date: 7-17-02
Subject: Drainage	Checked: MDP	Date: 7-17-02
Task: Sediment Basin #5 Check	Sheet 1	Of 7

Objective: Verify the construction of SB #5 with the design.

Drainage Area

Area Type = Newly Graded Area

Drainage Area (ac) =	20		
CN =	90		
Runoff Coeff =	0.45	Ag land, smooth	Ref 3
Soil Group =	C	Class C Soils having a moderately high runoff potential due to slow infiltration rates. These soils consist primarily of soils in which a layer exists near the surface that impede the downward movement of water or soils with moderately fine to fine texture	

Inflow Data

Calculate Peak Flow using the Rational Method (Q_p):

25-yr, 5-min Design Storm

Rainfall, P (inches) =	5.5		Ref 1, Figure 8.03k
I (in/hr) =	7.6	*Design Intensity*	
Q_P (cfs) = CIA =	68.40		

Estimate Depth of Runoff for design storm @ location:

Ref 2, page III-4

Determine Ultimate Storage Capacity (S):

$S = (1000/CN) - 10 =$ 1.11

Determine Runoff Depth (Q*):

Q^* (inches) $= (P-0.2S)^2/(P+0.8S) =$ 4.36

Determine Time to Peak (Tp):

T_P (min) $= 60.5(Q^*)A/Q_P/1.39 =$ 55 minutes

Ref 2, page III-4

Determine Shape of Basin:

Find the area of the Basin using AutoCADD.

Calculate Volume of the Basin using Truncated Pyramid Method

Elevation (ft)	Area (sf)	Volume (cf)	Cumulative Vol (cf)
0	0	0	0
2	31,913	21,275	21,275
4	38,643	70,449	91,724

Calculate the Sediment Storage Volume (V_c):

Clean Out Internal (T), days = 180 or as needed

Ref 1 pg 8.07.17

V_C (cf) $= 18*T(A)^{0.84} =$ 40,125

Project: Old Salisbury Road Landfill	Computed: PMD	Date: 7-17-02
Subject: Drainage	Checked: MDP	Date: 7-17-02
Task: Sediment Basin #5 Check	Sheet 2	Of 7

Determine Sediment Storage Elevation (Z_{sed}):

Z_{Sed} (ft) = $(V_C/K_S)^{1/b}$ Ref 2 pg III-8

Pick one point near max expected water surface and the other at the mid depth.

Z_1 (ft) = 2 S_1 (cf)= 21,275

Z_2 (ft) = 4 S_2 (cf) = 91,724

b = $\ln(S_2/S_1)/\ln(Z_2/Z_1)$ = 2.1

K_S = S_2/Z_2^b = 4,935

Z_{Sed} (ft) = 2.7 set riser a minimum of this height measured from bottom of pond

Determine the remaining volume for wet Storage (V_{rem}):

V_{rem} (cf) = S_2-V_C = 51,600

Route the Storm through the Basin using the Hydrograph Model

see attached calculations

Height of Emergency Spillway at (ft) = 4

Top of Dam at (ft) = 5

Determine Emergency Spillway Shape:

Required Capacity of Emergency Spillway (Q_E):

Q_E (cfs) = 3.49 Peak "Weir Flow" from Hydrograph

Determine Tailwater conditions to size spillway

Use Normal Depth Procedure (Manning's Eqn.)

$A * R^{2/3} = Q * n / 1.49\ s^{0.5}$ Area (A)= bd+z(d^2)

$Z_{req} = Q*n/1.49s^{0.5}$ R=Area/(b+2d((z^2)+1)^.5) $Z_{av} = A*R^{2/3}$

n =	0.030	6" Rip Rap
Q_B (cfs) =	-	Peak Outflow of Barrel from Hydrograph Model.
Vp (ft/sec) =	8.4	Permissible 6" Rip Rap at 4:1
Side Slope (z) =	3	enter X for X:1
s (ft/ft) =	0.150	Slope down the dam (estimated from as built survey)
Bottom Width (ft) =	10	estimated from as built survey

Z_{req}	Flow Depth d (ft)	A (sf)	R (ft)	Z_{av}	V (ft/sec)
0.18	0.09	0.9	0.09	0.18	3.8

Project: Old Salisbury Road Landfill	Computed: PAP	Date: 7-17-02
Subject: Drainage	Checked: MJP	Date: 7-17-02
Task: Sediment Basin #5 Check	Sheet 3	Of 7

Anti-Vortex Device:

Installed per design

Outlet Apron

Determine Tailwater conditions to size apron
Use Normal Depth Procedure (Manning's Eqn.)

$A*R^{2/3} = Q*n/1.49\ s^{0.5}$ Area (A)= bd+z(d^2)

$Z_{req} = Q*n/1.49s^{0.5}$ R=Area/(b+2d((z^2)+1)^.5) $Z_{av} = A*R^{2/3}$

n =	0.030	6" Rip Rap Lined Channel
Q_B (cfs) =	-	Peak Outflow of Barrel from Hydrograph Model.
Vp (ft/sec) =	8.4	Permissible Velocity for 6" Rip Rap
Side Slope (z) =	3	enter X for X:1
s (ft/ft) =	0.10	Outlet Slope (assumed)
Bottom Width (ft) =	6.0	3 * Barrel Diameter

Q_B (cfs)	Z_{req}	Depth d (ft)	A (sf)	R (ft)	Z_{av}	V (ft/sec)
34.3	2.18	0.52	3.9	0.42	2.18	8.8

Flow Depth = Tailwater (d) = 0.52 0.5* Barrel Diameter = 1.00
Minimum Tailwater Conditions: d<0.5*Diameter of Outlet Pipe
Maximum Tailwater Conditions: d>0.5*Diameter of Outlet Pipe
Since the Tailwater is less than half of the diameter of the outlet, use Minimum Tailwater conditions.

	Barrel Diameter (ft)	Entrance (ft)	Length (ft)	Outlet Width (ft)	Rip Rap Size d_{50}	Selected Rip Rap Size (in)
Design	2	6	10	12	0.3	Class B
As-Built	2	6	20	22	0.7	Class B

Ref 3 p. 8.06.4

Conclusion The Apron Outlet is adequate.

Computed By: PAW Date: 7-17-02

Checked By: MDP Date: 7-17-02

Sheet: 4 of 7

Old Salisbury Road C&D Landfill

Sediment Basin #5

25-Year Storm

HDR Project No. 162-525-018

Qp = 68.40 cfs

Tp = 55 min.

dT = 2

				Bottom	at 4' deep
Diameter of Barrel =	24	(in)	Length of Basin (ft) =	234	270
Height of Riser =	3.50	(ft)	Width of Basin (ft) =	142	164
Emergency Spillway =	5.0	(ft)	Slope of side & front walls =	3	(enter "X" for X:1)
Total Height of Dam =	6	(ft)	Slope of back wall =	3	(enter "X" for X:1)
Length of Overflow Weir =	20	(ft)	b =	2.11	
Diameter of Riser =	48	(in)	Ks =	4,935	

Notes:

1. Length of overflow weir is the width of the dam.
2. Datum is measured from the bottom of the barrel.

TIME [min]	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	RISER CAPACITY [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	BOUND DISCHG [cfs]	SETTLING EFF. [%]
0	0.0	0.00	0.00	0.0	0.00	0.00	0.00	0.0	N/A
3	0.5	0.00	0.00	0.0	0.00	0.00	0.00	0.0	N/A
4	0.9	30	0.09	0.0	0.00	0.00	0.00	1.6	N/A
5	1.4	82	0.14	0.0	0.00	0.00	0.00	2.7	N/A
6	2.0	164	0.20	0.0	0.00	0.00	0.00	3.8	N/A
7	2.7	281	0.26	0.0	0.00	0.00	0.00	5.1	N/A
8	3.4	440	0.32	0.0	0.00	0.00	0.00	6.4	N/A
9	4.3	647	0.38	0.0	0.00	0.00	0.00	7.9	N/A
10	5.3	908	0.45	0.0	0.00	0.00	0.00	9.4	N/A
11	6.4	1,228	0.52	0.0	0.00	0.00	0.00	11.0	N/A
12	7.6	1,613	0.59	0.0	0.00	0.00	0.00	12.7	N/A
13	8.9	2,069	0.66	0.0	0.00	0.00	0.00	14.5	N/A
14	10.2	2,600	0.74	0.0	0.00	0.00	0.00	16.3	N/A
15	11.6	3,211	0.82	0.0	0.00	0.00	0.00	18.3	N/A
16	13.1	3,908	0.90	0.0	0.00	0.00	0.00	20.2	N/A
17	14.7	4,694	0.98	0.0	0.00	0.00	0.00	22.3	N/A
18	16.3	5,573	1.06	0.0	0.00	0.00	0.00	24.4	N/A
19	18.0	6,550	1.14	0.0	0.00	0.00	0.00	26.6	N/A
20	19.7	7,627	1.23	0.0	0.00	0.00	0.00	28.8	N/A
21	21.5	8,808	1.32	0.0	0.00	0.00	0.00	31.0	N/A
22	23.3	10,095	1.40	0.0	0.00	0.00	0.00	33.3	N/A
23	25.1	11,492	1.49	0.0	0.00	0.00	0.00	35.7	N/A
24	27.0	12,999	1.58	0.0	0.00	0.00	0.00	38.1	N/A
25	28.9	14,620	1.67	0.0	0.00	0.00	0.00	40.5	N/A
26	30.8	16,354	1.77	0.0	0.00	0.00	0.00	43.0	N/A
27	32.8	18,204	1.86	0.0	0.00	0.00	0.00	45.5	N/A
28	34.7	20,170	1.95	0.0	0.00	0.00	0.00	48.0	N/A
29	36.6	22,251	2.04	0.0	0.00	0.00	0.00	50.5	N/A
30	38.6	24,449	2.14	0.0	0.00	0.00	0.00	53.1	N/A
31	40.5	26,763	2.23	0.0	0.00	0.00	0.00	55.7	N/A
32	42.4	29,191	2.32	0.0	0.00	0.00	0.00	58.3	N/A
33	44.2	31,733	2.42	0.0	0.00	0.00	0.00	60.9	N/A
34	46.1	34,386	2.51	0.0	0.00	0.00	0.00	63.5	N/A

35	47.9	37,150	2.61	0.0	0.00	0.00	0.00	66.1	N/A
36	49.6	40,022	2.70	0.0	0.00	0.00	0.00	68.8	N/A
37	51.3	42,998	2.79	0.0	0.00	0.00	0.00	71.4	N/A
38	53.0	46,077	2.89	0.0	0.00	0.00	0.00	74.1	N/A
40	56.1	52,433	3.07	0.0	0.00	0.00	0.00	79.3	N/A
42	58.9	59,162	3.25	0.0	0.00	0.00	0.00	84.5	N/A
44	61.4	66,230	3.43	0.0	0.00	0.00	0.00	89.6	N/A
46	63.6	73,600	3.60	1.4	0.00	24.37	1.38	94.7	100.0
48	65.4	81,065	3.77	5.9	0.00	25.15	5.89	99.7	99.5
50	66.8	88,202	3.93	11.5	0.00	25.84	11.55	104.2	98.3
52	67.7	94,828	4.06	17.5	0.00	26.43	17.55	108.2	96.6
54	68.3	100,851	4.18	23.5	0.00	26.95	23.46	111.8	94.6
56	68.4	106,229	4.29	29.0	0.00	27.39	27.39	114.9	93.3
58	68.1	111,148	4.38	34.3	0.00	27.77	27.77	117.6	93.2
60	67.3	115,982	4.47	39.7	0.00	28.14	28.14	120.3	93.1
62	66.1	120,681	4.56	45.0	0.00	28.48	28.48	122.8	93.1
64	64.5	125,195	4.64	50.2	0.00	28.80	28.80	125.2	93.0
66	62.5	129,480	4.71	55.2	0.00	29.09	29.09	127.5	92.9
68	60.2	133,491	4.78	60.0	0.00	29.36	29.36	129.5	92.9
70	57.6	137,188	4.84	64.4	0.00	29.60	29.60	131.4	92.8
72	54.9	140,546	4.90	68.5	0.00	29.82	29.82	133.1	92.8
74	52.4	143,561	4.95	72.2	0.00	30.00	30.00	134.6	92.8
76	50.0	146,253	4.99	75.5	0.00	30.17	30.17	135.9	92.7
78	47.7	148,636	5.03	78.4	0.30	30.32	30.62	137.1	92.6
80	45.6	150,691	5.06	81.0	0.93	30.44	31.37	138.1	92.3
82	43.5	152,393	5.09	83.1	1.60	30.54	32.14	138.9	92.1
84	41.5	153,753	5.11	84.8	2.21	30.62	32.83	139.5	91.9
86	39.6	154,791	5.13	86.1	2.72	30.68	33.40	140.0	91.7
88	37.8	155,534	5.14	87.0	3.10	30.72	33.82	140.4	91.5
90	36.0	156,007	5.15	87.6	3.35	30.75	34.10	140.6	91.4
92	34.4	156,240	5.15	87.9	3.48	30.77	34.24	140.7	91.4
94	32.8	156,258	5.15	87.9	3.49	30.77	34.25	140.7	91.4
96	31.3	156,086	5.15	87.7	3.39	30.76	34.15	140.6	91.4
98	29.9	155,746	5.14	87.3	3.21	30.74	33.95	140.5	91.5
100	28.5	155,258	5.13	86.6	2.95	30.71	33.66	140.2	91.6
102	27.2	154,640	5.12	85.9	2.64	30.67	33.31	140.0	91.7
104	26.0	153,907	5.11	85.0	2.28	30.63	32.91	139.6	91.8
106	24.8	153,073	5.10	83.9	1.90	30.58	32.48	139.2	92.0
108	23.6	152,149	5.09	82.8	1.49	30.53	32.02	138.8	92.1
110	22.6	151,143	5.07	81.5	1.10	30.47	31.56	138.3	92.3
112	21.5	150,063	5.05	80.2	0.71	30.40	31.12	137.8	92.4
114	20.5	148,912	5.03	78.8	0.37	30.33	30.70	137.2	92.6
116	19.6	147,692	5.01	77.3	0.10	30.26	30.36	136.6	92.7
118	18.7	146,401	4.99	75.7	0.00	30.18	30.18	136.0	92.7
120	17.8	145,024	4.97	74.0	0.00	30.10	30.10	135.3	92.7
122	17.0	143,554	4.95	72.2	0.00	30.00	30.00	134.6	92.8
124	16.2	141,997	4.92	70.3	0.00	29.91	29.91	133.8	92.8
126	15.5	140,358	4.89	68.3	0.00	29.80	29.80	133.0	92.8
128	14.8	138,642	4.87	66.2	0.00	29.69	29.69	132.1	92.8
130	14.1	136,854	4.84	64.0	0.00	29.58	29.58	131.2	92.8
132	13.5	134,999	4.80	61.8	0.00	29.46	29.46	130.3	92.9
134	12.9	133,080	4.77	59.5	0.00	29.33	29.33	129.3	92.9

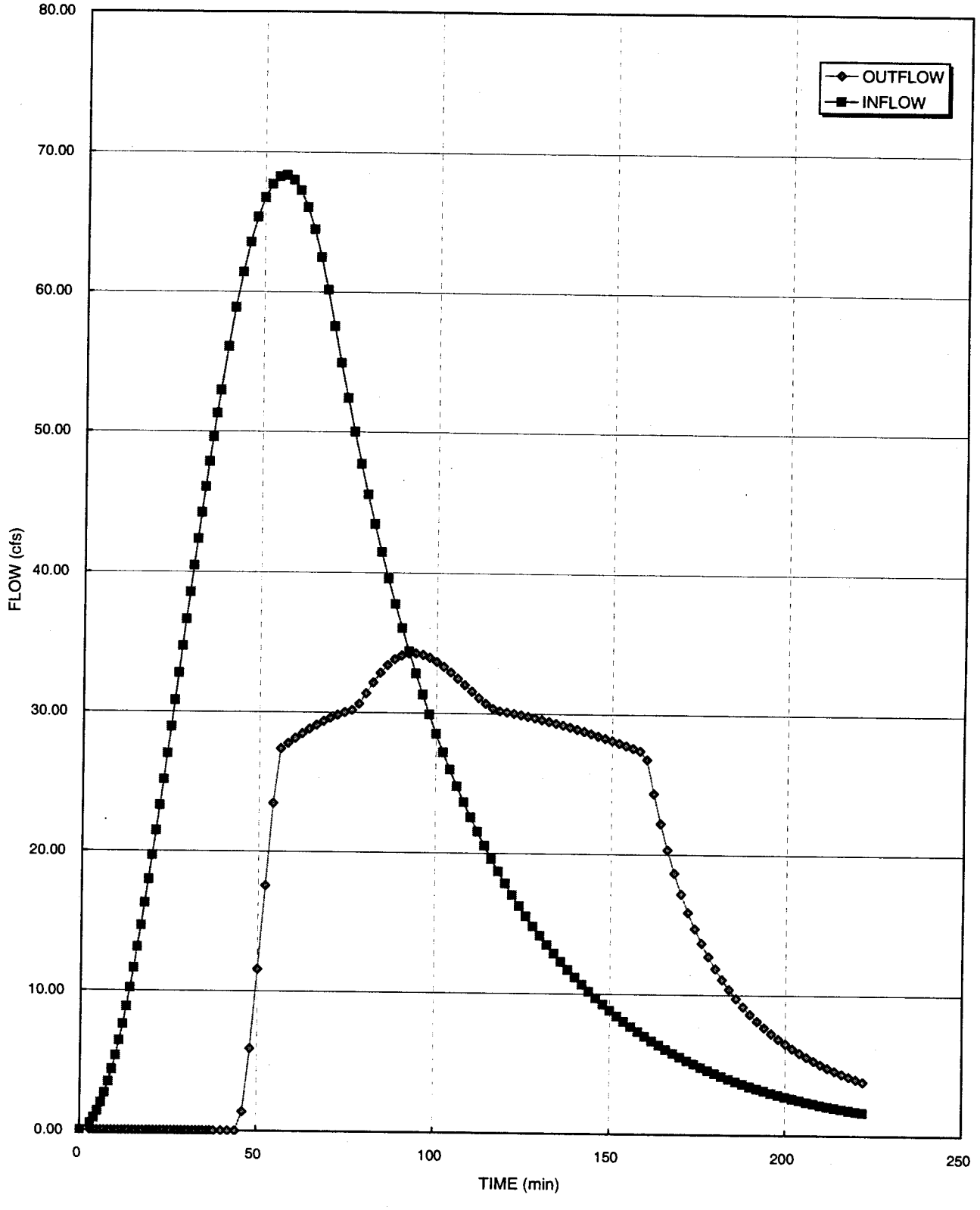
136	12.3	131,103	4.74	57.2	0.00	29.20	29.20	128.3	92.9
138	11.7	129,071	4.70	54.8	0.00	29.06	29.06	127.3	92.9
140	11.2	126,988	4.67	52.3	0.00	28.92	28.92	126.2	93.0
142	10.7	124,857	4.63	49.8	0.00	28.77	28.77	125.1	93.0
144	10.2	122,683	4.59	47.3	0.00	28.62	28.62	123.9	93.0
146	9.7	120,469	4.55	44.8	0.00	28.46	28.46	122.7	93.1
148	9.3	118,218	4.51	42.2	0.00	28.30	28.30	121.5	93.1
150	8.8	115,933	4.47	39.6	0.00	28.13	28.13	120.3	93.1
152	8.4	113,618	4.43	37.0	0.00	27.96	27.96	119.0	93.2
154	8.0	111,274	4.38	34.5	0.00	27.78	27.78	117.7	93.2
156	7.7	108,906	4.34	31.9	0.00	27.60	27.60	116.4	93.3
158	7.3	106,515	4.29	29.3	0.00	27.41	27.41	115.0	93.3
160	7.0	104,105	4.25	26.8	0.00	27.22	26.81	113.7	93.5
162	6.7	101,727	4.20	24.4	0.00	27.02	24.35	112.3	94.3
164	6.4	99,605	4.16	22.2	0.00	26.85	22.21	111.1	95.1
166	6.1	97,704	4.12	20.3	0.00	26.68	20.33	109.9	95.7
168	5.8	95,994	4.09	18.7	0.00	26.54	18.66	108.9	96.2
170	5.5	94,450	4.06	17.2	0.00	26.40	17.19	108.0	96.7
172	5.3	93,051	4.03	15.9	0.00	26.28	15.88	107.2	97.1
174	5.0	91,778	4.00	14.7	0.00	26.16	14.71	106.4	97.4
176	4.8	90,617	3.98	13.7	0.00	26.06	13.66	105.7	97.7
178	4.6	89,555	3.95	12.7	0.00	25.96	12.72	105.0	98.0
180	4.4	88,578	3.93	11.9	0.00	25.87	11.87	104.4	98.2
182	4.2	87,679	3.92	11.1	0.00	25.79	11.10	103.9	98.4
184	4.0	86,848	3.90	10.4	0.00	25.71	10.40	103.3	98.6
186	3.8	86,078	3.88	9.8	0.00	25.64	9.76	102.9	98.7
188	3.6	85,363	3.87	9.2	0.00	25.57	9.18	102.4	98.9
190	3.5	84,697	3.85	8.6	0.00	25.50	8.64	102.0	99.0
192	3.3	84,075	3.84	8.2	0.00	25.44	8.15	101.6	99.1
194	3.2	83,493	3.83	7.7	0.00	25.39	7.70	101.2	99.2
196	3.0	82,947	3.81	7.3	0.00	25.33	7.28	100.9	99.2
198	2.9	82,434	3.80	6.9	0.00	25.28	6.90	100.5	99.3
200	2.7	81,950	3.79	6.5	0.00	25.23	6.54	100.2	99.4
202	2.6	81,495	3.78	6.2	0.00	25.19	6.20	99.9	99.4
204	2.5	81,064	3.77	5.9	0.00	25.15	5.89	99.7	99.5
206	2.4	80,656	3.76	5.6	0.00	25.11	5.60	99.4	99.5
208	2.3	80,269	3.75	5.3	0.00	25.07	5.33	99.1	99.6
210	2.2	79,902	3.75	5.1	0.00	25.03	5.08	98.9	99.6
212	2.1	79,552	3.74	4.8	0.00	24.99	4.84	98.7	99.6
214	2.0	79,220	3.73	4.6	0.00	24.96	4.61	98.5	99.7
216	1.9	78,903	3.72	4.4	0.00	24.93	4.40	98.3	99.7
218	1.8	78,600	3.72	4.2	0.00	24.90	4.21	98.1	99.7
220	1.7	78,311	3.71	4.0	0.00	24.87	4.02	97.9	99.7
222	1.6	78,034	3.70	3.8	0.00	24.84	3.84	97.7	99.8

Computed By: PAW Date: 7-17-02

Checked By: MSP Date: 7-17-02

Sheet: 7 of 7

Sediment Basin Hydrograph
25-Yr Storm



Conclusion: The basin can pass the design storm without overtopping the dam and provide a settling efficiency greater than 75%.

Project:	Old Salisbury Road C&D Landfill	Computed:	PKW	Date:	7-11-02
Subject:	Drainage	Checked	MDP	Date	7-11-02
Task:	Perimeter Channels	Sheet	1	Of	2

Objective Design the channels between the landfill unit and the access road such that a grass lining will be adequate and limited to a maximum flow depth of 1.8'.

References

1. Elements of Urban Stormwater Design, H. Rooney Malcom, P.E.
2. NC Erosion and Sediment Control Planning and Design Manual
3. North American Green Product Brochure version 4.11

Equations

Normal Depth Procedure (Mannings Eqn)

$AR^{2/3} = Q\,n/\ 1.49s^{0.5}$ Area (A) = bd + z(d^2) $Z_{av} = AR^{2/3}$

$Z_{req} = Q\,n / 1.49s^{0.5}$ R = Area /(b+2d((z^2)+1)^.5) Avg Shear Stress(T) = K_b*d*s*unit weight of water

Design Channels along the access road

Min Channel Freeboard =	0.2	ft
Inside Channel Side Slope =	2	(enter X for X:1)
Outside Channel Side Slope =	2	(enter X for X:1)
Bottom Width, b =	4	ft
Runoff Coeff =	0.7	Ag land, smooth
I (in/hr) =	7.2	25-yr, 5-min Design Storm
Drainage Area (ac) =	8.6	Max Drainage Area
Q_P (cfs) = CIA =	43	

Various Lining Types

Lining Type	Lining Description	Mannings n depths of 0.5-2.0 ft	Vp (ft/sec)	Allowable Shear Stress psf
A	Jute Net (HEC-15)	0.015	2.0	0.45
B	Erosion Control Blanket Single Net (Curlex 1)	0.034	5.0	1.55
C	Erosion Control Blanket Double Net (Curlex HV)	0.026	10.0	1.65
D	Ordinary Firm Loam (Ref 2)	0.020	3.5	2.0
E	Grass Lined (Ref 2)	0.030	5.0	2.0
F	6" Rip Rap (Ref 2, Ref 1)	0.069	9.0	2.0
G	Unvegetated Turf Reinforcement Mat (TRM) (NAG C350)	0.025	9.5	2.25
H	Class D Phase 2 (Partially vegetated) TRM (NAG C350)	0.048	14.0	3.34
I	12" Rip Rap (Ref 2, Ref 1)	0.078	12.5	4.0
J	Class B Phase 3 (Fully vegetated) TRM (NAG C350)	0.048	18.0	5.7
K	Concrete (HEC-15, EPA 832-F-99-002)	0.013	25.0	10.0

Select Lining System for each channel slope that will handle the design flow when vegetated and when initially placed

Project: Old Salisbury Road C&D Landfill	Computed: PKW	Date: 7-11-02
Subject: Drainage	Checked MDP	Date 7-11-02
Task: Perimeter Channels	Sheet 2	Of 2

Lining Type	Channel Slope	Z_{req}	Flow Depth d (ft)	Cross Sectional Area (sf)	R	Z_{avail}	Velocity (ft/sec)	Average Shear Stress (lb/sf)	
Permanent Lining									
E	0.5%	12.34	1.6	11.92	1.05	12.34	3.6	0.5	
E	1.0%	8.73	1.4	9.27	0.91	8.73	4.7	0.9	
J	2.0%	9.87	1.5	10.13	0.96	9.87	4.3	1.8	
J	3.0%	8.06	1.3	8.75	0.88	8.06	5.0	2.5	
J	4.0%	6.98	1.2	7.89	0.83	6.98	5.5	3.1	
J	5.0%	6.24	1.2	7.28	0.79	6.24	6.0	3.6	
J	6.0%	5.70	1.1	6.82	0.76	5.70	6.4	4.1	
J	7.0%	5.28	1.1	6.45	0.74	5.28	6.7	4.6	
J	8.0%	4.94	1.0	6.15	0.72	4.94	7.0	5.1	
J	9.0%	4.65	1.0	5.90	0.70	4.65	7.4	5.5	
K	10.0%	1.20	0.5	2.30	0.38	1.20	18.9	2.9	
Initial Lining									
B	0.5%	13.99	1.7	13.07	1.11	13.99	3.3	0.5	
B	1.0%	9.89	1.5	10.15	0.96	9.89	4.3	0.9	
G	2.0%	5.14	1.0	6.33	0.73	5.14	6.8	1.3	
G	3.0%	4.20	0.9	5.48	0.67	4.20	7.9	1.7	
G	4.0%	3.64	0.9	4.95	0.63	3.64	8.7	2.2	
G	5.0%	3.25	0.8	4.57	0.60	3.25	9.5	2.5	FAILURE
I	6.0%	9.26	1.4	9.67	0.94	9.26	4.5	5.3	FAILURE
K	7.0%	1.43	0.5	2.59	0.41	1.43	16.7	2.2	
K	8.0%	1.34	0.5	2.48	0.40	1.34	17.5	2.5	
K	9.0%	1.26	0.5	2.38	0.39	1.26	18.2	2.7	
K	10.0%	1.20	0.5	2.30	0.38	1.20	18.9	2.9	

Find Max Q for following max allowable channel velocities & shear stresses

Lining Type	Channel Slope	Q (cfs)	Z_{req}	Flow Depth d (ft)	Cross Sectional Area (sf)	R	Z_{avail}	Velocity (ft/sec)	Average Shear Stress (lb/sf)
G	5.0%	34.8	2.61	0.7	3.92	0.54	2.61	8.9	2.25
G	6.0%	27.4	1.88	0.6	3.12	0.47	1.88	8.8	2.25
G	7.0%	22.5	1.43	0.5	2.59	0.41	1.43	8.7	2.25
G	8.0%	19.0	1.13	0.5	2.21	0.37	1.13	8.6	2.25
G	9.0%	16.4	0.92	0.4	1.92	0.33	0.92	8.6	2.25
G	10.0%	14.5	0.77	0.4	1.70	0.30	0.77	8.5	2.25

CONCLUSION

Design Flow Channels

Channels with slopes of 1% or less to be grass lined with temporary lining.
Use Turf Reinforcement Mat (TRM) for channels with slopes >1%.

Restricted Flow Channels

Limit the maximum flow for channels with slopes 5% to 10% to the values above until the channel is fully vegetated with temporary diversion channels.

Project:	Old Salisbury Road C&D Landfill	Computed: PAW	Date: 7-17-02
Subject:	Drainage	Checked MDP	Date 7-17-02
Task:	Sideslope Swales (Temporary Lining)	Sheet 1	Of 2

Objective: Determined if a temporary lining is adequate for the sideslope swales

References:
1. Elements of Urban Stormwater Design, H. Rooney Malcom, P.E.
2. NC Erosion and Sediment Control Planning and Design Manual

Equations and Givens:

Q (cfs) = CIA = Peak Flow
Drainage Area, A (acres) = varies, see below
Runoff Coefficient, C = 0.7

Design Storm: 25-Yr, 5-min

Rainfall, P (inches) = 5.5 Ref 1, Figure 8.03k
I (in/hr) = 7.2 Intensity for Design Storm

Normal Depth Procedure (Ref 1)

$AR^{2/3}=Qn/1.49s^{0.5}$ Area (A)= bd+z(d^2) $Z_{av}=AR^{2/3}$

$Z_{req}=Qn/1.49s^{0.5}$ R=Area/(b+2d((z^2)+1)^.5) Q=CIA

Avg Shear Stress (T) = K_b*d*s*unit weight of water

Desired Freeboard = 0.5 feet
Bench Width = 12 feet
Landfill Side Slope = 4
Design Channel Slope (s) = 0.03 ft fall / foot run
Mannings n = 0.034 Erosion Control Blanket Single Net, Curlex 1
permissible velocity (ft/sec) = 5.0 Erosion Control Blanket Single Net, Curlex 1
Allowable Shear Stress (psf) = 1.55 Erosion Control Blanket Single Net, Curlex 1

Scenario	Length (ft)	Vertical Spacing (ft)	Width / Spacing (ft)	Drainage Area (ac)	Q (cfs)	Inside Channel Side Slope (z)	Outside Channel Side Slope (m)	Bottom Width (ft)
1	982	30	132	3.0	15.0	4	2	3
2	924	30	132	2.8	14.3	4	2	2
3	627	30	132	1.9	13.8	4	2	1
4	363	30	132	1.1	12.8	4	2	0

Scenario	Flow Depth d (ft)	Cross Sectional A (sf)	Z_{req}	R	Z_{avail}	V (ft/sec)	Allowable Shear Stress (psf)	
1	0.7	3.32	1.98	0.46	1.98	4.5	1.25	OK
2	0.7	3.13	1.88	0.47	1.88	4.6	1.39	OK
3	0.8	3.01	1.82	0.47	1.82	4.6	1.59	FAILURE
4	1.0	2.84	1.69	0.46	1.69	4.5	1.82	FAILURE

Check Curlex II Lining

Project:	Old Salisbury Road C&D Landfill	Computed: DML	Date: 7-17-02
Subject:	Drainage	Checked MDP	Date 7-22-02
Task:	Sideslope Swales (Temporary Lining)	Sheet 2	Of 2

Mannings n =	0.026	Erosion Control Blanket Single Net, Curlex II
permissible velocity (ft/sec) =	7.5	Erosion Control Blanket Single Net, Curlex II
Allowable Shear Stress (psf) =	2	Erosion Control Blanket Single Net, Curlex II

Scenario	Flow Depth d (ft)	Cross Sectional A (sf)	Z_{req}	R	Z_{avail}	V (ft/sec)	Allowable Shear Stress (psf)	
3	0.8	3.0	1.39	0.47	1.82	4.6	1.59	OK
4	1.0	2.8	1.29	0.46	1.69	4.5	1.82	OK

CONCLUSION

Temporary Lining type = Curlex II
Permanent Lining type = Grass

Project:	Old Salisbury Road C&D Landfill	Computed: PAW	Date: 7-11-02
Subject:	Drainage	Checked MJP	Date 7-11-02
Task:	Sideslope Swales (Permenant Lining)	Sheet 1	Of 3

Objective

Determine max drainage area for sideslope swales based on constraints.

Constraints

Keep velocity relatively constant by varying the bottom width of channel.
Minimize the overall bench width.

References:

1. Elements of Urban Stormwater Design, H. Rooney Malcom, P.E.
2. NC Erosion and Sediment Control Planning and Design Manual

Drainage Area

Calculate Peak Flow

Q (cfs) = CIA = Peak Flow
Drainage Area, A (acres) = to be determined
Runoff Coefficent, C = 0.7
Design Storm: 25-Yr, 5-min

Rainfall, P (inches) =	5.5	Ref 1, Figure 8.03k
I (in/hr) =	7.2	Intensity for Design Storm

Equations:

Normal Depth Procedure (Ref 1)

$AR^{2/3} = Qn / 1.49s^{0.5}$ Area (A)= bd+z(d^2) $Z_{av}=AR^{2/3}$

$Z_{req} = Qn / 1.49s^{0.5}$ R=Area/(b+2d((z^2)+1)^.5) Q=CIA

Set velocity near the maximum allowed for grass lined channel and find maximum drainage area

Desired Freeboard =	0.5	feet
Overall Bench Width =	12	feet
Landfill Side Slope =	4	
Channel Slope (s) =	0.9-2.6%	Winston-Salem Unlined Closure As-Built
Design Channel Slope (s) =	0.03	ft fall / foot run
Mannings n =	0.030	Grass Lined, 0.5-2.0 ft (Ref 2)
max permissible velocity (ft/sec) =	5.0	for 0.5-2.0 ft (Ref 2)
Allowable Shear Stress (psf) =	2.0	Grass Lined, 0.5-2.0 ft (Ref 2)

Project:	Old Salisbury Road C&D Landfill	Computed: PAW	Date: 7-11-02
Subject:	Drainage	Checked MDP	Date 7-11-02
Task:	Sideslope Swales (Permenant Lining)	Sheet 2	Of 3

Scenario	Length (ft)	Vertical Spacing (ft)	Width / Spacing (ft)	Drainage Area (ac)	Q (cfs)	Inside Channel Side Slope (z)	Outside Channel Side Slope (m)	Bottom Width (ft)
1	982	30	132	3.0	15.0	4	2	3
2	924	30	132	2.8	14.3	4	2	2
3	627	30	132	1.9	13.8	4	2	1
4	363	30	132	1.1	12.8	4	2	0

Scenario	Flow Depth d (ft)	Cross Sectional A (sf)	Z_{req}	R	Z_{avail}	V (ft/sec)	Allowable Shear Stress (psf)	
1	0.6	3.03	1.74	0.44	1.74	5.0	1.17	ok
2	0.7	2.85	1.66	0.44	1.66	5.0	1.31	ok
3	0.8	2.73	1.60	0.45	1.60	5.0	1.50	ok
4	0.9	2.58	1.49	0.44	1.49	5.0	1.74	ok

Minimum Depth (ft) = 1.4 (includes freeboard)
Set Total Depth = 2.0

Check velocity in bare earth condition

Mannings n =	0.020	Ordinary Firm Loam (Ref 2)
max permissible velocity (ft/sec) =	3.5	Ordinary Firm Loam (Ref 2)
Allowable Shear Stress (psf) =	2.0	Ordinary Firm Loam (Ref 2)

Scenario	Length (ft)	Vertical Spacing (ft)	Width / Spacing (ft)	Drainage Area (ac)	Q (cfs)	Inside Channel Side Slope (z)	Outside Channel Side Slope (m)	Bottom Width (ft)
1	982	30	132	3.0	15.0	4	2	3
2	924	30	132	2.8	14.3	4	2	2
3	627	30	132	1.9	13.8	4	2	1
4	363	30	132	1.1	12.8	4	2	0

Scenario	Flow Depth d (ft)	Cross Sectional A (sf)	Z_{req}	R	Z_{avail}	V (ft/sec)	
1	0.5	2.27	1.16	0.37	1.16	6.6	> 3.5 fps need temp lining
2	0.6	2.13	1.11	0.38	1.11	6.7	> 3.5 fps need temp lining
3	0.7	2.02	1.07	0.38	1.07	6.8	> 3.5 fps need temp lining
4	0.8	1.90	0.99	0.38	0.99	6.7	> 3.5 fps need temp lining

Project:	Old Salisbury Road C&D Landfill	Computed: PAW	Date: 7-11-02
Subject:	Drainage	Checked MDP	Date 7-11-02
Task:	Sideslope Swales (Permenant Lining)	Sheet 3	Of 3

See attached calculations for Temporary Lining.

Check effects of settlement (flatter slope) on flow depth

Channel Slope After Setlement (s) =	0.015	ft fall / foot run (Assumed value)
max permissible velocity (ft/sec) =	5.0	for 0.5-2.0 ft (Ref 2)
Allowable Shear Stress (psf) =	2.0	Grass Lined, 0.5-2.0 ft (Ref 2)

Scenario	Length (ft)	Vertical Spacing (ft)	Width / Spacing (ft)	Drainage Area (ac)	Q (cfs)	Inside Channel Side Slope (z)	Outside Channel Side Slope (m)	Bottom Width (ft)
1	982	30	132	3.0	15.0	4	2	3
2	924	30	132	2.8	14.3	4	2	2
3	627	30	132	1.9	13.8	4	2	1
4	363	30	132	1.1	12.8	4	2	0

Scenario	Flow Depth d (ft)	Cross Sectional A (sf)	Z_{req}	R	Z_{avail}	V (ft/sec)	Allowable Shear Stress (psf)	
1	0.7	3.90	2.47	0.50	2.47	3.8	0.70	ok
2	0.8	3.69	2.35	0.51	2.35	3.9	0.77	ok
3	0.9	3.55	2.27	0.51	2.27	3.9	0.87	ok
4	1.1	3.34	2.10	0.50	2.10	3.8	0.99	ok

Flow Depths all less than 1.5' therefore channels all ok

Conclusion:

The swales should be constructed such that the bottom width is
greater than or equal to the design width for the corresponding drainage areas.
The maximum drainage area for this swale design is 1.1 acres
Construct a trapezodial shaped channel with the following dimensions:

Vertical Spacing (ft) =	30	
Min Depth of Swale (ft) =	1.6	(includes freeboard)
Set Depth of Swale (ft) =	2.0	
Outside Channel Side Slope (x:1) =	2	
Inside Channel Side Slope (x:1) =	4	
Design Channel Slope =	3%	
Bottom Width (ft) =	Varies from 0 to 1.6 feet	
Permanent Lining type =	Grass	
Temporary Lining type =	See attahced calcs	

HDR Computation | Job No. 00162-525-018

Project:	Old Salisbury Road C&D Landfill	Computed:	PMW	Date:	7-17-02
Subject:	Drainage	Checked	MDP	Date	7-17-02
Task:	Slope Drain	Sheet	1	Of	2

Objective

Determine the largest drainage area for a down chute pipe to carry the flow from the side slope swales to the perimeter channels.

References

1. Elements of Urban Stormwater Design, H. Rooney Malcom, P.E.
2. NC Erosion and Sediment Control Planning and Design Manual
3. Crumpler Plastic Pipe

Equations

$D = 16 * [Q * n / s^{0.5}]^{3/8}$

D (in) = Theoretical Pipe Diameter (in) for just full flow
Q (cfs) = Flow
n = Manning's Roughness Coefficient
s = Slope, ft fall / ft run

$Q (cfs) = CIA$

Q (cfs) = Flow
C = Runoff Coefficient
I (in/hr) = Intensity for Design Storm
A (acres) = Drainage Area

Assumptions

The drainage area may vary for each downchute, therefore determine the max drainage area that may be routed through the downchute.

Design Storm 25 yr, 5-min

Rational Coeff = 0.7 infiltration is restricted due to the final cover

Rainfall, P (inches) = 5.5 for 25 yr, 5-min storm

I (in/hr) = 7.2

n = 0.010 smooth Core Pipe Ref 3

Slope, s (X:1) =	3		3.5		4		4.5	
Slope, s (%) =	33%		29%		25%		22%	
D (in)	Q (cfs)	A (ac)	Q (cfs)	A (ac)	Q (cfs)	A (ac)	Q (cfs)	A (ac)
24	170.2	33.8	157.6	31.3	147.4	29.2	139.0	27.6
18	79.0	15.7	73.2	14.5	68.5	13.6	64.5	12.8
15	48.6	9.6	45.0	8.9	42.1	8.4	39.7	7.9
12	26.8	5.3	24.8	4.9	23.2	4.6	21.9	4.3
10	16.5	3.3	15.3	3.0	14.3	2.8	13.5	2.7
8	9.1	1.8	8.4	1.7	7.9	1.6	7.4	1.5

Set the max head then calculate the max drainage area to each inlet pipe to the downchute.

Project:	Old Salisbury Road C&D Landfill	Computed:	PAN	Date:	7-17-02
Subject:	Drainage	Checked	MJP	Date	7-17-02
Task:	Slope Drain	Sheet	2	Of	2

Outlet Protection

Minimum Tailwater Depth is assumed in accordance with NC Guidelines p. 6.41.1. Stormwater that is outlet onto broad flat areas with no defined channel may be assumed to have a minimum tailwater condition.

Refer to NC Guidelines p. 8.06.3 to size the apron and median Rip-Rap Size.

Pipe Dia. (ft)	Entrance (ft)	Q (cfs)	Length (ft)	Width (ft)	Median Rip Rap d_{50}	Rip Rap Sizeto Use (in)
1.25	3.75	42.1	26	27	1.4	Class 1
1	3.00	23.2	22	23	1.1	Class 1

Conclusion

Use 12"and 15" pipe for downchutes depending on drainage areas
Confirm that drainage areas are not exceeded during installation in asbuilt conditions.
Provide a 12" minimum cover of good soil over the pipes.

Appendix B

TECHNICAL SPECIFICATIONS

SECTION 02110
SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Site clearing, tree protection, stripping topsoil and demolition.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 02220 - Sitework.
   4. Section 02270 - Soil Erosion and Sediment Control.
   5. Section 02485 - Seeding.

1.2 QUALITY ASSURANCE

A. North Carolina Erosion and Sediment Control Planning and Design Manual, Current Edition.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect existing trees and other vegetation to remain outside limits of clearing against damage.
   1. Do not smother trees by stockpiling construction materials or excavated materials within drip line.
   2. Avoid foot or vehicular traffic or parking of vehicles within drip line.
   3. Provide temporary protection as required.

B. Repair or replace trees and vegetation outside clearing limits damaged by construction operations.
   1. Repair to be performed by a qualified tree surgeon.
   2. Remove trees which cannot be repaired and restore to full-growth status.
   3. Replace with new trees of minimum 4 IN caliper.

3.2 SITE CLEARING

A. Topsoil within the limits of construction to be removed upon completion of the clearing and grubbing. Topsoil to be stockpiled in a designated area. Do not use topsoil material as structural fill and do not respread topsoil for seeding. CQA Consultant to define topsoil.

B. Clearing and Grubbing:
   1. Clear from within limits of construction all trees not marked to remain.
      a. Include shrubs, brush, downed timber, rotten wood, heavy growth of grass and weeds, vines, rubbish, structures and debris.
   2. Grub (remove) from within limits of construction all stumps, roots, root mats, logs and debris encountered.
   3. In areas where there is no grading to occur, only clearing and grubbing, completely grub the area and fill in any depressions caused by stumps and prepare the area for permanent seeding.

C. Disposal of Waste Materials (Non-Saleable Material):
   1. Do not burn combustible materials on site.
   2. Do not bury organic matter on site.
   3. All waste materials shall be ground and stockpiled in an area designated by the Owner.

3.3 ACCEPTANCE

A. Upon completion of the site clearing, obtain Engineer's acceptance of the extent of clearing, depth of stripping and rough grade.

END OF SECTION

SECTION 02220
EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Earthwork.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bid Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 02276 - Soil Liner System.
   4. Construction Quality Assurance Plan.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society for Testing and Materials (ASTM):
      a. C33, Standard Specification for Concrete Aggregates.
      b. D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft3).
      c. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/f (2,700 kN-m/m)).
      d. D1586, Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.
      e. D2487, Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
      f. D4253, Standard Test Methods for Maximum Index Density of Soils Using a Vibratory Table.
      g. D4254, Test Methods for Minimum Index Density of Soils and Calculation of Relative Density.
   2. North Carolina Erosion and Sediment Control Planning and Design Manual, current edition.
   3. North Carolina Department of Transportation Standard Specification for Roads and Structures, current edition.

B. Contractor to employ an independent soils laboratory (CQC Consultant), in accordance with North Carolina General Statute 143-64.31 through 146-64.36 (the Minibrooks Act), to conduct the specified tests to assure that all work complies with this Specification.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   3. Certifications.
   4. Test reports:
      a. Soils inspection and testing results.

B. Samples:
   1. Submit samples and source of fill and backfill materials proposed for use.
   2. Submit samples and source of borrow materials proposed for use.
   3. Submit soil samples directly to CQA Consultant with notification to the Engineer.

1.4 SOILS/GEOTECHNICAL

A. The Owner will provide for the on-site services of a CQA Consultant (Soils Engineer) to selectively test materials and monitor compliance with the requirements of these Specifications. This will be in addition to Construction Quality Control (CQC), provided and paid for by the Contractor to be performed by the CQC Consultant in accordance with these Specifications and the CQA Plan.

B. The Contractor will afford these representatives access to the job site for the performance of their duties as described in the Contract Documents.

C. General Duties and Responsibilities of the Contractor's CQC Consultant: Under the direction of a qualified registered engineer or geologist:
   1. Perform stockpile and in-place testing of all soil and rock materials used in the work in conformance with these Specifications.
   2. Inspect subgrades and excavations and evaluate/determine suitability of materials encountered. Determine extent of any overexcavation required to remove unsuitable materials under roadways, structures, or other areas of construction.
   3. Document placement of fill materials and perform testing to confirm compliance with these Specifications.
   4. Evaluate the suitability of existing on-site materials for use in construction of embankments and fills within the proposed grading shown on the Contract Drawings.
   5. Measure quantity of unsuitable materials under contract provisions for authorized overexcavation and backfill.
   6. Provide to the CQA consultant on a weekly basis a summary of test results with a location map. The Owner may withhold payment if results are not submitted in a timely fashion.

D. General Duties and Responsibilities of Owner's CQA Consultant:
   1. Approve materials proposed for incorporation into the work as proposed by the CQC Consultant.
   2. Review subgrades and excavations and approve suitability of materials encountered as proposed by the CQC Consultant. Approve extent of any overexcavation required to remove unsuitable materials under roadways, structures, or other areas of construction, as proposed by the CQC Consultant.
   3. Observe placement of fill materials and testing by CQC Consultant for compliance with these specifications.
   4. Review/approve the suitability of existing on-site materials for use in construction of embankments and fills.
   5. Review construction operations and monitor for compliance with Contract Documents.
   6. Review/approve CQC Consultant quantity of unsuitable materials for payment on a unit price basis under contract provisions for authorized overexcavation and backfill.

E. Available Subsurface Information: Where provided, data on subsurface soil conditions are not intended as representations or warranties of the continuity of such conditions between borings or indicated sampling locations. It shall be expressly understood that neither the Owner nor the Engineer will be responsible for any interpretation or conclusion drawn therefrom by the Contractor. Data is made available for the convenience of the Contractor.

F. Additional or supplementary soil borings or other exploratory operations may be made by the Contractor at no additional cost to the Owner. The Contractor shall provide the Owner with a copy of any data obtained/developed during such work. Such additional work shall be performed in a timely manner in accordance with and not impacting or changing the project schedule set forth in the Contract Documents.

1.5 TOLERANCES

A. Grading shall be to a tolerance of + 0.1 FT unless otherwise noted in the construction documents and then the stricter criteria shall be used.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fill and Backfill: Selected material approved by Soils Engineer and Owner from site excavation or from site stockpile.

B. Structural Fill: Structural fill should conform to the following.

SIEVE SIZE	PERCENT FINER BY WEIGHT
3 IN	100
¼ IN	30-70
No. 40	5-40
No. 200	0-10

C. The Contractor shall conduct his own quantity and quality investigations and testing to determine availability and suitability of (on-site) borrow materials, as allowed by the Owner.

D. All earth materials proposed for use in the Work shall be adequately characterized prior to the Work by the CQC Consultant.

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect existing surface and subsurface features on-site and adjacent to site as follows:
1. Provide barricades, coverings, or other types of protection necessary to prevent damage to existing items indicated to remain in place.
2. Protect and maintain benchmarks, monitoring wells, existing structures, monuments, or other established reference points and property corners. If disturbed or destroyed, replace at own expense to full satisfaction of Owner and controlling agency.
3. Verify location of utilities. Omission or inclusion of utility items does not constitute non-existence or definite location. Secure and examine local utility records for location data.
   a. Take necessary precautions to protect existing utilities from damage due to any construction activity.
   b. Repair damages to utility items at own expense.
   c. In case of damage, notify Engineer at once so required protective measures may be taken.
4. Maintain free of damage, existing sidewalks, structures, and pavement not indicated to be removed. Any item known or unknown or not properly located that is inadvertently damaged shall be repaired to original condition. All repairs to be made and paid for by Contractor.
5. Provide full access to public and private premises, fire hydrants, street crossings, sidewalks, and other points as designated by Owner to prevent serious interruption of travel.
6. Maintain stockpiles and excavations in such a manner to prevent inconvenience or damage to structures on-site or on adjoining property.
7. Avoid surcharge or excavation procedures which can result in heaving, caving, or slides.
8. Conduct operation with minimum interference to daily landfill operations.

B. Construct erosion and sedimentation controls prior to beginning earthwork.

C. Salvageable Items: Carefully remove items to be salvaged, and store on Owner's premises unless otherwise directed.

D. Dispose of waste materials, legally, off site. Burning, as a means of waste disposal, is not permitted.

3.2 SITE EXCAVATION AND GRADING

A. The Work includes all operations in connection with excavation, borrow, construction of fills and embankments, rough grading, and disposal of excess materials in connection with the preparation of the site(s) for construction of the proposed facilities.

B. Excavation and Grading: Perform as required by the Contract Drawings.
   1. Contract Drawings may indicate both existing grade and finished grade required for construction of Project. Stake all units, structures, piping, roads, parking areas and walks and establish their elevations. Perform other layout work required. Replace property corner markers to original location if disturbed or destroyed.
   2. Preparation of ground surface for embankments or fills: Before fill is started, scarify to a minimum depth of 6 IN in all proposed embankment and fill areas. Where ground surface is steeper than one vertical to four horizontal, plow surface in a manner to bench and break up surface so that fill material will bind with existing surface.
   3. Protection of finish grade: During construction, shape and drain embankment and excavations. Maintain ditches and drains to provide drainage at all times. Protect graded areas against action of elements prior to acceptance of work. Re-establish grade where settlement or erosion occurs.

C. Borrow: Provide necessary amount of approved fill compacted to density equal to that indicated in this Specification. Include cost of all borrow material in original Bid. Fill material to be approved by Soils Engineer prior to placement.

D. Construct embankments and fills as required by the Contract Drawings:
   1. Construct embankments and fills at locations and to lines of grade indicated. Completed fill shall correspond to shape of typical cross section or contour indicated regardless of method used to show shape, size, and extent of line and grade of completed work.
   2. Provide approved fill material which is free from roots, organic matter, trash, frozen material, and stones having maximum dimension greater than 6 IN. Ensure that stones larger than 4 IN are not placed in upper 6 IN of fill or embankment. Do not place material in layers greater than 12 IN loose thickness. Place layers horizontally and compact each layer prior to placing additional fill.
   3. Compact by sheepsfoot, pneumatic rollers, vibrators, or by other equipment as required to obtain specified density. Control moisture for each layer necessary to meet requirements of compaction.

E. Upon reaching subgrade elevations shown, proofroll subgrade soils and obtain the CQC Consultant's review/recommendation and CQA Consultant's approval. If unsuitable materials are encountered at the subgrade elevation, repair as directed by the CQC Consultant and approved by the CQA Consultant to remove unsuitable materials. Excavation of 1 cy or greater should be preapproved by the CQC Consultant and CQA Consultant.

F. Proofrolling shall be conducted with a pneumatic-tired vehicle of at least 20 tons Gross Vehicle Weight (GVW), approved by the CQC and CQA Consultants. An alternate approved by the CQA Consultant may be used in constricted areas.

G. Where subgrade materials are determined to be unsuitable, such materials shall be removed to the lengths, widths, and depths directed by the CQC Consultant and approved by the CQA Consultant, and backfilled with suitable material unless further excavation or earthwork is required. No additional payment will be made for such excavation and backfill 6 IN or less than the finished subgrade. Payment for unsuitable material excavation greater than 6 IN beneath the finished subgrade shall be negotiated.

H. The subgrade of areas to receive fill shall be smooth and free of all vegetation, sticks, roots, rocks, and debris.

I. Dewatering (as required): Provide and maintain dewatering of all surface water and/or groundwater as required for excavation. Where groundwater is or is expected to be encountered during excavation, install a dewatering system to prevent softening and disturbance of subgrade below foundations and fill material, to allow foundations, fill material, and structures/backfill to be placed in the dry, and maintain a stable excavation. Soils and hydrogeologic information may be reviewed before beginning excavation to determine where goundwater is likely to be encountered during excavation. Employ a dewatering

specialist for selecting/designing, monitoring, and operating the dewatering system as needed. Keep dewatering system in operation until dead load of structure exceeds possible buoyant uplift force on structure or fill material. Dispose of groundwater to an area which will not interfere with construction operations or damage existing construction as approved by the Owner. Install groundwater monitoring points as necessary. Shut off dewatering system at such a rate so as to prevent a quick upsurge of water that might weaken the subgrade. Installation, start-up, monitoring maintenance, and shut-off of the dewatering system shall be at no additional cost to the Owner.

J. Do not place fill when the subgrade is frozen, wet, loose, or soft.

K. Moisture control:
   1. Moisture content of materials prior to, and during compaction, shall be uniform throughout each layer of material.
   2. Granular materials shall be thoroughly wetted during or immediately prior to compaction.
   3. Supplementary water shall be added as required to materials by sprinkling and mixing uniformly throughout layer.
   4. Materials too wet for placing shall be temporarily spread or aerated until moisture content is acceptable. If these materials cannot be processed in time to use, the Contractor shall find alternatives acceptable to the CQC Consultant and the CQA Consultant.

3.3 USE OF EXPLOSIVES

A. Blasting with any type of explosive must be in compliance with 3.4 of this Section.

3.4 ROCK EXCAVATION

A. Rock is defined as natural material that cannot be moved or ripped with a Caterpillar D9 equipped with a single tooth ripper or approved equal. A demonstration is required. The Contractor shall not remove rock until authorized by the Engineer.

B. All rock excavation shall be under one classification. This classification shall include solid ledge rock in its natural location that requires systematic quarrying, drilling, and/or blasting for its removal and also boulders that exceed 1 CY in volume.

C. When rock is encountered, strip free of earth. Employ an independent surveyor to determine rock quantities before removal operation begins. In computing the volumetric content of rock excavation for payment, the pay lines shall be taken as follows:
   1. For landfill cells: From rock surface to 2 FT below proposed subgrade and 10 FT outside the construction baseline.
   2. For structures: 3 FT outside the exterior limits of foundations and from rock surface to 6 IN below bottom of foundations.
   3. For piping and utilities: A width 18 IN wider than the outside diameter of the pipe or conduit and from rock surface to 6 IN below bottom exterior surface of the pipe or conduit.
   4. For paving: 2 FT outside the exterior limits of paving and from rock surface to 6 IN below bottom of pavement subbase.

D. The use of explosives shall be limited to the magnitude and location of the charge that will not cause damage to adjacent existing construction and utilities through shock vibrations or other stress loadings. Provide adequate blanket protection to ensure that there will not be fragments of rock or other debris flying through the air when discharging explosives. Any damage to existing construction or other features caused by blasting operations to be repaired and paid for by Contractor.
   1. Explosive permits shall be obtained from the appropriate local authorities by the Contractor.
   2. The Contract unit price for rock excavation shall include all permits, equipment and materials and other work necessary for excavation and hauling the rock from the site, and for furnishing and placing suitable replacement material as specified in its place.

E. Where explosives and blasting are used, comply with all laws and ordinances of municipal, state and Federal agencies relating to the use of explosives. Use qualified personnel for blasting and take proper precautions to protect persons, property or the work from damage or injury from blast or explosion. Conduct preblast survey in the company of the CQA Consultant to aid in determining any damage caused by blasting.

3.5 FIELD QUALITY CONTROL

A. Moisture density relations, to be established by the CQC Consultant are required for all materials to be compacted.

B. Extent of compaction testing will be as necessary to assure compliance with Specifications.

C. Give minimum of 24 HR advance notice to CQC Consultant and CQA Consultant when ready for compaction or subgrade testing and inspection.

D. Should any compaction density test or subgrade inspection fail to meet Specification requirements, perform corrective work as necessary.

E. Pay for all costs associated with corrective work and retesting resulting from failing compaction density tests.

3.6 COMPACTION DENSITY REQUIREMENTS

A. Obtain approval from Soils Engineer with regard to suitability of soils and acceptable subgrade prior to subsequent operations.

B. Provide dewatering system necessary to successfully complete compaction and construction requirements.

C. Remove frozen, loose, wet, or soft, material and replace with approved material as directed by Soils Engineer.

D. Stabilize subgrade with well graded granular materials as directed by Soils Engineer.

E. Assure by results of testing that compaction densities comply with the following requirements:

1. Sitework:

SOIL TYPE	COMPACTION DENSITY
Cohesive Soils	95 percent, ASTM D698
Cohesionless Soils	75 percent relative density per ASTM D4253 and D4254

2. Perform testing at a minimum frequency of 1 test per lift per 10,000 square feet. Refer to paragraph 3.2.D of this section for definition of a lift.

3.7 EXCAVATION, FILLING, AND BACKFILLING

A. General:

1. In general, work includes, but is not necessarily limited to, excavation removal of undesirable material, backfilling, filling, and subgrade compaction.
2. Obtain fill and backfill material necessary to produce grades required. Materials and source to be approved by Soils Engineer. Excavated material approved by Soils Engineer may also be used for fill and backfill.
3. In this Section of the Specifications, the word "foundations" includes footings, base slabs, foundation walls, mat foundations, grade beams, piers and any other support placed directly on soil.
4. In the paragraphs of this Section of the Specifications, the word "soil" also includes any type of rock subgrade that may be present at or below existing subgrade levels.

B. Filling and Backfilling. Prior to placing fill and backfill material, obtain optimum moisture and maximum density properties for proposed material from Soils Engineer. Place fill and backfill material in 12 IN loose lifts. Compact material with equipment of proper type and size to obtain density specified. Use only hand operated equipment for filling and backfilling next to walls and retaining walls. Do not place fill or backfill material when temperature is less than 40 DegF and when subgrade to receive material is frozen, wet, loose, or soft. Use vibratory equipment for compacting granular material; do not use water.

3.8 SPECIAL REQUIREMENTS

A. Erosion Control: Conduct work to minimize erosion of site. Construct stilling areas to settle and detain eroded material. Remove eroded material washed off site. Clean streets daily of any spillage of dirt, rocks, or debris from equipment entering or leaving site.

END OF SECTION

SECTION 02270
SOIL EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Soil erosion and sediment control.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bid Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 02220 - Earthwork.
   4. Section 02485 - Seeding.
   5. Section 02720 - Erosion Control Blankets.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. North Carolina Erosion and Sediment Control Planning and Design Manual, current edition.
   2. North Carolina State Department of Transportation Standard Specifications for Roads and Structures Construction, current edition.

1.3 SITE CONDITIONS

A. The Owner has installed sediment control features for their operations with the existing landfill area.

B. The Contractor may use these existing features with the Owner's prior approval, provided the Contractor maintains said features.

C. The Contractor shall protect streams and creeks from sediment laden runoff.

1.4 SUBMITTALS

A. See Section 01340.

B. Submit drawings indicating size, material, and length of materials to be used to construct erosion and sediment control features.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pipe Riser and Barrel: gage, diameter, and material as indicated on Drawings.

B. Stone for Stone Filter: NCDOT #5 stone.

C. Grass Seed: Refer to Section 02485, Seeding.

D. Silt Fence: Premanufactured or constructed on site.

E. Erosion Control Blankets – Refer to Section 02720, Erosion Control Blankets.

F. Concrete – Minimum 3,000 psi for antifloatation device.

G. Geotextile – 8 oz/sy nonwoven under stone used for sediment and erosion control.

H. Stone for apron outlets sized as indicated on Drawings in accordance with Section 02271, Stone Revetment.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prior to General Stripping Topsoil, Tree Clearing, and Excavating:
   1. Install silt fence, ditches, and channels.
   2. Excavate and shape sediment basins.
   3. Construct pipe spillways and install stone filter where required.
   4. Machine compact all berms, dikes, and embankments for basins.
   5. Refer to the construction sequence on the plans for further detail.

B. Temporarily seed basin slopes and stockpiles:
   1. Rate: Refer to Section 02485, Seeding.
   2. Reseed as required until good stand of grass is achieved.

3.2 DURING CONSTRUCTION PERIOD

A. Maintain Basins, Dikes, Stone Filters, Silt Fence, Etc.:
   1. Inspect regularly especially after rainstorms.
   2. Repair or replace damaged or missing items.

B. After rough grading, sow temporary grass cover over all exposed earth areas not draining into sediment basin.

C. Provide necessary swales and ditches to direct all water towards and into sediment basins.

D. Provide check dams as necessary in swales and ditches.

E. Do not disturb existing vegetation (grass and trees).

F. Excavate sediment out of basins when capacity has been reduced by 50 percent.
   1. Remove sediment from behind silt fence to prevent overtopping.

G. Topsoil and Fine Grade Slopes and Swales, Etc.:
   1. Seed and mulch as soon as areas become ready.

3.3 NEAR COMPLETION OF CONSTRUCTION

A. Cleanout sediment from each erosion control feature used during construction. Grade to finished or existing grades.

B. Fine grade all remaining earth areas, then seed and mulch in accordance with Section 02485, Seeding.

END OF SECTION

SECTION 02271
STONE REVETMENT (RIP RAP)

PART 1 - GENERAL

1.1 DESCRIPTION

A. General:
1. Furnish all labor, materials, tools, equipment and services for all stone revetment (rip rap) for protection of earthen slopes against erosion as indicated, in accord with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure, complete and compatible installation.
4. See Division 1 for General Requirements.

B. Work required in project includes but is not necessarily limited to:
1. Drainage Channels.
2. Sediment Basins.
3. Other areas indicated.

1.2 QUALITY STANDARDS

A. Perform all tests under supervision of Owner at an approved independent laboratory at no cost to Owner. Obtain samples in conformance with Corps of Engineers Specification CRD C 100-64 or other approved method.

B. Source Tests: Supply certified tests and service records to determine acceptability and application of stone materials. In event suitable test reports or a service record that is satisfactory are not available, as in case of newly operated sources, subject material to tests necessary to determine its acceptability for use. Tests to which materials may be subjected include but are not necessarily limited to:
1. Petrographic analysis.
2. Specific gravity.
3. Abrasion.
4. Absorption.
5. Wetting and drying.
6. Soundness in magnesium sulfate.
7. Freezing.
8. Thawing.
9. Such other tests as may be considered necessary to demonstrate satisfactorily that materials are acceptable.

C. Material acceptability tests:
1. Initial test: On material from each ledge sampled, prior to start of construction:
   a. Bulk specific gravity.
   b. Soundness in magnesium sulfate solution.
   c. Soundness in freezing and thawing.
2. Control tests: Perform control tests including one specific gravity, one soundness in magnesium sulfate solution test, and one soundness in freezing and thawing test for each type of stone protection material for every 1,000 tons of material.

D. Specific gravity test: ASTM C127.
1. Not less than 2.40 min.

E. Soundness in magnesium sulfate solution test: ASTM C88, except maintain samples immersed in solution at a temperature of 80 degF (26 degC) plus or minus 2 deg.

1. Loss at 5 cycles: Not more than 12 percent.

F. Soundness of aggregates in freezing and thawing test:
1. Ensure loss at 12 cycles of not more than 10 percent.
2. Modify and use AASHTO Designation T 103 Method.
3. Maintain temperature of cold liquid in range of -5 to 0 degF (-20 to -18 degC).
4. Maintain thaw fluid temperature in range of 45 to 50 degF (7 to 10 degC).
5. Permit length of freezing and of thawing cycles of two hours with one hour of freezing following by one hour of thawing.
6. Perform thawing by circulating thaw fluid around pan containing stone immersed in a depth of 1/4 IN (6 mm) rather than by total immersion.

1.3 SUBMITTALS

A. See Section 01300.

B. Supplier's certification of all materials.

C. Submit all tests and certification for stone revetment in a single coordinated submittal. Partial submittals will not be accepted.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stone: Approved durable broken stone quarry run.
1. Durable and of such quality that it will not disintegrate on exposure to water or weathering and free from structural fractures and defects.
2. Not containing shale, unsound sandstone, or other material which will readily disintegrate.
3. Graded within limits specified.
4. Neither breadth nor thickness of any stone less than one-third of its length.
5. Ensure that dirt and fines accumulated from interledge layers or from blasting or handling operation is less than 5 percent by weight.
6. The gradation of the material shall be well-graded from small to large of the sizes as indicated on the plans or as directed by the Engineer. The rock shall be sized so as to permit its interlocking.

PART 3 - EXECUTION

3.1 PREPARATION

A. Trim and dress all areas to conform to the Plans as indicated with tolerance of 0.1 FT from theoretical slope lines and grades.

B. Bring areas that are below allowable minus tolerance limit to grade by filling with embankment material similar to adjacent material.

C. Compact to density specified in Section 02220, Earthwork.

D. Do not place any stone material on prepared base prior to inspection and approval to proceed.

E. Lay geotextile fabric on prepared subgrade prior to placing rip rap.

3.2 PLACING RIP RAP

A. Place dumped rip rap on prepared foundation within limits indicated.

B. Place on prepared base to produce a well-graded mass of rock with minimum practicable percentage of voids, to required thickness and grades.

C. Place to full thickness in a single operation to avoid displacing the underlying material.

D. Distribute larger stones and entire mass in final position, roughly graded to conform to approximate gradation specified.

E. Keep finished rip rap free from objectionable pockets of small stones or clusters of larger stone.
   1. Hand place and rearrange individual stones as necessary to obtain a reasonably well-graded distribution.

F. Ensure a final tolerance of within 3 IN (75 mm) from indicated grade lines.
   1. Neither tolerance extreme continuous over an area greater than 200 SQ/FT (20 SM).

G. Distribute stones throughout mass either by selective loading at quarry or by controlled dumping of successive loads during final placing or by a combination of these methods.
   1. Do not place stone by dumping into chutes or by similar method likely to cause segregation.

H. Place stone revetment (rip rap) in conjunction with embankment construction at toe of revetment as necessary to prevent mixture of embankment and stone protection materials.
   1. Maintain stone revetment until accepted.
   2. Replace any displaced material to lines and grades shown.

END OF SECTION

SECTION 02485
SEEDING

PART 1 - GENERAL

1.1 DESCRIPTION

A. General:
1. Furnish all labor, materials, tools, equipment and services for seeding in accordance with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. See Division 1 for General Requirements.

B. Related work specified elsewhere:
1. Section 02110 - Site Clearing.
2. Section 02220 - Earthwork.
3. Section 02221 - Trenching, Backfilling, and Compacting.

C. Location of work: All disturbed areas, exclusive of lined landfill area.

1.2 QUALITY ASSURANCE

A. Fertilizer testing: Current methods of Association of Official Agricultural Chemists.
1. Testing will be conducted at discretion of Engineer.

1.3 SUBMITTALS

A. See Section 01300.

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

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

D. Indicate the mixture to be applied.

E. Indicate the application rate.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Establish a smooth, healthy, uniform, close strand of grass from specified seed.

B. Grass seed: Fresh, clean, latest available crop.
1. Species, proportions and minimum percentage of purity, germination, and maximum percentage of weed seed, as specified.
2. Provide following grass seed:

Botanical and Common Name	Min. pct. Germ	Min. pct. Purity
Kentucky 31 Fescue (tall)	80	97.0
Common Bermuda Grass	85	98.0
Lespedeza	85	97.0
Argentine Bahia Grass	85	98.0
Winter Rye	85	97.0

C. Mulch: Clean, seed-free, thressed straw of oats, wheat, barley, rye, beans, or other locally available mulch material.
   1. Do not use mulch containing a quantity of matured noxious weed seeds or other species that will be detrimental to seeding, or provide a menace to surrounding land.
   2. Do not use mulch material which is fresh or excessively brittle, or which is decomposed and will smother or retard growth of grass.

D. Fertilizer: Commercial grade fertilizer meeting applicable requirements of State and Federal law.
   1. Do not use cyanamic compounds of hydrated lime.

E. Limestone: agricultural grade ground limestone containing not less than 85 percent of combined calcium and magnesium carbonates.
   1. 50 percent passing 100 mesh sieve.
   2. 90 percent passing 20 mesh sieve.

F. Asphalt binder: Emulsified asphalt per State Specifications.

G. Water: Potable, free of substances harmful to growth.

H. Erosion Control Matting: Refer to Section 02720, Erosion Control Blankets. Contractor shall provide erosion control matting as required on slopes and ditchlines to obtain suitable vegetative cover.

2.2 DELIVERY, STORAGE AND HANDLING

A. Deliver seed in standard sealed containers labeled with producer's name and seed analysis, and in accord with US Department of Agriculture Rules and Regulations under Federal Seed Act.

B. Deliver fertilizer in original containers labeled with content analysis.

PART 3 - EXECUTION

3.1 JOB CONDITIONS

A. This project shall comply with the planting regime for the Piedmont Region.

B. Permanent Seeding – for areas where construction is complete, permanent seeding shall be completed in the time frame according to regulatory requirements. Engineer to verify surface prior to seeding.
   1. Spring (March 1 – April 30) and Fall (September 1 – November 15)
      a. Kentucky-31: 175 lbs/ac.
      b. Unhulled sercia lespedeza: 50 lbs/ac.
      c. Rye grain: 1 bushel/ac.
   2. Winter (November 16 – February 28)
      a. Kentucky-31: 200 lbs/ac.
      b. Unhulled sercia lespedeza: 50 lbs/ac.
      c. Rye Grain: 3 bushels/ac.
   3. Summer (May 1 – August 31)
      a. Kentucky-31: 50 lbs/ac.
      b. Unhulled sercia lespedeza: 50 lbs/ac.
      c. Korean or kobe lespedeza: 50 lbs/ac.
      d. Weeping love grass: 5 lbs/ac.
      e. Bermuda grass: 10 lbs/ac.
      f. Millet: 1 bushel/ac.

C. Temporary Seeding-for areas where construction has temporarily ceased for the time frame according to regulatory requirements.
   1. Provide winter rye at a rate of 224 lbs/acre.

3.2 SOIL PREPARATION

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

B. Loosen surface to minimum depth of four (4) IN.

C. Remove stones over one inch in any dimension, sticks, roots, rubbish and other extraneous matter.

D. Test soil pH using test kits approved by USDA NRCS. Use test results to determine rate of lime application needed to make soil circumneutral. Provide application rate to Engineer for approval prior to its application.

E. Spread lime uniformly over designated areas at rate determined by soil testing.

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

G. Test soil fertility according to USDA NRCS approved methods. Use test results to determine rate of fertilizer application. Engineer will approve fertilizer application rate prior to application.

H. Distribute fertilizer uniformly over areas to be seeded at a rate determined by soil testing.
   1. Use suitable distributor.
   2. Incorporate fertilizer into soil to depth of at least two IN.
   3. Remove stones or other substances which will interfere with turf development or subsequent mowing.

I. Grade seeded areas to smooth, even surface with loose, uniformly fine texture.
   1. Roll and rake, remove ridges and fill depressions, as required to meet finish grades.
   2. Fine grade just prior to planting.

J. Restore seeded areas to specified condition if eroded or otherwise disturbed between fine grading and planting.

K. If fertilizer application rate is determined (by invoices submitted) to be less than that specified, apply additional fertilizer.

L. Cover seeded areas with mulch.

3.3 SEEDING

A. Do not use seed which is wet, moldy, or otherwise damaged.

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

C. Distribute seed evenly over entire area at not less than 7LB/1000 SF, 50 percent sown in one direction, remainder at right angles to first sowing.

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

E. Resume work only when favorable condition develops.

F. Lightly rake seed into soil followed by light rolling or Culti-packing.

G. Immediately protect seeded areas against erosion by mulching or placing netting.
   1. Spread mulch in a continuous blanket using 1-1/2 TON/ACRE to depth of 4 or 5 straws.
   2. Immediately following spreading mulch, secure with evenly distributed emulsified asphalt at rate of 200 gal/acre.
   3. Protect all seeded slopes greater than 3:1 (horizontal to vertical) and ditches against erosion with approved erosion control netting or mats.

H. Immediately after planting, water to a reasonable depth.

I. Clean-up: Remove any soil or similar material from paved areas within same working day. Upon completion of seeding, remove all excess soil, stones, and other debris from site or dispose as directed by Owner. Repair all damages to existing construction caused by lawn operations to the satisfaction of Engineer and Owner at no additional cost to Owner

3.4 MAINTENANCE

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

B. Replant bare areas using same materials specified.

C. Contractor shall supply sufficient water until grass is established.

D. Contractor shall warranty work for one year from date of project final completion.

E. Inspect all seeded areas and make necessary repairs of re-seedings within planting season, if possible. If stand is over 60% damaged, re-establish planting area following recommendations specified for lime, fertilizer and seeding

END OF SECTION

SECTION 02511
AGGREGATE COURSE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Crushed stone paving course, compacted.

1.2 RELATED WORK

A. Section 01300 - Submittals

B. Section 02220 - Earthwork

1.3 REFERENCES

A. North Carolina Department of Transportation Standard Specifications for Roads and Structures, current edition.

1.4 TEST

A. Contractor to supply to Engineer certificate from supplier that material meets specifications.

B. Contractor to supply to Soils Engineer sample of material for determination of optimum moisture and density determination.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Material shall be ABC stone as provided in accordance with Section 1010 of the North Carolina Department of Transportation Standard Specifications for Roads and Structures.

PART 3 - EXECUTION

3.1 CONSTRUCTION

A. Construct aggregate course to grade, thickness, and typical section as indicated on drawings. Existing subgrade upon which aggregate course is to be placed shall be compacted in accordance with Section 02220.

B. Aggregate course shall be constructed in accordance with Section 520 of the North Carolina Department of Transportation Standard Specifications for Roads and Structures, unless indicated otherwise on plans or specifications.

3.2 COMPACTION

A. Compact by vibrating or other approved methods to 95 percent maximum dry density as determined by ASTM D1557.

B. Any irregularities in the surface shall be corrected by scarifying, remixing, reshaping and recompacting until a smooth surface is secure.

C. The crushed stone may be tested for depth and density by the Owner.

END OF SECTION

SECTION 02720
EROSION CONTROL BLANKETS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The erosion control blankets are for the purpose of erosion control and revegetation as described herein.

B. This work shall consist of furnishing and installation of the erosion control blankets and turf reinforced matting, including fine grading, blanketing, stapling, and miscellaneous related work, in accordance with these standard specifications and at the location(s) identified on Drawings or designated by Engineer. This work shall include all necessary materials, labor, supervision and equipment for installation of a complete system.

C. All work of this Section shall be performed in accordance with the Conditions and Requirements of the Contract Documents.

D. The erosion control blankets and turf reinforced matting shall be used where surface erosion is not desirable. The material shall be suitable for the following applications:
   1. Channel and ditch linings.
   2. Slope protection.

1.2 RELATED SECTIONS

A. Section 1300 - Submittals.

B. Section 02220 - Earthwork.

C. Section 02485 - Seeding.

1.3 PERFORMANCE REQUIREMENTS

A. Erosion control blankets shall provide a temporary, biodegradable cover material to reduce erosion and enhance revegetation.

1.4 SUBMITTALS

A. Submit product data on materials for erosion control blankets, and turf reinforced matting in accordance with Section 01300.

B. Submit product samples in accordance with Section 01300.

C. Any alternative system submitted for approval shall include complete design data, including test evidence of compliance to the essential design parameters of Project and reference installations similar in size and scope to that specified for Project.

1.5 DELIVERY, STORAGE AND HANDLING

A. Each material shall be furnished in rolls and wrapped with suitable material to protect against moisture and extended ultraviolet exposure prior to placement. Each roll shall be labeled to provide identification sufficient for inventory and quality control purposes.

B. Each material shall be free of defects that would interfere with the proper installation or impair the performance.

C. Each material shall be stored by Contractor in a manner which protects them from damage by construction traffic.

PART 2 - PRODUCTS

2.1 EROSION CONTROL BLANKETS

A. Erosion control blankets shall have a minimum permissible unit shear stress of 1.85 lb/sq.ft.

B. Erosion control blankets shall be Curlex II Excelsior as manufactured by American Excelsior, or approved equal.

C. Turf reinforced matting shall be C350 as manufactured by North American Green.

PART 3 - EXECUTION

3.1 SITE PREPARATION

A. Before placing erosion control or matting, the subgrade shall be inspected by Engineer to insure that it has been properly compacted; has been graded smooth; has no depressed, void, soft or uncompacted areas; is free from obstructions, such as tree roots, projecting stones or other foreign matter; and has been seeded. Contractor shall not proceed until all unsatisfactory conditions have been remedied. By beginning construction, Contractor signifies his approval of preceding work.

B. Contractor shall fine grade the subgrade by hand dressing where necessary to remove local deviations.

C. No vehicular traffic shall be permitted directly on the blankets.

3.2 CHANNEL INSTALLATION

A. Material shall be installed as directed by the Engineer in accordance with manufacturer's instructions. The extent of erosion control blankets shall be as shown on Drawings.

B. Material shall be installed parallel to the flow of water. The first roll shall be centered longitudinally in mid-channel and anchored. Subsequent rolls shall follow from channel center outward.

C. Successive lengths of material shall be overlapped ("shingled") sufficiently for a common row of connections with the upstream end on top. Connect the overlap across the end of each of the overlapping lengths.

D. A trench shall be located at the upstream termination. Material shall be connected to the bottom of the trench. Backfill and compact the trench.

3.3 SLOPE INSTALLATION

A. Before placing erosion control blanket, the subgrade shall be inspected by Contractor to insure that it has been properly compacted; has been graded smooth; has no depressed, void, soft or uncompacted areas; is free from obstructions, such as tree roots, projecting stones or other foreign matter; and has been seeded. Contractor shall not proceed until all unsatisfactory conditions have been remedied. By beginning construction, Contractor signifies his approval of preceding work.

B. Place on all slopes outside landfill construction baseline, excluding the stockpiles, on slopes greater than or equal to 3H:1V.

3.4 QUALITY ASSURANCE

A. Material shall not be defective or damaged. Any such problems shall be corrected by Contractor at no cost to Owner and to the satisfaction of Engineer.

3.5 CLEAN-UP

A. At the completion of this scope of work, Contractor shall remove from the job site and properly dispose of all remaining debris, waste materials, excess materials, and equipment required of or created by Contractor. Disposal of waste materials shall be solely the responsibility of Contractor and shall be done in accordance with applicable waste disposal regulations.

END OF SECTION

Appendix C

DRAWINGS

APPENDIX E

WETLAND DELINEATION

October 18, 2002

Mr. Edward Gibson, PE
Solid Waste Administrator
City/County Utility Commission
100 East 1st Street
Suite 131
Winston-Salem, NC 27101

Re: Wetland Delineation
Old Salisbury Road C&D Landfill
Forsyth County, North Carolina
HDR Project No. 00162-525-018

Dear Mr. Gibson:

HDR Engineering, Inc. of the Carolinas (HDR) has completed a wetlands field delineation of the proposed construction area for an expansion cell (Project) at the Old Salisbury Road Construction & Demolition (C&D) Debris Landfill Site (Site). The purpose of the Project was to delineate jurisdictional waters under Section 404 of the Clean Water Act (CWA).

This report includes a description of the methods and findings, a map showing the approximate locations of the streams and wetlands, and supporting documentation. A final survey plat will be sent to you once it is approved by the US Army Corps of Engineers (USACE).

Methods

The wetlands delineation was performed according to protocol set forth in the 1987 Wetlands Delineation Manual (Wetlands Research Program Technical Report Y-87-1). The three required parameters for wetlands; hydrophytic vegetation, hydric soils, and wetland hydrology, were examined to determine the presence and boundaries of jurisdictional wetlands within the Study Area (see enclosed map).

The Study Area was reviewed for potential wetlands, and those areas exhibiting wetland characteristics were sampled to verify their status. The data sheets from

HDR Engineering, Inc. of the Carolinas
128 S Tryon Street
Suite 1400
Charlotte, NC 28202-5004
Phone: (704) 338-6700
Fax: (704) 338-6760
www.hdrinc.com

representative wetland and upland sample points are enclosed. Upon completion of the sampling, the wetland/upland interface was determined, flagged, and surveyed. Stream channels were flagged at regular intervals and meanders and marked with a width at each location. Wetland areas were flagged along the boundary where at least one wetland characteristic became absent.

Results

Delineation was performed on the Study Area, which may be impacted by future development. The Study Area borders the eastern edge of the Site including the future expansion area (see enclosed map). This area includes an intermittent and perennial channel (Reach A), intermittent channels draining to Reach A from the east (Reaches B, C, D, and E), small headwater and floodplain wetlands (Areas V, X, Y, and Z), and a larger wetland (Area W).

Reach A begins at a distinct head cut where definite banks are present and continues north through a culvert under the entrance drive. At this location, check dams are in the channel, creating some ponding of water. Reach A continues north, paralleling the eastern edge of the property, until discharging into Wetland Area W, which then drains through a culvert to an off-site pond. Sedimentation was present throughout the channel. In addition, the channel was incised with steep banks near the confluences with Reaches C and D. The northernmost reach of the channel becomes less defined as it enters the wetland area. Riparian vegetation is present along the length of the channel and its tributaries.

All the wetland areas exhibited the three required criteria. Wetland Areas V, X, and Z were generally unvegetated flats or backwater areas along tributary drainages (Area Z) or in the floodplain (Areas V and X) of Reach A. Wetland Area Y is a small headwater wetland above Wetland Z. Wetland Area W includes hydrophytic vegetation with herb, vine, and shrub layers; however, a canopy tree layer is lacking throughout most of the area (see enclosed wetland data form). Hydric soil indicators, including low chroma matrices, are present, indicating prolonged saturation. The soil characteristics, along with supporting hydrological indicators such as saturation, sediment deposits, and drainage pattern, determined where the upland/wetland boundaries were located. In general, wetland boundaries were controlled by the lack of hydric soil indicators and hydrology, while hydrophytic vegetation extended beyond the wetland line.

Mr. Max Brady, a North Carolina licensed surveyor with Brady Surveying, Inc., will sign the enclosed map after which it will be submitted to the USACE for signature. A final copy will be sent to your attention. Verification of the map is expected since the delineation itself was verified as shown in the attached Notification of Jurisdictional Determination from the USACE.

Based on the surveyed location of the wetland and stream boundaries, no impacts to jurisdictional waters under the CWA are expected to result from the landfill construction. Therefore, no permitting or notification to the USACE will be required once the map has been signed.

If you have any questions or comments, please call me at your earliest convenience at 919-785-1118.

Sincerely,

HDR Engineering, Inc. of the Carolinas

Philip May
Environmental Scientist

JLH/jvd

Enclosures

cc: Mike Plummer, HDR Engineering, Inc. of the Carolinas
Danny Hockett, Environmental Compliance Officer,
City/County Utilities Commission

COPY

U.S. ARMY CORPS OF ENGINEERS
Wilmington District

Action ID: 200221317 **County:** Forsyth

NOTIFICATION OF JURISDICTIONAL DETERMINATION

Property Owner City of Winston-Salem/Forsyth County Utility Commission
Attn: David Sauders
Address Post Office Box 2511
Winston-Salem, NC 27102-2511
Telephone Number 336-727-8418

Authorized Agent HDR Engineering, Inc.
Attn: Phil May
Address 3725 National Drive, Suite 103
Raleigh, NC 277612
Telephone Number 919-785-1118

Size and Location of Property (waterbody, Highway name/number, town, etc.): The property is located west of Old Salisbury Street, 0.25 mile south of Muddy Creek, in Forsyth County, North Carolina. The site is located adjacent to an unnamed tributary of Muddy Creek, in the Yadkin River Basin.

Basis for Determination: The site contains wetlands and stream channels with indicators of ordinary high water marks, located adjacent to an unnamed tributary of Muddy Creek, above headwaters, in the Yadkin River Basin.

Indicate Which of the Following Apply:

___ There are waters of the U.S., to include wetlands, on the above described property which we strongly suggest should be delineated and surveyed. The surveyed wetland lines must be verified by our staff before the Corps will make a final jurisdictional determination on your property.

___ Because of the size of your property and our present workload, our identification and delineation of your wetlands cannot be accomplished in a timely manner. You may wish to obtain a consultant to obtain a more timely delineation of the wetlands. Once the consultant has flagged a wetland line on the property, Corps staff will review it, and, if it is accurate, we strongly recommend that you have the line surveyed for final approval by the Corps. The Corps will not make a final jurisdictional determination on your property without an approved survey.

X The waters of the U.S., to include wetlands, on your lot have been delineated, and the limits of the Corps jurisdiction have been explained to you. 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.

___ There are no waters of the U.S., to include wetlands, present on the above described property which are subject to the permit requirements of Section 404 of the Clean Water Act (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.

Placement of dredged or fill material in wetlands on this property without a Department of the Army Permit is in most cases a violation of Section 301 of the Clean Water Act (33 USC 1311). A permit is not required for work on the property restricted entirely to existing high ground. If you have any questions regarding the Corps of Engineers regulatory program, please contact Todd Tugwell **at telephone number** (919) 876 - 8441 extension 26.

Project Manager Signature Todd Tugwell

Date August 6, 2002 **Expiration Date** August 6, 2007

SURVEY PLAT OR FIELD SKETCH OF THE DESCRIBED PROPERTY AND THE WETLAND DELINEATION FORM MUST BE ATTACHED TO THE YELLOW (FILE) COPY OF THIS FORM.

NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL

Applicant: City of Winston-Salem/Forsyth County Utility Commission Old Salisbury Road Landfill	File Number: 200221317	Date: 08/06/2002

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
X	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://usace.army.mil/inet/functions/cw/cecwo/reg 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 division 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: Mr. Todd Tugwell, Regulatory Specialist Raleigh Regulatory Field Office 6508 Falls of the Neuse Road, Suite 120 Raleigh, North Carolina 27615	If you only have questions regarding the appeal process you may also contact: Mr. Arthur Middleton, Administrative Appeal Review Officer CESAD-ET-CO-R U.S. Army Corps of Engineers, South Atlantic Division 60 Forsyth Street, Room 9M15 Atlanta, Georgia 30303-8801

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:

DIVISION ENGINEER:
Commander
U.S. Army Engineer Division, South Atlantic
60 Forsyth Street, Room 9M15
Atlanta, Georgia 30303-3490

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Old Salisbury Rd (+D Landfill Applicant/Owner: City of Winston Salem Investigator: Phil Mann	Date: 7/17/02 County: Forsyth State: NC
Do Normal Circumstances exist on the site? (Yes) No Is the site significantly disturbed (Atypical Situation)? Yes (No) Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: WET Transect ID: A Plot ID: WL-W

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Salix nigra	S	OBL
2. Liquidambar styraciflua	S	FAC+
3. Platanus occidentalis	S	FACW-
4. Ephalanthus occidentalis	S	OBL
5. Smilax rotundifolia	V	FAC
6. Vitis rotundifolia	V	FAC
7. Toxicodendron radicans	V	FAC
8. Juncus sp.	H	-

Dominant Plant Species	Stratum	Indicator
9. Impatiens capensis	H	FACW
10. Boehmeria cylindrica	H	FACW+
11. Sagittaria sp	H	OBL
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 100%

Remarks: No trees (some Salix nigra approaching tree size).

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

X No Recorded Data Available

Field Observations:

Depth of Surface Water:	- (in.)
Depth to Free Water in Pit:	- (in.)
Depth to Saturated Soil:	0 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- X Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- X Sediment Deposits
- X Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- X Oxidized Root Channels in Upper 12 Inches
- X Water-Stained Leaves
- ___ Local Soil Survey Data
- X FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Chewacla loam

Drainage Class: Somewhat poorly

Taxonomy (Subgroup): Fluvaquentic Dystrochrepts

Field Observations
Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0"	A	2.5Y 3/3	10YR 4/6	Common/Fm/Dist	wet Micaceous silty loam
3"	B&1	2.5Y 5/2	10YR 4/6	Com/Lg/Dist	wet micaceous sandy loam
10"	B&2	2.5Y 6/2	–	–	wet fine-coarse sand

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks: NRCS Field Indicator F3 - Depleted matrix.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	(Yes) No (Circle)	(Circle)
Wetland Hydrology Present?	(Yes) No	
Hydric Soils Present?	(Yes) No	Is this Samplig Point Within a Wetland? (Yes) No

Remarks:

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Old Salisbury Rd C+D Landfill Applicant/Owner: City of Winston Salem Investigator: Phil Mann	Date: 7/17/02 County: Forsyth State: NC
Do Normal Circumstances exist on the site? (Yes) No Is the site significantly disturbed (Atypical Situation)? Yes (No) Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: WET Transect ID: A Plot ID: WL-W

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Salix nigra	S	OBL
2. Liquidambar styraciflua	S	FAC+
3. Platanus occidentalis	S	FACW-
4. Cephalanthus occidentalis	S	OBL
5. Smilax rotundifolia	V	FAC
6. Vitis rotundifolia	✓	FAC
7. Toxicodendron radicans	✓	FAC
8. Juncus sp.	H	-

Dominant Plant Species	Stratum	Indicator
9. Impatiens capensis	H	FACW
10. Boehmeria cylindrica	H	FACW+
11. Sagittaria sp.	H	OBL
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 100%

Remarks: No trees (some Salix nigra approaching tree size).

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

X No Recorded Data Available

Field Observations:

Depth of Surface Water:	- (in.)
Depth to Free Water in Pit:	- (in.)
Depth to Saturated Soil:	0 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- X Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- X Sediment Deposits
- X Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- X Oxidized Root Channels in Upper 12 Inches
- X Water-Stained Leaves
- ___ Local Soil Survey Data
- X FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Chewacla loam

Drainage Class: Somewhat poorly

Taxonomy (Subgroup): Fluvaquentic Dystrochrepts

Field Observations Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0"	A	2.5Y 3/3	10YR 4/6	Common/Sm/Dist	wet Micaceous silty loam
3"	B&1	2.5Y 5/2	10YR 4/6	Com/Lg/Dist	wet micaceous sandy loam
10"	B&2	2.5Y 6/2	–	–	wet fine-coarse sand

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks: NRCS Field Indicator F3 - Depleted matrix.

WETLAND DETERMINATION

Hydrophytic Vegetation Present? (Yes) No (Circle)
Wetland Hydrology Present? (Yes) No
Hydric Soils Present? (Yes) No

(Circle)
Is this Samplig Point Within a Wetland? (Yes) No

Remarks:

Approved by HQUSACE 3/92

APPENDIX F

OPERATION PLAN

OPERATION PLAN

FOR THE OLD SALISBURY ROAD

CONSTRUCTION AND DEMOLITION LANDFILL

FORYSTH COUNTY, NORTH CAROLINA

TABLE OF CONTENTS

Section **Page**

I. Introduction.....1

II. Standard Operating Procedures.....1
- A. Hours and Days of Operating
- B. Weigh Procedures
- C. Wastes Accepted
- D. Unacceptable Waste
- E. Filling Procedures
- F. Cover Material Requirements

III. Waste Screening Procedures.....2
- A. Waste Recycling and Inspection
- B. Waste Screening Record Keeping Procedures

IV. Progression of Fill.....3

V. Worker Safety and Training.....3
- A. Operators Training
- B. Safety Equipment
- C. Fires and Natural Disasters

VI. Miscellaneous Operational.....4
- A. Staffing
- B. Facility Access
- C. Purpose
- D. Definitions
- E. Responsible Persons
- F. Emergency Response Telephone Numbers
- G. Emergencies
  - i. Fire and Explosion
  - ii. Tornado and Hurricane
  - iii. Evacuation

APPENDICES

Appendix A – Site Map

Appendix B – Landfill Emergency Action Plan

Appendix C – Emergency Flow Chart/Telephone Procedures

I. INTRODUCTION

The purpose of this document is to identify protocols for the overall operation and maintenance of the Old Salisbury Road Construction and Demolition Landfill (Landfill), which is owned and operated by the City/County Utility Commission. This plan provides details of the procedures and policies, which shall be implemented throughout the life of the Landfill.

II. STANDARD OPERATING PROCEDURES

A. Hours and Days of Operating

The Landfill is open for operation between the hours of 7:00 am and 5:00 pm, Monday through Friday, and from 8:00 am and 4:00 pm on Saturday. The Landfill is normally closed on Sundays except where prior permission has been given to receive waste for special instances such as a natural disaster. The observed holidays are New Years' Day, Martin Luther King, Jr. Day, Good Friday, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and the day after, and Christmas Day.

Special notices are to be posted at the scalehouse advising users of the observed holidays. Such notices are posted at least one week in advance of the observed holiday.

B. Weighing Procedures

All vehicles entering the Landfill are required to stop at the scalehouse, which is located at the entrance to the facility. All visitors to the facility are required to sign in. All refuse transportation vehicles are weighed on permanent scales and the content of the load is assessed. The weighmaster requests, from the driver of the vehicle, a description of the waste to ensure that unacceptable waste is not entering the Landfill. The weighmaster then collects payment and visually checks the vehicle as it crosses the scale.

C. Wastes Accepted

This solid waste management facility is approved to receive only the following waste:

- Land-Clearing Debris as defined in General Statutes 130A-290;
- Asphalt in accordance with General Statutes 130A-294(m);
- Construction and Demolition Debris defined as solid waste resulting solely from construction, remodeling, repair or demolition operations on pavement, buildings or other structures;
- Inert Debris defined as soil waste, which is virtually inert, such as brick, concrete, rock, and uncontaminated soil.

NOTE: Yard waste defined as solid waste consisting solely of vegetative matter resulting from landscaping maintenance (see General Statues 130A-290) is banned from disposal in this facility per NC General Statutes. Yard waste is to be directed to the Overdale Yard Waste Facility.

D. Unacceptable Waste

The following wastes are prohibited from disposal at the Landfill:

- Whole Scrap Tires
- Used Oil
- Sanitary Waste
- Yard Waste
- White Goods
- Lead Acid Batteries
- Hazardous Waste

E. Filling Procedures

Solid waste transportation vehicles will arrive at the working face in random intervals. There may be several vehicles unloading waste at one time, while other vehicles are waiting. Solid waste unloading in the Landfill is controlled to prevent disposal in locations other than those specified by the site management. This control confines the working face to the minimum area required which improves the overall landfill aesthetics and minimizes the amount of cover soil required. Normally, only one working face is active on any given day.

F. Cover Material Requirements

Waste shall be covered at a minimum of once per week with at least 6 inches of suitable cover. Areas that will not have additional waste place on them for 12 months or more, but where final elevations have not been reached, shall be covered with one foot of soil cover. Within six months of termination of disposal operations, the final cover system shall be installed.

III. WASTE SCREENING PROCEDURES

In order to prevent unacceptable waste from entering the Landfill, the following screening procedures have been implemented; Waste received at the scalehouse entrance and waste taken to the working face is inspected by a trained personnel. These individuals are trained to spot indications of suspicious waste that include hazardous placards or markings, liquids, powders or dusts, sludges, bright or unusual colors, drums or commercial size containers and chemical odors. Screening procedures for visual and olfactory characteristics of prohibited wastes are an ongoing part of the Landfill operation.

A. Waste Receiving and Inspection

Approximately 10 percent of the Landfill traffic is selected for screening per quarter. Selected vehicles are directed to an area that is separate from the working face and the vehicle is unloaded. Waste is carefully spread using the appropriate equipment. A solid waste division employee trained to identify unacceptable material will inspect the waste discharged at the screening site. If unacceptable waste is found, including waste

generated outside the service area, the load will be isolated and secured. The Landfill Manager will then notify officials with the Department of Environment, and Natural Resources (NCDENR), Division of Solid Waste Management within 24 hours of the attempted disposal to inform them of the unacceptable waste and determine the appropriate course of action. The hauler is responsible for removing unacceptable waste from the Landfill property.

B. Waste Screening Record Keeping Procedures

The following records are kept on-site to document all inspections:

- The date and times waste were received for inspection.
- Source and type of waste.
- Vehicle and driver identification.
- All observations made by the inspector.
- Final disposition of waste after inspection.

IV. PROGRESSION OF FILL

The boundaries of the phases are shown on Figure 1. The purpose of the boundaries are to illustrate the general concept and progression of filling. Filling of each Phase will begin only when the Phase is excavated to the designed base grade and then certified by survey.

Each phase should be filled from the high end to allow storm water to drain freely into the sediment basins. Waste should be placed in uniform lifts that are as thin as practical and compacted to maximize the landfill capacity. The area of the working face will vary depending on disposal demand but should be kept as small as practical to limit the requirement for cover soil. Waste should be placed in approximately 10-foot high lifts across a phase and provide adequate maneuvering room for building subsequent lifts.

A 20-foot buffer should be maintained free of waste along the inside toe of the eastern slope to allow for the expansion of the Landfill into subsequent phases without having to rehandle the waste.

V. WORKER SAFETY AND TRAINING

All landfill operating personnel shall receive training, safety equipment, and supervision necessary to carry out their assigned duties.

A. Operations Training

The Utilities Supervisor and the Assistant Solid Waste Supervisor shall both be Certified Managers of Landfill Operations (MOLO) by the Solid Waste Association of North America (SWANA). In addition to trained supervisory staff, all new employees at the facility will be shown a video on operation "do's and don'ts." The Utilities Supervisor will then schedule the employee to take a SWANA certified operator training course. The course takes 30 hours to complete. The certification requirements include:

- ❖ High School Degree or GED.
- ❖ Minimum of 5 years experience in MSWM.
- ❖ Minimum of two years experience in management/supervisory position at an MSW landfill and currently in that position.
- ❖ Completion of SWANA Manger of Landfill Operations Training Course and passing grade on the examination.
- ❖ Thirty continuing education contact hours over three years to remain certified.

The employee will also be scheduled to participate in the waste screening program in order to gain hands on experience in determining inappropriate wastes.

B. Safety Equipment

All employees will be provided the following safety equipment: hard hat, safety vest, safety shoes, face mask, gloves, fire extinguisher, Emergency Action Plan and First Aid kit. All employees will be trained in the proper use of safety equipment. Additionally, the City of Winston-Salem regularly offers OSHA approved safety training classes for their employees.

C. Fires and Natural Disasters

i. Emergency Protocols

In the event of a fire or other natural disaster, all staff should follow the protocols outlined in the Landfill Emergency Action Plan. This plan was designed to meet the requirements of OSHA 1910.38a and 1910.120. It is incorporated herein as Appendix A.

ii. Follow up Procedures

The fire department will be notified in cases of Emergency. The NCDENR Solid Waste Section will be notified by telephone within 24 hours of an emergency response by the fire department to the facility. A follow up letter detailing the nature of the emergency and any action taken will be mailed to the section within 15 days of an emergency response.

VI. MISCELLANEOUS OPERATIONAL

A. Staffing

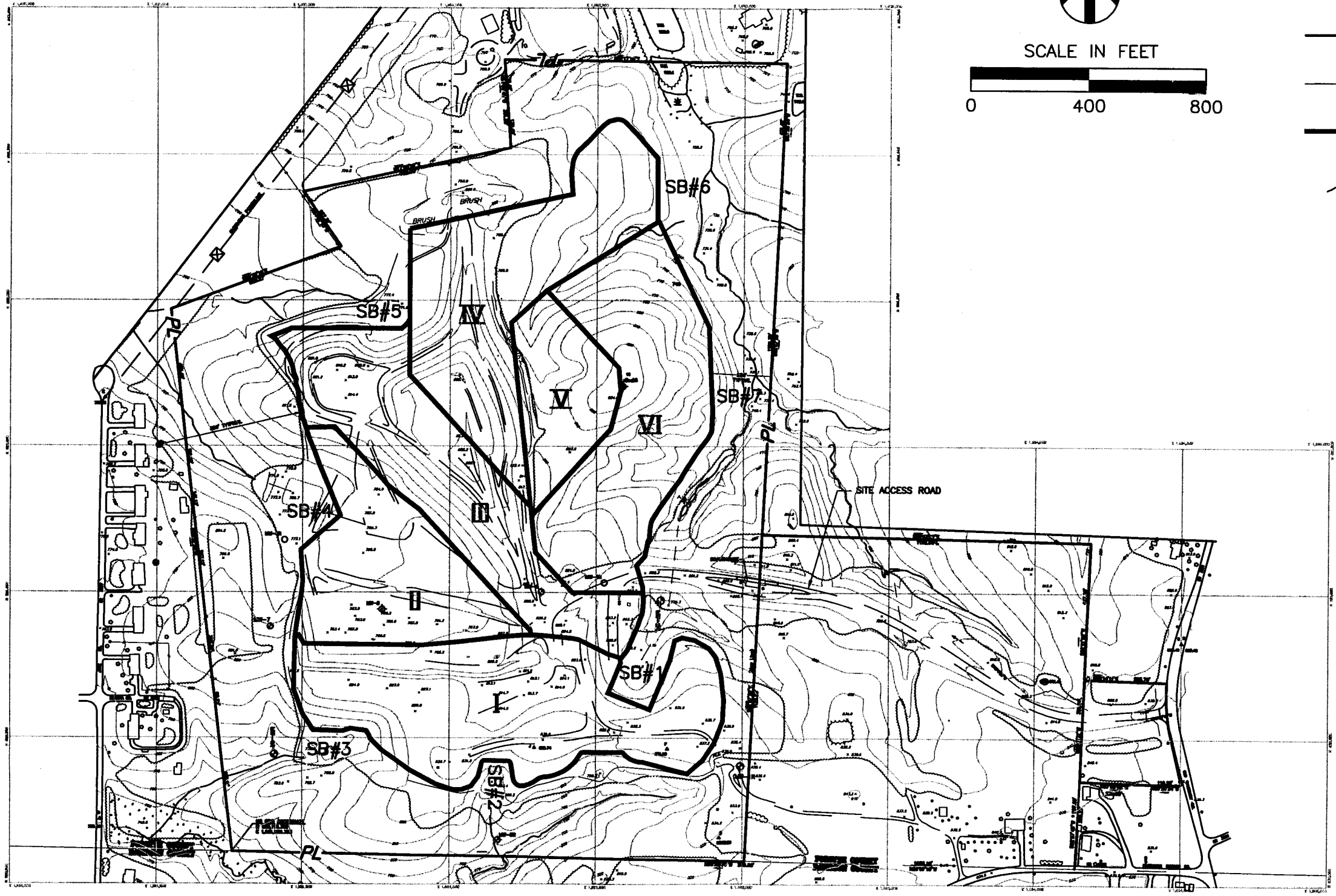
The facility will be staffed during all operating hours to ensure operational compliance.

B. Facility Access

The access road to the working face will be constructed for all-weather use and kept in good working condition. Dust control and tracked mud will be controlled as needed.

Proper signage directing and informing facility users, will be placed in high visibility areas. Signs shall indicate the types of material allowed in the facility.

APPENDIX A



N

SCALE IN FEET

0 400 800

LEGEND

- 810 — EXISTING CONTOURS
- PL — PROPERTY BOUNDARY
- COUNTY LINE
- PHASING LIMITS
- STREAM
- GW MONITORING WELL
- Ⓦ — PRIVATE WATER SUPPLY WELL
- SB#2 — SEDIMENT BASIN

NOTES

1. TOPOGRAPHIC INFORMATION PROVIDED BY CARTOGRAPHIC AERIAL MAPPING FOR PHASES I, II AND III DATED SEPTEMBER 29, 2001 AND FOR THE
2. REMAINDER OF THE SITE.

   PROPERTY SURVEY TAKEN FROM DATA SUPPLIED BY BRADY SURVEYING, INC.
3. MARCH 14, 1994.

   THIS SITE IS ANTICIPATED TO BE DEVELOPED AS A SERIES OF PHASES BEGINNING WITH PHASE IV AND ENDING WITH PHASE VI.

HDR Engineering, Inc. of the Carolinas
Suite 1400
128 S. Tryon Street
Charlotte, NC 28202-5001
(704) 338-1800

OLD SALISBURY ROAD CONSTRUCTION AND DEMOLITION LANDFILL

SITE MAP

WINSTON-SALEM NORTH CAROLINA

Date 7/02

Figure 1

P:\WINSLC\11117LOCM

APPENDIX B

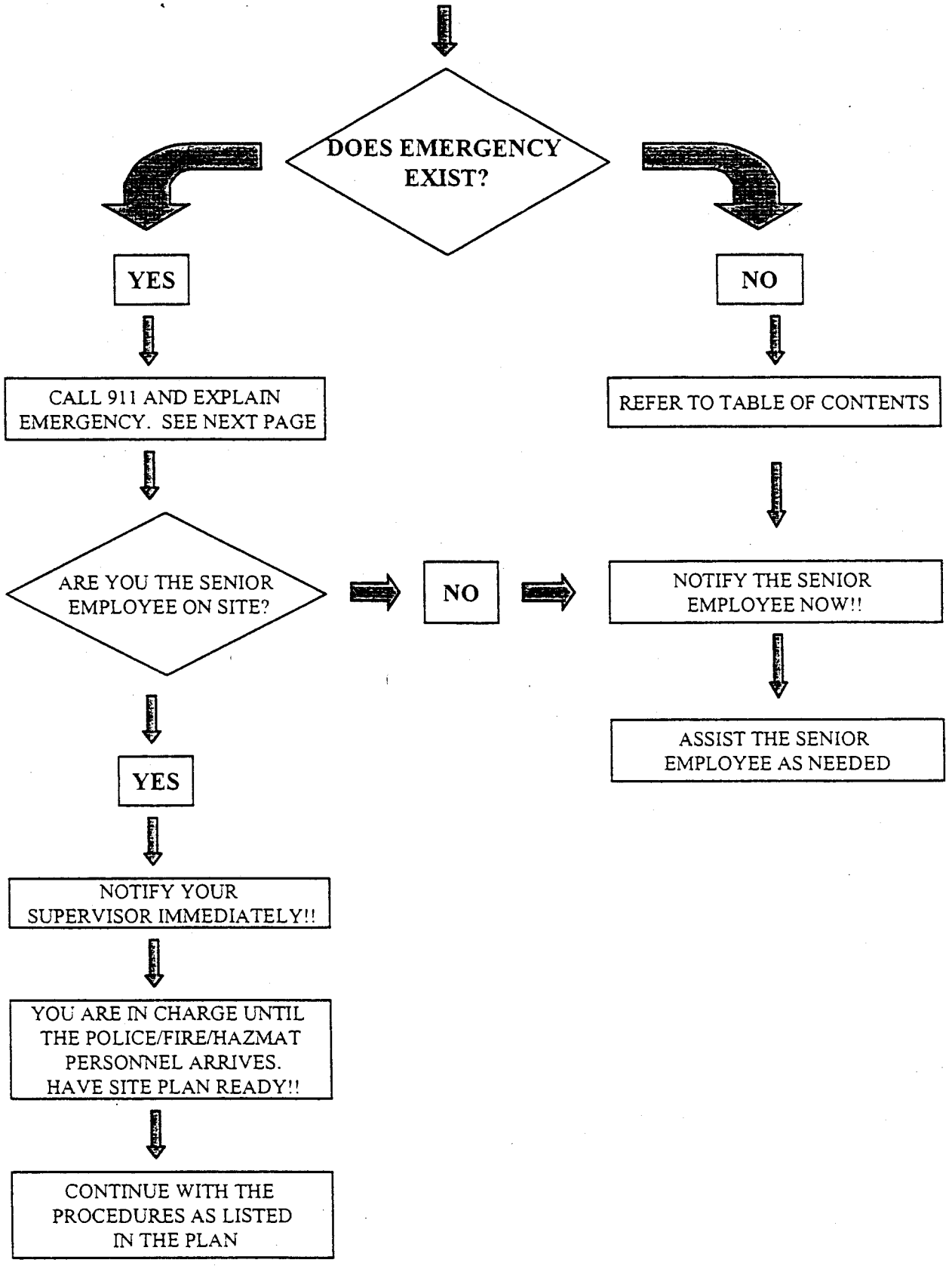
LANDFILL EMERGENCY ACTION PLAN

Approved by: _____
Ranking Official's Signature

Title: Utilities Superintendent

Date: _____

EMERGENGY FLOW CHART



EMERGENCY TELEPHONE PROCEDURES

1. **DIAL 911 ! !**
2. **Hello, my name is _____ _____, I work at the Old Salisbury Road Construction and Demolition Landfill for the City of Winston-Salem.**
3. **There is a _____emergency.**
   (NOTE: If the emergency is a chemical release, give the wind direction.*)
4. **The Landfill is located at:**

   Address: 3336 Old Salisbury Road
   Phone #: (336) 650-7659
5. **There are _____ persons injured.**

*WIND DIRECTION CAN BE DETERMINED BY USING THE WIND SOCKS AND COORDINATES LOCATED AT EACH LANDFILL SITE.

VII LANDFILL EMERGENCY ACTION PLAN:

A. Purpose:

The Landfill Emergency Action Plan is to provide all employees with the proper information to protect themselves, co-workers, and the public in the event of an emergency. This plan is designed to meet the requirements of OSHA 1910.38(a) and 1910.120.

B. Definitions:

i. Emergencies shall include such events as serious fires, explosions, tornadoes, hurricanes, or releases of hazardous or toxic materials. This plan will detail the appropriate emergency action for each.

ii. Severe fires shall be any fire which is extinguishable by a portable fire extinguisher or a fire within a confined space which would require entering the space to extinguish it or a fire involving explosive or toxic materials.

iii. Assembly Point shall be the area in which all employees gather in the event of an emergency.

C. Responsible Persons:

The following people are responsible for implementing and training employees on the emergency action plan. If employees have questions, they should contact the supervisor for their section listed below.

Edward Gibson, P. E. Solid Waste Administrator – (336) 727-8418 (w)

David Smith – Facility Manager – (336) 413-0540 (m)
(336) 208-2053 (p)
(336) 769-0970 (h)

In the case of emergency evacuation, each section supervisor is responsible for accountability of his/her employees and all visitors.

Every employee is responsible for his/her safety and for preventing job-related accidents or injuries by complying with all work place safety policies and related procedures.

D. Emergency Response Telephone Numbers

EMERGENCY (FIRE/POLICE)	911
Emergency Management (Local)	(336) 727-2200
Risk Management (Local)	(336) 727-2296
Emergency Medical Service (Local)	(336) 727-2404
Winston-Salem Regional Office Division of Environmental Management	(336) 896-7007
National Response Center	1-800-424-8802
N.C. Emergency Management	1-919-733-3867
Chemtrac	1-800-424-9300
State Emergency Number (After Hours)	1-800-662-7956
Poison Control Center	1-800-672-1697
Winston-Salem City Yard Emergency	(336) 727-2345

*If possible, consult your supervisor before using the number listed.

E. Emergencies

i. Fires and Explosions

a. In the event of a fire or explosion, all personnel shall evacuate the area with caution. There are no specific escape route assignments during the initial evacuation. **The assembly area is the front entrance of the landfill.**

ii. Tornado and Hurricane

a. In the event of a tornado or hurricane with sufficient warning, all Landfill personnel shall move with caution to the nearest secure public structure. In the event of a tornado without warning, personnel should temporarily retreat to the Scalehouse.

There are no specific escape route assignments during the initial evacuation.

iii. Evacuation

a. To alert other personnel on the Landfill site, the highest ranking person shall notify the employees by two-way radio.

b. Under no circumstances shall an employee remain in a hazardous area to operate equipment. Evacuation is mandatory.

c. Employee Accounting

In the event of an emergency, the Landfill supervisor(s) or in his/her absence, the senior operator will take charge at the assembly point and account for all persons at the Landfill site.

The highest ranking supervisor(s) at the assembly point will be responsible for accounting for all persons onsite. Once everyone has been accounted for, no one may leave the assembly point without the assembly point supervisor's permission.

All persons should reach the assembly point within 10 minutes of the alarm. All persons unaccounted for after this time will be assumed to be down and their names and last known location will be provided to the fire/rescue personnel by the assembly point supervisor.

d. Assigned Responsibilities

In the event of an emergency evacuation the following personnel shall have these responsibilities:

Person discovering the emergency condition

- Shall report the situation to 911 or radio 902.
- Shall take first aid kit to the assembly point.
- Landfill supervisor(s) or senior person.
- Report to the assembly point and begin accounting for persons on site.
- Coordinate actions with emergency response personnel; report all missing persons.

e. Employees are not required to administer medical attention but may offer first aid normally given to any accident victim. Only properly trained personnel shall attempt rescue of an employee in a hazardous atmosphere.

f. The preferred means of reporting an emergency is by telephone (i.e., call 911). The next preferred method of reporting is by radio (i.e., call 902). The least preferred method of reporting is by word of mouth. Under these conditions, no employee shall drive for help until weather conditions are safe for transit by automobile. Then an employee may seek help via Fire Station #9 located on Aviation Drive. In all cases, be sure to give emergency personnel an address, phone number, injuries, if any are known, and type of emergency (see Appendix B).

APPENDIX G

GROUND-WATER MONITORING PLAN

April 3, 2003 (Revised July 2003)

Mr. Bobby Lutfy, Hydrogeologist
North Carolina Department of Environment
and Natural Resources
Division of Solid Waste Management
Solid Waste Section
P. O. Box 27687
Raleigh, North Carolina 27611-7687

Re: Supplemental Revisions to Revised Ground-Water Monitoring Plan
Winston-Salem Construction and Demolition Landfill (No. 34-12)
Forsyth County, North Carolina
HDR Project No. 00162-525-018

Dear Mr. Lutfy:

HDR Engineering, Inc. of the Carolinas (HDR) is hereby submitting, on behalf of the City of Winston-Salem Utilities Division, the enclosed documents to be incorporated into the existing Revised Ground-Water Monitoring Plan (RGWMP), dated January 1996.

In response to the permitting of Phases IV, V, and VI at the Old Salisbury Road Construction and Demolition Landfill (Landfill), the abandonment and installation of ground-water monitoring wells will be conducted in a phased approach. With this phased approach, the abandonment and installations will take place immediately prior to filling of the respective phase, except where wells already exist.

A total of five additional ground-water monitoring wells are needed to adequately monitor the uppermost aquifer for a release from the proposed Phases IV, V, VI area. In keeping with the existing sequence, ground-water monitoring wells MW-9, MW-10, MW-11, MW-12, and 13 are being proposed at the approximate locations shown on the attached Drawing C-05. Ground-water monitoring wells MW-9 and MW-10 are positioned to monitor the downgradient extents of Phase IV. The remaining two Phases (V and VI) will be monitored by the installation of ground-water monitoring wells MW-11, MW-12, and MW-13 as shown on C-05.

With eight ground-water monitoring wells currently making up the monitoring well network, the horizontal distance between existing wells varies between 340 to 860 feet, with an average horizontal spacing of 630 feet. The distance from the edge of waste to each monitoring well also varies (between 75 to 275 feet). The placement of ground-water monitoring wells in the past has been predominantly based on the presence of presumed

HDR Engineering, Inc. of the Carolinas
128 S Tryon Street
Suite 1400
Charlotte, NC 28202-5004
Phone: (704) 338-6700
Fax: (704) 338-6760
www.hdrinc.com

subsurface features with the potential for preferential ground-water flow (i.e., small surface water features onsite being a surficial expression of subsurface fractures). However, ground-water level and water quality data from these wells for the past 6.5 years has not reported any C&D-related compound detections or has suggested that there is any preferential ground-water flow at these areas of the Site. Therefore, the horizontal placement of the proposed ground-water monitoring wells (approximately 500 feet apart and 50 to 100 feet from the edge of waste) is based on the potentiometric data and the estimated annual ground-water seepage velocity for the uppermost aquifer.

The zone of ground-water monitoring around most of the Phases IV, V, VI area is limited, with less than 100 feet available for monitoring well placement (e.g., along eastern stream). Therefore, these wells are expected to be installed at a distance of approximately 100 feet from the edge of waste based on the accessibility and practicality of installing a well that can be effectively monitored year round (i.e., areas prone to flooding). With a reported ground-water flow rate between 28.30 feet per year (ft/year) and 26.34 ft/year for the saprolite and transition zone hydrogeologic units. Assuming a worst-case scenario of a release at the edge of waste, it could potentially take 3.5 years for the proposed monitoring wells to detect this release given the aquifer properties and well spacing above. If one were to assume a release from the center of the waste unit, the distance to the monitoring network would be on the order of 375 feet, with a release detection potential of 13.2 years. Realistically, the scenario is somewhere in the middle (e.g., less than 200 feet). These scenarios assume no lateral dispersion, only particle movement perpendicular to the slope of the potentiometric surface (*i.e.,* dispersion ratio of 1:1). However, ground-water movement is rarely without some component of lateral dispersion. Lateral dispersion in soils containing a significant percentage of fine-gained material can be significant. Without contaminant plume data to directly approximate dispersion at the Landfill, a conservative (estimated) dispersion coefficient or ratio of 1:2 was assumed. For every foot of ground-water movement in the primary direction of flow there is an estimated 2 feet of lateral dispersion. If these values are considered, then a particle released at a distance of approximately 200 feet upgradient of the proposed monitoring well network (125 feet inside the waste unit) could potentially require a horizontal well spacing of 800 feet. This approximation does not have the ability to take into account other factors that could affect the well spacing (i.e., increase spacing) such as the filling sequence and the relationship of the placement of early waste to the nearest ground-water monitoring well.

As shown on the attached Drawing C-05, the horizontal placement of monitoring wells is approximately ~~450~~ 275 to ~~600~~ 700 feet apart, well within the 800-foot spacing calculated above.

Before the construction of Phase VI, monitoring well MW-6R will be permanently abandoned in accordance with North Carolina Department of Environment and Natural Resources (NCDENR) Well Abandonment Regulations. No replacement is currently planned for this well. These monitoring wells will not be sampled until the scheduled sampling event six months prior to their respective phase of the Landfill begins to receive waste. An initial sample will be collected and analyzed in accordance with the existing RGWMP for Appendix I volatile organic compounds (VOCs) and the eight RCRA metals during each sampling event. The enclosed site plan (Drawing C-05) shows the location of all abandoned, existing, and proposed ground-water monitoring wells at the Landfill. The following table summarizes the anticipated well construction details for the proposed detection monitoring wells for the Phases IV, V, VI area.

Summary of Proposed Ground-Water Monitoring Well Construction

Proposed Well	Estimated Ground Surface Elevation (ft MSL)	Estimated Screened Interval (ft MSL)	Estimated Total Well Depth (ft)
MW-9	731	736 - 721	70
MW-10	725	730 - 715	20
MW-11	725	730 - 715	20
MW-12	730	735 - 720	20
MW-13	730	735 - 720	20

MSL – mean sea level
All data is in feet.

Prior to well construction, each soil boring will be sampled at 5-foot intervals starting from 5 feet below land surface to the total depth of the boring. The samples will be collected using a standard 1.375-inch inside diameter (ID), 2-inch outside diameter (OD), 24-inch long stainless steel split-barrel sampler. In accordance with ASTM practice D1586, the sampler will be driven into the undisturbed soil ahead of the advancing augers using a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final 12 inches will be recorded as the designated penetration resistance value (N-value). The recovered soil samples will be visually inspected in the field by an HDR geologist and classified in general accordance with the Unified Soil Classification System (USCS). Soil boring logs for each location will be prepared.

Once each soil boring is completed to its final depth below the water table, a 2-inch diameter ground-water monitoring well will be constructed in accordance with the North Carolina Well Standards and Regulations. Each well will consist of 2-inch ID Schedule 40 polyvinyl chloride well pipe, which is flush-threaded to factory-slotted well screen with 0.010-inch openings. Each shallow well will be fitted with a 15-foot well screen positioned at the water table interface to allow for seasonal fluctuation (historically less than a foot).

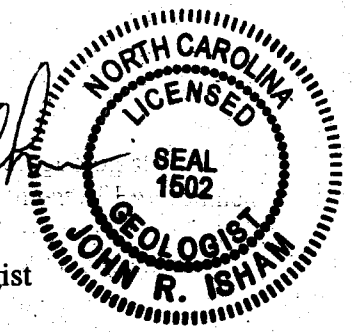
Each monitoring well will be constructed by lowering the well string through the center of the hollow stem augers to the bottom of the borehole. A washed, graded (No. 2) silica sand will be placed through the augers and allowed to settle (by gravity) around the annulus between the well screen and the augers. Upon removal of each 5-foot auger flight, the silica sand will be allowed to settle around the well screen, filling the annulus between the well screen and the wall of the borehole. The sand pack will be placed to a depth of ~~2 feet~~ 1 foot above the top of the well screen. A 2-foot annular seal consisting of 3/8-inch high-yield Wyoming bentonite chips will be placed above the sand pack (by gravity) and allowed to hydrate (swell). The remaining annular space from the top of the bentonite seal to ground surface will be sealed with a Portland Type I cement/3 percent bentonite mixture placed using a tremie pipe.

The wells will be permanently finished above-grade with a stickup of approximately 2.5 feet. The piezometer pipes will be secured against accidental opening or tampering with a locked, steel well box finished with an ID tag and concrete pad. A ground-water monitoring well construction record drawing for each of the proposed monitoring wells will be prepared and submitted upon completion of this task.

In addition to the ground-water monitoring wells, six methane probes (MM-7 through MM-12) will be installed around Phases IV, V, and VI for methane detection monitoring. A North Carolina licensed well driller will bore down to the top of the ground-water table and a Schedule 40 PVC gas probe will be inserted through the center of the borehole. Each probe will be constructed with flush-threaded joints and an appropriate screened interval of 0.020-inch, factory-slotted well screen. A coarse-grained silica gravel will be placed around the screen interval by gravity settling. The gravel pack will extend to a minimum of 6 inches above the top of the screen. A 6-inch minimum bentonite seal will be placed immediately above the gravel pack. The remaining probe annulus will be sealed to surface grade using a Portland Type I cement mixture. Each probe station will be completed above grade and protected by a 4-inch square steel locked well box secured in place with a 3-foot by 3-foot concrete pad. The outside of each station will be fitted with an identification tag indicating the station number, installation date, driller name and registration, completion depth, and, screened interval. A methane probe construction record drawing for each of the proposed probes will be prepared and submitted upon completion of this task. See Drawing C-05 for the approximate locations of the proposed methane monitoring probes.

If you have any questions or comments concerning the information summarized in this letter or on the enclosures, please do not hesitate to contact me or Mike Plummer at (704) 338-6700.

Sincerely,



John R. Isham, PG
Senior Hydrogeologist

Michael D. Plummer, PE
Project Engineer

JRI/MDP/jvd

7-30-03

Enclosures: Existing and Proposed Ground-Water Monitoring Well Locations (C-05)

cc: Edward L. Gibson, City of Winston-Salem (w/attachments)
Larry Rose, NCDENR Solid Waste Section (w/attachments)
Tim Jewett, NCDENR Solid Waste Section (w/attachments)
Brock Turner, Forsyth County Health Department (w/attachments)

April 3, 2003

Mr. Bobby Lutfy, Hydrogeologist
North Carolina Department of Environment
and Natural Resources
Division of Solid Waste Management
Solid Waste Section
P. O. Box 27687
Raleigh, North Carolina 27611-7687

Re: Supplemental Revisions to Revised Ground-Water Monitoring Plan
Winston-Salem Construction and Demolition Landfill (No. 34-12)
Forsyth County, North Carolina
HDR Project No. 00162-525-018

Dear Mr. Lutfy:

HDR Engineering, Inc. of the Carolinas (HDR) is hereby submitting, on behalf of the City of Winston-Salem Utilities Division, the enclosed documents to be incorporated into the existing Revised Ground-Water Monitoring Plan (RGWMP), dated January 1996.

In response to the permitting of Phases IV, V, and VI at the Old Salisbury Road Construction and Demolition Landfill (Landfill), the abandonment and installation of ground-water monitoring wells will be conducted in a phased approach. With this phased approach, the abandonment and installations will take place immediately prior to filling of the respective phase, except where wells already exist.

A total of five additional ground-water monitoring wells are needed to adequately monitor the uppermost aquifer for a release from the proposed Phases IV, V, VI area. In keeping with the existing sequence, ground-water monitoring wells MW-9, MW-10, MW-11, MW-12, and 13 are being proposed at the approximate locations shown on the attached Drawing C-05. Ground-water monitoring wells MW-9 and MW-10 are positioned to monitor the downgradient extents of Phase IV. The remaining two Phases (V and VI) will be monitored by the installation of ground-water monitoring wells MW-11, MW-12, and MW-13 as shown on C-05.

With eight ground-water monitoring wells currently making up the monitoring well network, the horizontal distance between existing wells varies between 340 to 860 feet, with an average horizontal spacing of 630 feet. The distance from the edge of waste to each monitoring well also varies (between 75 to 275 feet). The placement of ground-water monitoring wells in the past has been predominantly based on the presence of presumed

HDR Engineering, Inc. of the Carolinas
128 S Tryon Street
Suite 1400
Charlotte, NC 28202-5004
Phone: (704) 338-6700
Fax: (704) 338-6760
www.hdrinc.com

subsurface features with the potential for preferential ground-water flow (i.e., small surface water features onsite being a surficial expression of subsurface fractures). However, ground-water level and water quality data from these wells for the past 6.5 years has not reported any C&D-related compound detections or has suggested that there is any preferential ground-water flow at these areas of the Site. Therefore, the horizontal placement of the proposed ground-water monitoring wells (approximately 500 feet apart and 50 to 100 feet from the edge of waste) is based on the potentiometric data and the estimated annual ground-water seepage velocity for the uppermost aquifer.

The zone of ground-water monitoring around most of the Phases IV, V, VI area is limited, with less than 100 feet available for monitoring well placement (e.g., along eastern stream). Therefore, these wells are expected to be installed at a distance of approximately 100 feet from the edge of waste based on the accessibility and practicality of installing a well that can be effectively monitored year round (i.e., areas prone to flooding). With a reported ground-water flow rate between 28.30 feet per year (ft/year) and 26.34 ft/year for the saprolite and transition zone hydrogeologic units. Assuming a worst-case scenario of a release at the edge of waste, it could potentially take 3.5 years for the proposed monitoring wells to detect this release given the aquifer properties and well spacing above. If one were to assume a release from the center of the waste unit, the distance to the monitoring network would be on the order of 375 feet, with a release detection potential of 13.2 years. Realistically, the scenario is somewhere in the middle (e.g., less than 200 feet). These scenarios assume no lateral dispersion, only particle movement perpendicular to the slope of the potentiometric surface (*i.e.*, dispersion ratio of 1:1). However, ground-water movement is rarely without some component of lateral dispersion. Lateral dispersion in soils containing a significant percentage of fine-gained material can be significant. Without contaminant plume data to directly approximate dispersion at the Landfill, a conservative (estimated) dispersion coefficient or ratio of 1:2 was assumed. For every foot of ground-water movement in the primary direction of flow there is an estimated 2 feet of lateral dispersion. If these values are considered, then a particle released at a distance of approximately 200 feet upgradient of the proposed monitoring well network (125 feet inside the waste unit) could potentially require a horizontal well spacing of 800 feet. This approximation does not have the ability to take into account other factors that could affect the well spacing (i.e., increase spacing) such as the filling sequence and the relationship of the placement of early waste to the nearest ground-water monitoring well.

As shown on the attached Drawing C-05, the horizontal placement of monitoring wells is approximately 450 to 600 feet apart, well within the 800-foot spacing calculated above.

Before the construction of Phase VI, monitoring well MW-6R will be permanently abandoned in accordance with North Carolina Department of Environment and Natural Resources (NCDENR) Well Abandonment Regulations. No replacement is currently planned for this well. These monitoring wells will not be sampled until the scheduled sampling event six months prior to their respective phase of the Landfill begins to receive waste. An initial sample will be collected and analyzed in accordance with the existing RGWMP for Appendix I volatile organic compounds (VOCs) and the eight RCRA metals during each sampling event. The enclosed site plan (Drawing C-05) shows the location of all abandoned, existing, and proposed ground-water monitoring wells at the Landfill. The following table summarizes the anticipated well construction details for the proposed detection monitoring wells for the Phases IV, V, VI area.

Summary of Proposed Ground-Water Monitoring Well Construction

Proposed Well	Water Table Elevation (MSL)	Estimated Screened Interval (MSL)	Estimated Total Well Depth
MW-9	731	736 - 721	70
MW-10	725	730 - 715	20
MW-11	725	730 - 715	20
MW-12	730	735 - 720	20
MW-13	730	735 - 720	20

MSL – mean sea level
All data is in feet.

Prior to well construction, each soil boring will be sampled at 5-foot intervals starting from 5 feet below land surface to the total depth of the boring. The samples will be collected using a standard 1.375-inch inside diameter (ID), 2-inch outside diameter (OD), 24-inch long stainless steel split-barrel sampler. In accordance with ASTM practice D1586, the sampler will be driven into the undisturbed soil ahead of the advancing augers using a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final 12 inches will be recorded as the designated penetration resistance value (N-value). The recovered soil samples will be visually inspected in the field by an HDR geologist and classified in general accordance with the Unified Soil Classification System (USCS). Soil boring logs for each location will be prepared.

Once each soil boring is completed to its final depth below the water table, a 2-inch diameter ground-water monitoring well will be constructed in accordance with the North Carolina Well Standards and Regulations. Each well will consist of 2-inch ID Schedule 40 polyvinyl chloride well pipe, which is flush-threaded to factory-slotted well screen with 0.010-inch openings. Each shallow well will be fitted with a 15-foot well screen positioned at the water table interface to allow for seasonal fluctuation (historically less than a foot).

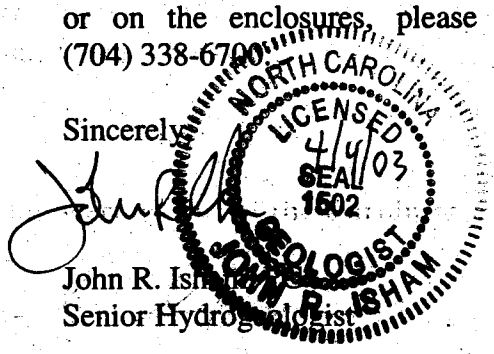
Each monitoring well will be constructed by lowering the well string through the center of the hollow stem augers to the bottom of the borehole. A washed, graded (No. 2) silica sand will be placed through the augers and allowed to settle (by gravity) around the annulus between the well screen and the augers. Upon removal of each 5-foot auger flight, the silica sand will be allowed to settle around the well screen, filling the annulus between the well screen and the wall of the borehole. The sand pack will be emplaced to a depth of 2 feet above the top of the well screen. A 2-foot annular seal consisting of 3/8-inch high-yield Wyoming bentonite chips will be placed above the sand pack (by gravity) and allowed to hydrate (swell). The remaining annular space from the top of the bentonite seal to ground surface will be sealed with a Portland Type I cement/3 percent bentonite mixture placed using a tremie pipe.

The wells will be permanently finished above-grade with a stickup of approximately 2.5 feet. The piezometer pipes will be secured against accidental opening or tampering with a locked, steel well box finished with an ID tag and concrete pad. A ground-water monitoring well construction record drawing for each of the proposed monitoring wells will be prepared and submitted upon completion of this task.

In addition to the ground-water monitoring wells, six methane probes (MM-7 through MM-12) will be installed around Phases IV, V, and VI for methane detection monitoring. A North Carolina licensed well driller will bore down to the top of the ground-water table and a Schedule 40 PVC gas probe will be inserted through the center of the borehole. Each probe will be constructed with flush-threaded joints and an appropriate screened interval of 0.020-inch, factory-slotted well screen. A coarse-grained silica gravel will be placed around the screen interval by gravity settling. The gravel pack will extend to a minimum of 6 inches above the top of the screen. A 6-inch minimum bentonite seal will be placed immediately above the gravel pack. The remaining probe annulus will be sealed to surface grade using a Portland Type I cement mixture. Each probe station will be completed above grade and protected by a 4-inch square steel locked well box secured in place with a 3-foot by 3-foot concrete pad. The outside of each station will be fitted with an identification tag indicating the station number, installation date, driller name and registration, completion depth, and, screened interval. A methane probe construction record drawing for each of the proposed probes will be prepared and submitted upon completion of this task. See Drawing C-05 for the approximate locations of the proposed methane monitoring probes.

If you have any questions or comments concerning the information summarized in this letter or on the enclosures, please do not hesitate to contact me or Mike Plummer at (704) 338-6700.

Sincerely,



John R. Isham
Senior Hydrogeologist

Michael D. Plummer, PE
Project Engineer

JRI/MDP/jvd

Enclosures: Existing and Proposed Ground-Water Monitoring Well Locations (C-05)

cc: Edward L. Gibson, City of Winston-Salem (w/attachments)
Larry Rose, NCDENR Solid Waste Section (w/attachments)
Tim Jewett, NCDENR Solid Waste Section (w/attachments)
Brock Turner, Forsyth County Health Department (w/attachments)

October 22, 2002

Mr. Bobby Lutfy, Hydrogeologist
North Carolina Department of Environment
and Natural Resources
Division of Solid Waste Management
Solid Waste Section
P. O. Box 27687
Raleigh, North Carolina 27611-7687

Re: Supplemental Revisions to Revised Ground-Water Monitoring Plan
Winston-Salem Construction and Demolition Landfill (#34-12)
Forsyth County, North Carolina
HDR Project No. 00162-525-018

Dear Mr. Lutfy:

HDR Engineering, Inc. of the Carolinas (HDR) is hereby submitting, on behalf of the City of Winston-Salem Utilities Division, the enclosed documents to be incorporated into the existing Revised Ground-Water Monitoring Plan, dated January 1996.

In response to the permitting of Phases IV, V, and VI at the Old Salisbury Road Construction and Demolition Landfill (Landfill), the abandonment and installation of ground-water monitoring wells will be conducted in a phased approach. With this phased approach, the abandonment and installations will take place immediately prior to filling of the respective phase, except where wells already exist. Monitoring wells MW-9 and MW-10 will be installed prior to Phase IV landfilling and will perform downgradient ground-water detection monitoring for both Phases IV and V. Before the construction of Phase VI, monitoring wells MW-6R, B-21A, and B-21B will be permanently abandoned according to North Carolina Department of Environment and Natural Resources (NCDENR) Well Abandonment Regulations. A replacement ground-water monitoring well (MW-6RR) will be installed in accordance with the locations approved by the Solid Waste Section immediately prior to filling in Phase VI. Ground-water monitoring wells MW-6RR, PZ-27 (will be renamed MW-11), and PZ-29 (will be renamed MW-12) will perform downgradient ground-water detection monitoring for Phase VI. These monitoring wells will not be monitored and sampled on a semiannual basis until their respective phase of the Landfill begins to receive waste. The enclosed site plan (Drawing C-5) shows the location of all abandoned, existing, and proposed ground-water monitoring wells at the Landfill. The following table summarizes the anticipated well construction details for the proposed detection monitoring wells for Phases IV through VI.

HDR Engineering, Inc. of the Carolinas

128 S Tryon Street
Suite 1400
Charlotte, NC 28202-5004

Phone: (704) 338-6700
Fax: (704) 338-6760
www.hdrinc.com

Summary of Proposed Ground-Water Monitoring Well Construction			
Proposed Well	Water Table Elevation (MSL)	Estimated Screened Interval (MSL)	Estimated Total Well Depth
MW-6RR	746	746 - 736	15
MW-9	737	737 - 727	65
MW-10	731	731 - 721	60
MW-11*	725	719 - 709	18
MW-12**	730	730 - 720	14

* Previously PZ-27
** Previously PZ-29
MSL – mean sea level
All data is in feet.

Each soil boring will be sampled at 5-foot intervals starting from 5 feet below land surface to the total depth of the boring. Where they are paired with shallow borings, deep soil borings will be sampled at the deeper intervals only. The samples will be collected using a standard 1.375-inch inside diameter (ID), 2-inch outside diameter (OD), 24-inch long stainless steel split-barrel sampler. In accordance with ASTM practice D1586, the sampler will be driven into the undisturbed soil ahead of the advancing augers using a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final 12 inches will be recorded as the designated penetration resistance value (N-value). The recovered soil samples will be visually inspected in the field by an HDR geologist and classified in general accordance with the Unified Soil Classification System (USCS). Soil boring logs for each location will be prepared.

Once each soil boring is completed to its final depth below the water table, a 2-inch diameter ground-water piezometer will be constructed in accordance with the North Carolina Well Standards and Regulations. Each piezometer will consist of 2-inch ID Schedule 40 polyvinyl chloride well pipe, which is flush-threaded to factory-slotted well screen with 0.010-inch openings. Each shallow piezometer will be fitted with a 10-foot well screen positioned just below the top of the water table.

Each piezometer will be constructed by lowering the well string through the center of the hollow stem augers to the bottom of the borehole. A washed, graded (No. 2) silica sand will be placed through the augers and allowed to settle (by gravity) around the annulus between the piezometer screen and the augers. Upon removal of each 5-foot auger flight, the silica sand will be allowed to settle around the piezometer screen, filling the annulus between the piezometer screen and the wall of the borehole. The sand pack will be emplaced to a depth of 2 feet above the top of the piezometer screen. A 2-foot annular seal consisting of 3/8-inch high-yield Wyoming bentonite chips will be placed above the sand pack (by gravity) and allowed to hydrate (swell). The remaining annular space from the top of the bentonite seal to ground surface will be sealed with a Portland Type I cement/3 percent bentonite mixture placed using a tremie pipe.

The piezometers will be permanently finished above-grade with a stickup of approximately 2.5 feet. The piezometer pipes will be secured against accidental opening or tampering with a locked, steel well box finished with an I.D. tag and concrete pad. A ground-water piezometer construction record drawing for each of the proposed monitoring wells will be prepared and submitted upon completion of this task.

In addition to the ground-water monitoring wells, six methane probes will be installed around Phases IV, V, and VI for methane detection monitoring. A NC licensed well driller will bore down to the top of the ground-water table and a Schedule 40 PVC gas probe will be inserted through the center of the borehole. Each probe will be constructed with flush-threaded joints and an appropriate screened interval of 0.020-inch, factory-slotted well screen. A coarse-grained silica gravel will be placed around the screen interval by gravity settling. The gravel pack will extend to a minimum of 6 inches above the top of the screen. A 6-inch minimum bentonite seal will be placed immediately above the gravel pack. The remaining probe annulus will be sealed to surface grade using a Portland Type I cement mixture. Each probe station will be completed above grade and protected by a 4-inch square steel locked well box secured in place with a 3-foot by 3-foot concrete pad. The top of each well probe will be fitted with a laboratory-type stop-cock valve for gas sample collection. The outside of each station will be fitted with an identification tag indicating the station number, installation date, driller name and registration, completion depth, and, screened interval. A methane probe construction record drawing for each of the proposed probes will be prepared and submitted upon completion of this task. See drawing C-5 for the approximate locations of the proposed methane monitoring probes.

If you have any questions or comments concerning the information summarized in this letter or on the enclosures, please do not hesitate to contact me at (704) 338-6700.

Sincerely,

HDR Engineering, Inc. of the Carolinas

John R. Isham, PG
Senior Hydrogeologist

JRI/jvd

Enclosures: Existing and Proposed Ground-Water Monitoring Well Locations (C-5)

cc: Edward L. Gibson, City of Winston-Salem (w/attachments)
Larry Rose, NCDENR Solid Waste Section (w/attachments)
Tim Jewett, NCDENR Solid Waste Section (w/attachments)
Brock Turner, Forsyth County Health Department (w/attachments)

October 8. 1999

HDR

Mr. Tim Jewett, P.E.
North Carolina Department of Environment
and Natural Resources
Division of Solid Waste Management
Solid Waste Section
585 Waughtown Street
Winston-Salem, North Carolina 27107-2241

Re: Existing Ground-Water Monitoring Plan
Winston-Salem Construction and Demolition Landfill (#34-12)
Forsyth County, North Carolina
HDR Project No. 00162-090-018

Dear Mr. Jewett:

HDR Engineering, Inc. of the Carolinas (HDR) is hereby submitting, on behalf of the City of Winston-Salem Utilities Division, the enclosed documents for inclusion with the existing Construction Permit Application for the construction of Phases II and III of the Old Salisbury Road Construction and Demolition (C&D) Landfill at the above-referenced location.

At the October 5, 1999, meeting with Jim Coffey regarding the permitting of Phases II and III, questions were raised concerning the ground-water monitoring program at the landfill. This letter and attached documentation is intended to provide a clearer understanding of the evolution of ground-water monitoring activities at the referenced facility.

The original Ground-Water Monitoring Plan for the C&D landfill was prepared by S&ME, Inc. in December of 1994. Attached is a copy of this plan. From December of 1994 until January of 1996, the ground-water monitoring well network at the site consisted of an upgradient monitoring well (MW-1) and four downgradient monitoring wells (MW-2 through MW-5). Figure 3 from this plan shows the location of the existing and proposed ground-water monitoring wells stated in this plan. The proposed analytical parameters to be sampled during this period are summarized in Table 2 of this plan.

In June of 1995, HDR amended the analytical parameters list of this proposed plan to include the current analytical parameters required for detection monitoring of C&D landfills. This amendment was in response to a memorandum from the Solid Waste Section.

HDR Engineering, Inc.
of the Carolinas

Employee Owned

128 S. Tryon Street
Suite 1400
Charlotte, North Carolina
28202-5001

Telephone
704 338-6700
Fax
704 338-6760

In response to a Solid Waste Section letter dated September 27, 1995, additional revisions to the original Ground-Water Monitoring plan were implemented. During the design and permitting of Phase I of the landfill, it was noted that background monitoring well MW-1 was positioned within the proposed footprint of Phase I. Therefore, HDR modified the existing Ground-Water Monitoring Plan to include the abandonment and installation of a replacement for background monitoring well MW-1. This installation was coupled with the replacement of ground-water monitoring wells MW-2, MW-4, and MW-5 to better monitor several of the "local" drainage features. These replacement wells (MW-1R, MW-2R, MW-4R, and MW-5R) were installed in December of 1995 in addition to two new monitoring wells (MW-6 and MW-7) to complete the ground-water monitoring well network for Phase I of the landfill. A Revised Ground-Water Monitoring Plan was prepared (by HDR) with these amendments and submitted to the Solid Waste Section in January of 1996 (including the initial sampling results from the wells). A copy of this plan is also included.

From January 1996 to August 1999, the ground-water monitoring well network at the landfill consisted of seven wells (MW-1R, MW-2R, MW-3, MW-4R, MW-5R, MW-6, and MW-7), of which MW-3 was the only remaining well from the original plan. These wells were sampled on a semiannual basis and reported to the Section.

More recently, the permitting of Phases II and III at the landfill prompted additional modifications to the Revised Ground-Water Monitoring Plan (HDR, 1996). Ground-water monitoring wells MW-3 and MW-6 were positioned within the proposed footprints of Phases II and III, respectively. Also, monitoring well MW-8 would be necessary to monitor the downgradient reach of Phase III. A plan to address these issues was presented to Mr. Bobby Lutfy of the Solid Waste Section prior to implementation. In July of 1999, ground-water monitoring wells MW-3 and MW-6 were abandoned (in accordance with proper well abandonment regulations) and replaced with monitoring wells MW-3R and MW-6R, and MW-8 was also installed. An amendment to the Revised Ground-Water Monitoring Plan of January 1996 was submitted to the Section on August 19, 1999. A copy of this amendment is attached to this submittal. Beginning with the fall 1999 semiannual sampling event and continuing at least until the initiation of permitting of Phase IV at the landfill, the ground-water monitoring plan for the subject site will consist of the following eight monitoring wells (MW-1R, MW-2R, MW-3R, MW-4R, MW-5R, MW-6R, MW-7, and MW-8). Keep in mind that the semiannual sampling of monitoring well MW-8 is not planned to begin until Phase III of the landfill is ready to receive waste.

We hope that this sequential summary of events leading up to the current Ground-Water Monitoring Plan at the Old Salisbury Road C&D Landfill will be helpful to the Section's review and approval of the pending Construction Permit Application for Phases II and III.

If you have any questions or comments concerning the information summarized in this letter or on the attachments, please do not hesitate to contact me at (704) 338-6832.

Sincerely,

HDR Engineering, Inc. of the Carolinas

John R. Isham, P.G.
Project Hydrogeologist

JRI/nct

Attachments: Ground-Water Monitoring Plan (S&ME, 1994)
Revised Ground-Water Monitoring Plan (HDR, 1996)
Supplemental Revisions to Revised Ground-Water Monitoring Plan (HDR, 1999)

cc: Edward L. Gibson, City of Winston-Salem (w/attachments)
Larry Rose, NCDENR Solid Waste Section (w/attachments)
Ellen Lorscheider, NCDENR Solid Waste Section (w/attachments)

SUPPLEMENTAL REVISIONS TO THE REVISED GROUND-WATER MONITORING PLAN

HDR ENGINEERING, INC. OF THE CAROLINAS

AUGUST 1999

August 19, 1999

Mr. Bobby Lutfy, Hydrogeologist
North Carolina Department of Environment
and Natural Resources
Division of Solid Waste Management
Solid Waste Section
P. O. Box 27687
Raleigh, North Carolina 27611-7687

Re: Supplemental Revisions to Revised Ground-Water Monitoring Plan
Winston-Salem Construction and Demolition Landfill (#34-12)
Forsyth County, North Carolina
HDR Project No. 00162-090-018

Dear Mr. Lutfy:

HDR Engineering, Inc. of the Carolinas (HDR) is hereby submitting, on behalf of the City of Winston-Salem Utilities Division, the enclosed attachments to be incorporated into the existing Revised Ground-Water Monitoring Plan, dated January 1996.

In response to the permitting of Phases II and III at the landfill, two previously sampled ground-water monitoring wells (MW-3 and MW-6) were abandoned as a result of being inside the proposed areas being permitted (North Carolina abandonment records are attached). Two replacement ground-water monitoring wells (MW-3R and MW-6R) were installed in accordance with the locations approved by the Solid Waste Section. An additional ground-water monitoring well (MW-8) was also installed downgradient of the proposed Phase III area of the landfill. However, this monitoring well will not be monitored and sampled on a semiannual basis until this portion of the landfill begins to receive waste. The geologists logs and monitoring well construction record drawings for each of the newly installed monitoring wells are attached to this submittal. The enclosed site plan (Drawing C-5) shows the location of all abandoned, existing, and proposed ground-water monitoring wells at the Old Salisbury Road C&D Landfill. Future semiannual, detection monitoring of the landfill will include monitoring wells MW-1R (background), MW-2R, MW-3R, MW-4R, MW-5R, MW-6R, and MW-7 for Appendix I volatile organic compounds (VOCs) and the eight RCRA metals.

HDR Engineering, Inc.
of the Carolinas

Employee-owned

Suite 1400
128 S. Tryon Street
Charlotte, North Carolina
28202-5001

Telephone
704 338-6700
Fax
704 338-6760

If you have any questions or comments concerning the information summarized in this letter or on the attachments, please do not hesitate to contact me at (704) 338-6832.

Sincerely,

HDR Engineering, Inc. of the Carolinas

John R. Isham, P.G.
Project Hydrogeologist

JRI/nct

Attachments: Geologists Log B-3R (MW-3R)
Geologists Log B-6R (MW-6R)
Geologists Log B-8 (MW-8)
Well Abandonment Records (MW-3 and MW-6)
Existing and Proposed Ground-Water Monitoring Well Locations (C-5)

cc: Edward L. Gibson, City of Winston-Salem (w/attachments)
Mark Poindexter, NCDENR Solid Waste Section (w/Drawing C-5)
Larry Rose, NCDENR Solid Waste Section (w/attachments)
Tim Jewett, NCDENR Solid Waste Section (w/Drawing C-5)
Brock Turner, Forsyth County Health Department (w/attachments)

Project No: 00162-090-018

Project: Winston-Salem C&D Landfill

Client: City of Winston-Salem

Location: Old Salisbury Road

Geologist Log B-3R (MW-3R)

Ground Elevation: 772.9' MSL

Geologist: John R. Isham, PG.

HDR

SUBSURFACE PROFILE | SAMPLE

Depth	Symbol	Description	Depth/Elev.	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
0		Ground Surface	0							
		RESIDUUM Dark to medium brown, micaceous silty clayey sand, slightly plastic, slightly moist, organics mixed, rooted.	773 / 1 / 772							
3		***CLAYEY SAND (SC)*** Orange-brown to tan, micaceous clayey sand, fine to medium-grained, some quartz granules, slightly plastic, moist.								
5				1		8	40%			Portland Type I Cement with 3% Bentonite
7			7 / 766							
9										3/8-inch Bentonite Chips
11		***SANDY CLAY (CL)*** Gray, soft, plastic, micaceous, mottled with orange-brown iron oxide staining, medium to coarse-grained quartz grains, very moist.		2		5	40%			Old Creek Deposits
15				3		8	40%			
17			17.5 / 755							
19										Granitic Saprolite

Drilled By: Engineering Tectonics, PA.

Drill Method: 4.25-inch ID HSA

Drill Date: July 7, 1999

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC. 28202

Hole Size 8-inch Diameter

Top-of-Casing 776.6' MSL

Project No: 00162-090-018

Project: Winston-Salem C&D Landfill

Client: City of Winston-Salem

Location: Old Salisbury Road

Geologist Log B-3R (MW-3R)

Ground Elevation: 772.9' MSL

Geologist: John R. Isham, PG.

HDR

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Depth/Elev.	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft (20 40 60 80)	Well Data	Remarks
21				4		9	50%			
22		***SILTY SAND (SM)*** Gray, white, and black, micaceous, medium-dense, fine to medium-grained, mottled with iron oxide staining, weak mineral alignment, very moist.								2-inch Diameter SCH 40 PVC 0.010-inch Slots
23										
24										
25										
26				5		18	50%			
27			27							
		End of Borehole	746							
28										
29										
30										
31										
32										
33										
34										
35										
36										
37										
38										
39										
40										

Drilled By: Engineering Tectonics, PA.

Drill Method: 4.25-inch ID HSA

Drill Date: July 7, 1999

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC. 28202

Hole Size 8-inch Diameter

Top-of-Casing 776.6' MSL

Project No: 00162-090-018

Project: Winston-Salem C&D Landfill

Client: City of Winston-Salem

Location: Old Salisbury Road

Geologist Log B-6R (MW-6R)

Ground Elevation: 817.8' MSL

Geologist: John R. Isham, PG.

HDR

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Depth/Elev.	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
0		Ground Surface	0							
0		***RESIDUUM*** Tan to light brown sandy loam.	818							
2		***SANDY SILT (ML)*** Orange-brown, micaceous, fine-grained quartz grains, dry.	3.5							
4			814							
6				1		8	60%			
10				2		7	75%			Portland Type I Cement with 3% Bentonite
12		***SILTY SAND (SM)*** Tan to yellow-brown, micaceous, fine to coarse-grained quartz grains, weak mineral alignment (horizontal), iron oxide staining, mottled, dry.								
16				3		8	75%			
20										

Drilled By: Engineering Tectonics, PA.

Drill Method: 4.25-inch ID HSA

Drill Date: July 8, 1999

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC. 28202

Hole Size 8-inch Diameter

Top-of-Casing 820.4' MSL

Project No: 00162-090-018

Project: Winston-Salem C&D Landfill

Client: City of Winston-Salem

Location: Old Salisbury Road

Geologist Log B-6R (MW-6R)

Ground Elevation: 817.8' MSL

Geologist: John R. Isham, PG.

HDR

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Depth/Elev.	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
21		***SILTY SAND (SM)*** Tan to yellow-brown, micaceous, fine to coarse-grained quartz grains, weak mineral alignment (horizontal), iron oxide staining, mottled, dry.		4		12	80%			
22										
23			23 / 795							
24										
25										Granitic Saprolite
26				5		15	75%			
27										
28		***SILTY SAND (SM)*** Same as above, becoming mixed with partially weathered rock lenses, dry.								
29										
30										
31				6		27	75%			Portland Type I Cement with 3% Bentonite
32										
33										
34			34 / 784							
35		***SILTY SAND w/ GRAVEL*** White, to light gray and tan, micacous, mottled with iron oxide staining, fine to coarse-grained quartz, feldspar, mica, weak foliation as mineral alighment, dry.								
36				7		48	85%			
37										
38										
39										
40										

Drilled By: Engineering Tectonics, PA.

Drill Method: 4.25-inch ID HSA

Drill Date: July 8, 1999

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC. 28202

Hole Size 8-inch Diameter

Top-of-Casing 820.4' MSL

Project No: 00162-090-018

Project: Winston-Salem C&D Landfill

Client: City of Winston-Salem

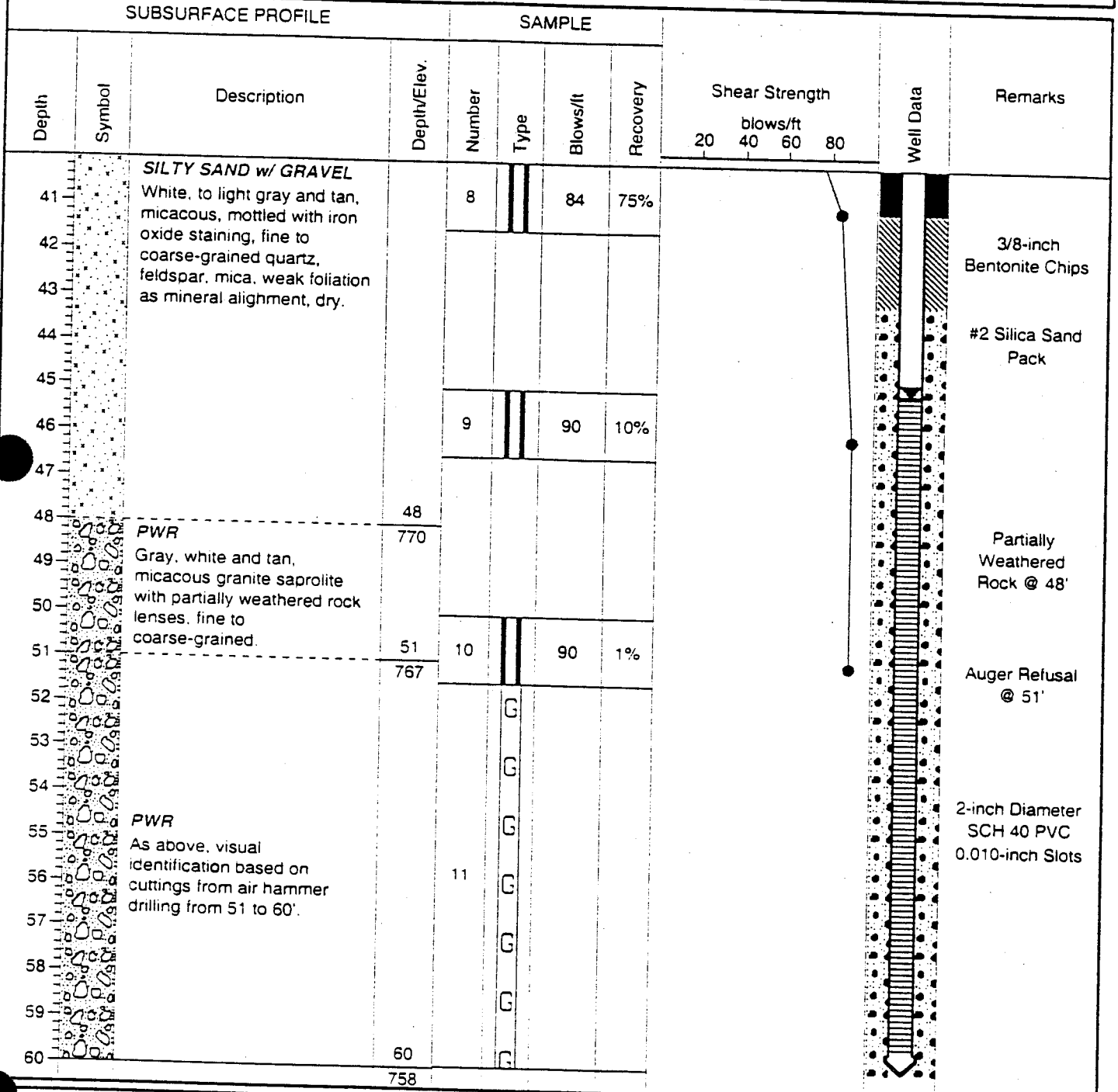
Location: Old Salisbury Road

Geologist Log B-6R (MW-6R)

Ground Elevation: 817.8' MSL

Geologist: John R. Isham, PG.

HDR



Drilled By: Engineering Tectonics, PA.

Drill Method: 4.25-inch ID HSA

Drill Date: July 8, 1999

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC. 28202

Hole Size 8-inch Diameter

Top-of-Casing 820.4' MSL

Sheet: 3 of 3

Project No: 00162-090-018

Project: Winston-Salem C&D Landfill

Client: City of Winston-Salem

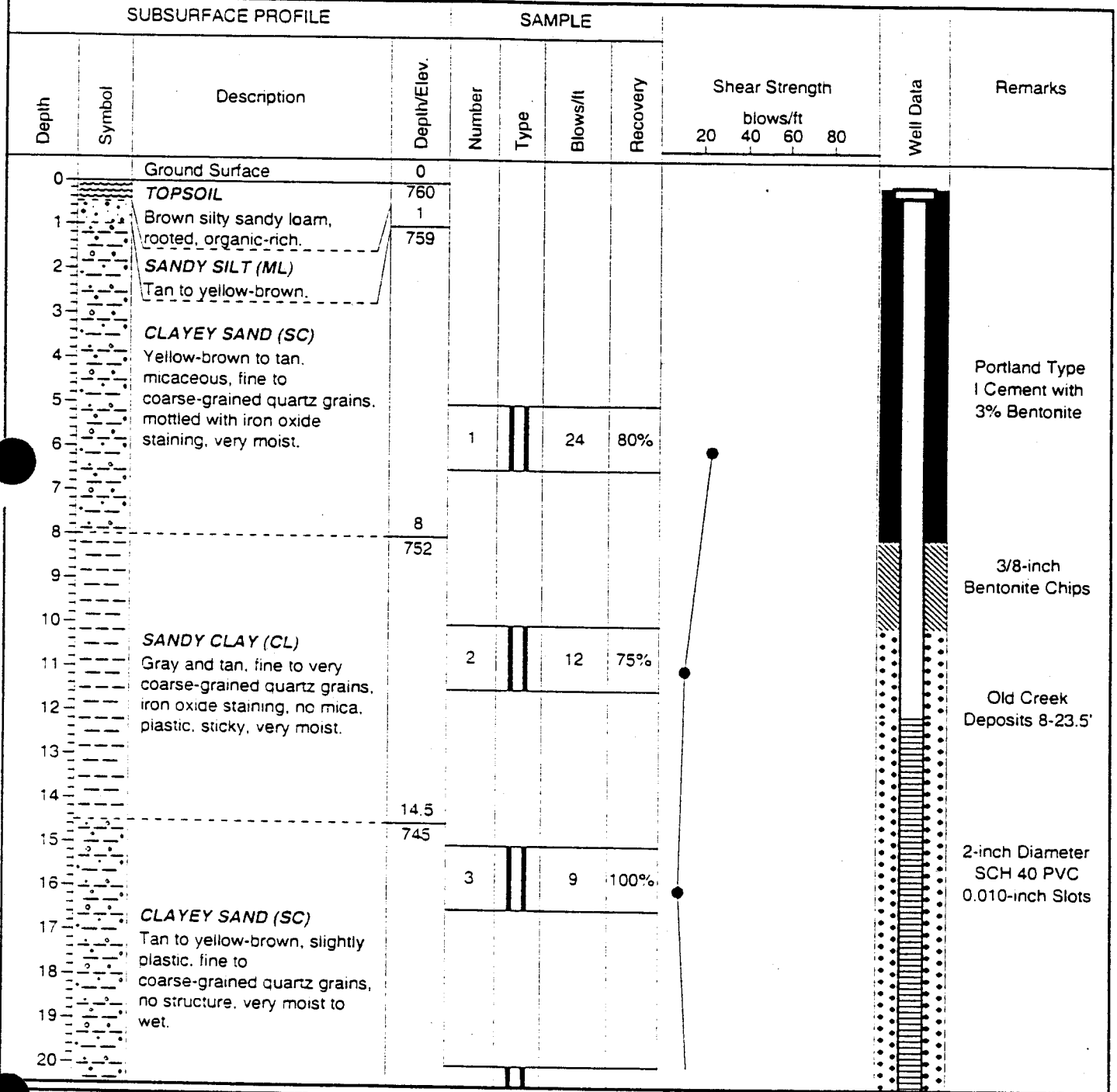
Location: Old Salisbury Road

Geologist Log B-8 (MW-8)

Ground Elevation: 759.8' MSL

Geologist: John R. Isham, PG.

HDR



Drilled By: Engineering Tectonics, PA.

Drill Method: 4.25-inch ID HSA

Drill Date: July 7, 1999

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC. 28202

Hole Size 8-inch Diameter

Top-of-Casing 762.5' MSL

Project No: 00162-090-018

Project: Winston-Salem C&D Landfill

Client: City of Winston-Salem

Location: Old Salisbury Road

Geologist Log B-8 (MW-8)

Ground Elevation: 759.8' MSL

Geologist: John R. Isham, PG.

HDR

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Depth/Elev.	Number	Type	Blows/ft	Recovery	Shear Strength blows/ft 20 40 60 80	Well Data	Remarks
21			21	4		14	100%			
		CLAYEY GRAVEL (GM) Yellow-brown to tan, poorly graded, large angular quartz gravel, limonite staining, very wet.	739							2-inch Diameter SCH 40 PVC 0.010-inch Slots
22										
23			23.5							
24		***SILTY SAND (SM)*** Brown, white and tan, micaceous, fine to very coarse-grained quartz grains. weak horizontal mineral alignment, pegmatite zone at base, wet.	736							Granitic Saprolite @ 23.5'
25										
26				5		14	90%			
27			27							
		End of Borehole	733							
28										
29										
30										
31										
32										
33										
34										
35										
36										
37										
38										
39										
40										

Drilled By: Engineering Tectonics, PA.

Drill Method: 4.25-inch ID HSA

Drill Date: July 7, 1999

HDR Engineering, Inc. of the Carolinas
128 S. Tryon Street
Suite 1400
Charlotte, NC. 28202

Hole Size 8-inch Diameter

Top-of-Casing 762.5' MSL

North Carolina
Department of Natural Resources and Community Development
Division of Environmental Management
Groundwater Section
P.O. Box 27687 - Raleigh, N.C. 27611

WELL ABANDONMENT RECORD

CONTRACTOR Engineering Tectonics, PA REG. NO. 835

1. WELL LOCATION: (Show a sketch of the location on back of form.)
Nearest Town: Old Salisbury Road Landfil County Forsyth
Old Salisbury Road, Winston-Salem
(Road, Community, Subdivision, Lot No.) Quadrangle No.

2. OWNER: City of Winston-Salem

3. ADDRESS:

4. TOPOGRAPHY : draw, slope, hilltop, (valley), flat

5. USE OF WELL: monitoring DATE: 7-9-99

6. TOTAL DEPTH: 39.0' DIAMETER: 2.0"

7. CASING REMOVED:

feet	diameter

8. SEALING MATERIAL:

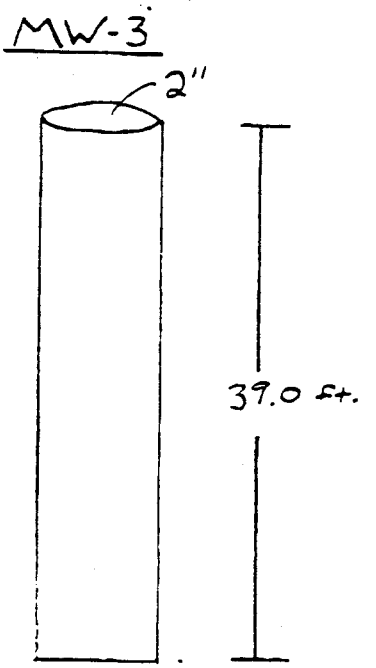
Neat cement	Sand cement
bags of cement	bags of cement
gals. of water	yds. of sand
	gals. of water

Other
Type material pumpable grout

Amount 0.83 cubic feet

9. EXPLAIN METHOD EMPLACEMENT OF MATERIAL.
a grout pump

WELL DIAGRAM: Draw a detailed sketch of the well showing total depth, depth and diameter of screens remaining in the well, gravel interval, intervals of casing perforations, and depths and types of fill materials used.



I do hereby certify that this well abandonment record is true and exact.

Signature of Contractor or Agent Mark Taylor Date 8-3-99

WELL LOCATION: Draw a location sketch on the reverse of this sheet, showing the direction and distance of the well to at least two (2) nearby reference points such as roads, intersections and streams. Identify roads with State Highway road identification numbers.

Submit original to the Division of Environmental Management, one copy to the Driller, and one copy to the owner.

GW -30 Revised 5/15/89

North Carolina
Department of Natural Resources and Community Development
Division of Environmental Management
Groundwater Section
P.O. Box 27687 - Raleigh, N.C. 27611

WELL ABANDONMENT RECORD

CONTRACTOR Engineering Tectonics, PA REG. NO. 835

1. WELL LOCATION: (Show a sketch of the location on back of form.)
Nearest Town: Old Salisbury Road Landfill County Forsyth
Old Salisbury Road, Winston-Salem
(Road, Community, Subdivision, Lot No.) Quadrangle No.

2. OWNER: City of Winston-Salem

3. ADDRESS:

4. TOPOGRAPHY : draw, slope, (hilltop), valley, flat

5. USE OF WELL: monitoring DATE: 7-9-99

6. TOTAL DEPTH: 59.0' DIAMETER: 2.0"

7. CASING REMOVED:

feet	diameter

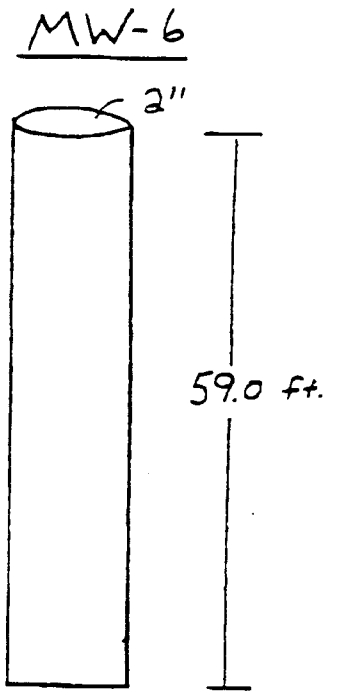
8. SEALING MATERIAL:

Neat cement	Sand cement
bags of cement	bags of cement
gals. of water	yds. of sand
	gals. of water

Other
Type material pumpable grout
Amount 1.26 cubic feet

9. EXPLAIN METHOD EMPLACEMENT OF MATERIAL.
a grout pump

WELL DIAGRAM: Draw a detailed sketch of the well showing total depth, depth and diameter of screens remaining in the well, gravel interval, intervals of casing perforations, and depths and types of fill materials used.



I do hereby certify that this well abandonment record is true and exact.

Signature of Contractor or Agent Mark Tyler Date 8-3-99

WELL LOCATION: Draw a location sketch on the reverse of this sheet, showing the direction and distance of the well to at least two (2) nearby reference points such as roads, intersections and streams. Identify roads with State Highway road identification numbers.

Submit original to the Division of Environmental Management, one copy to the Driller, and one copy to the owner.

GW -30 Revised 5/15/89

REVISED GROUND-WATER MONITORING PLAN

HDR ENGINEERING, INC. OF NORTH CAROLINA

JANUARY 1996

WINSTON-SALEM CONSTRUCTION AND DEMOLITION DEBRIS LANDFILL

OLD SALISBURY ROAD (SR 3011) WINSTON-SALEM, NORTH CAROLINA

REVISED GROUND-WATER MONITORING PLAN

Conducted for:

Winston-Salem/Forsyth County Utilities Commission
North Carolina

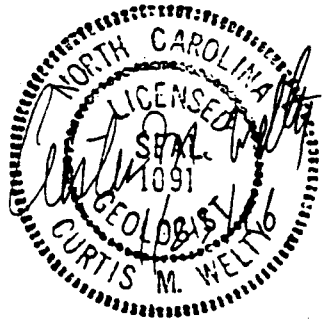
Prepared by:

HDR Engineering, Inc. of North Carolina

HDR

Project No. 00162-082-018

January 1996



FORWARD

The existing Ground-water Monitoring Plan for the proposed Winston-Salem Construction and Demolition Debris Landfill (C&D) was prepared by S&ME, Inc. in December, 1994. This document provides the basic foundation of this Revised Ground-Water Monitoring Plan.

An amendment (updated analytical parameters list) to this plan was made by HDR in June of 1995 in response to a memorandum from the Solid Waste Section in Raleigh to the Solid Waste Section in the Winston-Salem Regional Office of the North Carolina Department of Environment, Health and Natural Resources (NCDEHNR). A copy of this memorandum and final amendment has been attached to this document as Appendix A.

In response to a letter dated September 27, 1995 from the Solid Waste Section (Raleigh), additional revisions to the existing Ground-Water Monitoring Plan were warranted as a result of the replacement (and additional installation) of several of the existing on-site detection monitoring wells. Well replacements for existing wells for MW-1, MW-2, MW-4, and MW-5 were installed between December 27 and 29, 1996, in addition to the installation of two new wells (MW-6 and MW-7). Soil boring and monitoring well construction records for each of the newly installed (and existing) monitoring wells for the detection monitoring system have been included as Appendix B. The monitoring wells being replaced were effectively sealed in accordance with state abandonment procedures. In addition, a 24-inch diameter, bored water well was also abandoned. Well abandonment records are included in Appendix C of this document.

Appendix D of this document contains a scaled base map showing the location of the existing detection monitoring well locations along with the water table potentiometric surface contours for the C&D landfill based on water level data collected during the initial "background" sampling of the wells.

GROUNDWATER MONITORING PLAN

PROPOSED CONSTRUCTION AND DEMOLITION DEBRIS LANDFILL
FORSYTH COUNTY, NORTH CAROLINA
S&ME PROJECT NO. 1584-93-143B

Prepared For:

Winston-Salem/Forsyth County Utilities Commission
102 West Third Street, Suite 460
Winston-Salem, North Carolina 27102

Prepared By:

S&ME, Inc.
3718 Old Battleground Road
Greensboro, North Carolina 27410

December 1994

S&ME

December 2, 1994

Winston-Salem/Forsyth County Utilities Commission
102 West Third Street, Suite 460
Winston-Salem, North Carolina 27102

Attention: Mr. Dan Miles

Reference: **GROUNDWATER MONITORING PLAN**
Proposed Construction and Demolition Debris Landfill
Forsyth County, North Carolina
S&ME Project No. 1584-93-143B

Dear Mr. Miles:

S&ME, Inc. (S&ME) has completed the authorized Groundwater Monitoring Plan (ref. S&ME proposal no. 1584-94-P113) for the proposed construction and demolition debris landfill in Forsyth County. The enclosed Groundwater Monitoring Plan was completed in accordance with North Carolina Solid Waste Management Rules (15A NCAC 13B). If you have any questions regarding the contents of the Groundwater Monitoring Plan or if we may be of further service to you, please call either of the undersigned at (910) 288-7180.

Sincerely,

S&ME, Inc.

Wayne H. Watterson, P.E.
Senior Engineer
N.C. Registration No. 19243

Scott D. Berg
Project Manager

WHW/SDB/mjf

Enclosures

S&ME, Inc. 3718 Old Battleground Road, Greensboro, North Carolina 27410, (910) 288-7180, Fax (910) 288-8980
Mailing address: P.O. Box 38728, Greensboro, North Carolina 27438-8728

TABLE OF CONTENTS

Page

1.0 INTRODUCTION 1

2.0 PURPOSE 2

3.0 GEOLOGIC CHARACTERISTICS 3
- 3.1 PHYSIOGRAPHY 3
- 3.2 REGIONAL HYDROLOGY 3
- 3.3 SITE GEOLOGY AND HYDROGEOLOGY 4
  - 3.3.1 Site Geology 4
  - 3.3.2 Hydrogeology 5

4.0 GROUNDWATER MONITORING PLAN 7
- 4.1 MONITOR WELL LOCATIONS 7
- 4.2 MONITOR WELL CONSTRUCTION 8
- 4.3 MONITOR WELL INSTALLATION PROCEDURES 8
- 4.4 MONITOR WELL DEVELOPMENT 10
- 4.5 SAMPLING FREQUENCY 10
- 4.6 MONITOR WELL SAMPLING 11
  - 4.6.1 Groundwater Measurements 11
  - 4.6.2 Monitor Well Purging 11
  - 4.6.3 Sample Collection 12
- 4.7 LABORATORY CONSIDERATIONS 12
  - 4.7.1 Laboratory Qualifications 12
  - 4.7.2 Laboratory Procedures 13
- 4.8 EVALUATION OF GROUNDWATER MONITORING DATA 13
- 4.9 RECORDKEEPING AND REPORTING REQUIREMENTS 13

5.0 REFERENCES 15

TABLES

Table 1 Groundwater Elevation Measurements
Table 2 Constituents For Detection Monitoring

1.0 INTRODUCTION

This Groundwater Monitoring Plan is presented to provide a detection monitoring program for a proposed construction and demolition debris (C&D) landfill scheduled to be constructed off Old Salisbury Road in southern Forsyth County, North Carolina.

The Groundwater Monitoring Plan includes the procedures outlined by the North Carolina Department of Environment, Health and Natural Resources, Division of Solid Waste Management (Division) for a groundwater monitoring plan at a newly constructed C&D landfill. The information in this plan is designed to assist the Division, the landfill operations personnel and its agents in the evaluation of future groundwater quality at the landfill cell. Monitor well locations, monitor well construction, monitor well installation procedures, monitor well development, sampling frequency, monitor well sampling procedures, laboratory considerations, evaluation of groundwater monitoring data, and recordkeeping and reporting requirements are included in the Groundwater Monitoring Plan. Monitor well sampling and analytical procedures will be performed in accordance with the Division's rules and policies.

S&ME completed a Geologic and Hydrological Report (S&ME Project No. 1581-93-052) for the proposed C&D landfill in June, 1994. Twenty-six soil borings were performed for the Geologic and Hydrological Report. Permanent groundwater monitor wells were installed at several of the soil boring locations. One of the monitor wells (B-3/MW-1) completed for the Geologic and Hydrological Report has been incorporated into the Groundwater Monitoring Plan and will serve as an upgradient groundwater monitoring point. Four additional groundwater monitor wells will be installed to serve as downgradient groundwater monitoring points.

2.0 PURPOSE

The Groundwater Monitoring Plan is designed for the purpose of detecting a release of hazardous constituents from the C&D landfill into the uppermost aquifer at a relevant point of compliance in order to protect human health and the environment. The Groundwater Monitoring Plan has been completed in accordance with Division policy and includes relevant information presented in Title 15A of the North Carolina Administrative Code (NCAC) Subchapter 13B Section .1604 and Sections .1630 through .1633. The Division policy for groundwater monitoring at C&D landfills as stated by Mr. Bobby Lutfy, Hydrogeologist, Solid Waste Section, requires a minimum of one upgradient and three downgradient groundwater monitoring points. Statistical analyses of groundwater monitoring data is not required.

3.0 GEOLOGIC CHARACTERISTICS

3.1 PHYSIOGRAPHY

The site planned for development of the C&D landfill is comprised of two contiguous tracts, a 29 acre tract and a 108.24 acre tract. The smaller tract is near the intersection of Old Salisbury Road and Friedberg Road. This tract will not be developed with the exception of an access road along its northern limits. Access to the proposed landfill site will be from Old Salisbury Road. In the southern portion of the 108.24 acre tract, a 10.3 acre cell is planned for development. The southernmost boundary of the cell is parallel to the Forsyth/Davidson County line.

Site elevations generally range from a high of 840 feet above mean sea level in the southeastern portion of the site to a low of 725 feet above mean sea level near the northernmost section of the site. Surface drainage at the subject site is primarily controlled by a north-northwesterly trending ridge within the property. Surface runoff is directed northeast, west and southwest into tributaries of South Fork Muddy Creek. The majority of surface runoff within this site is directed to South Fork Muddy Creek on the north. A small area in the extreme southeasterly section of the site appears to drain south into Miller Creek. Both the South Fork Muddy Creek and Miller Creek flow to the west where they converge with Muddy Creek. Muddy Creek flows to the south and converges with the Yadkin River.

3.2 REGIONAL HYDROLOGY

Ridges and hilltops are generally water-table divides in addition to being surface-water divides. The majority of ridges and hilltops in the region are composed of rocks that were

poorly fractured during the immediate past stage of weathering and erosion. Upland slopes, like the ridges and hilltops, are central recharge areas to the upper aquifer. Draws, or upland topographic lows, are normally underlain by permeable fracture zones and may be discharge areas, where groundwater discharges at the ground surface. Alignment of some draws and surface drainage systems suggest fracture alignment. However, much of the surface drainage pattern is dendritic and not related to rock structures (LeGrand, 1988).

3.3 SITE GEOLOGY AND HYDROGEOLOGY

3.3.1 Site Geology

According to the Geologic Map of North Carolina dated 1985, the subject site is in the Charlotte belt of the Piedmont Physiographic Province. This Province contains metamorphic and igneous plutonic rock which in some areas have been extensively weathered and eroded forming an undulating and well-dissected topography. The area is underlain by intrusive granite rock which is commonly megacrystic to equigranular in texture.

The bedrock is typically fractured and is overlain by highly weathered bedrock called saprolite. The saprolite varies in thickness from a few feet near bedrock outcrops to over 100 feet. The saprolitic material retains some of the original (relict) structural features of the parent rock. The nearer surface residual soils are formed by the in-place physical and chemical weathering of the saprolite and usually do not retain the relict structural features.

Subsurface conditions as indicated by the Geologic and Hydrological Report (S&ME, Inc., 1994) generally consist of a veneer of topsoil underlain by residual soils, saprolite, partially

weathered rock, and fractured rock. There is generally a gradual transition from one material type to the next with varying thickness of each. Generally, the depth to rock in the area of the proposed cell is greater than 35 feet below land surface.

3.3.2 Hydrogeology

In the Piedmont Physiographic Province, groundwater is present within the openings created by fractures and joints within the bedrock and within the pore spaces of the overlying saprolite. The saprolite/bedrock aquifers are primarily recharged by precipitation in the interstream areas which infiltrates through the unsaturated zone to the water table. The depth to ground water is deeper beneath uplands than beneath valleys. The water table is commonly close to the top of bedrock and is more often than not, located within the saprolite. The seasonal fluctuation of the water table generally ranges between 1 foot and 6 feet. Groundwater moves laterally and downward through the saprolite and bedrock toward streams, springs and other surface water bodies (discharge areas) to streams in the adjacent valleys and to bedrock fractures. The water table surface is generally a subdued reflection of the surface topography.

3.3.2.1 Hydraulic Conductivity

Soil permeability values were determined for the Geologic and Hydrological Report from field testing using a rising head (slug) test. The results of rising head field permeability tests performed in the rock indicated hydraulic conductivities in the range of 9.41×10^{-5} cm/sec. to 1.92×10^{-4} cm/sec. The field rising head permeability tests performed in partially weathered rock indicated hydraulic conductivity values ranging between 2.19×10^{-4} and 7.5×10^{-4} cm/sec.

3.3.2.2 Hydraulic Gradient

The horizontal hydraulic gradient in the area of the proposed landfill cell ranges from 0.033 foot per foot to 0.1 foot per foot (Geologic and Hydrological Report, S&ME, Inc., 1994). Based on the hydraulic conductivity values of the partially weathered rock and an assumed effective porosity of 0.20, the groundwater flow rate at the site ranges from 0.10 to 1.1 feet per day (37 to 390 feet per year).

4.0 GROUNDWATER MONITOR PLAN

4.1 MONITOR WELL LOCATIONS

At a minimum, one upgradient and three downgradient groundwater monitor wells are required in a Groundwater Monitoring Plan for a C&D landfill. However, the plan must include a sufficient number of wells to adequately measure groundwater quality upgradient of the landfill cell and at a relevant point of compliance downgradient of the landfill cell. Monitor wells should not be placed greater than 250 feet from the landfill cell boundary or within 50 feet of a property boundary.

Monitor well locations for the Groundwater Monitoring Plan are based on review of the Potentiometric Map completed for the Geologic and Hydrological Report. Based on data contained in the Geologic and Hydrological Report, the area east of the proposed landfill cell is upgradient. The general direction of groundwater flow from the landfill cell is to the north toward an unnamed tributary of South Fork Muddy Creek and to the south and west to an unnamed intermittent tributary of South Fork Muddy Creek. Groundwater elevations were measured in October, 1994 to verify that seasonal change in groundwater flow direction were not encountered (see Table 1).

One upgradient monitor well (B-3/MW-1) has been installed during the acquisition of data for the Geologic and Hydrological Report. Four downgradient monitor wells (MW-2, MW-3, MW-4 and MW-5) will also be installed. These four monitor well locations were selected to determine groundwater quality downgradient from the landfill cell and are each located within 200 feet of the cell boundary.

4.2 MONITOR WELL CONSTRUCTION

The four downgradient monitor wells will be constructed of 2-inch PVC schedule 40 flush-joint threaded casing and 0.010-inch slotted screen. All joints will be water-tight. Well construction materials will be shipped in factory sealed containers. The four monitor wells to be constructed for the Groundwater Monitoring Plan will be constructed and installed according to the requirements of Title 15A NCAC 2C. Generalized details for the construction of monitor wells are shown on the Well Schematic included in the Appendix. The four additional monitor wells will have a screened interval of at least 10 feet. A Well Log for monitor well B-3/MW-1 is included in the Appendix.

A geologist/engineer will be present during the installation of the new monitor wells to record the lithology and document well construction details. The screen interval at each well will be set at a depth which intersects the water table throughout the seasonal fluctuations of water levels.

4.3 MONITOR WELL INSTALLATION PROCEDURES

Boreholes drilled for well installation and the monitor well construction will be performed by a licensed drilling contractor. All equipment used for drilling and completion of the wells will be properly cleaned before and after monitor well installation utilizing high pressure steam. Boreholes will be advanced using hollow-stem rotary augers. Once the boreholes are drilled, the monitor well construction will be completed using the following criteria.

1. The four additional monitor wells will be located at the site by a licensed surveyor.

2. The well screen and casing will be lowered through the hollow-stem augers. The annular space between the borehole wall and the well screen will be backfilled with clean, washed sand. The sand will consist of clean sand properly sized to formation material. The sand pack will extend at least 1 foot but no more than 2 feet above the well screen. The hollow-stem augers will be incrementally withdrawn while the filter pack is placed. The sand pack level will be frequently sounded and kept at the base of the augers until the desired length of sand pack is in place.

3. A 2-foot pelletized bentonite seal will be placed above the sand pack and allowed to hydrate. The augers will be withdrawn to above the top of the bentonite pellets prior to allowing the bentonite pellet seal to hydrate. Adequate time shall be provided for the hydration of the bentonite seal prior to grouting the annular space of the wells.

4. The remainder of the annular space will be filled with a neat cement grout from the top of the bentonite seal to the ground surface. The grout will be slowly pumped into a tremmie pipe at a constant rate to fill the annular space. The tremmie pipe will be slowly raised along with the augers to allow for an evenly distributed placement. After grouting, no work will be performed at the wells for a minimum of 24 hours to allow the grout to set.

5. A 6-inch diameter, steel protective casing with a locking cap will be placed over the well's riser pipe and into the grout seal. The protective casing will extend from about 2 feet below the ground surface to slightly above the well casing top. The protective casing will be primed, painted, and provided with a permanently affixed name plate.

6. A 6-inch thick concrete pad, which slopes away from the well in all directions, will be constructed to serve as anchorage and will prevent surface water from migrating along the wall of the casing.

7. The location, installation method and construction details of the four additional wells may be modified, according to site specific conditions. The modifications must be approved by the Division prior to the construction of any monitor well by techniques other than those described herein.

Monitor well elevations will be surveyed by a licensed surveyor after installation. The top of casing and ground surface elevation of each monitor well will be recorded.

4.4 MONITOR WELL DEVELOPMENT

The four downgradient monitor wells will be developed in order to remove clay, silt, sand and other fines that may have been introduced into the well or sand pack during drilling and well installation. Monitor well B-3/MW-1 will also be developed. Well development will be continued until the suspended solids are removed from the well and turbidity is minimized. The wells will be developed by removing water from the well with a decontaminated Teflon bailer or a pneumatic purge pump to facilitate hydraulic communication with the aquifer.

4.5 SAMPLING FREQUENCY

Each monitor well included in the Groundwater Monitoring Plan will be sampled semi-annually. The first semi-annual sampling event will be performed after construction of the landfill cell and prior to its use to establish background groundwater quality.

4.6 MONITOR WELL SAMPLING

The primary concern during the collection of groundwater samples is to obtain a representative groundwater sample from the near surface aquifer. Decontaminated Teflon bailers will be used for monitor well purging and sampling. One equipment blank will be collected during each sampling event by filling a decontaminated bailer with deionized water. The water will then be transferred to laboratory prepared containers labeled for the corresponding laboratory analysis to be performed. After filling, the containers will be placed into a precleaned cooler containing ice.

4.6.1 Groundwater Measurements

Prior to monitor well sampling, the depth to water and the total well depth will be measured in each monitor well from the top of the PVC casing to calculate the amount of water within the well casing. The depth to water will be measured with a decontaminated electronic water level indicator. The measurements will be made to the nearest 0.01 foot. The volume of water in the well will then be calculated and recorded, along with the static water level.

4.6.2 Monitor Well Purging

Five well casing volumes of water will be purged from the monitor wells prior to sampling, unless the wells are purged to dryness. The monitor wells will be purged utilizing laboratory decontaminated Teflon bailers. Field measurements of pH, specific conductance and temperature will be recorded after purging to evaluate the removal of the stagnant water from the monitor well.

4.6.3 Sample Collection

After purging, a groundwater sample will be collected from each monitor well by slowly lowering the Teflon bailer into the well to minimize the potential for volatilization. Samples will be collected from the upper portion of the water column. Samples will be transferred to laboratory prepared containers labeled for the corresponding laboratory analyses. Samples to be analyzed for organic constituents will be collected first followed by samples to be analyzed for inorganic constituents. Preservatives will be added as necessary (in accordance with EPA Method SW-846 protocol) to the sample bottles prior to field operations or by the laboratory prior to shipment. Care will be taken to prevent the bailer from contacting the sample bottle during sample collection. After filling, the sample bottles will be securely placed into a precleaned cooler containing ice. A chain of custody form will be initiated. The Chain of Custody will include the sample number, the sample collector's signature, the date and time of sample collection, the sample type, the number of containers, signature of person(s) in the chain of possession, inclusive dates of possession, and temperature of shipping container upon opening in the laboratory. Each monitor well will be secured after sample collection.

Samples will be shipped to the lab within 1 day of sample collection by courier. Samples will be shipped in a cooler containing ice to maintain a sample temperature at or below 4 degrees celsius. The Chain of Custody form will accompany sample shipment inside the cooler.

4.7 LABORATORY CONSIDERATIONS

4.7.1 Laboratory Qualifications

Sample analyses will be performed by a North Carolina certified/qualified laboratory using EPA methods acceptable to the Division.

4.7.2 Laboratory Procedures

Each groundwater sample will be analyzed for the constituents listed in 40 CFR Part 258 Appendix I (see Table 2) using EPA methods acceptable to the Division. The laboratory reports will contain the referenced methodologies, the constituent concentrations, the method detection limits, QA/QC data, and corresponding Chain of Custody forms.

4.8 EVALUATION OF GROUNDWATER MONITORING DATA

The laboratory analyses included in the Groundwater Monitoring Plan are based on the Detection Monitoring Program requirements outlined in Title 15A NCAC Subchapter 13B Section .1633. Background groundwater quality will be established in the surficial aquifer by performing one sampling event prior to placement of waste into the landfill cell. Semi-annual monitoring will subsequently be used to evaluate the quality of groundwater at the C&D landfill cell. The evaluation of groundwater quality will be based on the North Carolina Groundwater Classifications and Standards as defined in Title 15A NCAC Subchapter 2L Section .0202 and on the results of the initial (background) sampling event which will be completed before the placement of materials into the landfill cell.

4.9 RECORDKEEPING AND REPORTING REQUIREMENTS

All field and laboratory data will be maintained on file during the active life of the landfill and during the post-closure period. The sample collector will maintain a field log to record all pertinent information regarding the purging and sampling of the monitor wells. The information to be recorded will include the following.

1. Collectors name, date and time,
2. Site name and location,
3. Well identification,
4. Well depth,
5. Depth to water measured from top of casing,
6. Well casing inside diameter,
7. Well volume (the amount of water occupying the casing prior to purging),
8. Time that purging was initiated and completed,
9. Reason for sampling,
10. Sample pH, temperatures and specific conductivity,
11. Sample volume, containers, preservatives,
12. Sample observations, color, turbidity,
13. Analyses to be performed on each sample,
14. Weather conditions at the time of sampling,
15. Additional comments.

A report will be submitted to the Division within 30 days of receipt of the results of the laboratory analyses. The report will include an outline of the field procedures used, the results of the laboratory analyses, QA/QC documentation, chain of custody, analytical methods, and groundwater analyte concentrations. If the laboratory test data reports an analyte concentration above the background concentration, the Division will be notified in writing by the operator within 14 days of receipt of the results of the laboratory analyses.

TABLE 1
GROUNDWATER ELEVATION MEASUREMENTS
PROPOSED C&D LANDFILL
FORSYTH COUNTY, NORTH CAROLINA
S&ME PROJECT NO. 1584-93-143B

Boring Number	Date Drilled	Elevation Ground Surface	Elevation Bottom of Boring	Groundwater Elevation 04/14/94	Groundwater Elevation 05/04/94	Groundwater Elevation 10/06/94
B-1	12/29	841.25	794.15	NM	NM	Dry
B-2	12/30	838.66	787.46	NM	NM	Dry
B-3	03/23	833.67	783.77	796.90	797.02	796.55
B-4	04/04	822.85	774.25	Dry	Dry	Dry
B-5	03/30	818.45	769.45	777.12	777.21	776.67
B-6	03/24	824.46	774.46	777.46	777.42	777.12
B-7	03/30	814.61	764.61	773.50	773.69	772.97
B-8	03/31	791.64	742.84	761.59	761.60	759.76
B-9	03/31	820.98	772.08	774.10	774.15	773.59
B-12	03/31	826.93	778.33	780.46	780.56	780.07
B-13	03/31	814.05	779.05	783.95	784.12	783.08
B-14	04/04	804.22	755.62	787.59	787.70	787.60
B-15A	03/24	780.93	735.93	772.13	772.19	771.35
B-16A	03/28	762.17	717.17	751.42	751.17	749.13
B-16B	03/28	761.07	732.07	752.34	751.70	750.95
B-17	04/11	762.19	713.49	756.99	756.99	754.12
B-22	03/30	817.34	768.74	Dry	Dry	Dry
B-23	04/07	811.68	763.08	777.59	777.94	777.21

NM - Not Measured

See Figure 2 for boring locations

TABLE 2
CONSTITUENTS FOR DETECTION MONITORING
PROPOSED C&D LANDFILL
FORSYTH COUNTY, NORTH CAROLINA
S&ME PROJECT NO. 1584-93-143B

Inorganic Constituents:

~~Antimony~~
Arsenic
Barium
~~Beryllium~~
Cadmium
Chromium
~~Cobalt~~
~~Copper~~
Lead
Mercury
~~Nickel~~
Selenium
Silver
~~Thallium~~
~~Vanadium~~
~~Zinc~~

Organic Constituents:

Acetone
Acrylonitrile
Benzene
Bromochloromethane
Bromodichloromethane
Bromoform
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Chloroethane
Chloroform
Dibromochloromethane
1,2-Dibromo-3-chloropropane
1,2-Dibromoethane
o-Dichlorobenzene
p-Dichlorobenzene
trans-1,4-Dichloro-2-butene
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethylene
cis-1,2-Dichloroethylene
trans-1,2-Dichloroethylene
1,2-Dichloroethylene
cis-1,3-Dichloropropene
trans-1,3-Dichloropropene
Ethylbenzene
2-Hexanone
Methyl bromide
Methyl chloride
Methylene bromide
Methylene chloride
Methyl ethyl ketone
Methyl iodide
4-Methyl-2-pentanone
Styrene
1,1,1,2-Tetrachloroethane
1,1,2,2-Tetrachloroethane
Tetrachloroethylene
Toluene
1,1,1-Trichlorothane
1,1,2-Trichlorothane
Trichloroethylene
Trichlorofluoromethane
1,2,3-Trichloropropane
Vinyl acetate
Vinyl chloride
Xylenes

APPENDIX A

INITIAL AMENDMENT TO GROUND-WATER MONITORING PLAN

June 26, 1995

HDR

Ms. Jan McHargue, P.E.
NCDEHNR
Solid Waste Section
585 Waughtown Street
Winston-Salem, NC 27107-2241

Re: - Proposed Construction and Demolition Landfill
Winston-Salem, North Carolina
Response to Comments from Jim Bateson, dated April 27, 1995
HDR Project No. 00162-082-018

Dear Ms. McHargue:

This letter is provided in response to the memorandum to you from Jim Bateson, dated April 27, 1995. The comments have been retyped in *italics*, with the responses following. Per our previous discussions, please insert this response letter behind the tab entitled "Exhibit 4 - Review Comments and Responses." Some of the information attached herewith should replace previously submitted material. These items are referenced in the responses below.

NCDEHNR April 27, 1995, Comments

1. ***Section .0504(1)(a) of 15A NCAC 13B requires two versions of the quarter-mile map: one, a photographic version similar to the one already submitted, and another blueline version with topographic contours. The current photographic version was printed with the mylar reversed left to right. On both versions, the following need to be specifically marked:***

A corrected and updated aerial photograph is included herewith. Take out the existing aerial photograph and replace with the attached aerial photograph. Also, a topographic version of the quarter-mile map has been prepared and is included herewith.

ii) ***land use and zoning***

Land use and zoning classifications have been shown or noted on both versions of the quarter-mile map.

HDR Engineering, Inc.
of North Carolina

Suite 1400
128 S. Tryon Street
Charlotte, North Carolina
28202-5001

Telephone
704 338-1800
Fax
704 338-6760

iii) ***utilities; power lines and the public water supply lines need to be shown and labeled.***

Utilities, power lines, and public water lines have been located and shown or noted on both versions.

iv) ***Location of all wells within the quarter-mile radius. For those areas substantially further than 500 feet away from the proposed waste boundaries, a note in the margin of the map, stating that residences may have private wells, will suffice. For those lots adjacent to the site, the exact location of all wells needs to be shown on the map. If private wells are located on the back parts of any of those lots, the 500-foot buffer needs to be measured from the wells, and not the residences. The waste boundaries may then require adjustment. If the operators or their consultants do not wish to locate all of the nearby wells, they have the option of locating the waste boundaries 500 feet from the edges of the adjacent residential properties.***

The City has recently sent letters to all area residences requesting that information regarding private drinking water wells be returned to the Utility Department. While all responses have not been received, two residents located on June Lane (Little, 5635 June Lane; and Bertini, 5665 June Lane) have indicated that they do have residential wells. Both residents are connected to public water supply, and city staff has verified that the well at 5665 June Lane is inactive. City staff will follow up as other responses are received from the area residents.

The 500-foot buffer line adjacent to June Lane has been relocated based on the location of the two known drinking water wells. This shift was approximately 40 feet. Based on the minimal number of homes which could influence the 500-foot buffer line by the existence of a drinking water well, it is anticipated that no future adjustment to the buffer line will be required. When all responses have been received from the area residents, further correspondence will be transmitted to the section.

v) ***margins of flood plains***.

From an obtained flood insurance map, pertinent floodplains are shown on both versions of the quarter-mile map.

2. ***On the two-mile map, if none of the items (i) through (iv) occur within the radius, then this needs to be noted specifically for each in the margin of the map.***

The two-mile radius map has been updated and is included herewith. Remove the existing two-mile map and replace it with the conformed two-mile map attached.

Items (i) through (iv) have been researched and noted on the conformed two-mile map.

3. *In section 8.8 of the Site Plan Report, the reference to a 100-foot buffer between disposal areas and property lines needs to be changed to 200 feet.*

Remove pages eleven and twelve which include section 8.8 and replace with the revised pages attached.

The 100-foot buffer was modified in the text.

4. *Grading limits will need to be raised in the easternmost part of the proposed footprint, near soil boring B-3. Base grades needs to be at least four feet above long-term seasonable high ground water levels, estimated by S&ME to be six feet above the February 1995 levels contoured in the recently submitted potentiometric surface map. Although the February 1995 readings were lower, in some cases, than previous readings; and therefore, do not represent the seasonable high, the Section feels that the six feet of additional vertical separation meant to account for long-term variation of the seasonable high is generous enough to account, as well, for some uncertainty in the seasonal high for this year.*

Base grade changes will be redesigned, as necessary, and the updated design will be submitted in the Construction Plan Application.

5. *In the monitoring plan, the list of constituents to be analyzed needs to be changed. Sampling and Analysis Requirements for Construction and Demolition Landfills, recently revised by the Solid Waste Section, is attached.*

Remove Table 2 in the monitoring plan of Exhibit 3 and replace with revised list of constituents attached.

Table 2 - list of constituents was revised with the new list obtained from the Solid Waste Section.

6. *The Solid Waste Section issues permits for landfill units designed to contain a maximum of five years of projected fill. The monitoring system needs to be designed to monitor the first five-year cell. If Phase I of the proposed landfill is intended to accommodate five years of fill, then volume estimates for that period need to be included in the application.*

Phase I is intended to accommodate approximately five years of fill. Two of the groundwater monitoring wells currently in place may conflict with the revised base grade

plan prepared for the Construction Plan Application. The revisions proposed for the groundwater monitoring plan will be further addressed in the Construction Plan.

7. ***The proposed monitoring plan needs to be revised to reflect the currently proposed footprint, rather than the rectangular conceptual footprint shown on S&ME's plan sheets. Proposed waste boundaries need to be clearly marked on the monitoring plan. The revised version of the monitoring plan may be submitted with the construction plan application.***

   The revised groundwater monitoring plan will be submitted with the Construction Plan Application.

Other Attached Information

1. The City of Winston-Salem has created a response to all C & D written comments received as of June 8, 1995. The attached response should be placed in Exhibit 4 of the Site Plan Application.

2. S & ME of Greensboro has compiled a temporary monitor well abandonment report for the C & D Site (per comment No. 5 by Jim Bateson in December 19, 1994, memorandum to Jan McHargue). The attached report should be placed in Exhibit 4 of the Site Plan Application.

Sincerely,

HDR Engineering, Inc. of North Carolina

Joseph C. Readling, P.E.
Project Manager

JCR/nct

List of Attachments:
Revised 1/4-Mile Aerial Photograph
New 1/4-Mile Topographic Map
Revised 2-Mile Regional Map
Revised Pages 11 and 12 of Site Plan Report
Revised List of Monitoring Plan Constituents
New City of Winston-Salem Response
New Temporary Well Abandonment Report

TABLE 2
CONSTITUENTS FOR DETECTION MONITORING
PROPOSED C&D LANDFILL
FORSYTH COUNTY, NORTH CAROLINA
S&ME PROJECT NO. 1584-93-143B

Inorganic Constituents:

~~Antimony~~
Arsenic
Barium
~~Beryllium~~
Cadmium
Chromium
~~Cobalt~~
~~Copper~~
Lead
Mercury
~~Nickel~~
Selenium
Silver
~~Thallium~~
~~Vanadium~~
~~Zinc~~

Organic Constituents:

Acetone
Acrylonitrile
Benzene
Bromochloromethane
Bromodichloromethane
Bromoform
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Chloroethane
Chloroform
Dibromochloromethane
1,2-Dibromo-3-chloropropane
1,2-Dibromoethane
o-Dichlorobenzene
p-Dichlorobenzene
trans-1,4-Dichloro-2-butene
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethylene
cis-1,2-Dichloroethylene
trans-1,2-Dichloroethylene
1,2-Dichloroethylene
cis-1,3-Dichloropropene
trans-1,3-Dichloropropene
Ethylbenzene
2-Hexanone
Methyl bromide
Methyl chloride
Methylene bromide
Methylene chloride
Methyl ethyl ketone
Methyl iodide
4-Methyl-2-pentanone
Styrene
1,1,1,2-Tetrachloroethane
1,1,2,2-Tetrachloroethane
Tetrachloroethylene
Toluene
1,1,1-Trichlorothane
1,1,2-Trichlorothane
Trichloroethylene
Trichlorofluoromethane
1,2,3-Trichloropropane
Vinyl acetate
Vinyl chloride
Xylenes

APPENDIX B

EXISTING DETECTION MONITORING WELL CONSTRUCTION AND SOIL BORING RECORDS

PROJECT: WINSTON-SALEM C & D LANDFILL PROJECT NO: 00162-082-018

LOCATION: OLD SALISBURY ROAD BORING NUMBER: MW-1R PAGE: 1 OF 2

BORING LOG

DATE: 12/27/95

NUMBER	DEPTH	SPT	T	WL	SI	DESCRIPTION (USCS)	COMMENTS
	4'						
SS-1		7	SS			REDDISH-BROWN TO TAN, FIRM SANDY CLAY (CL), SLIGHTLY PLASTIC, RELICT GRANTIC TEXTURE, QUARTZ, FELDSPAR, BIOTITE, IRON OXIDATION, DRY	GRANITIC SAPROLITE
	8'						
SS-2		NA	SS			REDDISH-BROWN TO TAN, CLAYEY SAND (SC), MEDIUM GRAINED, QUARTZ, FELDSPAR ABUNDANT, PHANERITIC TEXTURE, DRY, BRITTLE, SLIGHT PLASTICITY, WHITE MOTTLING	
	12'						
SS-3	16'	NA	SS			LIGHT BROWN TO TAN CLAYEY SANDY SILT (ML), SOFT, DRY, QUARTZ, FELDSPAR ABUNDANT	
	20'						
SS-4		NA	SS			SAME AS ABOVE, SLIGHT MOISTURE IN PLACES, SOFT, MANGANESE OXIDE STAINING	
	24'						
SS-5		NA	SS			SIMILAR TO ABOVE, MOIST CLAYEY ZONES, LARGE QUARTZ/FELDSPAR FRAGMENTS, SOFT, GRANITIC TEXTURE	
	28'						
SS-6		NA	SS			LIGHT BROWN TO TAN CLAYEY SAND (SC), SLIGHTLY STICKY, MEDIUM TO COARSE GRAINED, IRON OXIDES, VERY MOIST, QUARTZ/FELDSPAR RICH	
	32'			▽			
SS-7	36'	NA	SS			LIGHT BROWN TO TAN SANDY SILTY CLAY, (CL), MOIST, SOFT, SLIGHTLY PLASTIC, LESS RELICT GRANITIC TEXTURE, FINER GRAINED	▽ AT DRILLING
	40'			▽			▽ 24 HR

BOREHOLE COMPLETION: 60 FT. BELOW LAND SURFACE

WATER DEPTH: 38.77 FT. BELOW TOC DATE: 1/3/96

DRILLING METHOD: 4 1/4-INCH HOLLOW STEM AUGER

LOGGED BY: J. ISHAM

KEY:
SI - SCREEN
SS - SPLITSPOON
SPT - SOIL PENETRATION TEST-N NUMBER
ST - SHELBY TUBE
T - TYPE
WL - WATER LEVEL

HDR

PROJECT: WINSTON-SALEM C & D LANDFILL PROJECT NO: 00162-082-018

LOCATION: OLD SALISBURY ROAD BORING NUMBER: MW-1R PAGE: 2 OF 2

BORING LOG

DATE: 12/27/95

NUMBER	DEPTH	SPT	T	WL	SI	DESCRIPTION (USCS)	COMMENTS
SS-8		NA	SS			SAME AS ABOVE, VERY MOIST, LAST 2" IS WHITE MOTTLED WEATHERED GRANITIC SAPROLITE WITH VERY PREDOMINANT TEXTURE	GRANITIC SAPROLITE
	44'						
	48'						
	52'						
	56'						
	60'					TD = 60 FT.	
	64'						
	68'						
	72'						
	76'						
	80'						

BOREHOLE COMPLETION: 60 FT. BELOW LAND SURFACE

WATER DEPTH: 38.77 FT. BELOW TOC DATE: 1/3/96

DRILLING METHOD: 4 1/4-INCH HOLLOW STEM AUGER

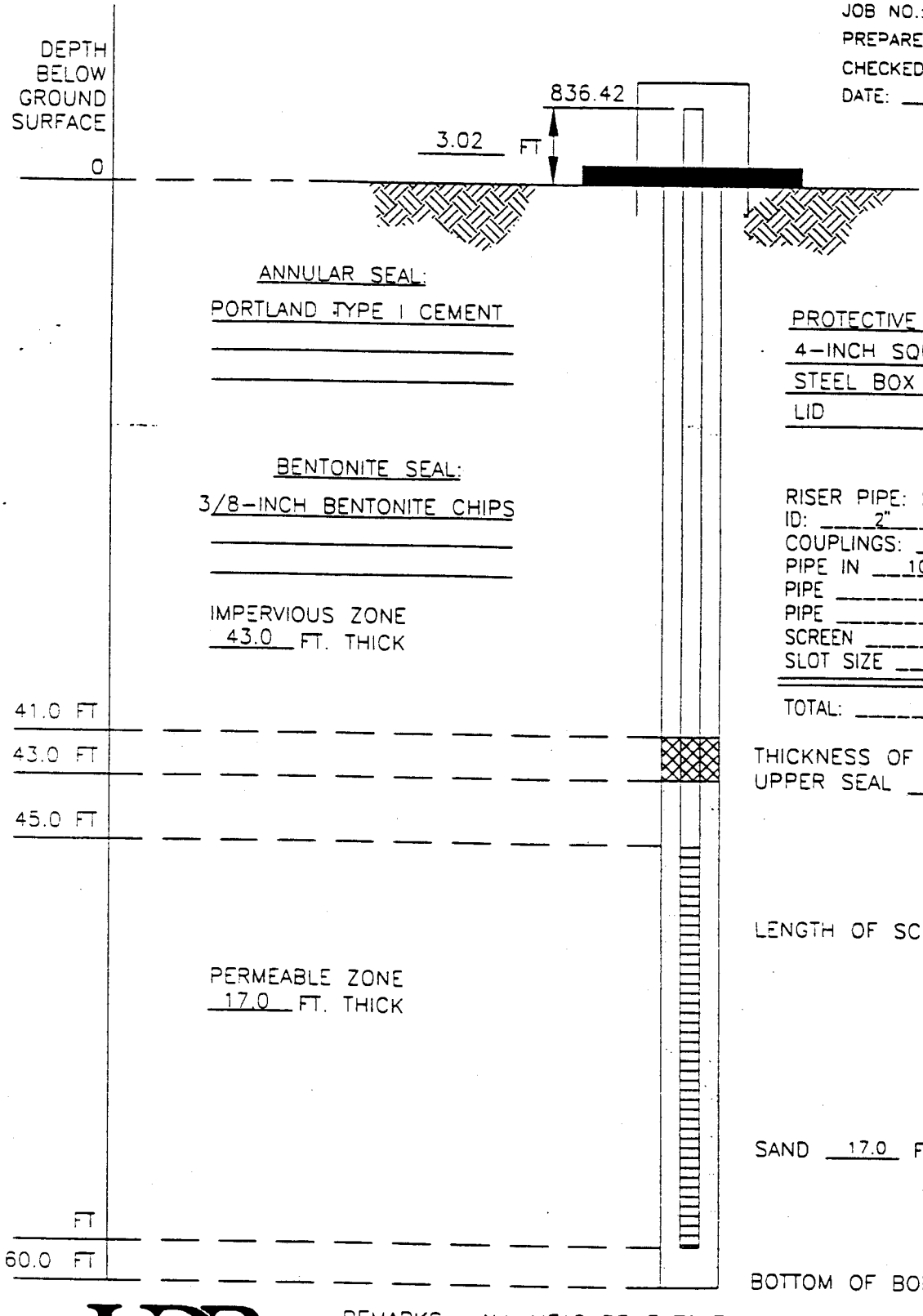
LOGGED BY: J. ISHAM

KEY:
SI - SCREEN
SS - SPLITSPOON
SPT - SOIL PENETRATION TEST-N NUMBER
ST - SHELBY TUBE
T - TYPE
WL - WATER LEVEL

HDR

MONITORING WELL INSTALLATION DIAGRAM

LOCATION: WINSTON-SALEM C&D
WELL NO.: MW-1R
BORING NO.:
JOB NO.: 00162-082-018
PREPARED BY: J. ISHAM
CHECKED BY:
DATE: 12/27/95



HDR

HDR Engineering, Inc.

REMARKS: ALL MEASUREMENTS TO THE NEAREST 0.1 FT.

FILENAME: MONITOR

North Carolina - Department of Environment, Health, and Natural Resources
Division of Environmental Management - Groundwater Section
P.O. Box 29535 - Raleigh, N.C. 27626-0535
Phone (919) 733-3221

FOR OFFICE USE ONLY
QUAD. NO. _____ SERIAL NO. _____
Lat. _____ Long. _____ RO
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR: Geologic Exploration, Inc.

DRILLER REGISTRATION NUMBER: 1175

STATE WELL CONSTRUCTION PERMIT NUMBER: _____

1. WELL LOCATION: (Show sketch of the location below)
   Nearest Town: Winston Salem County: Forsyth
   Friedberg Lane
   (Road, Community, or Subdivision and Lot No.)
2. OWNER City of Winston Salem Utilities Division
   ADDRESS PO Box 2511
   (Street or Route No.)
   Winston Salem NC 27102
   City or Town State Zip Code
3. DATE DRILLED 12-27-95 USE OF WELL monitor
4. TOTAL DEPTH 60.0' ft
5. CUTTINGS COLLECTED YES [ ] NO [X]
6. DOES WELL REPLACE EXISTING WELL? YES [ ] NO [X]
7. STATIC WATER LEVEL Below Top of Casing: 3.0 FT.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS 3.0 FT. Above Land Surface*

* Casing Terminated at/or below land surface is illegal unless a variance is issued in accordance with 15A NCAC 2C .0118

9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth): N/A

CHLORINATION: Type N/A Amount N/A

CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft	Material
From	0.0	To 45.0 Ft.	2 inch	Sch. 40	PVC
From		To Ft.			
From		To Ft.			

13. GROUT:

	Depth		Material	Method
From	0.0	To 41.0 Ft.	Portland	Bentonite Slurry
From		To Ft.		

14. SCREEN:

	Depth		Diameter	Slot Size	Material
From	45.0	To 60.0 Ft	2 in.	.010 in.	PVC
From		To Ft.	in.	in.	
From		To Ft.	in.	in.	

15. SAND/GRAVEL PACK:

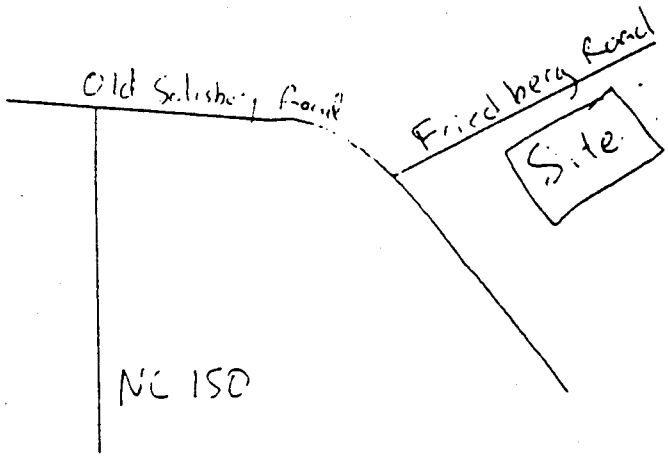
	Depth		Size	Material
From	43.0	To 60.0 Ft.	20-40	Fine Silica Sand
From		To Ft.		

16. REMARKS: MW-1R Bentonite seal from 41.0 to 43.0 feet.

DEPTH From	DEPTH To	DRILLING LOG Formation Description
0.0'	20.0'	Tan sandy clay
20.0'	60.0'	Brown sandy clay

If additional space is needed use back of form

LOCATION SKETCH
(Show direction and distance from at least two State Roads, or other map reference points)



I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CONTRACTOR OR AGENT

12-28-95
DATE

GW-1 REV. 9/91

Submit original to Division of Environmental Management and copy to well owner.

PROJECT: WINSTON-SALEM C & D LANDFILL PROJECT NO: 00162-082-018

LOCATION: OLD SALISBURY ROAD BORING NUMBER: MW-2R PAGE: 1 OF 1

BORING LOG

DATE: 12/29/95

NUMBER	DEPTH	SPT	T	WL	SI	DESCRIPTION (USCS)	COMMENTS
						RED, VERY SOFT, MICACEOUS CLAY (CL) WITH SAND, PLASTIC, VERY MOIST	FILL MATERIAL
SS-1	4'	2	SS			LIGHT BROWN TO TAN, VERY LOOSE, SLIGHTLY CLAYEY SAND (SC), MEDIUM TO FINE GRAINED QUARTZ, STRUCTURELESS, VERY MOIST, ORGANIC MATTER	ALLUVIAL DEPOSITS (?)
	8'			▽			
SS-2		50+	SS			LIGHT GRAY TO DARK BROWN/BLACK, VERY DENSE, SILTY SAND (SM) MEDIUM TO FINE GRAINED, HEAVY IRON AND MANGANESE OXIDE STAINING, MICACEOUS, QUARTZ, FELDSPAR, BRITTLE, DRY	GRANITIC SAPROLITE
	12'						
SS-3		50+	SS	▽		PARTIALLY WEATHERED ROCK AND SAPROLITE (SILTY SAND), QUARTZ, FELDSPAR, BIOTITE, BRITTLE, HARD, DRY	
	16'						
	20'					PARTIALLY WEATHERED ROCK	AUGAR REFUSAL
	24'					TD = 23 FT.	
	28'						
	32'						
	36'						
	40'						

▽ AT DRILLING

▽ 24 HR

BOREHOLE COMPLETION: 23 FT. BELOW LAND SURFACE

WATER DEPTH: 11.41 FT. BELOW TOC DATE: 1/3/96

DRILLING METHOD: 4 1/4-INCH HOLLOW STEM AUGER

LOGGED BY: J. ISHAM

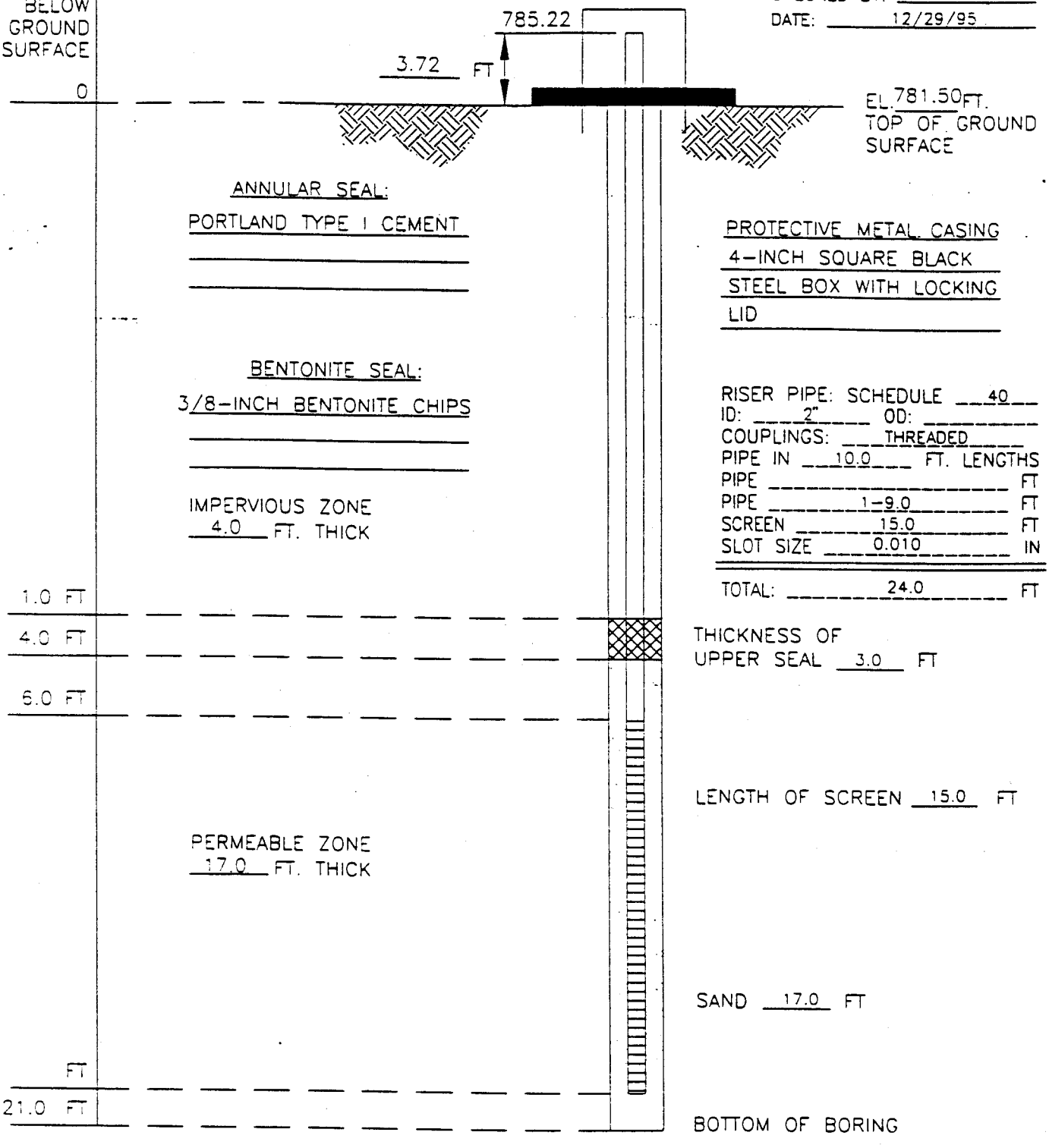
KEY:

SI - SCREEN
SS - SPLITSPOON
SPT - SOIL PENETRATION TEST-N NUMBER
ST - SHELBY TUBE
T - TYPE
WL - WATER LEVEL

HDR

MONITORING WELL INSTALLATION DIAGRAM

LOCATION: WINSTON-SALEM C&D
WELL NO.: MW-2R
BORING NO.:
JOB NO.: 00162-082-018
PREPARED BY: J. ISHAM
CHECKED BY:
DATE: 12/29/95



REMARKS: ALL MEASUREMENTS TO THE NEAREST 0.1 FT.

HDR

HDR Engineering, Inc.

FILENAME: MONITOR

PROJECT:	Construction & Demolition Debris Landfill Forsyth County	WELL LOG	MW-3
PROJECT NO.:	1584-93-1430	ELEVATION: 807.0	NOTES:
LOGGED BY:	Butler	BORING DEPTH: 43.5 FEET	
DATE DRILLED:	02/10/95	WATER LEVEL: 36.1	
DRILLING METHOD:	4 1/4" HSA	DRILL RIG: B-59 ATV	

DEPTH (ft)	GRAPHIC LOG	Description & Remarks	SAMPLE NUMBER	SAMPLE	OVM (ppm)	SPR	ELEV.
5		Residuum–Firm orange brown slightly micaceous medium to fine **SANDY SILT**				6.0	802.0
10		Stiff orange, white gray micaceous coarse to fine **SANDY SILT**				10.0	797.0
15		Stiff to hard white gray coarse to fine very **SANDY SILT**				14.0	792.0
20						21.0	787.0
25						38.0	782.0
30		**PARTIALLY WEATHERED ROCK** sampled as white gray coarse to fine very sandy silt with small rock fragments.				50/2	777.0
35		**PARTIALLY WEATHERED ROCK** sampled as white gray silty coarse to fine sand				50/4	772.0
40						50/4	767.0
45		Boring Terminated					762.0

WELL DIAGRAM

Cement Grout

Bentonite Seal

Fine Filter Sand

2" PVC Schedule 40 Casing

2" PVC Schedule 40 Screen, 0.010" Slot

S&ME
Environmental Services
Engineering * Testing

DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, N.C. 27611, PHONE (919) 733-3063

Quad. No. _____ Serial No. _____
Lat. _____ Long. _____ Pc _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

MW-3

DRILLING CONTRACTOR: Groundwater Protection, Inc.

DRILLER REGISTRATION NUMBER: 1105

STATE WELL CONSTRUCTION PERMIT NUMBER: NA

WELL LOCATION (Show sketch of the location below)

Nearest Town: Winston-Salem, North Carolina
Friedburg Road
(Road, Community, or Subdivision and Lot No.)

County: Forsyth

OWNER: Winston-Salem/Forsyth County Utilities Comm.

ADDRESS: 102 West Third Street , Suite 460
(Street or Route No.)
Winston-Salem, North Carolina 27102
City or Town State Zip Code

DATE DRILLED: February 10,1995 USE OF WELL: MONITOR

TOTAL DEPTH: 43.5 CUTTINGS COLLECTED: ☐ Yes ☒ No

DOES WELL REPLACE EXISTING WELL? ☐ Yes ☒ No

STATIC WATER LEVEL: 36.1 FT. ☐ above ☒ below TOP OF CASING.

TOP OF CASING IS 3.1 FT. ABOVE LAND SURFACE.

YIELD (gpm): NA METHOD OF TEST: _____

WATER ZONES (depth): NA

CHLORINATION: Type NA Amount: _____

CASING

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From	+0.1	To 31.5 Ft.	2"	SCH 40	PVC
From	41.0	To 41.5 Ft.	2"	SCH 40	PVC
From		To Ft.			

GROUT

	Depth		Material	Method
From	0	To 25.5 Ft.	PORTLAND	TREMMIE
From		To Ft.		

SCREEN

	Depth		Diameter	Slot Size	Material
From	31.5	To 41.0 Ft.	2"	.010 in	PVC
From		To Ft.	In.	In.	
From		To Ft.	In.	In.	

GRAVEL PACK

	Depth		Size	Material
From	27.5	To 43.5 Ft.	FINE FILTER SAND	SAND
From		To Ft.		

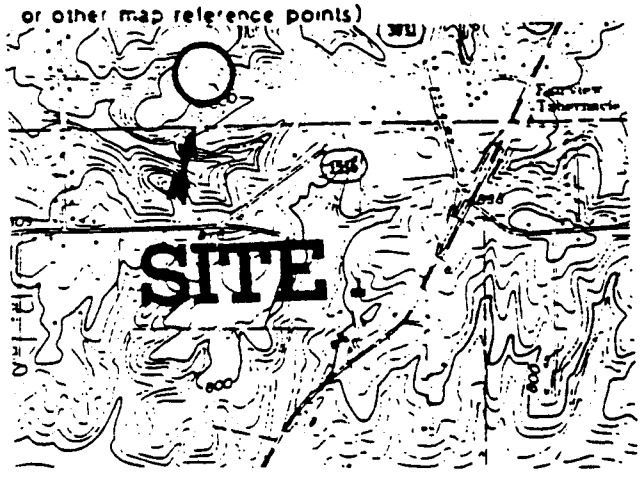
REMARKS: Bentonite Seal From 25.5 to 27.5 Feet Below Ground Surface

Depth From	Depth To	DRILLING LOG Formation Description
0	6	Orange Brown Slightly Micaceou Medium To Fine Sandy Silt
6	13	Orange, White Gray Micaceous Coarse to Fine Sandy Silt
13	27	White Gray Coarse To Fine Very Sandy Silt
27	32	Partially Weathered Rock As White Gray Coarse To Fine Very Sandy Silt With Small Rock Fragments
32	43.5	Partially Weathered Rock As White Gray Silty Coarse To Fin Sand

If additional space is needed use back of form.

LOCATION SKETCH

(Show direction and distance from at least two State Roads or other map reference points)



I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15 NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Signature of Contractor or Agent — Date: 04-03-95

PROJECT: WINSTON-SALEM C & D LANDFILL PROJECT NO: 00162-082-018

LOCATION: OLD SALISBURY ROAD BORING NUMBER: MW-4R PAGE: 1 OF 1

BORING LOG

DATE: 12/28/95

NUMBER	DEPTH	SPT	T	WL	SI	DESCRIPTION (USCS)	COMMENTS
				▽		GRAY, LOOSE, CLAYEY SAND (SC), MEDIUM TO COARSE GRAINED, SOFT, PLASTIC, IRON OXIDE STAINING, TRACE OF ORGANIC MATTER, WET	ALLUVIAL DEPOSITS (?)
SS-1	4'	9	SS				
	8'			▼		LT. TAN, MEDIUM DENSE CLAYEY SAND (SC), WET, SOFT, MINOR IRON OXIDATION, MEDIUM TO COARSE QUARTZ SAND	
SS-2		12	SS				
	12'					LIGHT GRAY TO WHITE, VERY DENSE CLAYEY SILTY SAND (SM), MEDIUM TO FINE GRAINED, QUARTZ, FELDSPAR, BIOTITE MICA, MOIST, BRITTLE, IRON OXIDATION	GRANITIC SAPROLITE
SS-3		50+	SS				
	16'						
	20'					TD = 20 FT.	
	24'						
	28'						
	32'						
	36'						
	40'						

▽ AT DRILLING

▼ 24 HR

BOREHOLE COMPLETION: 20 FT. BELOW LAND SURFACE

WATER DEPTH: 10.06 FT. BELOW TOC DATE: 1/3/96

DRILLING METHOD: 4 1/4-INCH HOLLOW STEM AUGER

LOGGED BY: J. ISHAM

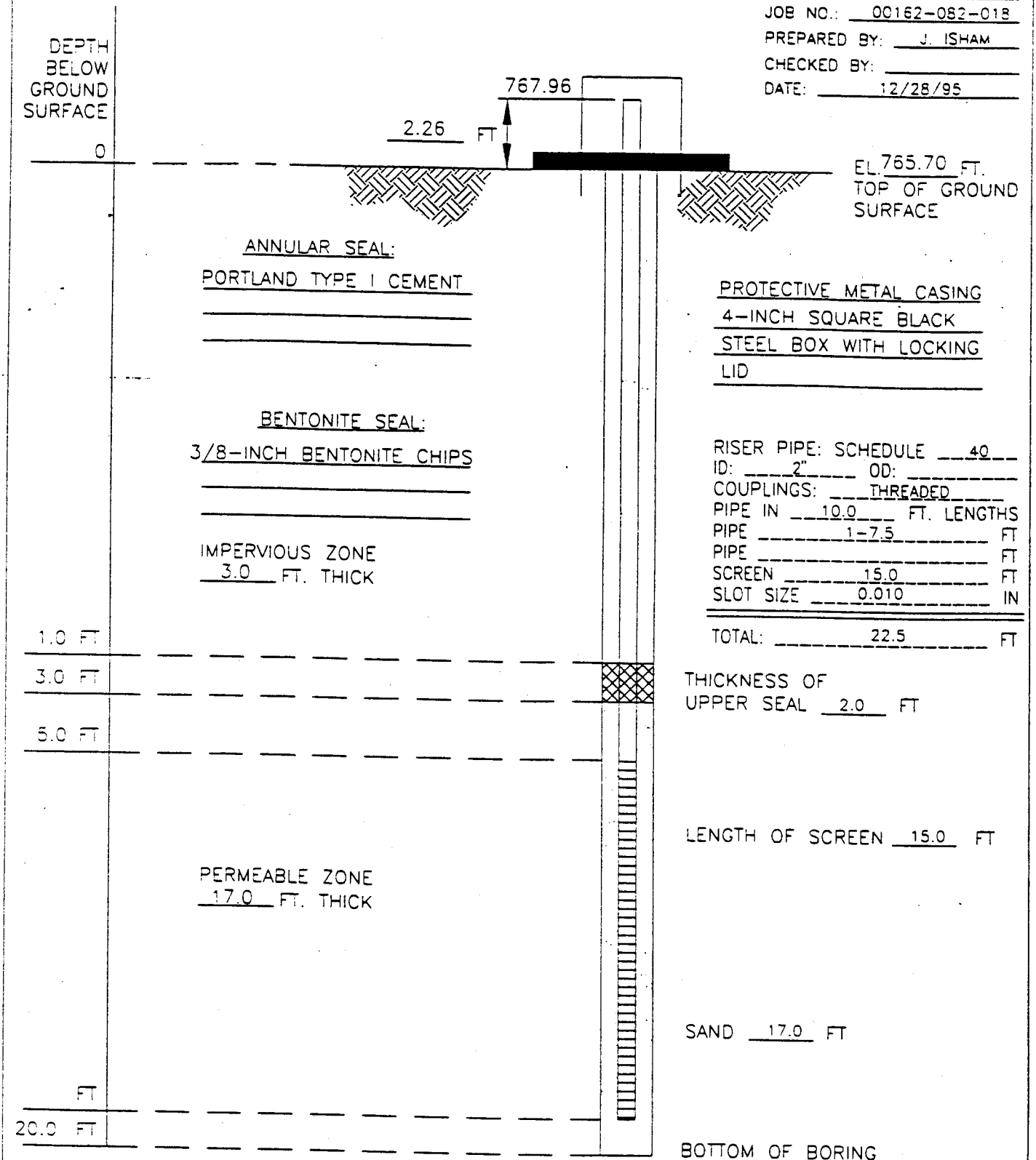
KEY:

SI - SCREEN
SS - SPLITSPOON
SPT - SOIL PENETRATION TEST-N NUMBER
ST - SHELBY TUBE
T - TYPE
WL - WATER LEVEL

HDR

MONITORING WELL INSTALLATION DIAGRAM

LOCATION: WINSTON-SALEM C&D
WELL NO.: MW-4R
BORING NO.:
JOB NO.: 00162-082-018
PREPARED BY: J. ISHAM
CHECKED BY:
DATE: 12/28/95



RISER PIPE: SCHEDULE 40
ID: 2" OD:
COUPLINGS: THREADED
PIPE IN 10.0 FT. LENGTHS
PIPE 1-7.5 FT
PIPE FT
SCREEN 15.0 FT
SLOT SIZE 0.010 IN

TOTAL: 22.5 FT

THICKNESS OF UPPER SEAL 2.0 FT

LENGTH OF SCREEN 15.0 FT

SAND 17.0 FT

REMARKS: ALL MEASUREMENTS TO THE NEAREST 0.1 FT.

HDR

HDR Engineering, Inc.

FILENAME: MONITOR

PROJECT: WINSTON-SALEM C & D LANDFILL PROJECT NO: 00162-082-018

LOCATION: OLD SALISBURY ROAD BORING NUMBER: MW-5R PAGE: 1 OF 1

BORING LOG

DATE: 12/29/95

NUMBER	DEPTH	SPT	T	WL	SI	DESCRIPTION (USCS)	COMMENTS
						LIGHT BROWN TO REDDISH-TAN, FIRM SANDY CLAY (CL), SLIGHTLY PLASTIC, MOIST, ABUNDANT IRON OXIDATION, ORGANIC MATTER, QUARTZ AND FELDSPAR GRAINS (MEDIUM TO FINE GRAINED)	ALLUVIAL DEPOSITS(?)
SS-1	4'	8	SS				
	8'					TAN TO BROWN AND WHITE, VERY DENSE SILTY SAND (SM), GRANITIC SAPROLITE, MEDIUM TO COARSE GRAINED, FELDSPAR-RICH, ABUNDANT QUARTZ, DRY, IRON OXIDATION BANDING, BRITTLE	GRANITIC SAPROLITE
SS-2		50+	SS	▽			
	12'					REDDISH-BROWN TO TAN, VERY DENSE CLAYEY SAND (SC), MEDIUM TO COARSE GRAINED, HEAVY IRON OXIDATION, MOTTLING, QUARTZ, FELDSPAR, MOIST	
SS-3		50+	SS				
	16'						
SS-4		50+	SS			SAME AS ABOVE, DRY	
	20'						
				▽			
SS-5	24'	50+	SS			SAME AS ABOVE, WET	
	28'						
	32'					TD = 30 FT.	
	36'						
	40'						

▽ AT DRILLING

▽ 24 HR

BOREHOLE COMPLETION: 30 FT. BELOW LAND SURFACE

WATER DEPTH: 12.39 FT. BELOW TOC DATE: 1/3/96

DRILLING METHOD: 4 1/4-INCH HOLLOW STEM AUGER

LOGGED BY: J. ISHAM

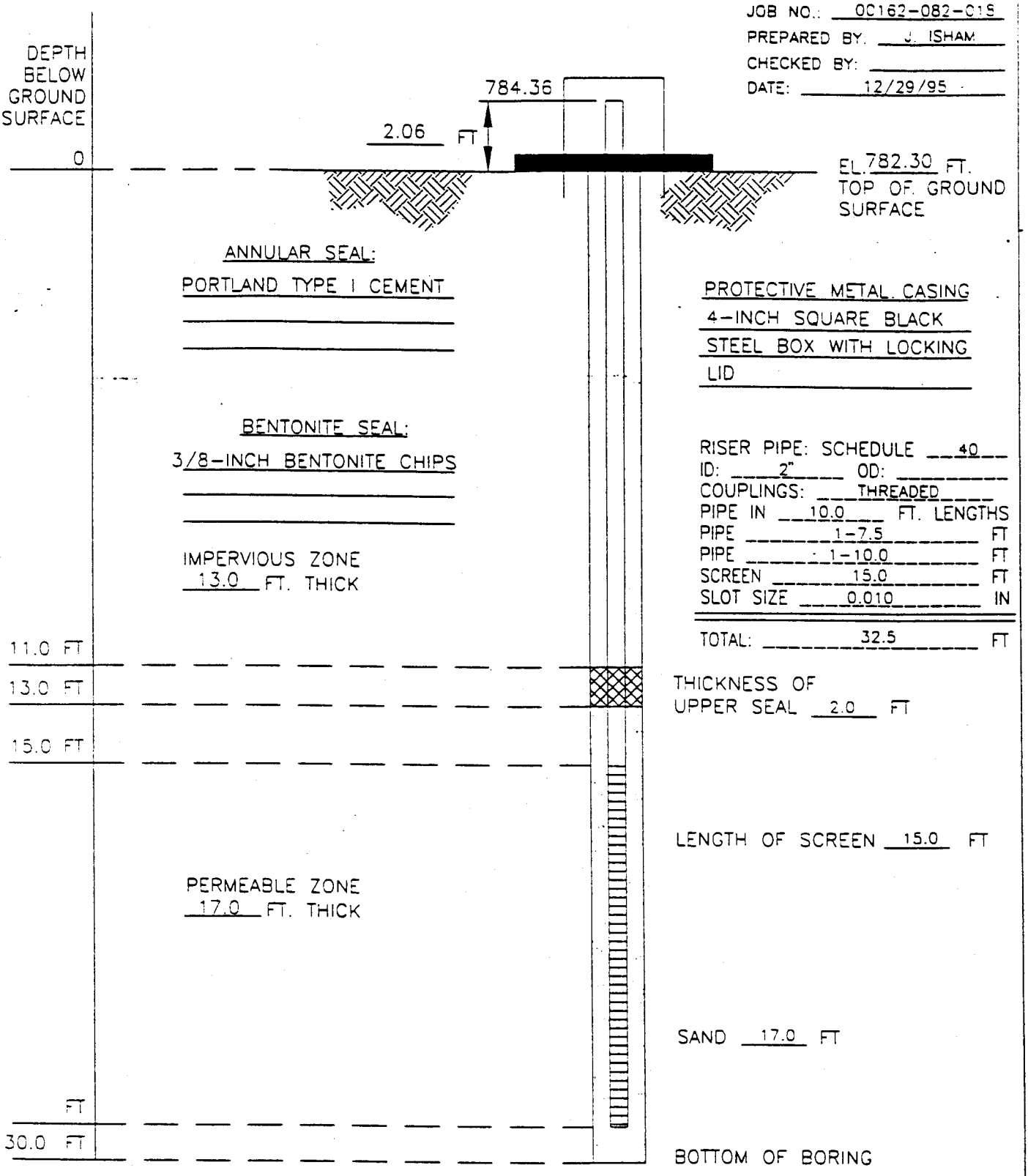
KEY:

SI - SCREEN
SS - SPLITSPOON
SPT - SOIL PENETRATION TEST-N NUMBER
ST - SHELBY TUBE
T - TYPE
WL - WATER LEVEL

HDR

MONITORING WELL INSTALLATION DIAGRAM

LOCATION: WINSTON-SALEM C&D
WELL NO.: MW-5R
BORING NO.:
JOB NO.: 00162-082-015
PREPARED BY: J. ISHAM
CHECKED BY:
DATE: 12/29/95



HDR

HDR Engineering, Inc.

REMARKS: ALL MEASUREMENTS TO THE NEAREST 0.1 FT.

FILENAME: MONITOR

PROJECT: WINSTON-SALEM C & D LANDFILL PROJECT NO: 00162-082-018

LOCATION: OLD SALISBURY ROAD BORING NUMBER: MW-6 PAGE: 1 OF 2

BORING LOG

DATE: 12/27/95

NUMBER	DEPTH	SPT	T	WL	SI	DESCRIPTION (USCS)	COMMENTS
	4'					RED, MICACEOUS, FIRM CLAY (CL) WITH MINOR SAND, PLASTIC, MOIST, NO RELICT STRUCTURES	CLAY SOIL HORIZON
SS-1		9	SS				
	8'					LIGHT YELLOW-BROWN TO WHITE SILTY SAND (SM), FINE TO COARSE GRAINED, DRY, GRANITIC TEXTURE	
SS-2		11	SS				
	12'					SAME AS ABOVE, MANGANESE OXIDE STAINING, DRY, BRITTLE, QUARTZ, BIOTITE, FELDSPAR GRAINS, MEDIUM TO FINE GRAINED	GRANITIC SAPROLITE
SS-3	16'	10	SS				
	20'					LIGHT BROWN TO TAN, MEDIUM DENSE SILTY SAND (SM), SOFT, DRY, MICACEOUS, IRON OXIDE STAINING, MEDIUM TO FINE GRAINED	
SS-4		13	SS				
	24'					LIGHT BROWN TO MOTTLED WHITE, MEDIUM DENSE SILTY SAND (SM), ABUNDANT FELDSPAR, DRY, IRON AND MANGANESE OXIDE STAINING, MEDIUM TO FINE GRAINED	
SS-5		15	SS				
	28'					LIGHT BROWN TO TAN, MEDIUM DENSE SILTY SAND (SM), MICACEOUS, SOFT, BIOTITE, QUARTZ, FELDSPAR GRAINS, DRY	
SS-6		13	SS				
	32'					SAME AS ABOVE, DRY	
SS-7	36'	12	SS				
	40'			▽			

BOREHOLE COMPLETION: 60 FT. BELOW LAND SURFACE

WATER DEPTH: 49.90 FT. BELOW TOC DATE: 1/3/96

DRILLING METHOD: 4 1/4-INCH HOLLOW STEM AUGER

LOGGED BY: J. ISHAM

KEY:
SI - SCREEN
SS - SPLITSPOON
SPT - SOIL PENETRATION TEST-N NUMBER
ST - SHELBY TUBE
T - TYPE
WL - WATER LEVEL

HDR

PROJECT: WINSTON-SALEM C & D LANDFILL PROJECT NO: 00162-082-018

LOCATION: OLD SALISBURY ROAD BORING NUMBER: MW-6 PAGE: 2 OF 2

BORING LOG

DATE: 12/27/95

NUMBER	DEPTH	SPT	T	WL	SI	DESCRIPTION (USCS)	COMMENTS
SS-8		10	SS			LIGHT BROWN TO TAN, LOOSE SILTY SAND (SM), MOIST, MEDIUM TO COARSE GRAINED, QUARTZ, BIOTITE, FELDSPAR ABUNDANT, STICKY, SOFT	
	44'						
SS-9		8	SS	▽		SAME AS ABOVE, WET, SOFT	GRANITIC SAPROLITE
	48'						
SS-10		9	SS			SAME AS ABOVE, WET, SOFT	
	52'						
SS-11	56'	9	SS			SAME AS ABOVE, WET, SOFT, PRONOUNCED GRANITIC (PHANERITIC) TEXTURE	
	60'						
	64'					TD = 60 FT.	
	68'						
	72'						
	76'						
	80'						

▽ AT DRILLING

▽ 24 HR

BOREHOLE COMPLETION: 60 FT. BELOW LAND SURFACE

WATER DEPTH: 49.90 FT. BELOW TOC DATE: 1/3/96

DRILLING METHOD: 4 1/4-INCH HOLLOW STEM AUGER

LOGGED BY: J. ISHAM

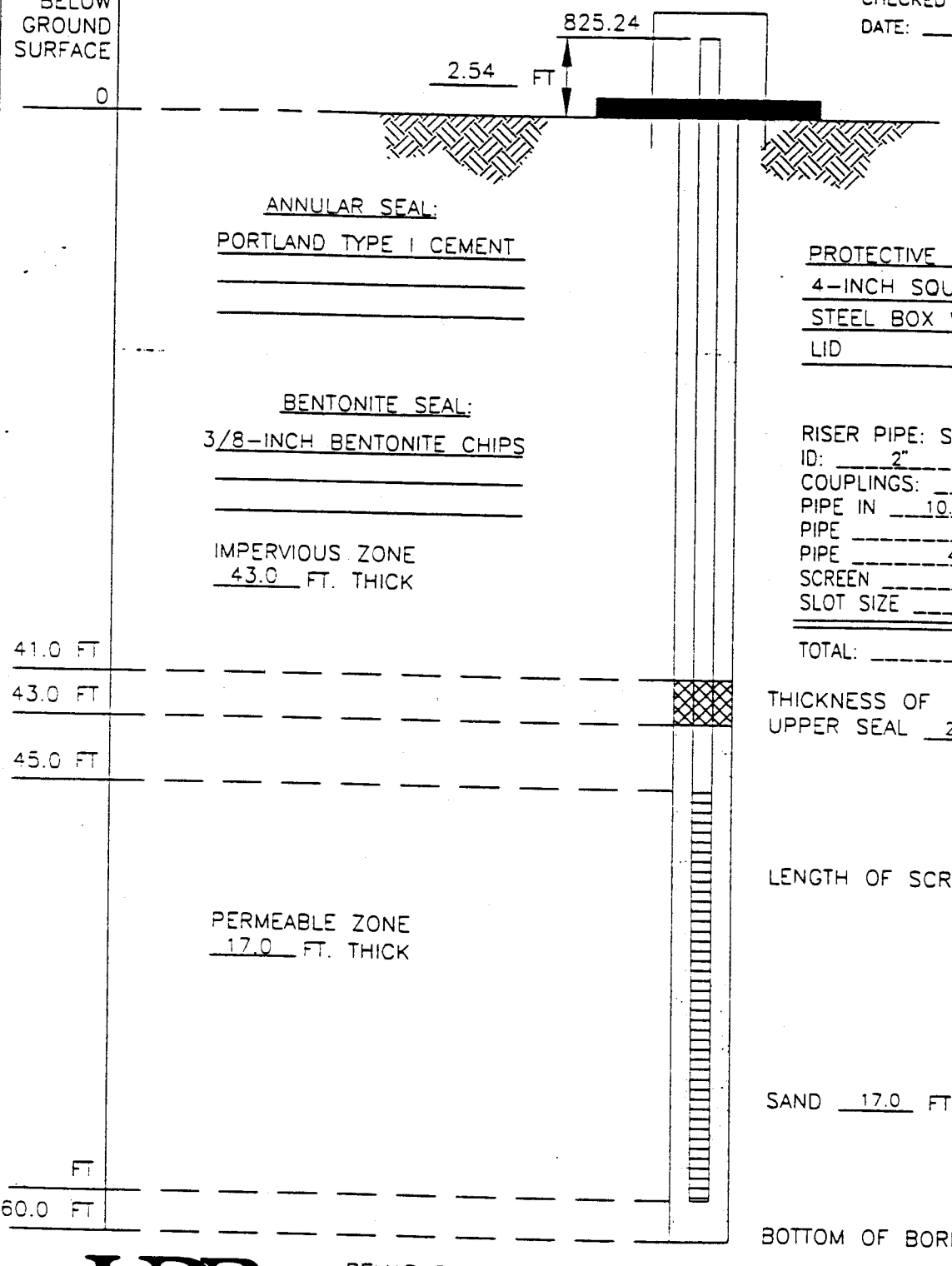
KEY:

SI - SCREEN
SS - SPLITSPOON
SPT - SOIL PENETRATION TEST-N NUMBER
ST - SHELBY TUBE
T - TYPE
WL - WATER LEVEL

HDR

MONITORING WELL INSTALLATION DIAGRAM

LOCATION: WINSTON-SALEM C&D
WELL NO.: MW-6
BORING NO.:
JOB NO.: 00162-082-018
PREPARED BY: J. ISHAM
CHECKED BY:
DATE: 12/27/95



REMARKS: ALL MEASUREMENTS TO THE NEAREST 0.1 FT.

HDR

HDR Engineering, Inc.

FILENAME: MONITOR

North Carolina - Department of Environment, Health, and Natural Resources
Division of Environmental Management - Groundwater Section
P.O. Box 29535 - Raleigh, N.C. 27626-0535
Phone (919) 733-3221

FOR OFFICE USE ONLY
QUAD NO. SERIAL NO.
Lat. Long.
Minor Basin
Basin Code
Header Ent. GW-1 Ent.

WELL CONSTRUCTION RECORD

LING CONTRACTOR: Geologic Exploration, Inc.

DRILLER REGISTRATION NUMBER: 1175

STATE WELL CONSTRUCTION PERMIT NUMBER:

1. WELL LOCATION: (Show sketch of the location below)
   Nearest Town: Winston Salem County: Forsyth
   Friedberg Lane
   (Road, Community, or Subdivision and Lot No.)
2. OWNER City of Winston Salem Utilities Division
   ADDRESS PO Box 2511
   (Street or Route No.)
   Winston Salem NC 27102
   City or Town State Zip Code
3. DATE DRILLED 12-27-95 USE OF WELL monitor
4. TOTAL DEPTH 60.0' ft
5. CUTTINGS COLLECTED YES [ ] NO [X]
6. DOES WELL REPLACE EXISTING WELL? YES [ ] NO [X]
7. STATIC WATER LEVEL Below Top of Casing: 3.0 FT.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS 3.0 FT. Above Land Surface*
   * Casing Terminated at/or below land surface is illegal unless a variance is issued in accordance with 15A NCAC 2C .0118
9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth): N/A

DEPTH From	DEPTH To	DRILLING LOG Formation Description
0.0'	35.0'	brown sandy clay
35.0'	60.0'	brown silty sandy clay

If additional space is needed use back of form

CHLORINATION: Type N/A Amount N/A

CASING:

Depth From	Depth To	Diameter	Wall Thickness or Weight/Ft.	Material
0.0	45.0 Ft.	2 inch	Sch.40	PVC
	Ft.			
	Ft.			

13. GROUT:

Depth From	Depth To	Material	Method
0.0	41.0 Ft.	Portland Bentonite Slurry	
	Ft.		

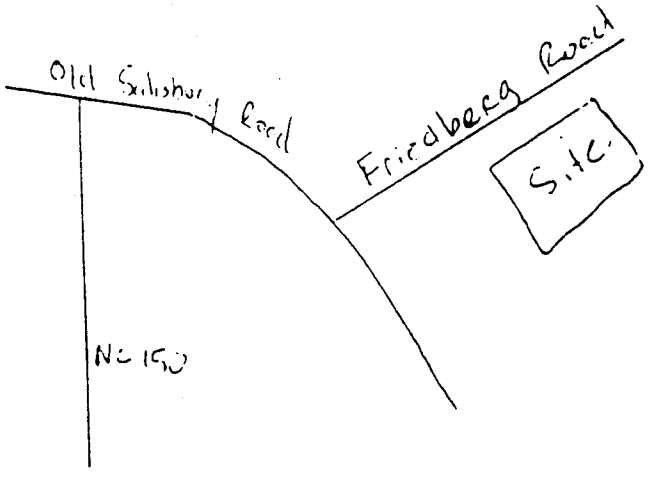
14. SCREEN:

Depth From	Depth To	Diameter	Slot Size	Material
45.0	60.0 Ft	2 in.	.010 in.	PVC
	Ft.	in.	in.	
	Ft.	in.	in.	

15. SAND/GRAVEL PACK:

Depth From	Depth To	Size	Material
43.0	60.0 Ft.	20-40	Fine Silica Sand
	Ft.		

LOCATION SKETCH
(Show direction and distance from at least two State Roads, or other map reference points)



16. REMARKS: MW-6 Bentonite seal from 41.0 to 43.0 feet.

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

[signature] 12-28-95

SIGNATURE OF CONTRACTOR OR AGENT DATE

GW-1 REV. 9/91

Submit original to Division of Environmental Management and copy to well owner.

PROJECT: WINSTON-SALEM C & D LANDFILL PROJECT NO: 00162-082-018

LOCATION: OLD SALISBURY ROAD BORING NUMBER: MW-7 PAGE: 1 OF 2

BORING LOG

DATE: 12/28/95

NUMBER	DEPTH	SPT	T	WL	SI	DESCRIPTION (USCS)	COMMENTS
	4'						
SS-1	8'	36	SS			LIGHT BROWN TO TAN, DENSE, CLAYEY SILTY SAND (SM), MEDIUM TO FINE GRAINED, BRITTLE, VERY DRY, QUARTZ, FELDSPAR, BIOTITE	GRANITIC SAPROLITE
	12'						
SS-2		34	SS			YELLOW-BROWN TO TAN, DENSE, CLAYEY SILTY SAND (SM), MEDIUM TO FINE GRAINED, MANGANESE OXIDE STAINING, VERY DRY, BRITTLE	
	16'						
SS-3	20'	34	SS			LIGHT TAN TO WHITE, DENSE, SILTY SAND (SM) AND PARTIALLY WEATHERED ROCK FRAGMENTS, ABUNDANT FELDSPAR, BRITTLE, SLIGHT MOISTURE, QUARTZ, BIOTITE ABUNDANT, IRON OXIDE STAINING	
SS-4	24'	31	SS			SAME AS ABOVE, WHITE, MEDIUM TO COARSE GRAINED, BRITTLE, DRY	
	28'						
SS-5		50+	SS			LIGHT GRAY TO WHITE, VERY DENSE, SILTY SAND (SM), WEATHERED GRANITE, BRITTLE, DRY, MEDIUM GRAINED, IRON OXIDE STAINING, QUARTZ, FELDSPAR, BIOTITE	
	32'			▽			
SS-6		50+	SS			SAME AS ABOVE, MOIST, SOFT	
	36'						
	40'			▽			

▽ AT DRILLING

▽ 24 HR

BOREHOLE COMPLETION: 48 FT. BELOW LAND SURFACE

WATER DEPTH: 35.86 FT. BELOW TOC DATE: 1/3/96

DRILLING METHOD: 4 1/4-INCH HOLLOW STEM AUGER

LOGGED BY: J. ISHAM

KEY:

SI - SCREEN
SS - SPLITSPOON
SPT - SOIL PENETRATION TEST-N NUMBER
ST - SHELBY TUBE
T - TYPE
WL - WATER LEVEL

HDR

PROJECT: WINSTON-SALEM C & D LANDFILL PROJECT NO: 00162-082-018

LOCATION: OLD SALISBURY ROAD BORING NUMBER: MW-7 PAGE: 2 OF 2

BORING LOG

DATE: 12/28/95

NUMBER	DEPTH	SPT	T	WL	SI	DESCRIPTION (USCS)	COMMENTS
	44'					HARD, SLOW DRILLING	GRANITIC SAPROLITE
	48'					TD = 48 FT.	
	52'						
	56'						
	60'						
	64'						
	68'						
	72'						
	76'						
	80'						

BOREHOLE COMPLETION: 48 FT. BELOW LAND SURFACE

WATER DEPTH: 35.86 FT. BELOW TOC DATE: 1/3/96

DRILLING METHOD: 4 1/4-INCH HOLLOW STEM AUGER

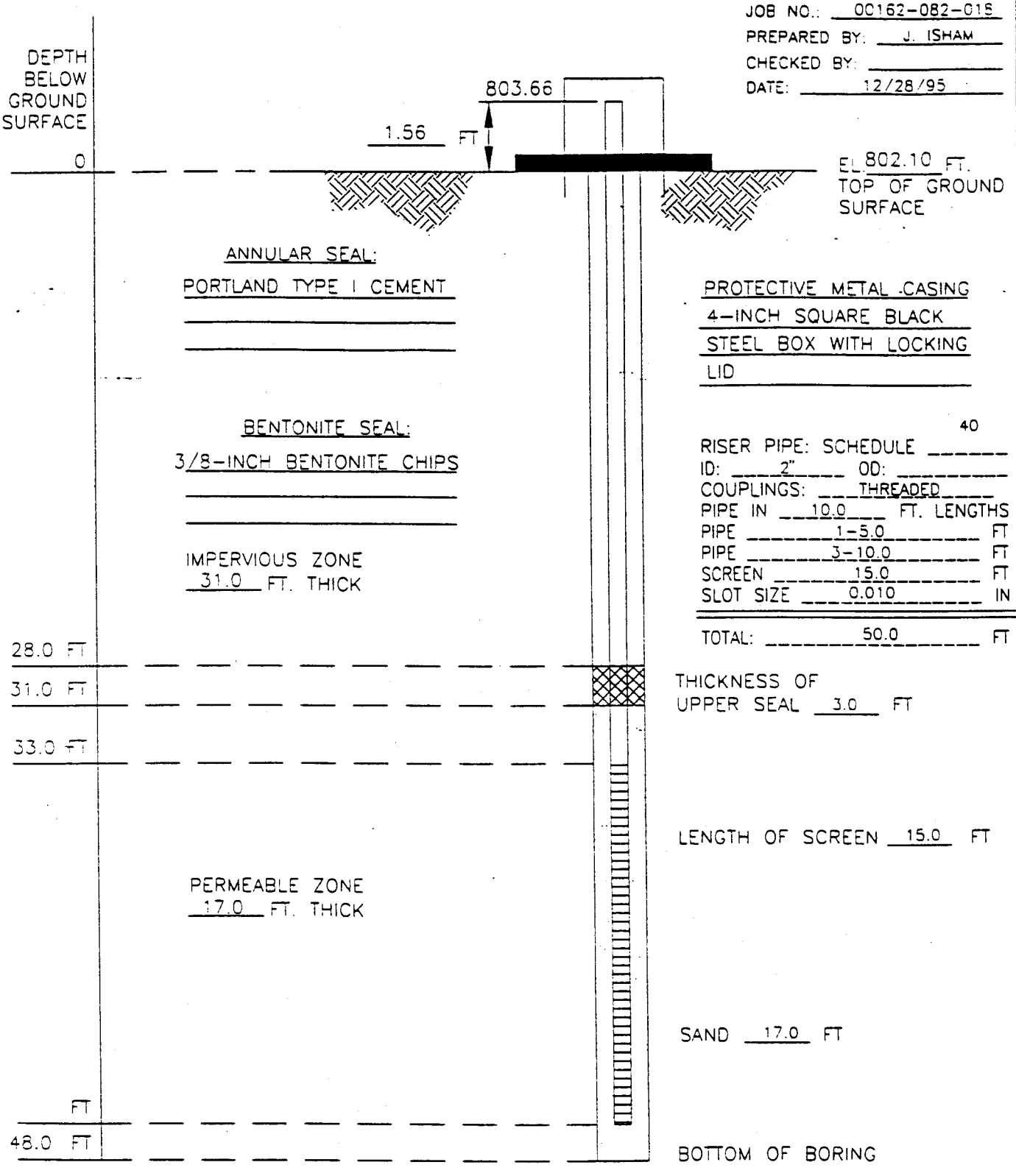
LOGGED BY: J. ISHAM

KEY:
SI - SCREEN
SS - SPLITSPOON
SPT - SOIL PENETRATION TEST-N NUMBER
ST - SHELBY TUBE
T - TYPE
WL - WATER LEVEL

HDR

MONITORING WELL INSTALLATION DIAGRAM

LOCATION: WINSTON-SALEM C&D
WELL NO.: MW-7
BORING NO.:
JOB NO.: 00162-082-018
PREPARED BY: J. ISHAM
CHECKED BY:
DATE: 12/28/95



REMARKS: ALL MEASUREMENTS TO THE NEAREST 0.1 FT.

HDR

HDR Engineering, Inc.

FILENAME: MONITOR

APPENDIX C

GROUND-WATER MONITORING AND BORED WELL ABANDONMENT RECORDS

Department of Natural Resources and Community Development
Division of Environmental Management
Groundwater Section
P.O. Box 27687 - Raleigh, N.C. 27611

WELL ABANDONMENT RECORD

CONTRACTOR Geologic Exploration REG. NO. 1175

1. WELL LOCATION: (Show a sketch of the location on back of form.)
Nearest Town: Winston Salem County Forysth
Friedburg Lane
(Road, Community, Subdivision, Lot No.) Quadrangle No.

2. OWNER: City of Winston Salem Utilities Div.

3. ADDRESS: PO Box 2511 Winston Salem, NC

4. TOPOGRAPHY : draw, slope, hilltop, valley, flat

5. USE OF WELL: monitor DATE: 12/28/95

6. TOTAL DEPTH: 50.0 ft DIAMETER: 2 inch

7. CASING REMOVED:

feet	diameter
N/A	N/A

8. SEALING MATERIAL:

Neat cement	Sand cement
bags of cement	bags of cement
gals. of water	yds. of sand
	gals. of water

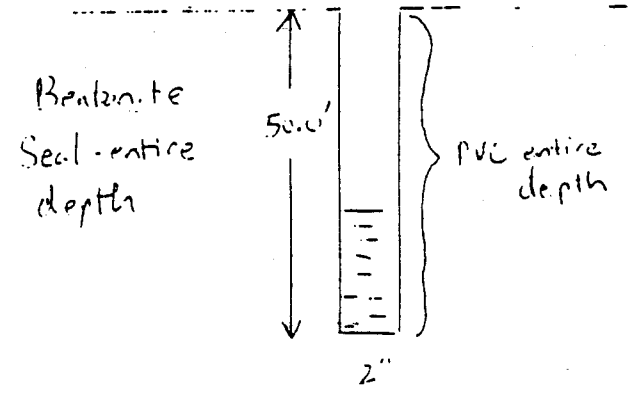
Other
Type material Bentonite Holeplug

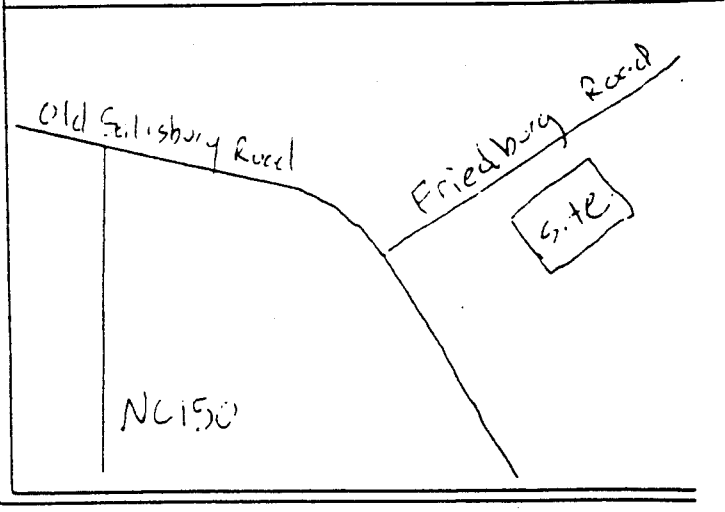
Amount 8 gallons

9. EXPLAIN METHOD EMPLACEMENT OF MATERIAL.
pour/wet

MW-1

WELL DIAGRAM: Draw a detailed sketch of the well showing total depth, depth and diameter of screens remaining in the well, gravel interval, intervals of casing perforations, and depths and types of fill materials used.





I do hereby certify that this well abandonment record is true and exact.

Signature of Contractor or Agent [signature] Date 1-4-96

WELL LOCATION: Draw a location sketch on the reverse of this sheet, showing the direction and distance of the well to at least two (2) nearby reference points such as roads, intersections and streams. Identify roads with State High way road identification numbers.

Submit original to the Division of Environmental Management, one copy to the Driller, and one copy to the owner.

GW -30 Revised 5/15/89

Department of Natural Resources and Community Development
Division of Environmental Management
Groundwater Section
P.O. Box 27687 - Raleigh, N.C. 27611

WELL ABANDONMENT RECORD

CONTRACTOR Geologic Exploration REG. NO. 1175

1. WELL LOCATION: (Show a sketch of the location on back of form.)
Nearest Town: Winston Salem County Forysth
Friedburg Lane
(Road, Community, Subdivision, Lot No.) Quadrangle No.

2. OWNER: City of Winston Salem Utilities Div.

3. ADDRESS: PO Box 2511 Winston Salem, NC

4. TOPOGRAPHY : draw, slope, hilltop, valley, flat

5. USE OF WELL: monitor DATE: 12/28/95

6. TOTAL DEPTH: 16.0 ft DIAMETER: 2 inch

7. CASING REMOVED:

feet	diameter
N/A	N/A

8. SEALING MATERIAL:

Neat cement	Sand cement
bags of cement	bags of cement
gals. of water	yds. of sand
	gals. of water

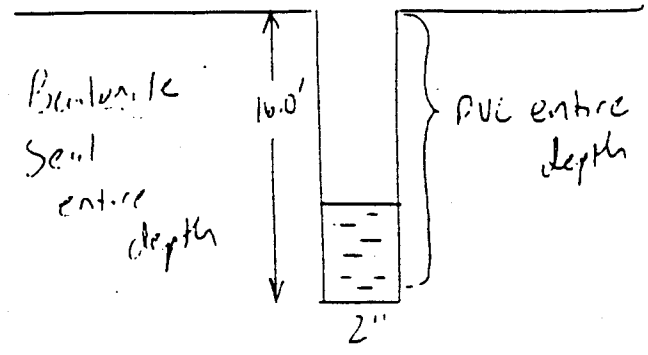
Other
Type material Bentonite Holeplug

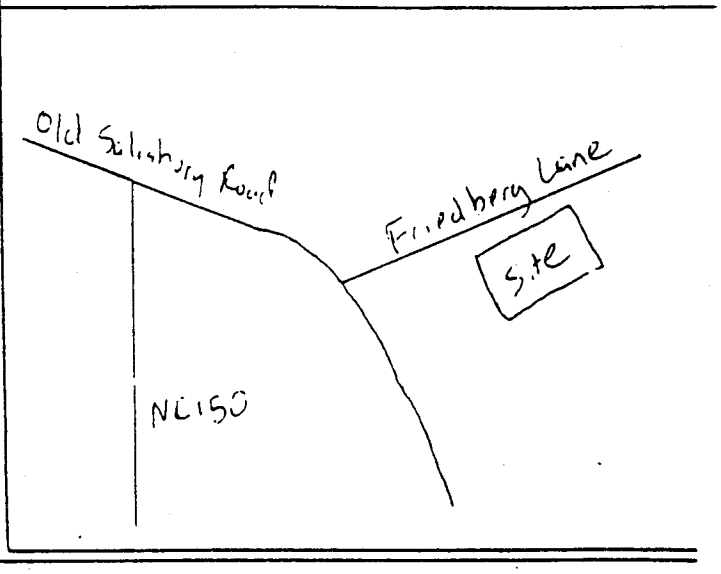
Amount 3 gallon

9. EXPLAIN METHOD EMPLACEMENT OF MATERIAL.
pour/wet

MW-2

WELL DIAGRAM: Draw a detailed sketch of the well showing total depth, depth and diameter of screens remaining in the well, gravel interval, intervals of casing perforations, and depths and types of fill materials used.





I do hereby certify that this well abandonment record is true and exact.

Signature of Contractor or Agent Date 1-4-96

WELL LOCATION: Draw a location sketch on the reverse of this sheet, showing the direction and distance of the well to at least two (2) nearby reference points such as roads, intersections and streams. Identify roads with State Highway road identification numbers.

Submit original to the Division of Environmental Management, one copy to the Driller, and one copy to the owner.

GW -30 Revised 5/15/89

DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, N.C. 27611, PHONE (919) 733-3063

Quad. No. _____ Serial No. _____
Lat. _____ Long. _____ Pc _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

MW-2

3 CONTRACTOR Groundwater Protection, Inc.

LER REGISTRATION NUMBER 1105

STATE WELL CONSTRUCTION PERMIT NUMBER: NA

LL LOCATION (Show sketch of the location below)

arest Town Winston-Salem, North Carolina

Friedburg Road

ad. Community, or Subdivision and Lot No.)

County: Forsyth

NER Winston-Salem/Forsyth County Utilities Comm.

DRESS 102 West Third Street , Suite 460 (Street or Route No.)

Winston-Salem, North Carolina 27102

City or Town State Zip Code

TE DRILLED February 13, 1995 USE OF WELL MONITOR

TAL DEPTH 16.0 CUTTINGS COLLECTED ☐ Yes ☒ No

DES WELL REPLACE EXISTING WELL? ☐ Yes ☒ No

ATIC WATER LEVEL: 14.8 FT. ☐ above ☒ below TOP OF CASING.

TOP OF CASING IS 2.7 FT. ABOVE LAND SURFACE.

ELD (ppm). NA METHOD OF TEST _____

ATER ZONES (depth): NA

INATION. Type NA Amount _____

Depth From	Depth To	DRILLING LOG Formation Description
0	2	Tan and Brown Coarse To Fine Sandy Silt
2	7	Partially Weathered Rock Sampled As Orange, Tan and Brown Micaceous Coarse To Fine Very Sandy Silt
7	16	Rock, Cuttings Sampled As White to Light Gray Very Coarse Sand

If additional space is needed use back of form.

ASING

	Depth From	Depth To	Diameter	Wall Thickness or Weight/Ft	Material
	+ 2.7	5.5 Ft.	2"	SCH 40	PVC
	15.0	15.5 Ft.	2"	SCH 40	PVC
		Ft.			

ROUT

	Depth From	Depth To	Material	Method
	0	3.0 Ft.	PORTLAND	HAND
		Ft.		

CREEN

	Depth From	Depth To	Diameter	Slot Size	Material
	5.5	15.0 Ft.	2"	.010 in.	PVC
		Ft.	In.	In.	
		Ft.	In.	In.	

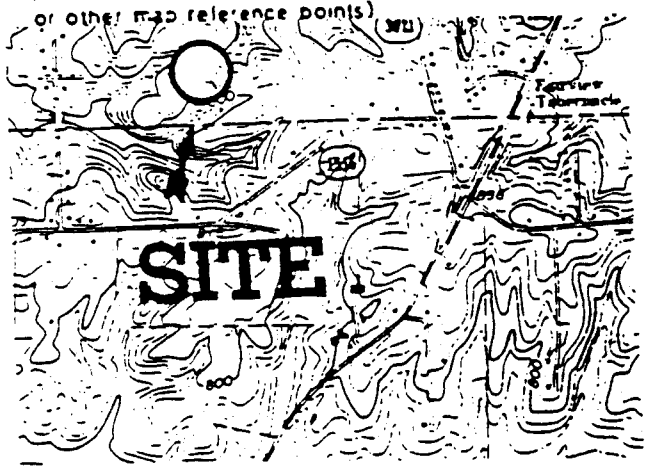
GRAVEL PACK

	Depth From	Depth To	Size	Material
	4.0	16.0 Ft.	FINE FILTER SAND	SAND
		Ft.		

MARKS Bentonite Seal From 3.0 to 4.0 Feet Below Ground Surface

LOCATION SKETCH

(Show direction and distance from at least two State Roads or other map reference points)



I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15 NCAC 2C. WELL CONSTRUCTION STANDARDS. AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CONTRACTOR OR AGENT

04-03-95
DATE

North Carolina
Department of Natural Resources and Community Development
Division of Environmental Management
Groundwater Section
P.O. Box 27687 - Raleigh, N.C. 27611

WELL ABANDONMENT RECORD

CONTRACTOR Geologic Exploration REG. NO. 1175

1. WELL LOCATION: (Show a sketch of the location on back of form.)
Nearest Town: Winston Salem County Forysth
Friedburg Lane
(Road, Community, Subdivision, Lot No.) Quadrangle No.

2. OWNER: City of Winston Salem Utilities Div.

3. ADDRESS: PO Box 2511 Winston Salem, NC

4. TOPOGRAPHY : draw, slope, hilltop, valley, flat

5. USE OF WELL: monitor DATE: 12/28/95

6. TOTAL DEPTH: 25.0 ft DIAMETER: 2 inch

7. CASING REMOVED:

feet	diameter
N/A	N/A

8. SEALING MATERIAL:

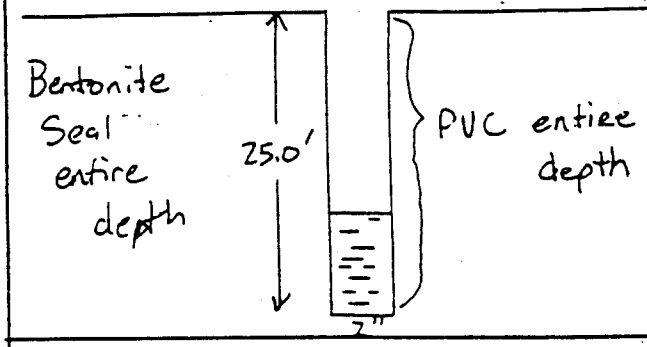
Neat cement	Sand cement
bags of cement	bags of cement
gals. of water	yds. of sand
	gals. of water

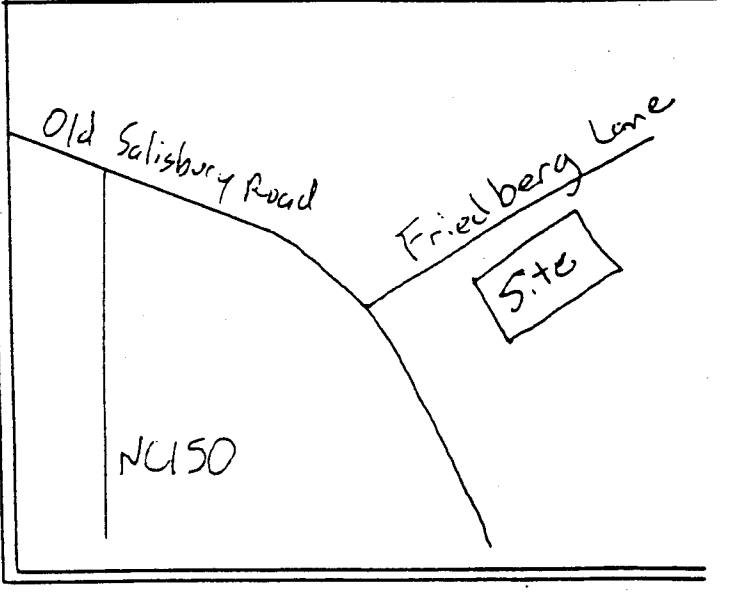
Other
Type material Bentonite Holeplug
Amount 4 gallons

9. EXPLAIN METHOD EMPLACEMENT OF MATERIAL.
pour/wet

MW-4

WELL DIAGRAM: Draw a detailed sketch of the well showing total depth, depth and diameter of screens remaining in the well, gravel interval, intervals of casing perforations, and depths and types of fill materials used.





I do hereby certify that this well abandonment record is true and exact.

Signature of Contractor or Agent Steve Zyl Date 1-4-96

WELL LOCATION: Draw a location sketch on the reverse of this sheet, showing the direction and distance of the well to at least two (2) nearby reference points such as roads, intersections and streams. Identify roads with State High way road identification numbers.

Submit original to the Division of Environmental Management, one copy to the Driller, and one copy to the owner.

GW -30 Revised 5/15/89

DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, N.C. 27611, PHONE (919) 733-3063

Quad. No. _____ Serial No. _____
Lat. _____ Long. _____ Pc _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

MW-4

CONTRACTOR Groundwater Protection, Inc.

LER REGISTRATION NUMBER 1105

STATE WELL CONSTRUCTION PERMIT NUMBER: NA

LL LOCATION (Show sketch of the location below)

arest Town: Winston-Salem, North Carolina

Friedburg Road

oad, Community, or Subdivision and Lot No.)

NER Winston-Salem/Forsyth County Utilities Comm.

DRESS 102 West Third Street , Suite 460 (Street or Route No.)

Winston-Salem, North Carolina 27102

City or Town State Zip Code

ATE DRILLED February 13 1995 USE OF WELL MONITOR

OTAL DEPTH 37-0 CUTTINGS COLLECTED ☐ Yes ☒ No

OES WELL REPLACE EXISTING WELL? ☐ Yes ☒ No

TATIC WATER LEVEL: 26.1 FT. ☐ above ☒ below TOP OF CASING.

TOP OF CASING IS 2.6 FT. ABOVE LAND SURFACE.

ELD (ppm): NA METHOD OF TEST _____

ATER ZONES (depth): NA

_____

NATION. Type NA Amount _____

County: Forsyth

Depth From	Depth To	DRILLING LOG Formation Description
	0-5	Medium To Fine Sandy Silt
	5-16	Partially Weathered Rock As Coarse to Fine Very Sandy Sil
		~~To Silty Coarse To Fine Sand~~
	16-37	Partially Weathered Rock As Silty Coarse To Fine Sand

If additional space is needed use back of form.

ASING

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	2.6	To 19.75	Ft.	2"	SCH 40	PVC
From	34.25	To 34.75	Ft.	2"	SCH 40	PVC
From		To	Ft.			

ROUT

	Depth			Material	Method
From	0	To 15.25	Ft.	PORTLAND	HAND
From		To	Ft.		

CREEN

	Depth			Diameter	Slot Size	Material
From	19.75	To 34.25	Ft.	2"	.010 in	PVC
From		To	Ft.	In.	In.	
From		To	Ft.	In.	In.	

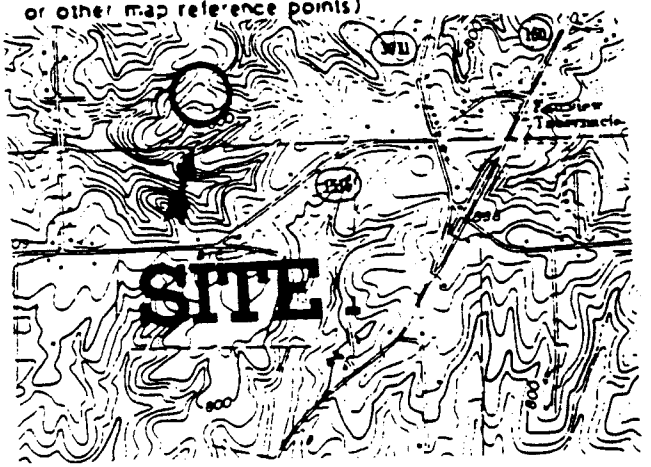
GRAVEL PACK

	Depth			Size	Material
From	17.75	To 37.0	Ft.	FINE FILTER SAND	SAND
From		To	Ft.		

ARKS Bentonite Seal From 15.25 To 17.75 Feet Below Ground Surface

LOCATION SKETCH

(Show direction and distance from at least two State Road or other map reference points)



I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15 NCAC 2C. WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CONTRACTOR OR AGENT

04-03-95
DATE

Department of Natural Resources and Community Development
Division of Environmental Management
Groundwater Section
P.O. Box 27687 - Raleigh, N.C. 27611

WELL ABANDONMENT RECORD

CONTRACTOR Geologic Exploration REG. NO. 1175

1. WELL LOCATION: (Show a sketch of the location on back of form.)
Nearest Town: Winston Salem County Forysth
Friedburg Lane
(Road, Community, Subdivision, Lot No.) Quadrangle No.

2. OWNER: City of Winston Salem Utilities Div.

3. ADDRESS: PO Box 2511 Winston Salem, NC

4. TOPOGRAPHY : draw, slope, hilltop, valley, flat

5. USE OF WELL: monitor DATE: 12/28/95

6. TOTAL DEPTH: 35.0 ft DIAMETER: 2 inch

7. CASING REMOVED:

feet	diameter
N/A	N/A

8. SEALING MATERIAL:

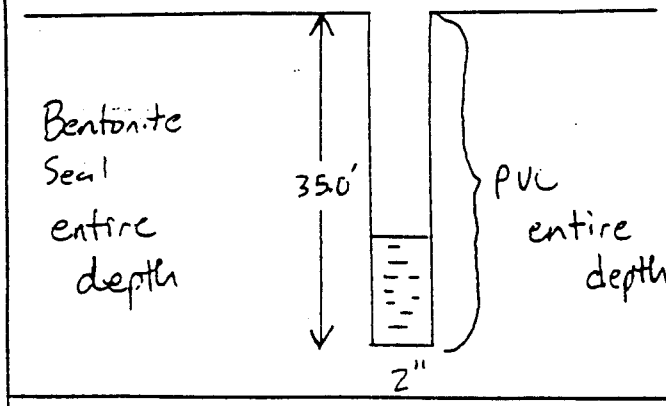
Neat cement	Sand cement
bags of cement	bags of cement
gals. of water	yds. of sand
	gals. of water

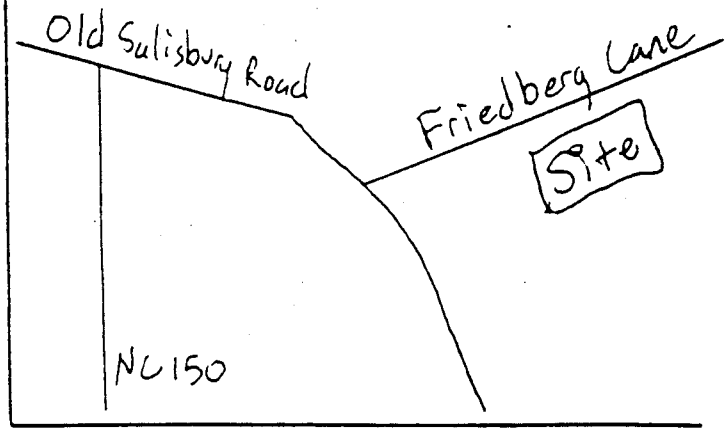
Other
Type material Bentonite Holeplug
Amount 5.5 gallons

9. EXPLAIN METHOD EMPLACEMENT OF MATERIAL.
pour/wet

MW-5

WELL DIAGRAM: Draw a detailed sketch of the well showing total depth, depth and diameter of screens remaining in the well, gravel interval, intervals of casing perforations, and depths and types of fill materials used.





I do hereby certify that this well abandonment record is true and exact.

Signature of Contractor or Agent Steve Taylor Date 1-4-96

WELL LOCATION: Draw a location sketch on the reverse of this sheet, showing the direction and distance of the well to at least two (2) nearby reference points such as roads, intersections and streams. Identify roads with State High way road identification numbers.

Submit original to the Division of Environmental Management, one copy to the Driller, and one copy to the owner.

GW -30 Revised 5/15/89

DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, N.C. 27611, PHONE (919) 733-3083

Quad. No. _____ Serial No. _____
Lat. _____ Long. _____ Pc ____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. ____

WELL CONSTRUCTION RECORD

MW-5

...G CONTRACTOR Groundwater Protection, Inc.

...LER REGISTRATION NUMBER 1105

STATE WELL CONSTRUCTION PERMIT NUMBER: NA

...LL LOCATION (Show sketch of the location below)

...arest Town Winston-Salem, North Carolina
Friedburg Road
...ad, Community, or Subdivision and Lot No.)

County: Forsyth

...NER Winston-Salem/Forsyth County Utilities Comm.

...DRESS 102 West Third Street , Suite 460
(Street or Route No.)
Winston-Salem, North Carolina 27102
City or Town State Zip Code

...ATE DRILLED February 11, 1995 USE OF WELL MONITOR

...OTAL DEPTH 25.0 CUTTINGS COLLECTED ☐ Yes ☒ No

...OES WELL REPLACE EXISTING WELL? ☐ Yes ☒ No

...TATIC WATER LEVEL: 14.0 FT. ☐ above ☐ below TOP OF CASING.

TOP OF CASING IS 2.4 FT. ABOVE LAND SURFACE.

...ELD (gpm): NA METHOD OF TEST _____

...ATER ZONES (depth): NA

...INATION. Type NA Amount _____

Depth From	Depth To	DRILLING LOG Formation Description
0	10	Coarse To Fine Sandy Silt
10	25.7	Partially Weathered Rock As Silty Coarse To Find Sand

If additional space is needed use back of form.

...ASING

	Depth From	Depth To	Ft.	Diameter	Wall Thickness or Weight/Ft.	Material
	2.4	10.0	Ft.	2"	SCH 40	PVC
	24.5	25.0	Ft.	2"	SCH 40	PVC
			Ft.			

...ROUT

	Depth From	Depth To	Ft.	Material	Method
	0	6.0	Ft.	PORTLAND	HAND
			Ft.		

...CREEN

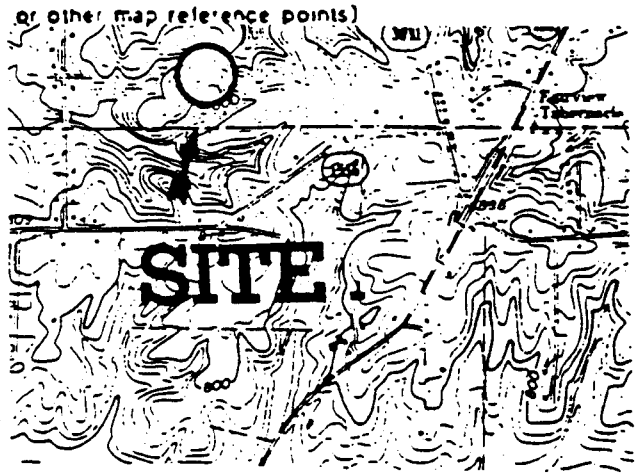
	Depth From	Depth To	Ft.	Diameter	Slot Size		Material
	10.0	24.5	Ft.	2"	.010	in.	PVC
			Ft.	In.	In.		
			Ft.	In.	In.		

...RAVEL PACK

	Depth From	Depth To	Ft.	Size	Material
	8.0	25.0	Ft.	FINE FILTER SAND	SAND
			Ft.		

LOCATION SKETCH

(Show direction and distance from at least two State Road or other map reference points)



...ARKS Bentonite Seal From 6.0 to 8.0 Feet Below Ground Surface

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15 NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CONTRACTOR OR AGENT

04-03-95
DATE

Department of Natural Resources and Community Development
Division of Environmental Management
Groundwater Section
P.O. Box 27687 - Raleigh, N.C. 27611

WELL ABANDONMENT RECORD

CONTRACTOR Geologic Exploration, Inc. REG. NO. 1175

1. WELL LOCATION: (Show a sketch of the location on back of form.)
Nearest Town: Winston Salem County Forysth
Friedberg Lane
(Road, Community, Subdivision, Lot No.) Quadrangle No.

2. OWNER: City of Winston Salem Utilities Div.

3. ADDRESS: PO Box 2511 Winston Salem, NC 27102

4. TOPOGRAPHY : draw, slope, hilltop, valley, flat

5. USE OF WELL: drinking water DATE: 12-28-95

6. TOTAL DEPTH: 65.0 ft DIAMETER: 24 inch

7. CASING REMOVED:

feet	diameter
N/A	N/A

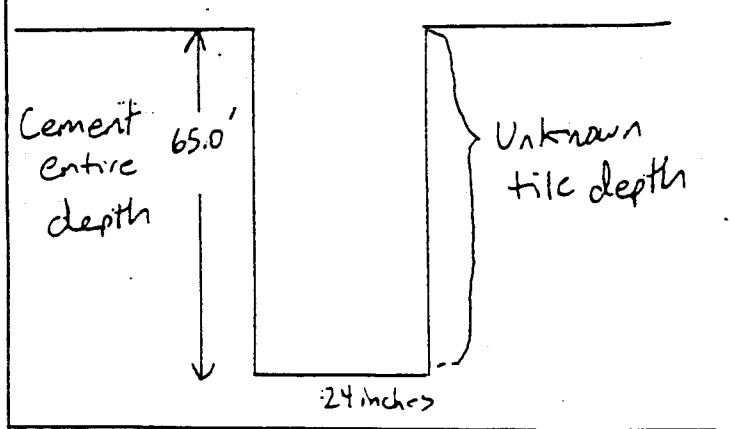
8. SEALING MATERIAL:

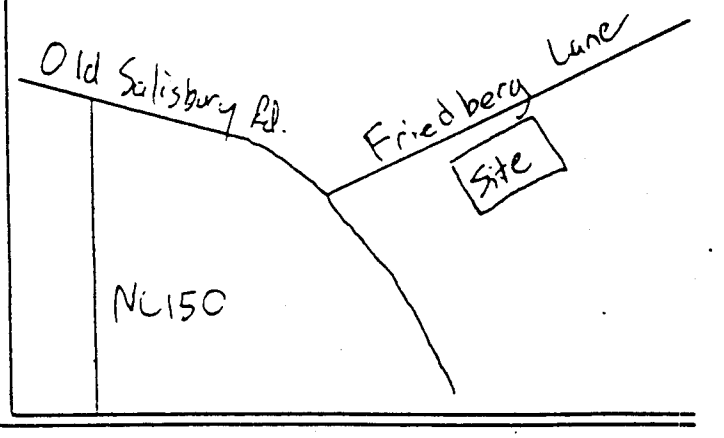
Neat cement	Sand cement
bags of cement	bags of cement
gals. of water	yds. of sand
	gals. of water

Other
Type material Portland Cement
Amount 8.5 yards

9. EXPLAIN METHOD EMPLACEMENT OF MATERIAL.
poured/dumped

WELL DIAGRAM: Draw a detailed sketch of the well showing total depth, depth and diameter of screens remaining in the well, gravel interval, intervals of casing perforations, and depths and types of fill materials used.





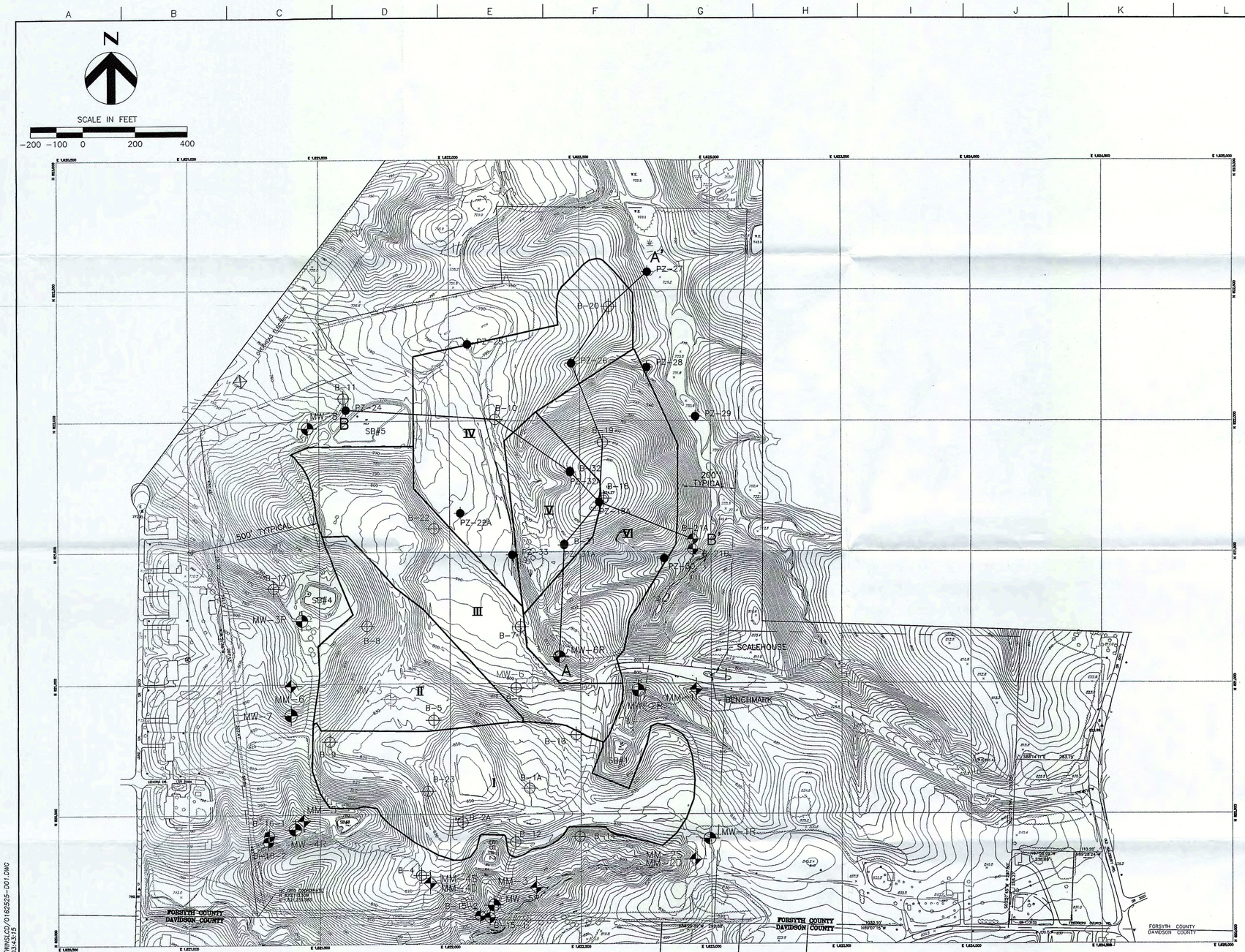
I do hereby certify that this well abandonment record is true and exact.

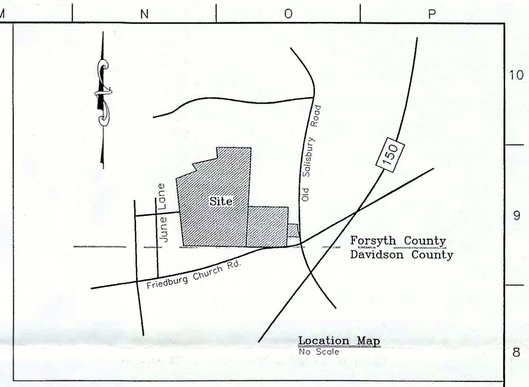
Signature of Contractor or Agent Steve Taylor Date 01-04-96

WELL LOCATION: Draw a location sketch on the reverse of this sheet, showing the direction and distance of the well to at least two (2) nearby reference points such as roads, intersections and streams. Identify roads with State High way road identification numbers.

Submit original to the Division of Environmental Management, one copy to the Driller, and one copy to the owner.

GW -30 Revised 5/15/89





Location Map
No Scale

LEGEND

- EXISTING CONTOURS
- PROPERTY BOUNDARY
- COUNTY LINE
- PROPOSED PHASING BOUNDARY
- SWAMP/STANDING WATER
- STREAM
- SOIL BORING (ABANDONED)
- GROUND-WATER MONITORING WELL (ABANDONED)
- GROUND-WATER MONITORING WELL (EXISTING)
- GROUND-WATER OBSERVATION WELL (EXISTING)
- PRIVATE WATER SUPPLY WELL
- SB#2 SEDIMENTATION BASIN
- METHANE MONITORING PROBE (EXISTING)
- GROUND-WATER PIEZOMETER (NEWLY INSTALLED)
- SOIL BORING (NEWLY INSTALLED)
- A A' PATH OF HYDROGEOLOGIC CROSS SECTIONS

NOTES

1. PHASE I, II, III AND IV TOPOGRAPHIC INFORMATION PROVIDED BY CARTOGRAPHIC AERIAL MAPPING, INC. DATED FEBRUARY 2, 2003.
2. TOPOGRAPHIC INFORMATION PROVIDED BY CARTOGRAPHIC AERIAL MAPPING DATED APRIL 2, 1999.
3. PROPERTY SURVEY TAKEN FROM DATA SUPPLIED BY BRADY SURVEYING, INC. DATED MARCH 14, 1994.
4. THE POTENTIAL EXTENT OF WASTE LINE SHOWN IS BASED ON BUFFERS REQUIRED BY UNIFIED DEVELOPMENT ORDINANCE.
5. METHANE MONITORING PROBES WERE INSTALLED IN AUGUST 1999.
6. THE PHASE I/II BOUNDARY LINE WAS TAKEN FROM CERTIFICATION NO. 7 12/28/99.

Issue No.	Description	Date	Drwn.	Chkd.	Resp. Engr.	Proj. Mgr.
B	ADDED NEW PIEZOMETER LOCATIONS AND SUBMITTED FOR NCDENR APPROVAL					
A	ADDED NEW PIEZOMETER LOCATIONS AND SUBMITTED FOR NCDENR APPROVAL	8/02	JEG	JI		

NORTH CAROLINA LICENSED SEAL 19021 PROFESSIONAL ENGINEER JOHN R. ISHAM
4/4/03

HDR
HDR Engineering, Inc. of the Carolinas
Suite 1400
128 S. Tryon Street
Charlotte, NC 28202-5001
(704) 338-6700
BAR LENGTH ON ORIGINAL DRAWING EQUALS ONE INCH. ADJUST SCALE ACCORDINGLY.

Project Manager: J.C. READLING, P.E.
Designed: J. ISHAM, P.G.
Designed:
Checked: J. ISHAM, P.G.
Drawn: J. GAUL

OLD SALISBURY ROAD CONSTRUCTION AND DEMOLITION LANDFILL PHASE IV THROUGH VI

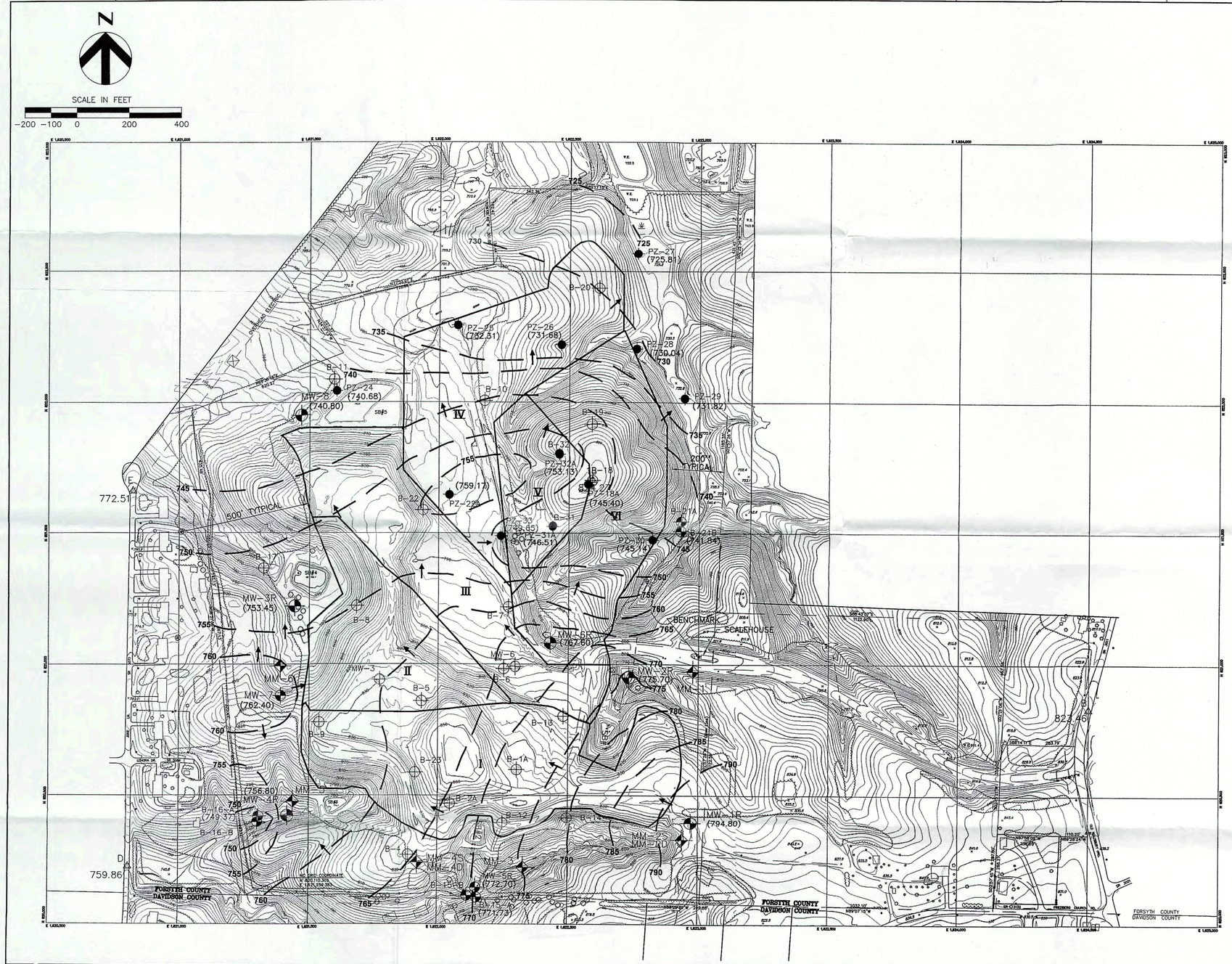
CONSTRUCTION PLAN APPLICATION

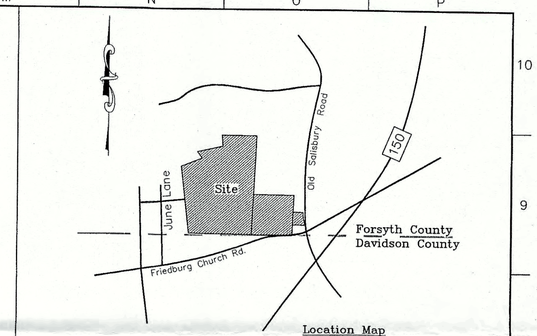
WINSTON-SALEM NORTH CAROLINA

OVERALL SITE PLAN

Date	Project No.	Drawing No.	Issue
JULY 2002	00162-525-018	D-01	B
Scale: 1"=200'	File Name: 162525-D01		

//CLTSMAIN/DWGS_P/WINSLCD/0162525-D01.DWG
03-17-03 JGAUL 03:43:15





Location Map
No Scale

LEGEND

- EXISTING CONTOURS
- PROPERTY BOUNDARY
- COUNTY LINE
- PROPOSED PHASING BOUNDARY
- SWAMP, STANDING WATER
- STREAM
- SOIL BORING (ABANDONED)
- GROUND-WATER MONITORING WELL (EXISTING)
- GROUND-WATER MONITORING WELL (ABANDONED)
- GROUND-WATER OBSERVATION WELL (EXISTING)
- PRIVATE WATER SUPPLY WELL
- SB#2 — SEDIMENTATION BASIN
- METHANE MONITORING PROBE (EXISTING)
- GROUND-WATER PIEZOMETER (NEWLY INSTALLED)
- SOIL BORING (NEWLY INSTALLED)
- (794.80) — GROUND-WATER ELEVATION (FEET MSL)
- 735 — POTENTIOMETRIC CONTOURS (FEET MSL)
- GROUND-WATER FLOW DIRECTION

NOTES

1. PHASE I, II, III AND IV TOPOGRAPHIC INFORMATION PROVIDED BY CARTOGRAPHIC AERIAL MAPPING, INC. DATED FEBRUARY 2, 2003.
2. TOPOGRAPHIC INFORMATION PROVIDED BY CARTOGRAPHIC AERIAL MAPPING DATED APRIL 2, 1999.
3. PROPERTY SURVEY TAKEN FROM DATA SUPPLIED BY BRADY SURVEYING, INC. DATED MARCH 14, 1994.
4. THE POTENTIAL EXTENT OF WASTE LINE SHOWN IS BASED ON BUFFERS REQUIRED BY UNIFIED DEVELOPMENT ORDINANCE.
5. METHANE MONITORING PROBES WERE INSTALLED IN AUGUST 1999.
6. THE PHASE I/II BOUNDARY LINE WAS TAKEN FROM CERTIFICATION NO. 7 12/28/99.
7. GROUND-WATER ELEVATIONS MEASURED ON MARCH 4, 2003.
8. MSL– MEAN SEA LEVEL

Received
DEC 2003
Solid Waste Section

Issue No.	Description	Date	Drwn.	Chkd.	Resp. Engr.	Proj. Mgr.
	REVISED GW Elev. Value for P2-33					
C	REVISED GROUNDWATER CONTOURS PER NCDENR COMMMENTS					
B	ADDED NEW PIEZOMETER LOCATIONS AND MARCH 2003 GROUND-WATER DATA	4/03	JEG	JI		
A	ADDED NEW PIEZOMETER LOCATIONS AND SUBMITTED FOR NCDENR APPROVAL	8/02	JEG	JI		

NORTH CAROLINA LICENSED SEAL 1502 GEOLOGIST JOHN R. ISHAM

HDR Engineering, Inc. of the Carolinas
Suite 1400
128 S. Tryon Street
Charlotte, NC 28202-5009
(704) 338-6700

BAR LENGTH ON ORIGINAL DRAWING EQUALS ONE INCH. ADJUST SCALE ACCORDINGLY.

Project Manager	J.C. READLING, P.E.
Designed	J. ISHAM, P.G.
Designed	
Checked	
Drawn	J. GAUL

OLD SALISBURY ROAD C & D LANDFILL EXPANSION PHASE IV, V AND VI

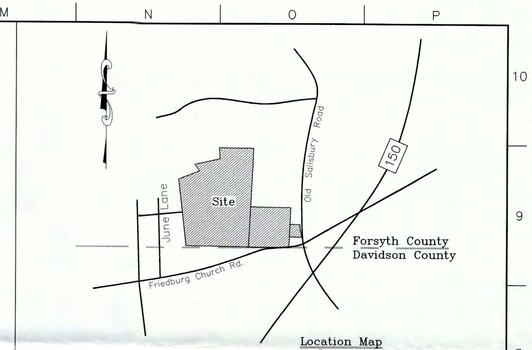
CONSTRUCTION PERMIT APPLICATION

WINSTON-SALEM NORTH CAROLINA

GROUND-WATER POTENTIOMETRIC MAP MARCH 4, 2003

Date	Project No.	Drawing No.	Issue
JULY 2002	00162-525-018	D-02	C
Scale 1"=200'	File Name 162525-D02		

P:\WINSLC\D0162525\D02.DWG, Layout1, 12/02/2003 02:37:18 PM, jgaul



Location Map
No Scale

LEGEND

- EXISTING CONTOURS
- PROPERTY BOUNDARY
- COUNTY LINE
- PROPOSED PHASING BOUNDARY
- SWAMP, STANDING WATER
- STREAM
- SOIL BORING (ABANDONED)
- GROUND-WATER MONITORING WELL (EXISTING)
- GROUND-WATER MONITORING WELL (ABANDONED)
- GROUND-WATER OBSERVATION WELL (EXISTING)
- PRIVATE WATER SUPPLY WELL
- SB#2 SEDIMENTATION BASIN
- METHANE MONITORING PROBE (EXISTING)
- GROUND-WATER PIEZOMETER (NEWLY INSTALLED)
- (783.77) SOIL BORING (NEWLY INSTALLED) GROUND-WATER ELEVATION (FEET MSL)
- 735 POTENTIOMETRIC CONTOURS (FEET MSL)
- GROUND-WATER FLOW DIRECTION

NOTES

1. PHASE I, II, III AND IV TOPOGRAPHIC INFORMATION PROVIDED BY CARTOGRAPHIC AERIAL MAPPING, INC. DATED FEBRUARY 2, 2003.
2. TOPOGRAPHIC INFORMATION PROVIDED BY CARTOGRAPHIC AERIAL MAPPING DATED APRIL 2, 1999.
3. PROPERTY SURVEY TAKEN FROM DATA SUPPLIED BY BRADY SURVEYING, INC. DATED MARCH 14, 1994.
4. THE POTENTIAL EXTENT OF WASTE LINE SHOWN IS BASED ON BUFFERS REQUIRED BY UNIFIED DEVELOPMENT ORDINANCE.
5. METHANE MONITORING PROBES WERE INSTALLED IN AUGUST 1999.
6. THE PHASE I/II BOUNDARY LINE WAS TAKEN FROM CERTIFICATION NO. 7 12/28/99.
7. SEE HDR DESIGN HYDROGEOLOGICAL REPORT FOR DETERMINATION OF LONG-TERM SEASONAL HIGH GROUND-WATER CONTOURS.
8. MSL-MEAN SEA LEVEL.

Issue No.	Description	Date	Drwn.	Chkd.	Resp. Engr.	Proj. Mgr.
C	REVISED GROUNDWATER CONTOURS PER NCDENR COMMENTS					
B	ADDED NEW PIEZOMETER LOCATIONS AND ADJUSTED GROUND-WATER CONTOURS	4/03	JEG	JRI		JCR
A	ADDED NEW PIEZOMETER LOCATIONS AND SUBMITTED FOR NCDENR APPROVAL	8/30/02	JG	JRI		JCR

NORTH CAROLINA LICENSED SEAL 1502 GEOLOGIST JOHN R. ISHAM 7-30-03

HDR Engineering, Inc. of the Carolinas
Suite 1400
128 S. Tryon Street
Charlotte, NC 28202-5009
(704) 338-6700

BAR LENGTH ON ORIGINAL DRAWING EQUALS ONE INCH. ADJUST SCALE ACCORDINGLY.

Project Manager: J.C. READLING, P.E.
Designed: J. ISHAM, P.G.
Designed:
Checked: J. ISHAM, P.G.
Drawn: J. GAUL

OLD SALISBURY ROAD C & D LANDFILL EXPANSION PHASE IV, V AND VI

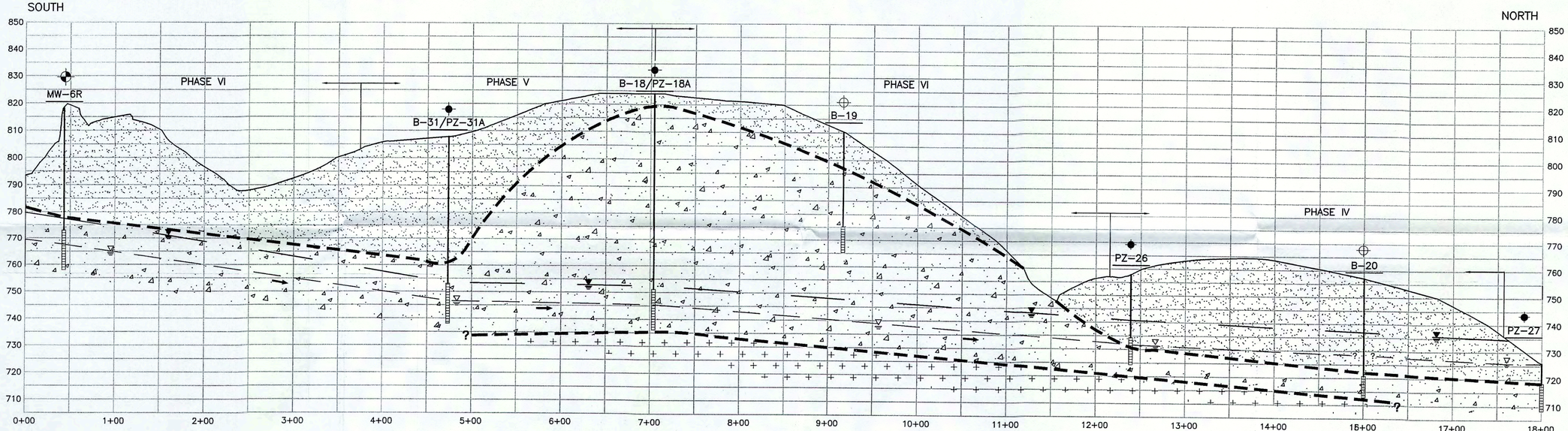
CONSTRUCTION PERMIT APPLICATION

WINSTON-SALEM NORTH CAROLINA

ESTIMATED LONG-TERM SEASONAL HIGH GROUND-WATER POTENTIOMETRIC MAP

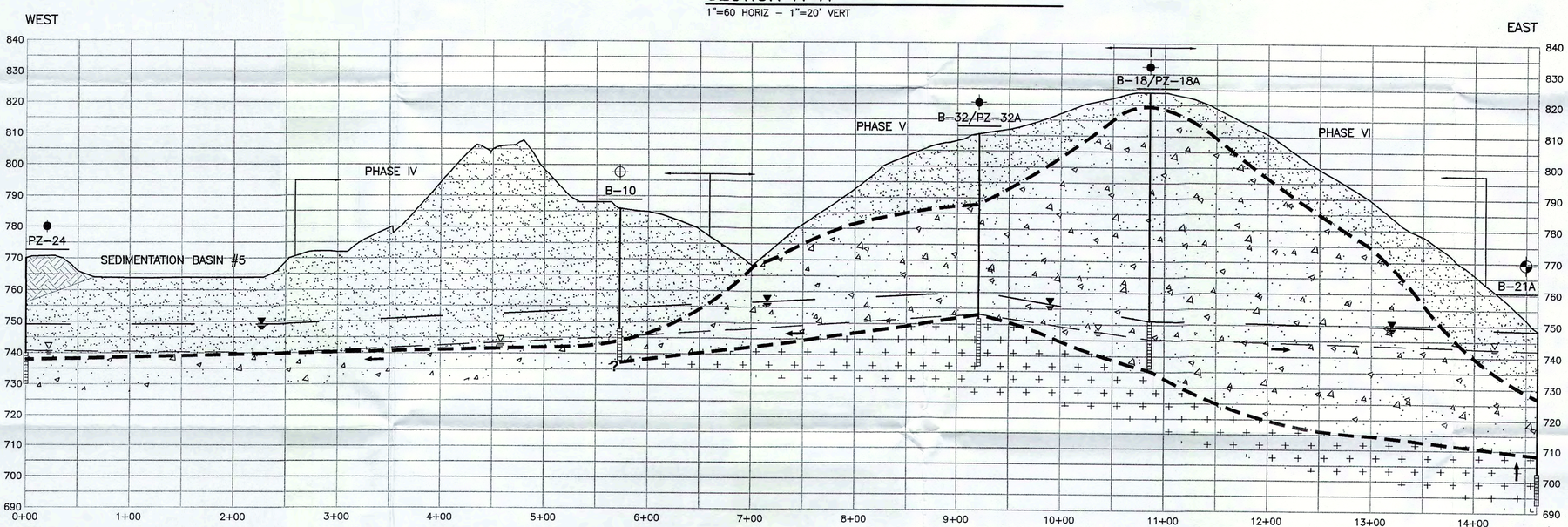
Date	Project No.	Drawing No.	Issue
JULY 2002	00162-525-018	D-02A	C
Scale: 1"=200'	File Name: 162525-D02A		

//CLTSMAIN/DWGS_P/WINSLCD/0162525-D02C.DWG
07-31-03 JGAUL 09:16:29



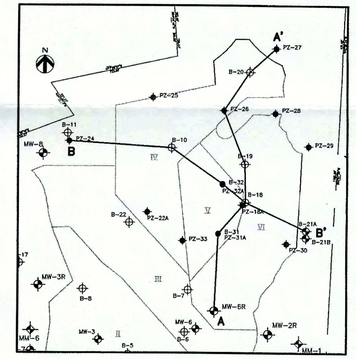
SECTION A–A'

1"=60 HORIZ – 1"=20' VERT



SECTION B–B'

1"=60 HORIZ – 1"=20' VERT



KEYMAP

LEGEND

- ESTIMATED LONG–TERM SEASONAL HIGH GROUND–WATER LEVEL (10 FEET HIGHER THAN JUNE 20, 2002 WATER TABLE ELEVATION)
- GROUND–WATER LEVEL (3/4/03)
- INFERRED LITHOLOGIC UNIT CONTACT
- WELL SCREEN INTERVAL
- GROUND–WATER FLOW COMPONENT
- ENGINEERED FILL
- SAPROLITE (N ≤ 50)
- TRANSITION ZONE (N ≥ 50)
- BEDROCK (GRANODIORITE)

SCALE IN FEET
−60 −30 0 60 120
HORIZONTAL SCALE

SCALE IN FEET
−20 −10 0 20 40
VERTICAL SCALE

Issue No.	Description	Date	Drwn.	Chkd.	Resp. Engr.	Proj. Mgr.
B	ADDED NEW PIEZOMETERS WITH GEOLOGIC DATA		JEG	JRI	MDP	JCR
A	ISSUED FOR APPROVAL					

C:/WINDM/WINSLCD/march03-D03.DWG
03-19-03 JGAUL 06:41:45

NORTH CAROLINA LICENSED GEOLOGIST SEAL 1502 JOHN R. ISHAM
4/4/03

HDR
HDR Engineering, Inc. of the Carolinas
Suite 1400
128 S. Tryon Street
Charlotte, NC 28202-5009
(704) 338-6700

BAR LENGTH ON ORIGINAL DRAWING EQUALS ONE INCH. ADJUST SCALE ACCORDINGLY.

Project Manager	J.C. READLING, P.E.
Designed	J. ISHAM, P.G.
Designed	
Checked	J. ISHAM, P.G.
Drawn	J. GAUL

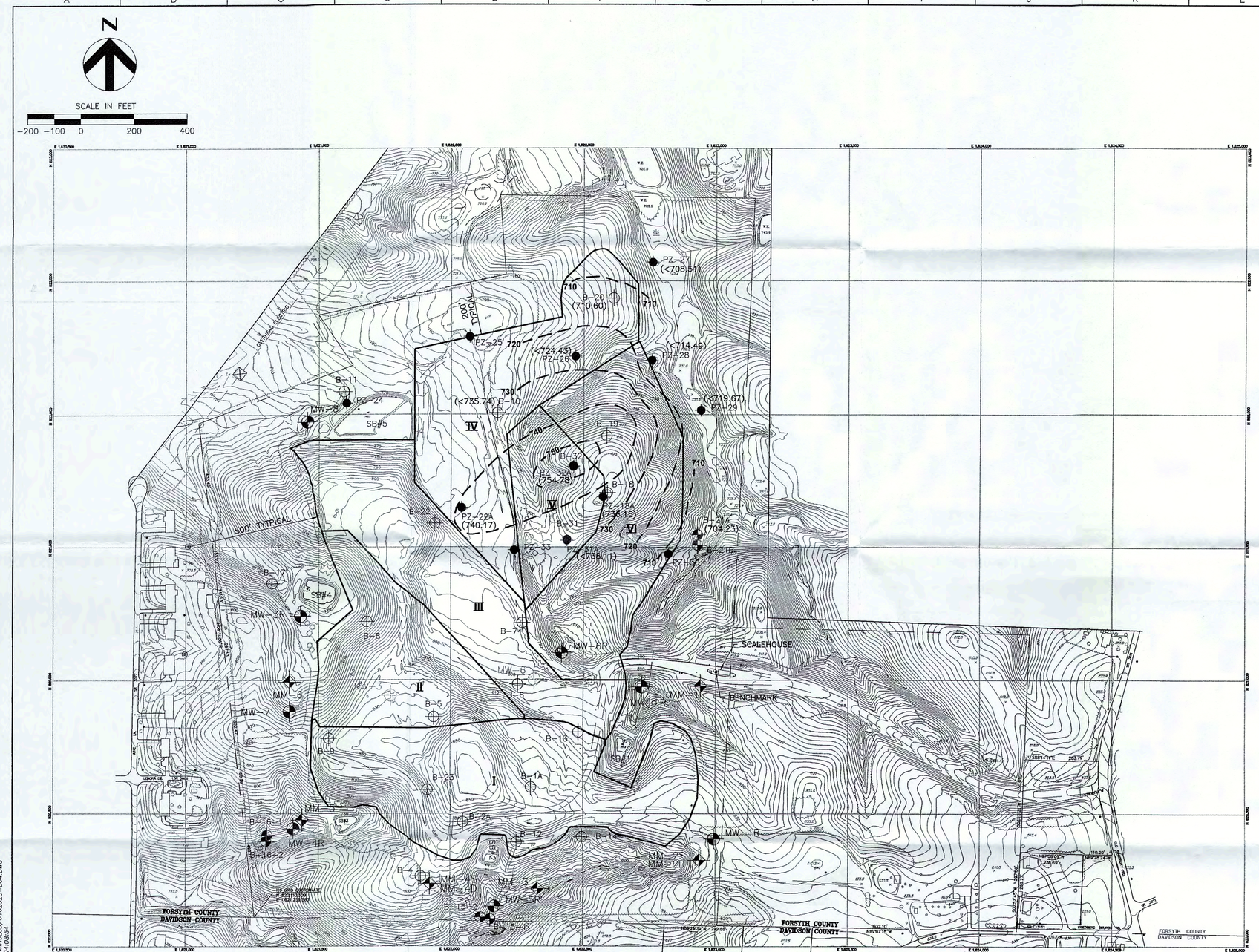
OLD SALISBURY ROAD CONSTRUCTION AND DEMOLITION LANDFILL PHASE IV THROUGH VI

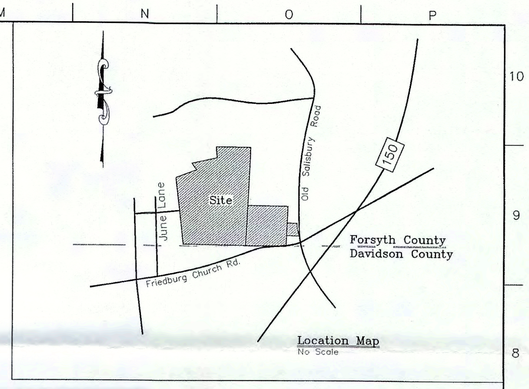
CONSTRUCTION PLAN APPLICATION

WINSTON-SALEM NORTH CAROLINA

HYDROGEOLOGIC CROSS SECTIONS A-A' AND B-B'

Date: JULY 2002	Project No.: 00162-525-018	Drawing No.: D-03	Issue: B
Scale: AS SHOWN	File Name: 0162525-D03		





Location Map
No Scale

LEGEND

510	EXISTING CONTOURS
	PROPERTY BOUNDARY
	COUNTY LINE
	PROPOSED PHASING BOUNDARY
	SWAMP/STANDING WATER
	STREAM
	SOIL BORING (ABANDONED)
	GROUND-WATER MONITORING WELL (ABANDONED)
	GROUND-WATER MONITORING WELL (EXISTING)
	GROUND-WATER OBSERVATION WELL (EXISTING)
W	PRIVATE WATER SUPPLY WELL
SB#2	SEDIMENTATION BASIN
	METHANE MONITORING PROBE (EXISTING)
	GROUND-WATER PIEZOMETER (NEWLY INSTALLED)
	SOIL BORING (NEWLY INSTALLED)
(754.78)	BEDROCK SURFACE ELEVATION (FT MSL)
730	INFERRED BEDROCK SURFACE ELEVATION CONTOUR CONTOUR INTERVAL = 10 FT.

NOTES

1. PHASE I, II, III AND IV TOPOGRAPHIC INFORMATION PROVIDED BY CARTOGRAPHIC AERIAL MAPPING, INC. DATED FEBRUARY 2, 2003.
2. TOPOGRAPHIC INFORMATION FOR THE REMAINING SITE PROVIDED BY CARTOGRAPHIC AERIAL MAPPING DATED APRIL 2, 1999.
3. PROPERTY SURVEY TAKEN FROM DATA SUPPLIED BY BRADY SURVEYING, INC. DATED MARCH 14, 1994.
4. THE PHASE I/II BOUNDARY LINE WAS TAKEN FROM CERTIFICATION NO. 7 12/28/99.
5. THE POTENTIAL EXTENT OF WASTE LINE SHOWN IS BASED ON BUFFERS REQUIRED BY UNIFIED DEVELOPMENT ORDINANCE.
6. METHANE MONITORING PROBES WERE INSTALLED IN AUGUST 1999.

Issue No.	Description	Date	Drwn.	Chkd.	Resp. Engr.	Proj. Mgr.
A	ISSUED FOR NCDENR APPROVAL					

NORTH CAROLINA LICENSED GEOLOGIST SEAL 1921 JOHN R. ISHAM
4/4/03

HDR
HDR Engineering, Inc. of the Carolinas
Suite 1400
128 S. Tryon Street
Charlotte, NC 28202-5009
(704) 338-6700

BAR LENGTH ON ORIGINAL DRAWING EQUALS ONE INCH. ADJUST SCALE ACCORDINGLY.

Project Manager: J.C. READLING, P.E.
Designed: J. ISHAM, P.G.
Designed:
Checked: J. ISHAM, P.G.
Drawn: J. GAUL

OLD SALISBURY ROAD CONSTRUCTION AND DEMOLITION LANDFILL PHASE IV THROUGH VI

CONSTRUCTION PLAN APPLICATION

WINSTON-SALEM NORTH CAROLINA

BEDROCK SURFACE ELEVATION CONTOUR MAP

Date	Project No.	Drawing No.	Issue
JULY 2002	00162-525-018	D-04	A
Scale: 1"=200'	File Name: 162525-D04		

//CLTSMAIN/DWGS_P/WINSLCD/0162525-D04.DWG
03-17-03 JGAUL 04:08:54

POINT NO.	NORTHING	EASTING	ELEV.	LOCATION
5000	821255.10	1622352.07	798.70	"""TP1450"""
5001	821638.27	1621489.16	810.97	"""TP1449"""
5002	821638.25	1621489.23	810.92	"""BSCHECK#1449"""
5003	820985.85	1622386.37	802.65	"""TP"""
5004	821255.09	1622352.07	798.75	"""BSCHECK#1450"""
5005	821080.38	1622749.83	801.99	"""TP"""
5006	820985.86	1622386.38	802.73	"""BSCHECK"""
5007	820954.69	1622744.87	774.74	"""A6-4FT"""
5008	820948.72	1622746.33	775.22	"""A5-B"""
5009	820937.15	1622743.87	775.07	"""A4-2FT"""
5010	820942.16	1622758.20	776.39	"""A5-A"""
5011	820943.25	1622768.16	775.67	"""B2-6FT"""
5012	820913.65	1622722.59	777.27	"""A3-2FT"""
5013	820893.86	1622723.48	776.51	"""A2-2FT"""
5014	820879.23	1622712.15	777.79	"""A1-3FT"""
5015	820936.44	1622786.31	775.15	"""B1-3FT"""
5016	821241.12	1622783.48	750.86	"""A7-6FT"""
5017	821341.22	1622847.78	751.40	"""TP"""
5018	821080.40	1622749.83	802.06	"""BSCHECK"""
5019	821276.78	1622811.73	751.18	"""A8-A"""
5020	821285.58	1622790.19	750.00	"""A8-B"""
5021	821338.61	1622841.82	749.76	"""A9-A"""
5022	821342.08	1622829.99	749.21	"""A9-B"""
5023	821382.37	1622866.76	745.59	"""A10-9FT"""
5024	821404.88	1622896.26	745.19	"""A11-3FT"""
5025	821427.79	1622913.72	743.21	"""A12-3FT"""
5026	821446.03	1622920.14	741.20	"""A13-4FT"""
5027	821471.23	1622948.20	741.04	"""A14-4FT"""
5028	821516.35	1622983.66	743.65	"""TP"""
5029	821341.23	1622847.79	751.49	"""BSCHECK"""
5030	821487.85	1622977.15	740.98	"""A15-4FT"""
5031	821509.19	1622957.04	740.15	"""A16-3FT"""
5032	821537.06	1622980.75	739.76	"""A17-3FT"""
5033	821549.56	1623006.49	739.71	"""A18-3FT"""
5034	821567.16	1623006.73	739.59	"""A19-4FT"""
5035	821599.78	1623025.94	739.24	"""A20-4FT"""
5036	821630.75	1623005.16	739.36	"""A21-10FT"""
5037	821717.75	1623079.04	739.71	"""TP"""
5038	821516.36	1622983.67	743.65	"""BSCHECK"""
5039	821663.02	1623016.48	738.80	"""A22-A"""
5040	821657.99	1623026.04	738.98	"""A22-B"""
5041	821697.76	1623027.22	738.13	"""A23-8FT"""
5042	821735.07	1623039.30	736.79	"""A24-3FT"""
5043	821729.26	1623053.63	737.10	"""C2-4FT"""
5044	821711.37	1623062.10	737.23	"""C1-2FT"""
5045	821739.81	1623035.32	738.08	"""V1"""
5046	821747.28	1623043.58	736.90	"""A25-4FT"""
5047	821758.59	1623009.75	736.90	"""V2-6FT"""
5048	821782.75	1623000.07	736.44	"""V3-6FT"""
5049	821790.86	1623039.95	736.75	"""A26-4FT"""
5050	821805.44	1623020.66	736.70	"""A27-3FT"""
5051	821824.97	1623025.07	736.48	"""A28-3FT"""
5052	821839.32	1623004.29	736.41	"""A29-4FT"""
5053	821937.26	1622945.57	736.70	"""TP"""
5054	821817.64	1622975.38	736.24	"""V4-7"""
5055	821846.84	1622968.35	736.62	"""V5-3"""
5056	821888.00	1622964.51	735.68	"""A30-6"""
5057	821927.13	1622992.63	735.16	"""A31-6"""
5058	821920.199	1623004.75	735.15	"""D2-3"""
5059	821896.68	1623018.39	736.24	"""D1-3"""
5060	821952.77	1623003.58	733.88	"""A32-4"""
5061	821996.45	1623003.24	734.25	"""A33-4"""
5062	822019.82	1622984.78	734.77	"""A34-4"""
5063	822048.00	1622950.43	734.40	"""A35-7"""
5064	822084.36	1622948.76	733.45	"""A36-5"""
5065	822092.54	1622960.42	732.90	"""A37-3"""
5066	822116.90	1622864.16	732.74	"""TP"""
5067	822140.16	1622939.93	731.75	"""A38-8"""
5068	822172.42	1622913.56	727.90	"""A39-8"""
5069	822165.88	1622896.07	728.74	"""A40-10"""
5070	822189.71	1622910.54	727.27	"""A41-10"""
5071	822220.00	1622905.60	731.78	"""TP"""
5072	822211.72	1622916.80	727.27	"""A42-4"""
5073	822239.70	1622911.25	726.97	"""A43-4"""
5074	822245.84	1622931.05	726.78	"""A44-8"""
5075	822269.00	1622944.65	726.52	"""A45-6"""
5076	822283.76	1622938.55	726.87	"""A46-5"""1.53
5077	822322.46	1623004.72	731.94	"""TP"""
5078	822315.28	1622980.24	730.95	"""E5-3"""
5079	822297.51	1622994.71	730.95	"""E4-6"""
5080	822307.54	1623035.90	727.71	"""E3-4"""
5081	822290.27	1623040.99	728.64	"""E2-5"""
5082	822286.50	1623080.85	728.53	"""E1-4"""
5083	822296.80	1622946.05	727.28	"""A47-8"""
5084	822348.59	1622945.69	726.28	"""A48-5"""
5085	822396.31	1622939.11	725.83	"""A49-6"""
5086	822423.75	1622897.03	725.72	"""A50-6"""
5087	822451.15	1622903.99	726.75	"""A51-5"""
5088	822458.47	1622881.19	725.35	"""A52-6"""
5089	822480.06	1622858.62	727.87	"""TP"""
5090	822511.59	1622890.05	725.12	"""A54-4"""
5091	822487.58	1622888.25	725.35	"""A53-4"""
5092	822539.61	1622881.39	725.13	"""A55-5"""
5093	822584.12	1622896.61	725.17	"""A56-6"""
5094	822608.63	1622876.87	724.77	"""A57-6"""
5095	822606.33	1622901.30	725.90	"""Y2"""
5096	822606.48	1622924.26	726.39	"""Y1"""
5097	822616.44	1622899.97	726.72	"""Y3"""
5098	822588.87	1622837.25	725.92	"""X4B"""
5099	822559.21	1622854.35	726.17	"""X3A"""
5100	822522.65	1622860.66	726.75	"""X2A"""
5101	822485.61	1622861.68	727.62	"""X1"""
5102	822525.58	1622844.72	726.77	"""X2B"""
5103	822561.58	1622839.98	725.81	"""X3B"""
5104	822583.49	1622827.73	725.24	"""X4B"""
5105	822643.71	1622916.87	729.91	"""TP"""
5106	822606.32	1622944.18	727.48	"""Z5"""
5107	822581.99	1622968.16	729.63	"""Z4"""
5108	822593.00	1623004.51	730.50	"""Z3"""
5109	822601.10	1622991.01	730.16	"""Z2"""
5110	822622.00	1622985.32	730.37	"""Z1"""
5111	822599.09	1622967.71	729.12	"""Z6"""
5112	822614.78	1622831.43	725.39	"""X5A"""
5113	822626.47	1622870.39	725.25	"""W1"""
5114	822632.33	1622845.37	725.57	"""W2"""
5115	822655.76	1622833.10	725.56	"""W3"""
5116	822654.47	1622795.28	725.48	"""TP"""
5117	822677.24	1622822.16	725.02	"""W4"""
5118	822712.91	1622826.91	725.85	"""W5"""
5119	822748.77	1622819.87	724.72	"""W5"""
5120	822777.16	1622812.48	721.53	"""W6"""
5121	822804.88	1622802.17	721.44	"""W7"""
5122	822827.16	1622801.91	722.33	"""W8"""
5123	822846.72	1622679.91	721.16	"""W9"""
5124	822820.57	1622674.94	723.51	"""W10"""
5125	822777.93	1622703.30	723.33	"""W11"""
5126	822741.04	1622701.25	724.05	"""W12"""
5127	822708.26	1622727.11	724.16	"""W13"""
5128	822687.08	1622743.80	724.66	"""W14"""
5129	822653.07	1622763.85	724.60	"""W15"""
5130	822627.31	1622767.77	725.47	"""W16"""
5131	822623.15	1622786.96	725.17	"""W17"""
5132	822597.04	1622791.08	725.64	"""W18"""
5133	822592.53	1622806.91	725.62	"""W18"""
5134	822632.49	1622812.27	725.72	"""W19"""
5135	822621.37	1622818.63	726.09	"""X5B"""
5136	822506.97	1622671.79	750.21	"""TP"""
5137	822432.35	1622599.39	759.68	"""CHTP#18"""
5138	822346.42	1622366.65	780.62	"""TP#14"""
5139	822341.54	1622250.59	787.23	"""TP#12"""
5140	821638.53	1621489.33	811.94	"""CH1449"""

THIS IS TO CERTIFY THAT THIS COPY OF THIS PLAT ACCURATELY DEPICTS THE BOUNDARY OF THE JURISDICTION OF SECTION 404 OF THE CLEAN WATER ACT AS DETERMINED BY THE UNDERSIGNED ON THIS DATE UNLESS THERE IS A CHANGE IN THE LAW OR OUR PUBLIC REGULATION. THIS DETERMINATION OF SECTION 404 JURISDICTION MAY BE RELIED UPON FOR A PERIOD NOT TO EXCEED 5 YEARS FROM THIS DATE. THIS DETERMINATION WAS MADE UTILIZING THE 1987 CORPS OF ENGINEERS WETLANDS DELINEATION MANUAL.

NAME: Todd [signature]

TITLE: Regulatory Project Manager

DATE: February 6, 2003 200221317

I, Max Brady, certify that the points indicated on this map were plotted from a field survey performed under my supervision on August 8, 2002 and is an accurate representation of the flagging provided by others for the purpose of delineating the limits of wetlands as performed by HDR Engineering, Inc., of the Carolinas in July, 2002.

SURVEYOR W. Max Brady Jr. [signature]
NC Registration Number L-2578
Date of Certification 1/21/03

NORTH CAROLINA PROFESSIONAL SEAL L-2578 WMB LAND SURVEYOR W. MAX BRADY, JR.

Z

SCALE IN FEET

-100 -50 0 100 200

LEGEND

EXISTING CONTOUR

PHASING LIMITS

STREAM

WETLANDS

NOTES

1. PHASE I, II AND III TOPOGRAPHIC INFORMATION PROVIDED BY CARTOGRAPHIC AERIAL MAPPING, INC. DATED SEPT. 27, 2001.
2. TOPOGRAPHIC INFORMATION PROVIDED BY CARTOGRAPHIC AERIAL MAPPING DATED APRIL 2, 1999.
3. PROPERTY SURVEY TAKEN FROM DATA SUPPLIED BY BRADY SURVEYING, INC. DATED MARCH 14, 1994.
4. THE PHASE I/II BOUNDARY LINE WAS TAKEN FROM CERTIFICATION NO. 7 12/28/99.

Location Map
No Scale

//CLTSMAIN/DWGS_P/WINSLCD/52501-C07a.DWG
10-29-02 JGAUL 15:12:49

Issue No.	Description	Date	Drwn.	Chkd.	Resp. Engr.	Proj. Mgr.
A	ISSUED FOR APPROVAL					

HDR
HDR Engineering, Inc. of the Carolinas
Suite 1400
128 S. Tryon Street
Charlotte, NC 28202-5001
(704) 338-6700

BAR LENGTH ON ORIGINAL DRAWING EQUALS ONE INCH. ADJUST SCALE ACCORDINGLY.

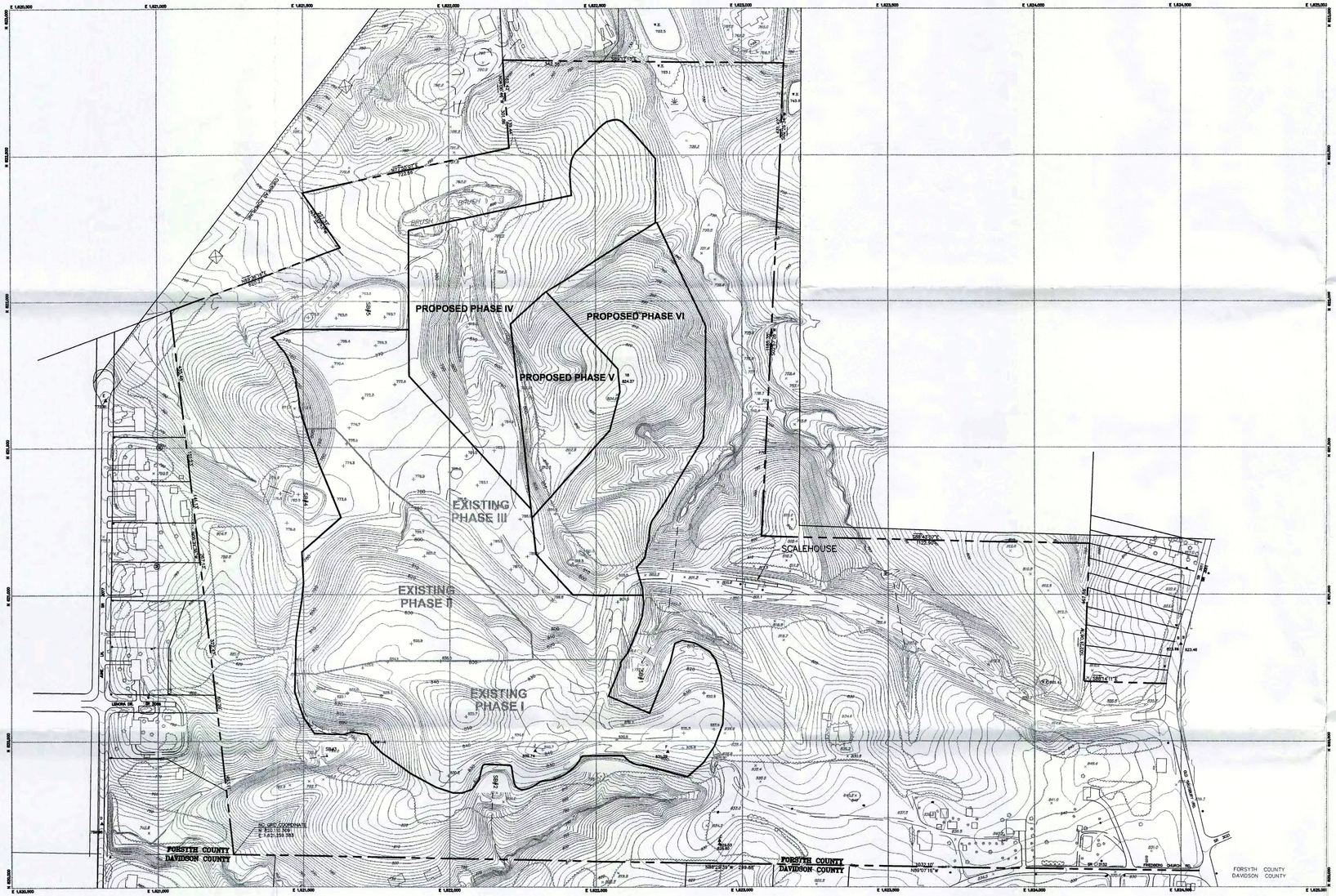
Project Manager: J.C. READLING, P.E.
Designed: M.D. PLUMMER, P.E.
Designed:
Checked:
Drawn: J. GAUL

OLD SALISBURY ROAD C & D LANDFILL EXPANSION PHASE IV, V AND VI
CONSTRUCTION PERMIT APPLICATION

WINSTON-SALEM NORTH CAROLINA

WETLAND DELINEATION MAP

Date: OCTOBER 2002
Scale: AS SHOWN
Project No.:
File Name:
Drawing No.: FIG-1
Issue: A



N

SCALE IN FEET

−200 −100 0 200 400

NOTES

1. PHASE I, II AND III TOPOGRAPHIC INFORMATION PROVIDED BY CARTOGRAPHIC AERIAL MAPPING, INC. DATED SEPT. 29, 2001.
2. TOPOGRAPHIC INFORMATION FOR THE REMAINING SITE PROVIDED BY CARTOGRAPHIC AERIAL MAPPING DATED APRIL 2, 1999.
3. PROPERTY SURVEY TAKEN FROM DATA SUPPLIED BY BRADY SURVEYING, INC. DATED MARCH 14, 1994.

LEGEND

- 830 — EXISTING GRADES
- PHASE BOUNDARY
- PROPERTY LINE

Issue No.	Description	Date	Drwn.	Chkd.	Resp. Engr.	Proj. Mgr.
A	ISSUED FOR APPROVAL	10/24/02	JBG	MDP		

HDR Engineering, Inc. of the Carolinas
Suite 1400
128 S. Tryon Street
Charlotte, NC 28202-5001
(704) 338-6700

BAR LENGTH ON ORIGINAL DRAWING EQUALS ONE INCH. ADJUST SCALE ACCORDINGLY.

Project Manager: J.C. READLING, P.E.
Designed: M.D. PLUMMER, P.E.
Designed:
Checked:
Drawn: J. GAUL

OLD SALISBURY ROAD
C & D LANDFILL EXPANSION
PHASE IV, V AND VI
CONSTRUCTION PERMIT APPLICATION

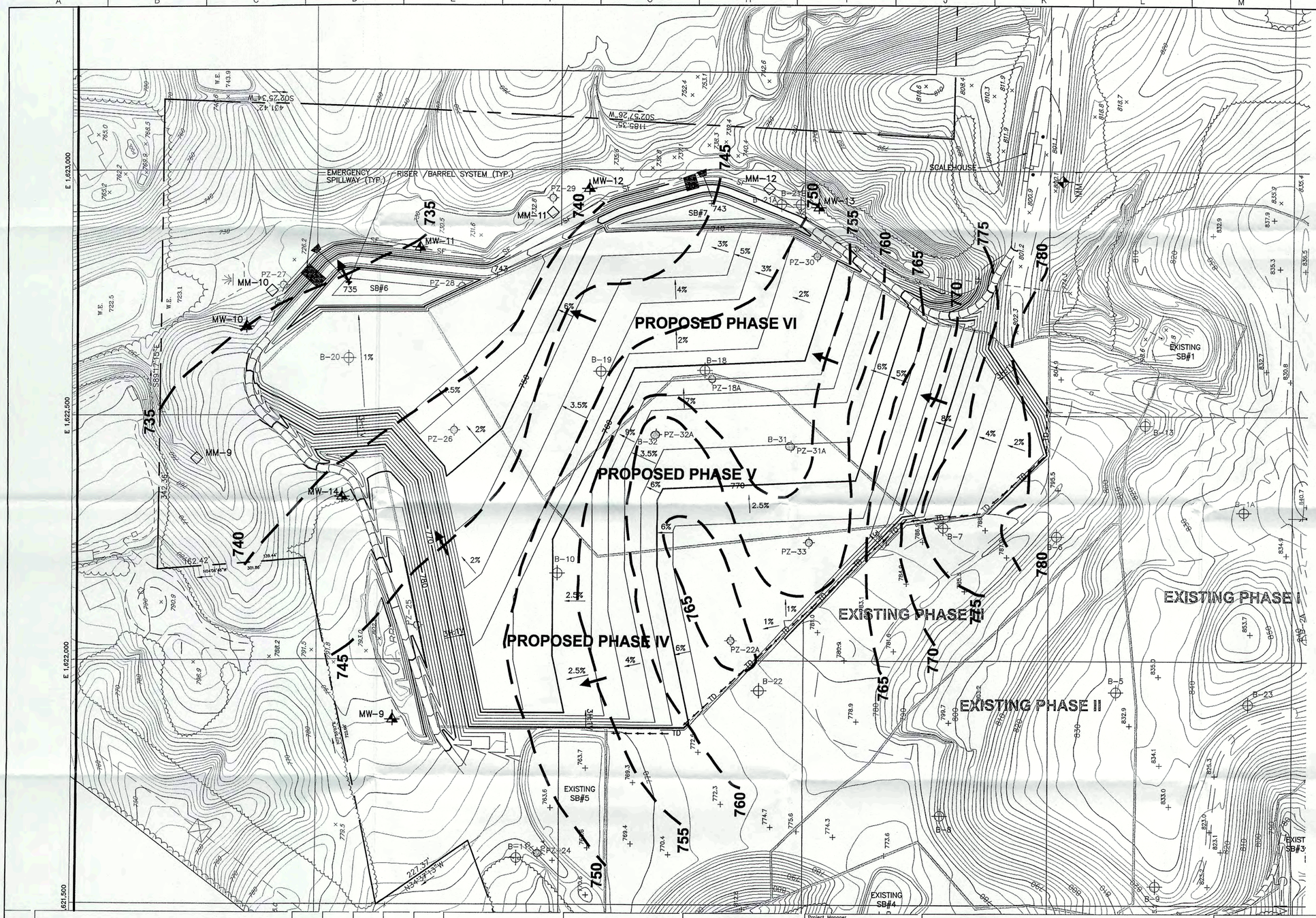
WINSTON-SALEM NORTH CAROLINA

OVERALL SITE PLAN

Date	Project No.	Drawing No.	Issue
OCTOBER 2002	00162-525-018	C-01	A

Scale: AS SHOWN
File Name:

//CLT3MAIN/DWGS_P/WINSLCD/52501-C01.DWG
10-22-02 JGAUL 12:56:22



Z

SCALE IN FEET

−100 −50 0 100 200

NOTES

1. PHASE I, II AND III TOPOGRAPHIC INFORMATION PROVIDED BY CARTOGRAPHIC AERIAL MAPPING, INC. DATED SEPT. 29, 2001.
2. TOPOGRAPHIC INFORMATION FOR THE REMAINING SITE PROVIDED BY CARTOGRAPHIC AERIAL MAPPING DATED APRIL 2, 1999.
3. PROPERTY SURVEY TAKEN FROM DATA SUPPLIED BY BRADY SURVEYING, INC. DATED MARCH 14, 1994.
4. THE PHASE IV, V AND VI BASEGRADES MAINTAIN A MINIMUM OF 4 FEET OF SEPARATION ABOVE THE ESTIMATED SEASONAL HIGH GROUNDWATER CONTOURS.

LEGEND

- EXISTING CONTOUR
- 848 PROPOSED BASEGRADE CONTOURS
- PHASING LIMITS
- SF SILT FENCE
- OUTLET APRON
- TD TEMPORARY DIVERSION CHANNEL
- 765 ESTIMATED LONG-TERM SEASONAL HIGH

Issue No.	Description	Date	Drwn.	Chkd.	Resp. Engr.	Proj. Mgr.
C	REVISED SUBGRADE PER NCDENR COMMENTS (6FT SEPARATION)					
B	REVISED SUBGRADE PER NCDENR COMMENTS					
A	ISSUED FOR APPROVAL	4/03	JEG	MDP		JCR

NORTH CAROLINA PROFESSIONAL SEAL 025495 ENGINEER MICHAEL D. PLUMMER 6/7/03

HDR

HDR Engineering, Inc. of the Carolinas
Suite 1400
128 S. Tryon Street
Charlotte, NC 28202-5009
(704) 338-6700

BAR LENGTH ON ORIGINAL DRAWING EQUALS ONE INCH. ADJUST SCALE ACCORDINGLY.

Project Manager: J.C. READLING, P.E.
Designed: M.D. PLUMMER, P.E.
Designed:
Checked:
Drawn: J. GAUL

OLD SALISBURY ROAD C & D LANDFILL EXPANSION PHASE IV, V AND VI

CONSTRUCTION PERMIT APPLICATION

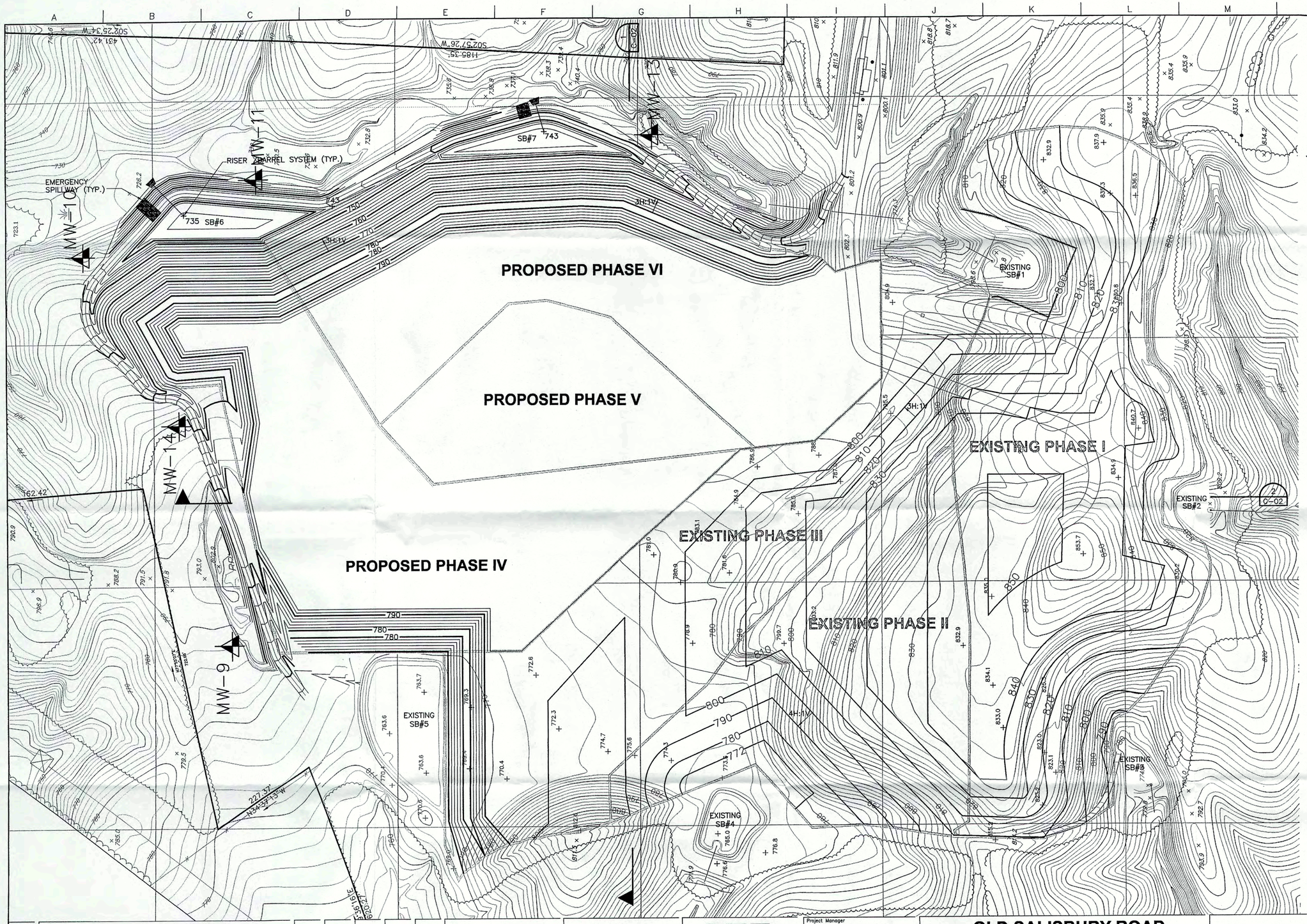
WINSTON-SALEM NORTH CAROLINA

EXCAVATION PLAN

Received DEC 2003 Solid Waste Section

Date	Project No.	Drawing No.	Issue
OCTOBER 2002	00162-525-018	C-02	C
Scale: AS SHOWN	File Name		

C:\WINDMWINS\LCD\52501-C02\33103\SEASONAL\GWLHIGH\REV.DWG, Layout2, 12/02/2003 03:15:01 PM, jgaul



SCALE IN FEET

-100 -50 0 100 200

NOTES

1. PHASE I, II AND III TOPOGRAPHIC INFORMATION PROVIDED BY CARTOGRAPHIC AERIAL MAPPING, INC. DATED SEPT. 29, 2001.
2. TOPOGRAPHIC INFORMATION FOR THE REMAINING SITE PROVIDED BY CARTOGRAPHIC AERIAL MAPPING DATED APRIL 2, 1999.
3. PROPERTY SURVEY TAKEN FROM DATA SUPPLIED BY BRADY SURVEYING, INC. DATED MARCH 14, 1994.
4. FINAL CAP CONTOURS OVER PHASE I, II AND III ARE THE PERMITTED CAP CONTOURS APPROVED BY NCDENR ON AUGUST 2, 2000 WHICH ARE SHOWN WITH SIDESLOPES AT 4 HORIZONTAL AND 1 VERTICAL (4H:1V). THE NEW PROPOSED FINAL CAP CONTOURS ARE OF 3 HORIZONTAL AND 1 VERTICAL (3H:1V). PHASES IV, V AND VI SHOW THE PROPOSED FINAL CAP TYING INTO THE EXISTING GRADE. ALL PHASES WILL EVENTUALLY HAVE 3H:1V SIDESLOPES.
5. REFER TO DRAWING C-06 FOR PROPOSED FINAL GRADES ALL PHASES.

LEGEND

- EXISTING CONTOUR
- 848 PROPOSED BASEGRADE CONTOURS
- PHASING LIMITS
- SILT FENCE
- OUTLET APRON

Received DEC 2003 Solid Waste Section

Issue No.	Description	Date	Drwn.	Chkd.	Resp. Engr.	Proj. Mgr.
B	REVISED BASIN #7 PER NCDENR COMMENTS					
A	ISSUED FOR APPROVAL					

NORTH CAROLINA PROFESSIONAL SEAL 025495 ENGINEER MICHAEL D. PLUMMER

HDR
HDR Engineering, Inc. of the Carolinas
Suite 1400
128 S. Tryon Street
Charlotte, NC 28202-5009
(704) 338-6700

BAR LENGTH ON ORIGINAL DRAWING EQUALS ONE INCH. ADJUST SCALE ACCORDINGLY.

Project Manager: J.C. READLING, P.E.
Designed: M.D. PLUMMER, P.E.
Designed:
Checked:
Drawn: J. GAUL

OLD SALISBURY ROAD C & D LANDFILL EXPANSION PHASE IV, V AND VI

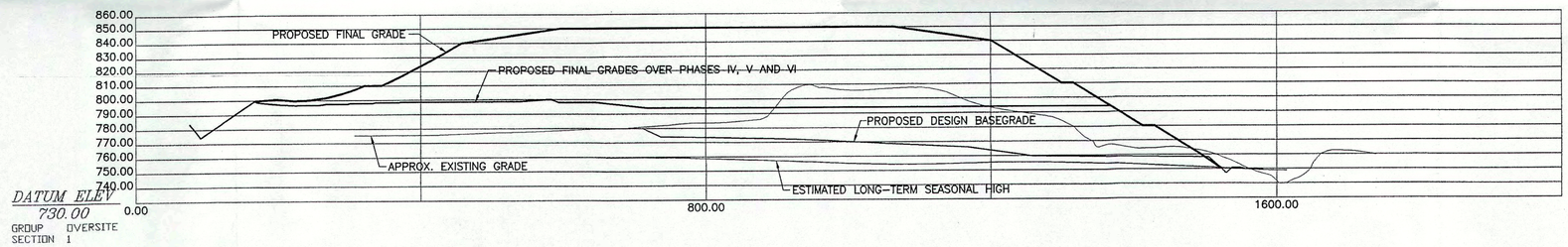
CONSTRUCTION PERMIT APPLICATION

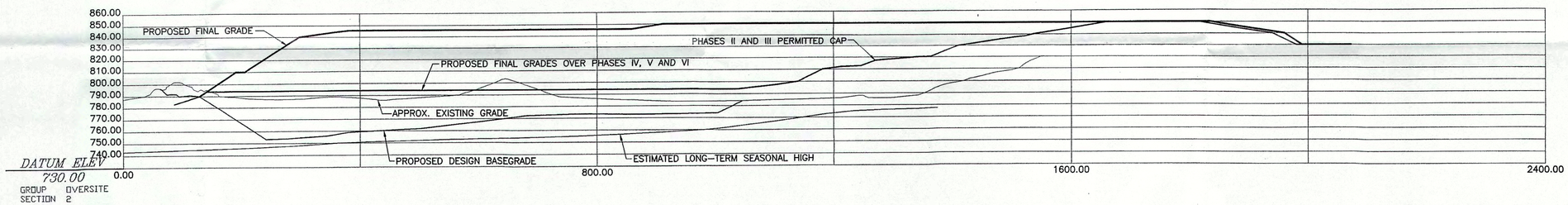
WINSTON-SALEM NORTH CAROLINA

PHASE IV, V AND VI PROPOSED 5 YEAR GRADES

Date	Project No.	Drawing No.	Issue
OCTOBER 2002	00162-525-018	C-03	B
Scale: AS SHOWN	File Name:		

C:\WINDMWINSLCD\S2501-C03.DWG, C-03, 12/02/2003 02:32:12 PM, jgaul





Received
DEC 2003
Solid Waste Section

SCALE IN FEET
-100 -50 0 100 200
HORIZONTAL

SCALE IN FEET
-50 -25 0 50 100
VERTICAL

Issue No.	Description	Date	Drwn.	Chkd.	Resp. Engr.	Proj. Mgr.
B	REVISED PER NCDENR COMMENTS (6FT SEPARATION)					
A	ISSUED FOR APPROVAL					

NORTH CAROLINA PROFESSIONAL SEAL 025495 ENGINEER MICHAEL D. PLUMMER

HDR

HDR Engineering, Inc. of the Carolinas
Suite 1400
128 S. Tryon Street
Charlotte, NC 28202-5009
(704) 338-6700

BAR LENGTH ON ORIGINAL DRAWING EQUALS ONE INCH. ADJUST SCALE ACCORDINGLY.

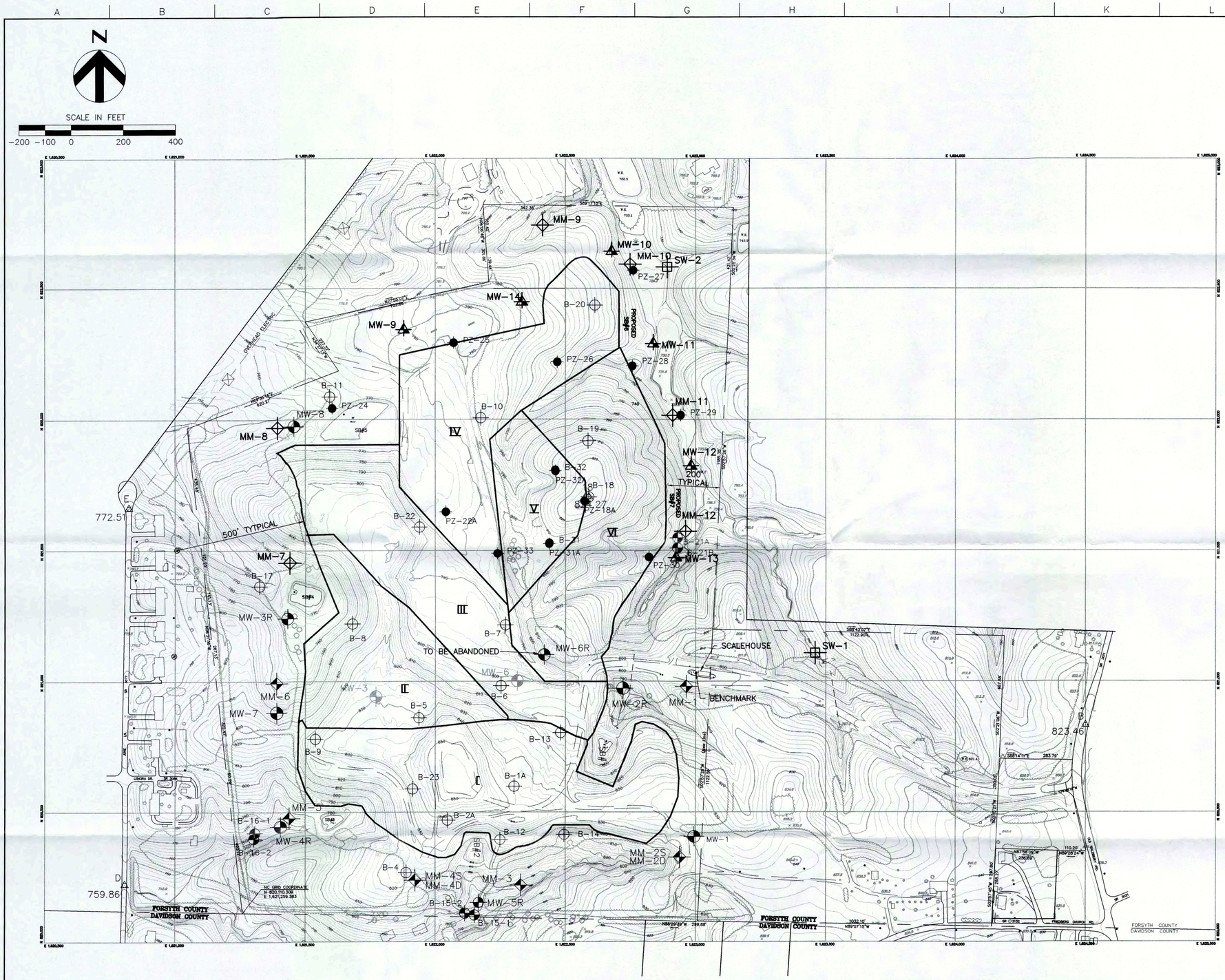
Project Manager: J.C. READLING, P.E.
Designed: M.D. PLUMMER, P.E.
Designed:
Checked:
Drawn: J. GAUL

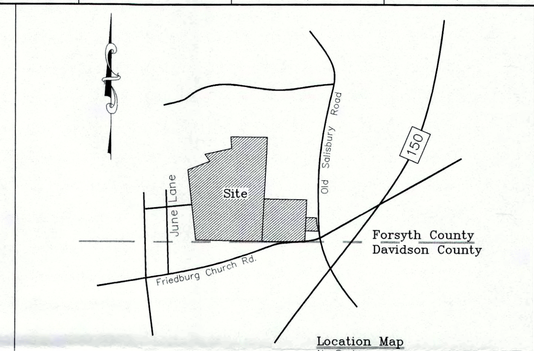
OLD SALISBURY ROAD
C & D LANDFILL EXPANSION
PHASE IV, V AND VI
CONSTRUCTION PERMIT APPLICATION
WINSTON-SALEM NORTH CAROLINA

CROSS SECTIONS

Date: OCTOBER 2002
Scale: AS SHOWN
Project No.: 00162-525-018
File Name:
Drawing No.: C-04
Issue: B

C:\WINDMWINSLCD\S2S01-C03.DWG, C-04, 12/02/2003 02:34:59 PM, jgaul





Location Map
No Scale

LEGEND

- EXISTING CONTOURS
- PROPERTY BOUNDARY
- COUNTY LINE
- PROPOSED PHASING BOUNDARY
- SWAMP/STANDING WATER
- STREAM
- SOIL BORING (ABANDONED)
- GROUND-WATER MONITORING WELL (ABANDONED)
- GROUND-WATER MONITORING WELL (EXISTING)
- GROUND-WATER OBSERVATION WELL (EXISTING)
- PROPOSED GROUND-WATER MONITORING WELL
- PRIVATE WATER SUPPLY WELL
- SB#2 SEDIMENTATION BASIN
- METHANE MONITORING PROBE (EXISTING)
- PROPOSED METHANE MONITORING PROBE
- GROUND-WATER PIEZOMETER (NEWLY INSTALLED)
- SOIL BORING (NEWLY INSTALLED)
- SURFACE WATER MONITORING POINT

NOTES

1. PHASE I, II, III AND IV TOPOGRAPHIC INFORMATION PROVIDED BY CARTOGRAPHIC AERIAL MAPPING, INC. DATED FEBRUARY 2, 2003.
2. TOPOGRAPHIC INFORMATION FOR THE REMAINING SITE PROVIDED BY CARTOGRAPHIC AERIAL MAPPING DATED APRIL 2, 1999.
3. PROPERTY SURVEY TAKEN FROM DATA SUPPLIED BY BRADY SURVEYING, INC. DATED MARCH 14, 1994.
4. THE POTENTIAL EXTENT OF WASTE LINE SHOWN IS BASED ON BUFFERS REQUIRED BY UNIFIED DEVELOPMENT ORDINANCE.
5. METHANE MONITORING PROBES WERE INSTALLED IN AUGUST 1999.

Received
JAN 2004
Waste Management

Issue No.	Description	Date	Drwn.	Chkd.	Resp. Engr.	Proj. Mgr.
D	ADDED MW-14 AND SHIFTED THE LOCATIONS OF MW-9,10,11 AND 13 PER NCDENR COMMENTS					
C	ADDED NEW PIEZOMETERS AND GW MONITORING WELLS					
B	ADDED PROPOSED SEDIMENT BASINS					
A	ISSUED FOR APPROVAL	10/22/02	JEG	MDP		

NORTH CAROLINA PROFESSIONAL SEAL 025495 ENGINEER MICHAEL D. PLUMMER 12/22/02

HDR
HDR Engineering, Inc. of the Carolinas
Suite 1400
128 S. Tryon Street
Charlotte, NC 28202-5009
(704) 338-6700

BAR LENGTH ON ORIGINAL DRAWING EQUALS ONE INCH. ADJUST SCALE ACCORDINGLY.

Project Manager	J.C. READLING, P.E.
Designed	M.D. PLUMMER, P.E.
Designed	
Checked	
Drawn	J. GAUL

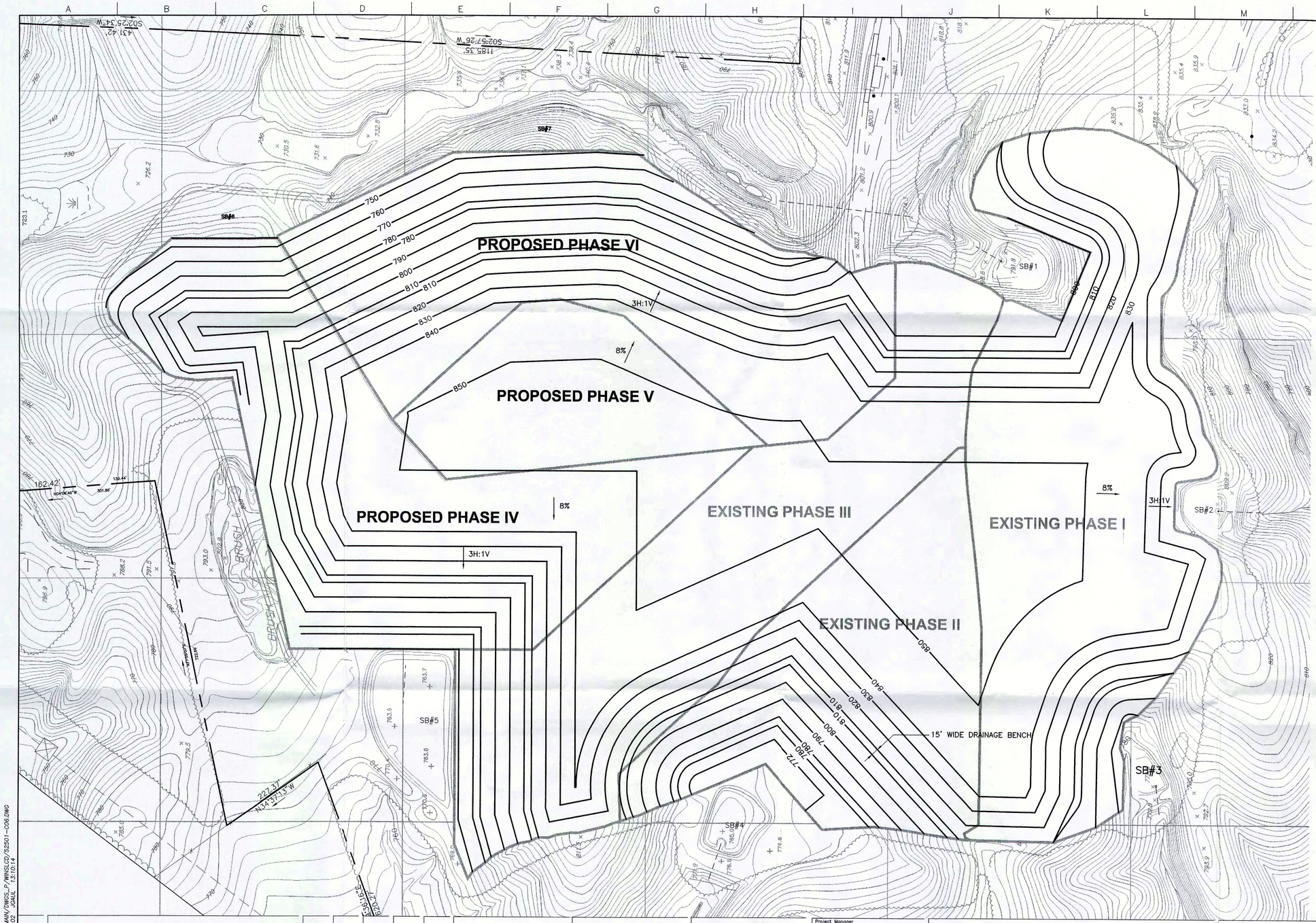
OLD SALISBURY ROAD C & D LANDFILL EXPANSION PHASE IV, V AND VI

CONSTRUCTION PERMIT APPLICATION

WINSTON-SALEM NORTH CAROLINA

EXISTING AND PROPOSED GROUND-WATER AND METHANE MONITORING WELL LOCATIONS

Date	Project No.	Drawing No.	Issue
OCTOBER 2002	00162-525-018	C-05	D
Scale: AS SHOWN	File Name		



SCALE IN FEET

−100 −50 0 100 200

NOTES

1. PHASE I, II AND III TOPOGRAPHIC INFORMATION PROVIDED BY CARTOGRAPHIC AERIAL MAPPING, INC. DATED SEPT. 29, 2001.
2. TOPOGRAPHIC INFORMATION FOR THE REMAINING SITE PROVIDED BY CARTOGRAPHIC AERIAL MAPPING DATED APRIL 2, 1999.
3. PROPERTY SURVEY TAKEN FROM DATA SUPPLIED BY BRADY SURVEYING, INC. DATED MARCH 14, 1994.
4. PROPOSED FINAL CAP CONTOURS ARE SHOWN AT THREE HORIZONTAL TO ONE VERTICAL SLOPE WITH A FIFTEEN FOOT WIDE BENCH EVERY THIRTY VERTICAL FEET.
5. THE OVERALL HEIGHT OF THE LANDFILL IS NOT CHANGED FROM THE ORIGINAL PERMITTED CAP.

LEGEND

- 770 — EXISTING CONTOUR
- PHASING LIMITS
- 770 — EXISTING CONTOUR

Issue No.	Description	Date	Drwn.	Chkd.	Resp. Engr.	Proj. Mgr.
A	ISSUED FOR APPROVAL	10/24/02	JBS	MDP		

HDR Engineering, Inc. of the Carolinas
Suite 1400
128 S. Tryon Street
Charlotte, NC 28202-5001
(704) 338-6700

BAR LENGTH ON ORIGINAL DRAWING EQUALS ONE INCH. ADJUST SCALE ACCORDINGLY.

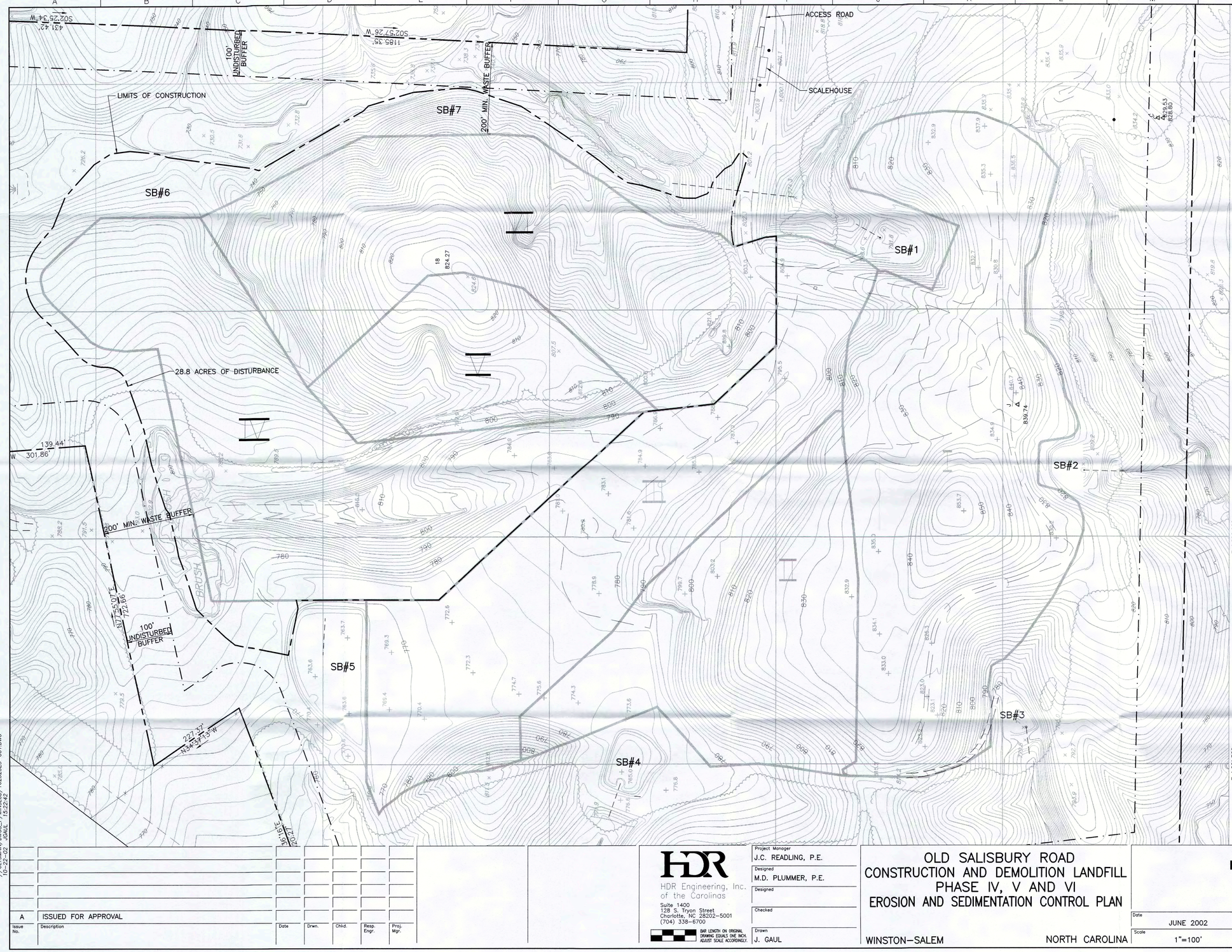
Project Manager	J.C. READLING, P.E.
Designed	M.D. PLUMMER, P.E.
Designed	
Checked	
Drawn	J. GAUL

OLD SALISBURY ROAD
C & D LANDFILL EXPANSION
PHASE IV, V AND VI
CONSTRUCTION PERMIT APPLICATION
WINSTON-SALEM NORTH CAROLINA

PHASES I-VI
PROPOSED FINAL GRADES
MAXIMUM DEVELOPMENT

Date	Project No.	Drawing No.	Issue
OCTOBER 2002	00162-525-018	C-06	A
Scale: AS SHOWN	File Name		

//CLTSMAN/DWGS_P/WINSLCD/32501-C06.DWG
10-22-02 JGAUL 13:10:14



NOTES

1. TOPOGRAPHY FOR PHASES I, II AND III WERE SURVEYED BY BRADY SURVEYING CO. SEPTEMBER 29, 2001. TOPOGRAPHY OUTSIDE OF THESE PHASES WAS SURVEYED BY BRADY SURVEYING CO. ON APRIL 2, 1999.
2. THIS SITE IS OWNED BY THE CITY OF WINSTON-SALEM AND OPERATED BY THE CITY/COUNTY UTILITY COMMISSION.
3. MATERIAL EXCAVATED WITHIN THE PHASE LIMITS WILL EITHER BE USED IN ONSITE OPERATIONS OR HAULED OFFSITE TO OTHER PROJECTS.
4. A 200' BUFFER FROM THE PROPERTY LINE TO WASTE IS REQUIRED BY NCDENR REGULATIONS

GENERAL CONSTRUCTION SEQUENCE

1. INSTALL SILT FENCE AS SHOWN. DO NOT PLACE SILT FENCE AT OUTLETS OF SEDIMENT BASINS AND OUTLET APRONS.
2. INSTALL SEDIMENT BASINS #6 AND #7.
3. CLEAR AND GRUB AREA WITHIN THE LIMITS OF CONSTRUCTION.
4. INSTALL DRAINAGE CHANNELS AS SHOWN.
5. STABILIZE AND PERFORM PERMANENT SEEDING AND MULCHING OF ALL DISTURBED AREAS WITHIN 15 WORKING DAYS FOLLOWING COMPLETION OF ANY CLEARING AND GRUBBING.
6. INSTALL TEMPORARY DIVERSION CHANNELS SO NO MORE THAN HALF OF THE DISTURBED AREA IS DIRECTED TO SEDIMENT BASIN NO. 7 DURING CONSTRUCTION.
7. EXCAVATION WILL START IN PHASE IV AND PROCEED EAST INTO PHASE V AND VI.
8. PERIODICALLY AND AFTER MAJOR STORM EVENTS, INSPECT ALL EROSION AND SEDIMENT CONTROL DEVICES. REPAIR AS NEEDED.
9. ACCUMULATED SEDIMENT IS TO BE REMOVED FROM THE EROSION AND SEDIMENT CONTROL DEVICES WHEN 1/2 OF THE HOLDING CAPACITY IS DEPLETED.
10. REMOVE SILT FENCE AND OTHER TEMPORARY EROSION AND SEDIMENT CONTROL DEVICES UPON ESTABLISHMENT OF VEGETATIVE COVER AND COMPLETION OF PROJECT.

LEGEND

- 810 — EXISTING CONTOUR
- PROPERTY LINE
- PHASING LIMITS
- LIMITS OF CONSTRUCTION

Issue No.	Description	Date	Drwn.	Chkd.	Resp. Engr.	Proj. Mgr.
A	ISSUED FOR APPROVAL					

//CLTSMAN/DWGS_P/WINSLCD/162525ES-C01.DWG
10-22-02 JGAUL 15:22:42

HDR Engineering, Inc. of the Carolinas
Suite 1400
128 S. Tryon Street
Charlotte, NC 28202-5001
(704) 338-6700

BAR LENGTH ON ORIGINAL DRAWING EQUALS ONE INCH. ADJUST SCALE ACCORDINGLY.

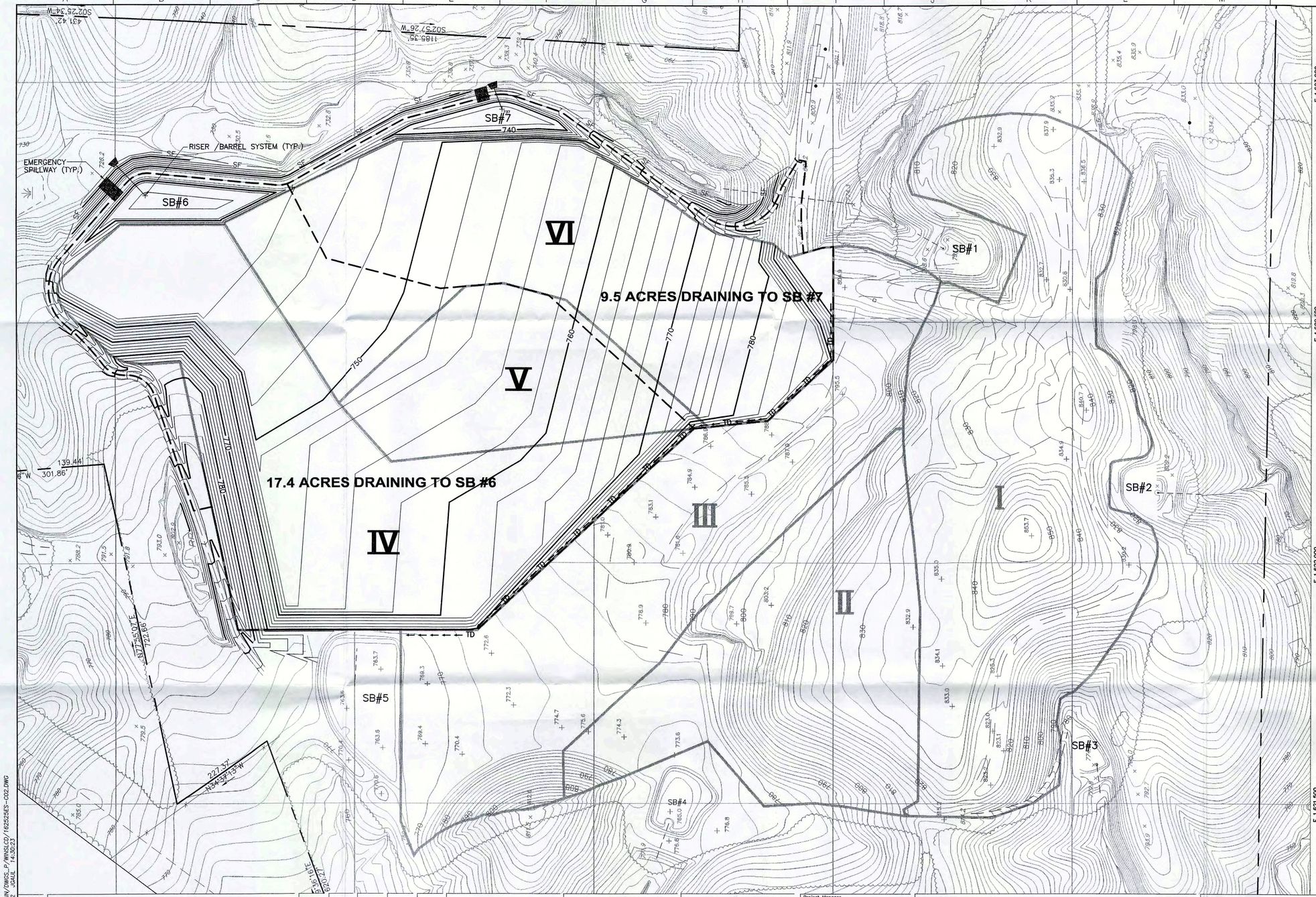
Project Manager	J.C. READLING, P.E.
Designed	M.D. PLUMMER, P.E.
Designed	
Checked	
Drawn	J. GAUL

OLD SALISBURY ROAD CONSTRUCTION AND DEMOLITION LANDFILL PHASE IV, V AND VI EROSION AND SEDIMENTATION CONTROL PLAN

WINSTON-SALEM NORTH CAROLINA

EXISTING CONDTIONS

Date: JUNE 2002	Project No.: 00162-525-018	Drawing No.: ES-01	Issue: A
Scale: 1"=100'	File Name: 162525ES-C01		



SCALE IN FEET

−100 −50 0 100 200

NOTES

1. TOPOGRAPHY FOR PHASES I, II AND III WERE SURVEYED BY BRADY SURVEYING CO. SEPTEMBER 29, 2001. TOPOGRAPHY OUTSIDE OF THESE PHASES WAS SURVEYED BY BRADY SURVEYING CO. ON APRIL 2, 1999.
2. THIS SITE IS OWNED BY THE CITY OF WINSTON−SALEM AND OPERATED BY THE CITY/COUNTY UTILITY COMMISSION.
3. MAINTENANCE OF EROSION CONTROL FEATURES SHALL BE PERFORMED AFTER A MAJOR STORM EVENT AND AS OTHERWISE NEEDED.
4. TEMPORARY DIVERSION CHANNELS WILL BE USED TO DIRECT DRAINAGE TO THE SEDIMENT BASIN WHILE VEGETATION IS ESTABLISHED IN THE PERIMETER CHANNELS.
5. LINES AND GRADES WILL BE CONSTRUCTED IN A MANNER TO MINIMIZE EROSION AND PROMOTE STORMWATER DRAINAGE.
6. BASEGRADES SHOWN ARE EDITED TO REFLECT THE CONSTRUCTION PERMIT APPLICATION GRADES AND ARE PENDING APPROVAL.

LEGEND

- EXISTING CONTOUR
- PROPOSED BASEGRADE CONTOURS
- PHASING LIMITS
- DRAINAGE DIVIDE
- SF — SILT FENCE
- OUTLET APRON
- TD — TEMPORARY DIVERSION CHANNEL

Issue No.	Description	Date	Drwn.	Chkd.	Resp. Engr.	Proj. Mgr.
B	REVISED BASEGRADES FOR MAXIMUM DEPTH					
A	ISSUED FOR APPROVAL					

HDR Engineering, Inc. of the Carolinas
Suite 1400
128 S. Tryon Street
Charlotte, NC 28202−5001
(704) 338−6700

BAR LENGTH ON ORIGINAL DRAWING EQUALS ONE INCH. ADJUST SCALE ACCORDINGLY.

Project Manager: J.C. READLING, P.E.
Designed: M.D. PLUMMER, P.E.
Designed: P.A. WESTMORELAND
Checked:
Drawn: J. GAUL

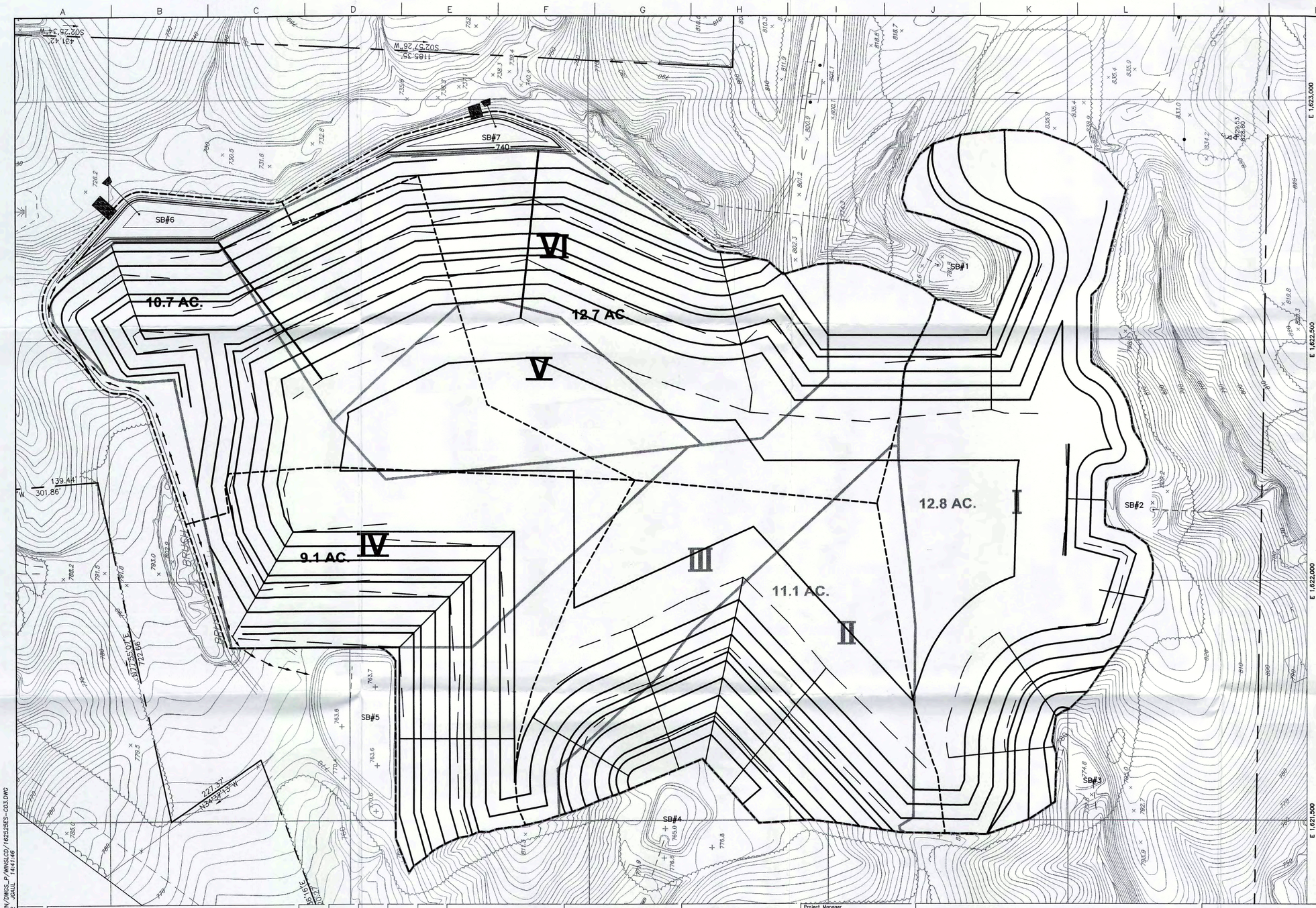
OLD SALISBURY ROAD CONSTRUCTION AND DEMOLITION LANDFILL PHASE IV, V AND VI EROSION AND SEDIMENTATION CONTROL PLAN

WINSTON−SALEM NORTH CAROLINA

PROPOSED EXCAVATION PLAN

Date	Project No.	Drawing No.	Issue
JUNE 2002	00162−525−018	ES−02	B
Scale: 1"=100'	File Name: 162525ES−C02		

//C:\TSMAIN\DWGS_P\WINSLCD\162525ES−C02.DWG
10−22−02 JGAUL 14:30:23



NOTES

1. TOPOGRAPHY FOR PHASES I, II AND III WERE SURVEYED BY BRADY SURVEYING CO. SEPTEMBER 29, 2001. TOPOGRAPHY OUTSIDE OF THESE PHASES WAS SURVEYED BY BRADY SURVEYING CO. ON APRIL 2, 1999.
2. THIS SITE IS OWNED BY THE CITY OF WINSTON–SALEM AND OPERATED BY THE CITY/COUNTY UTILITY COMMISSION.
3. PROPOSED FINAL GRADE SIDESLOPES TO BE 4H:1V.
4. ALL SIDESLOPE DIVERSION CHANNELS TO HAVE A 2% CHANNEL SLOPE.
5. ALL SLOPE DRAINS TO BE EITHER 12" OR 15" CORRUGATED PLASTIC PIPE AT THE APPROXIMATE LOCATIONS SHOWN ON THIS DRAWING AND COVERED WITH A MINIMUM OF 1' OF SOIL.
6. AS FILLING PROGRESSES, DRAINAGE WILL BE MAINTAINED TO THE PROPER SEDIMENT BASIN.
7. FINAL GRADES WERE REVISED TO REFLECT THE CONSTRUCTION PERMIT APPLICATION GRADES AND ARE PENDING APPROVAL.

LEGEND

- 820 — EXISTING CONTOUR
- 850 — PROPOSED FINAL GRADE CONTOURS
- PHASING LIMITS
- DRAINAGE DIVIDE
- 12"ø SLOPE DRAIN
- 15"ø SLOPE DRAIN
- DIVERSION SWALE
- PERIMETER CHANNEL

Issue No.	Description	Date	Drwn.	Chkd.	Resp. Engr.	Proj. Mgr.
A	ISSUED FOR APPROVAL					

HDR Engineering, Inc. of the Carolinas
Suite 1400
128 S. Tryon Street
Charlotte, NC 28202-5001
(704) 338-6700

BAR LENGTH ON ORIGINAL DRAWING EQUALS ONE INCH. ADJUST SCALE ACCORDINGLY.

Project Manager	J.C. READLING, P.E.
Designed	M.D. PLUMMER, P.E.
Designed	P.A. WESTMORELAND
Checked	
Drawn	J. GAUL

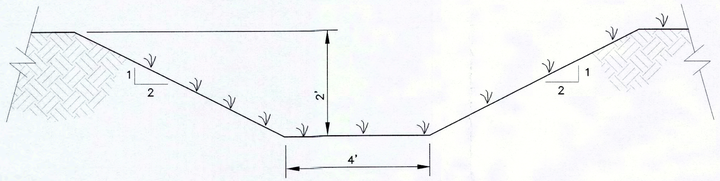
OLD SALISBURY ROAD CONSTRUCTION AND DEMOLITION LANDFILL PHASE IV, V AND VI EROSION AND SEDIMENTATION CONTROL PLAN

WINSTON–SALEM NORTH CAROLINA

PROPOSED FINAL GRADING PLAN

Date	Project No.	Drawing No.	Issue
JUNE 2002	00162-525-018	ES-03	A
Scale: 1"=100'	File Name: 162525ES-C03		

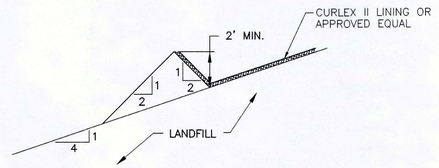
//CLTSMAIN/DWGS_P/WNSLCD/162525ES-C03.DWG
10-22-02 JGAUL 14:41:46



PERIMETER CHANNEL DETAIL (1)

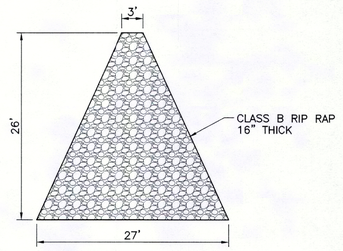
N.T.S.

NOTE:
USE TURF REINFORCED MATTING (NORTH AMERICAN GREEN C350) FOR PERIMETER CHANNEL OR APPROVED EQUAL.



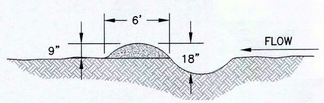
SIDESLOPE DIVERSION CHANNEL (2)

N.T.S.



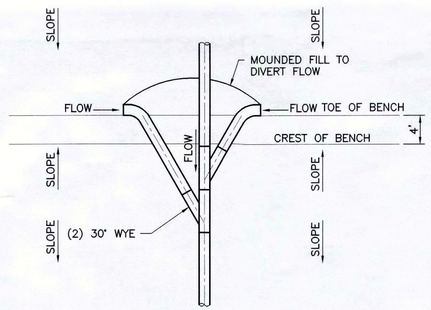
SLOPE DRAIN OUTLET (3)

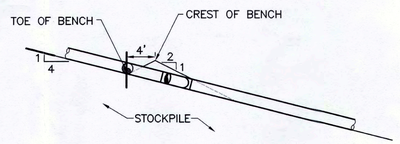
1"=10'



TEMPORARY DIVERSION CHANNEL (4)

N.T.S.

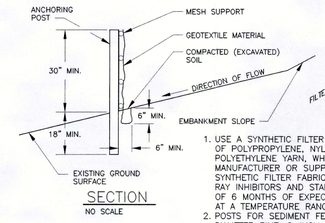




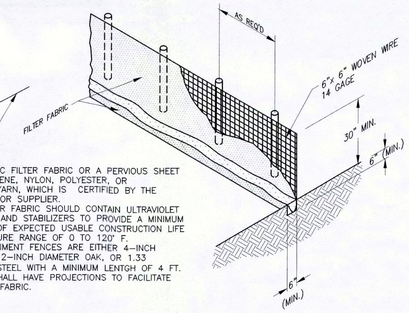
SLOPE DRAIN (5)

1"=10'

NOTE:
1. SLOPE DRAINS TO BE 12 OR 15 INCH DIAMETER CORRUGATED HDPE. CONTRACTOR TO PROVIDE ADEQUATE BALLASTS.



SECTION
NO SCALE



1. USE A SYNTHETIC FILTER FABRIC OR A PERVIOUS SHEET OF POLYPROPYLENE, NYLON, POLYESTER, OR POLYETHYLENE YARN, WHICH IS CERTIFIED BY THE MANUFACTURER OR SUPPLIER. SYNTHETIC FILTER FABRIC SHOULD CONTAIN ULTRAVIOLET RAY INHIBITORS AND STABILIZERS TO PROVIDE A MINIMUM OF 6 MONTHS OF EXPECTED USABLE CONSTRUCTION LIFE AT A TEMPERATURE RANGE OF 0 TO 120° F.
2. POSTS FOR SEDIMENT FENCES ARE EITHER 4-INCH DIAMETER PINE, 2-INCH DIAMETER OAK, OR 1.33 LB/LINEAR FT. STEEL WITH A MINIMUM LENTGH OF 4 FT. STEEL POSTS SHALL HAVE PROJECTIONS TO FACILITATE FASTENING THE FABRIC.

SILT FENCE (6)

N.T.S.

//CLTSMAIN/DWGS_P/WINSLCD/162525ES-C04.DWG
10-22-02 JGAUL 15:23:39

Issue No.	Description	Date	Drwn.	Chkd.	Resp. Engr.	Proj. Mgr.
A	ISSUED FOR APPROVAL					

HDR
HDR Engineering, Inc. of the Carolinas
Suite 1400
128 S. Tryon Street
Charlotte, NC 28202-5001
(704) 338-6700

BAR LENGTH ON ORIGINAL DRAWING EQUALS ONE INCH. ADJUST SCALE ACCORDINGLY.

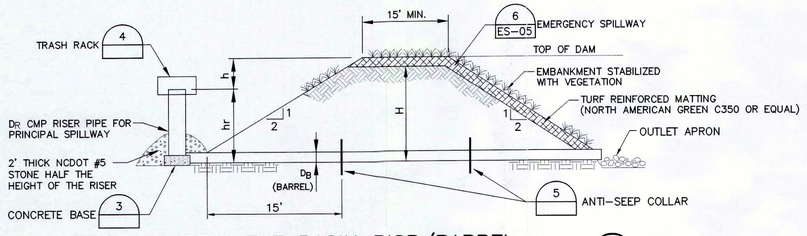
Project Manager: J.C. READLING, P.E.
Designed: M.D. PLUMMER, P.E.
Designed: P.A. WESTMORELAND
Checked:
Drawn: J. GAUL

OLD SALISBURY ROAD
CONSTRUCTION AND DEMOLITION LANDFILL
PHASE IV, V AND VI
EROSION AND SEDIMENTATION CONTROL PLAN

WINSTON-SALEM NORTH CAROLINA

EROSION CONTROL DETAILS (1 OF 2)

Date	Project No.	Drawing No.	Issue
JUNE 2002	00162-525-018	ES-04	A
Scale: AS SHOWN	File Name: 162525ES-C04		

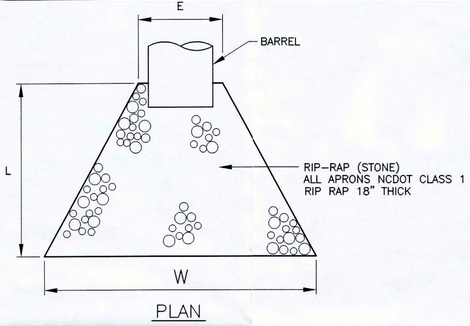


SEDIMENT BASIN RISR/BARREL

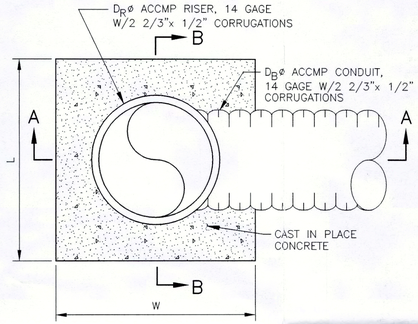
N.T.S. 1

NOTE: SPACE ANTI-SEEP COLLARS AT 15' INTERVAL ALONG THE BARREL.

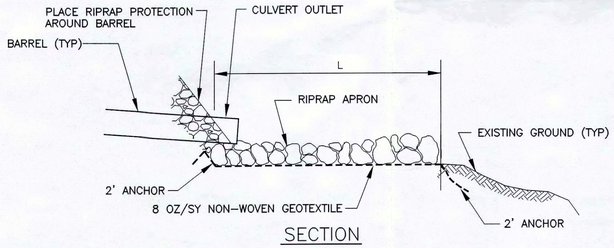
BASIN/APRON SCHEDULE								
BASIN ID	D_B (IN)	D_R (IN)	h_r (FT)	h (FT)	H (FT)	W (FT)	L (FT)	E (FT)
6	18	24	6	3	8	27	22	4.5
7	18	24	5	2	6	26	24	4.5



PLAN



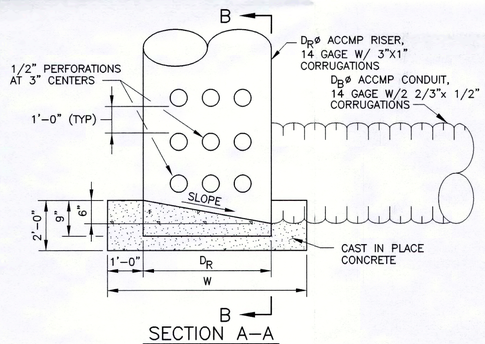
SB	DR (IN)	W (FT)	L (FT)	D_B (IN)
6	24	4	4	18
7	24	4	4	18



SECTION

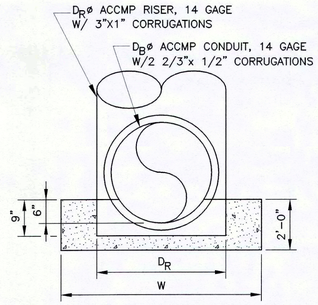
OUTLET APRONS

N.T.S. 2



SECTION A-A

N.T.S.



SECTION B-B

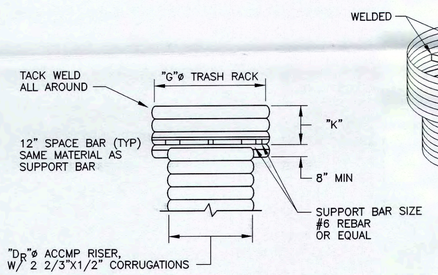
N.T.S.

SEDIMENTATION BASIN RISER BASE PLAN

N.T.S. 3

NOTES

1. CONTRACTOR TO REMOVE ASPHALT COATING FROM PERFORATIONS
2. USE STANDARD CONNECTING BAND WITH OVAL LUG CONNECTORS.



SECTION C-C

ISOMETRIC DETAIL

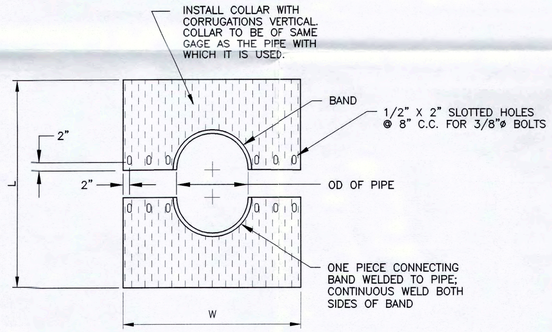
NOTE:

1. THE CYLINDER MUST BE FIRMLY FASTENED TO THE TOP OF THE RISER.
2. SUPPORT BARS ARE WELDED TO THE TOP OF THE RISER OR ATTACHED BY STRAPS BOLTED TO THE TOP OF THE RISER.

CONCENTRIC TRASH RACK AND ANTI-VORTEX DEVICE

N.T.S. 4

ANTI-VORTEX SCHEDULE				
BASIN ID	G (IN)	D_R (IN)	K (IN)	GAGE THICKNESS (N)
6	36	24	5	16
7	36	24	5	16

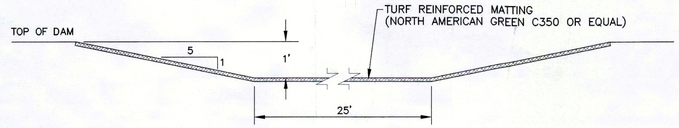


ANTI-SEEP COLLAR

N.T.S. 5

SED. BASIN #	D_B (IN)	W (FT)	L (FT)
6	18	3	3
7	18	3	3

NOTE: INSTALL ANTI SEEP COLLARS EVERY 15' ALONG THE BARREL.



EMERGENCY SPILLWAY

1"=2' 6

Issue No.	Description	Date	Drawn.	Chkd.	Resp. Engr.	Proj. Mgr.
A	ISSUED FOR APPROVAL					

HDR Engineering, Inc. of the Carolinas
Suite 1400
128 S. Tryon Street
Charlotte, NC 28202-5001
(704) 338-6700

BAR LENGTH ON ORIGINAL DRAWING EQUALS ONE INCH. ADJUST SCALE ACCORDINGLY.

Project Manager	J.C. READLING, P.E.
Designed	M.D. PLUMMER, P.E.
Designed	P.A. WESTMORELAND
Checked	
Drawn	J. GAUL

OLD SALISBURY ROAD
CONSTRUCTION AND DEMOLITION LANDFILL
PHASE IV, V AND VI
EROSION AND SEDIMENTATION CONTROL PLAN

WINSTON-SALEM NORTH CAROLINA

EROSION CONTROL DETAILS (2 OF 2)

Date	Project No.	Drawing No.	Issue
JUNE 2002	00162-525-018	ES-05	A
Scale: AS SHOWN	File Name: 162525ES-C05		

//CLTSMAN/DWGS_P/WNSLCD/162525ES-C05.DWG
10-22-02 JGAUL 15:26:10