Part 2 – Permit to Construct Application

Construction & Demolition Debris Landfill (Phase 2)
Pitt County, North Carolina

Prepared for:

C&D Landfill, Inc.
802 Recycling Lane
Greenville, North Carolina 27834

To the Attention of:

Mr. Judson Whitehurst
President

This report was prepared as a collaborative effort between the undersigned individuals:

2/27/2008
John A.K. Tucker, P.E.
Project Engineer

NORTH CAROLINA PROFESSIONAL SEAL ENGINEER JOHN A.K. TUCKER

G. David Garrett, P.G., P.E.
Project Geologist

NORTH CAROLINA LICENSED SEAL 983 GEOLOGIST G. DAVID GARRETT

2/27/2008

February 2008

C&D Landfill, Inc., is a privately owned and operated disposal facility located south of US 264 in eastern Pitt County, within the Pactolus community (see in-text **Figure 1**). Phase 1 commenced operations in 2001. Phase 2 is a non-contiguous expansion involving an addition of land to the permitted facility boundary. A Site Suitability evaluation for Phase 2 was prepared under then-current rules, **15A NCAC 13B .0500,** *et seq.*, which was submitted to NC DENR Division of Waste Management for review in early 2003. A hydrogeologic review was completed in 2004, involving one round of responses to review comments documented in September 2004, but the facility plan amendment and engineering plans were never reviewed by the Division due, in part, to pending rule changes and legislative action that delayed the review of many permit applications between 2004 and 2007.

New rules pertaining to C&D landfills were promulgated, i.e., **15A NCAC 13B .0531** *et seq.*, known as the "**2006 C&D Rules**", which require that ongoing facilities after January 2007 conform to the application submittal requirements and operational conditions prescribed by those rules. This is an "existing" facility as of August 31, 2007, with respect to the 2007 Solid Waste Act, and the facility meets the vertical separation requirements of the 2006 C&D Rules, as such the facility and subsequent expansions do not require a synthetic liner – the soil-type requirements prescribed by the 2006 C&D Rules for the upper two (2) feet beneath the base grade do apply for Phase 2.

At present, the Phase 1 is approaching 80 percent of full capacity, and the Owner/Operator desires a permit amendment to include the Phase 2 expansion, in conjunction with a renewal of the Permit to Operate. The Franchise Agreement with Pitt County was renewed in 2003, which identified the footprint expansion and increased waste tonnages, with a term of seven (7) years – the Franchise Agreement is valid and in force relative to the Phase 2 expansion. This document has been prepared to meet the requirements of the 2006 C&D Rules, i.e., the Design Hydrogeologic Evaluation, Engineering Plan, Construction Requirements, Construction Quality Assurance (CQA), Operations Plan, Monitoring Plan, and Financial Assurance. Please note, the .0500 rules required a single hydrogeologic investigation but in practice, a two-part approach was required by Division policy that has now been codified in the 2006 C&D Rules.

The original site characterization study for Phase 2, performed in 2003, included a sufficient number and depth of borings to provide the information for the **Site Suitability Evaluation** (Part 1) and the **Design Hydrogeologic Study** (Part 2); as such, no additional borings were performed since the earlier submittal. Ongoing monitoring of Phase 1 since 2000 provides ample historic data for the evaluation of the long-term seasonal high ground water table. Based on the site characterization study, conditions at Phase 2 are similar to those at Phase 1 with respect to ground water depths, flow directions, and absence of down-gradient ground water users. The data indicate an upward vertical gradient beneath the site and there is a partial confining layer present. Site conditions are present that will facilitate effective monitoring of Phases 1 and 2 as separate CDLF units.

This work is presented in two Volumes: **Volume 1** is the **Design Hydrogeologic Study**; **Volume 2** pertains to the **Facility Plan** and **Operations Plan**.

EXECUTUVE SUMMARY ..... *preface*
1.0 BACKGROUND INFORMATION 1
1.1 Development History 1
1.2 Existing Facilities 1
1.3 Facility Plan Amendment 1
1.4 Regulatory Requirements 2
2.0 PHASE 1 CDLF CLOSURE 4
3.0 PHASE 1A CDLF FACILITY PLAN 5
3.1 Regulatory Summary 5
3.2 Facility Drawings 5
3.2.1 Facility Layout 5
3.2.2 Operational Sequence 5
3.3 Facility Report 6
3.3.1 Waste Stream 6
3.3.2 Landfill Capacity 7
3.3.3 Special Engineering Features 7
4.0 HYDROGEOLOGIC INVESTIGATIONS 8
4.1 Site Hydrogeologic Report 8
4.1.1 Local and Regional Geology 8
4.1.2 Field Reconnaissance 11
4.1.2.1 Topographic Setting and Drainage 11
4.1.2.2 Springs, Seeps and Ground Water Discharge Features 12
4.1.3 Test Borings/Piezometers 12
4.1.4 Laboratory Geotechnical Testing 13
4.1.4.1 Laboratory Analysis 13
4.1.4.2 Formation Descriptions 15
4.1.4.3 Field Hydrologic Testing 15
4.1.4.4 Hydrogeologic Units 15
4.1.4.5 Dispersivity Characteristics 16
4.1.5 Other Investigative Tools 17
4.1.6 Stratigraphic Cross Sections 17
4.1.7 Water Table Information 20
4.1.7.1 Short-Term Water Levels 20
4.1.7.2 Long-Term Water Levels 20
4.1.7.3 Maximum Long-Term Seasonal High Water 20
4.1.7.4 Factors That Influence Water 26
4.1.8 Horizontal and Vertical Flow Dimensions 26
4.1.9 Ground Water Contour Maps 27
4.1.10 Test Location Map 28
4.1.11 Local Well and Water Use Information 28
4.1.12 Special Geologic Considerations 28
4.1.13 Summary Report 29
4.2 Design Hydrogeologic Report – CDLF Phase 1A 30
4.2.1 Ground Water Monitoring System Design 30
4.2.1.1 Aquifer Characteristics 30
4.2.1.2 Relative Point of Compliance 30
4.2.1.3 Monitoring Plan Amendments 31
4.2.2 Rock Core Information (Not Applicable) 31

4.2.3 Estimated Long-Term Seasonal High Water Table 31
4.2.4 Bedrock Contour Map (Not Applicable) 31
4.2.5 Hydrogeologic Cross Sections 32
4.2.6 Ground Water Flow Regime 32
4.2.7 On-site Soils Report 32
4.2.8 Certification 32

REFER TO THE TABLE OF CONTENTS IN VOLUME 2
FOR A GUIDE TO THE ENGINEERING ASPECTS OF THE FACILITY PLAN

FIGURES *Refer to page numbers in text*

1 General Vicinity Map (USGS Topo) 3

2 North Carolina Geologic Map Excerpt 9

3A Palmer Hydrologic Drought Index (1895 - 1951) 22

3B Palmer Hydrologic Drought Index (1952 - 2007) 22

3C Palmer Hydrologic Drought Index (2001 - 2007) 23

4 Monitoring Well Hydrograph (2001 - 2007) 23

TABLES *Refer to the tabbed section that follows Section 1*

1 Test Boring/Piezometer Data

1A Supplemental Boring/Well Data

2 Geotechnical Laboratory Test Data

3 Hydrologic Properties of Hydrogeologic Units

4 Short-Term Ground Water Observations

5 Long-Term Ground Water Levels and Hydrograph

5A Historic Monitoring Well Levels and Hydrograph

6 Vertical Ground Water Gradient Calculations

7 Horizontal Ground Water Gradient and Velocity Calculations

DRAWINGS *Refer to the rolled drawing set that accompanies this report*

–	Cover Sheet with Vicinity Map
S1	Regional Characterization Map
S2	Local Area Map
S3	Local Area Photo and Facility Plan
S4	Site Boundary and Test Boring Locations
E1	Base Grades with Ground Water Contours
E2	Final Cover Contours
E3	Top of Confining Unit Map
X1	Hydrogeological Cross Sections (Sheet 1 of 2)
X2	Hydrogeological Cross Sections (Sheet 2 of 2)
X3	Cross Section Through Waste A –A
X4	Cross Section Through Waste B – B
EC1	S&EC Plan
EC2	S&EC Details
MP1	Ground Water Monitoring Plan

APPENDICES – VOLUME 1

1 Local Government Information

2 Airspace & Earthwork Calculations

3 Stream & Wetland Permits

4 Geotechnical Data for CDLF

5 Test Borings (including Phase 1 Monitoring Wells)

6 Ground Water Sampling and Analysis Plan

APPENDICES – VOLUME 2

7 Stability and Settlement Calculations

8 Sedimentation and Erosion Control Calculations

9 Operation Plan Information

- 9A Facility Plan Maps
- 9B Waste Screening Form
- 9C Hazardous Waste Responders
- 9D Fire Notification Form

10 Financial Assurance Documents

1.0 BACKGROUND INFORMATION

1.1 Development History

C&D Landfill, Inc. Phase 1 encompasses a 15-acre footprint within a 33-acre facility boundary. The facility is owned and operated by C&D Landfill, Inc., in conjunction with the adjacent EJE Recycling, Inc., both of which family owned business entities that operate from the one location. The C&D Landfill serves portions of multiple counties defined in the franchise agreement. Phase 1 commenced operations in 2001, and a permitted expansion (Phase 1B) was completed in 2002. When completed, Phase 1 will contain an estimated 842,000 cubic yards (421,000 tons) of inert debris. The facility has served as a disaster debris disposal site for the region.

Mixed agricultural, commercial, light industrial and residential properties exist within the community. No significant ground water users or potential sources of contaminants are located in the immediate vicinity, but certain inorganic constituents have been noted at somewhat elevated in the natural background geochemistry. Public water is available in the vicinity of the site, but no public water supply wells or surface water intakes have been identified near the site. The site suitability studies for Phases 1 and 2 identified no conditions that would limit the ongoing use of the site as a C&D disposal facility.

1.2 Existing Facilities

EJE Recycling operates a material recovery facility and a MSW transfer station north of the CDLF units. An office (doubles as a scale house) and equipment maintenance shop are located near the recycling yard. White goods are stored on a paved pad located between the Transfer Station and the CDLF Phase 1 – these materials are sold for scrap metal and removed periodically by EJE. Tires are generally not accepted at the facility; occasional tires from on-site equipment are disposed off-site, like any other consumer's. The Facility Plan map (**Drawing S4**) identifies the relevant waste management facilities.

1.3 Facility Plan Amendment

Pending approval of these plans, Phase 2 will encompass a 23-acre footprint on a 90-acre addition – separate from Phase 1 – bringing the permitted facility boundary to 123 acres. When completed, Phase 2 will contain an estimated 964,000 cubic yards (482,000 tons) of debris, bringing the total disposed volume to 1,806,000 cubic yards (903,000 tons). The estimated life of Phase 2 is 9 years. This document provides detailed design information pertaining to a Permit to Construct application for the Phase 2 expansion.

1.4 Regulatory Requirements

Solid Waste Rules 15A NCAC 13B .0531 *et seq.* became effective January 1, 2007 – these are known as the "**2006 C&D Rules**." Rule .0547 requires that existing CDLF units (i.e., accepted waste prior to January 1, 2007) that wish to continue operating under the "**2006 C&D Rules**" submit an application to depict the proposed long-term development of the site and demonstrate compliance with new rule requirements. This document constitutes said application and is organized in general accordance with the sequence of presentation of topics under **Rules .0531** through **.0547** (with references). Contained in this document are revisions to previous permit documents, including provisions of the "2006 C&D Rules" that must be met, as follows:

(1) Existing C&D units that did not and will not receive solid waste after June 30, 2008 must be closed under the requirements of Rule .0510 (the previous rules).

Design capacity in Phase 1 will not be reached by June 30, 2008. The Engineer has tentatively projected that the 3H:1V side slopes will have reached final grades and, thus, will be closed under the old Rule .0510, under which Phase 1 was permitted and operated, by June 30, 2008. Plans are to close the remaining portions of Phase 1 (not already closed on June 30, 2008) under the Rule .0547, hence making those portions subject to the financial assurance requirements, but not to include the previously closed portions of Phase 1 in the financial assurance calculations. Currently, it is believed that only the final cap area will fall subject to the Rule .0547. A survey of Phase 1 will be completed close to June 30, 2008 to verify the remaining portions of that unit that will remain open and be subject to Rule .0547. The Engineer will submit a formal closure plan for the remaining portions of Phase 1 along with a 180-day notification at a later time.

(2) Financial Assurance must be demonstrated prior to July 1, 2008 to cover the estimated costs of closure and post-closure for C&D units (typically, a local government test for political subunits of the State, i.e., counties).

The Owners of C&D Landfill, Inc. will furnish an appropriate fiduciary instrument within the specified time frame, based on costs estimates developed elsewhere in this document for Phase 2 and the remaining portions of Phase 1 at the time of closure (as yet to be determined).

(3) A Permit to Construct application for a new phase must contain a comprehensive facility plan for long-range development, including the layout, aerial limits and

capacity of various proposed waste management units, along with identification of the anticipated waste stream and criteria for waste acceptance and segregation; an Engineering Plan for the initial phase of development; a Construction Quality Assurance (CQA) plan; an Operation Plan prepared under the "**2006 C&D Rules**" that includes amended monitoring programs (both environmental and waste acceptance monitoring); a Closure and Post-Closure Plan (with cost estimates to facilitate the financial assurance demonstration).

C&D Landfill, Inc., has met the application requirements within this document (presented in later sections). The Facility Plan depicts the Phase 2 expansion; further development of the facility is possible utilizing land to the west of the Phase 2 site, but no formal plans have been derived at this time for further expansion. The Owner understands that further Facility Amendment will require additional Site Suitability characterization and local government approval.

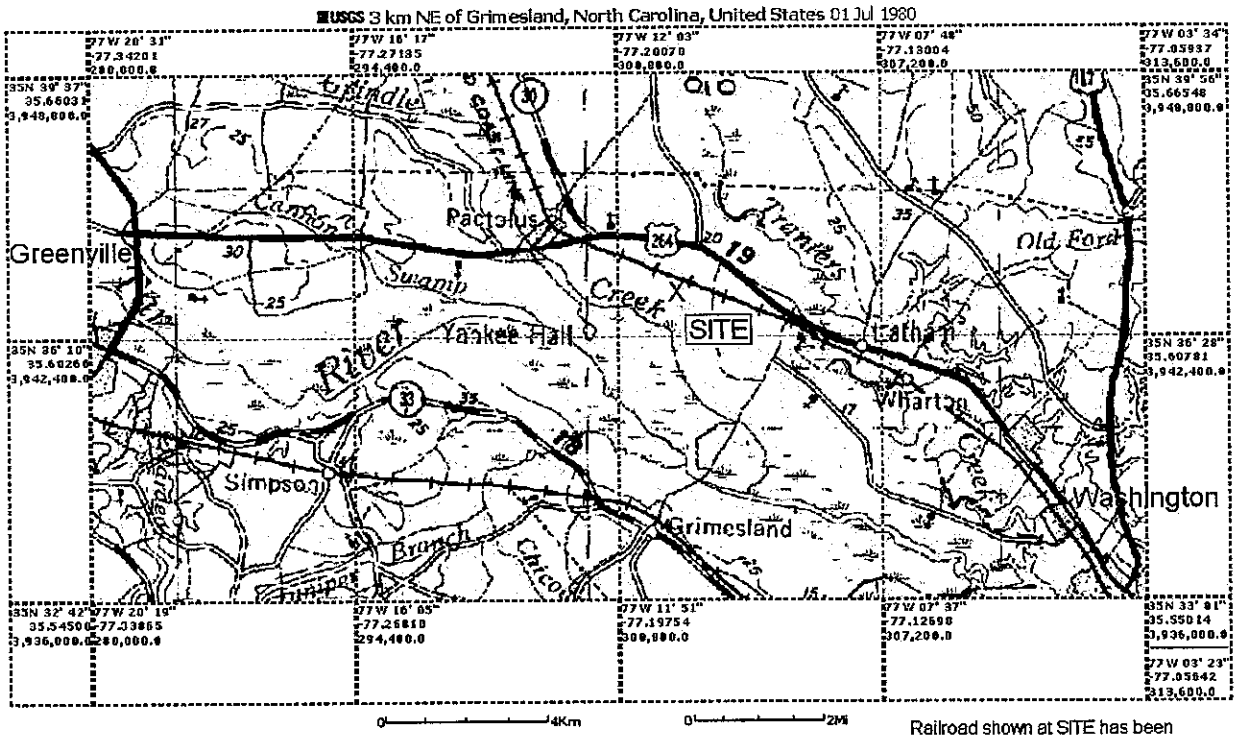

Image courtesy of the U.S. Geological Survey

Railroad shown at SITE has been abandoned and tracks removed

Figure 1 – General Vicinity Map

2.0 PHASE 1 CDLF CLOSURE (15A NCAC 13B .0510)

Phase 1 will have not received solid waste after June 30, 2008 and, thus, is subject to the final closure requirements of Rule .0510. Regulatory final cover requirements for these areas include 24 inches of final cover soil, with the upper 6 inches capable of supporting vegetation. Slope ratios shall be 33% maximum (3H:1V) along side slopes, 5% minimum on upper cap surfaces (post-settlement). Although no specific permeability is required under Rule .0510, nor is a CQA plan required, efforts will be made to compact the soils as densely as practical to assure long-term cover performance, and the final cover thickness will be slightly overbuilt. Typically, slope stability is not an issue for these slope ratios. A sedimentation and erosion control (S&EC) plan has been in place for Phase 1 throughout its operation; anticipated work associated with the closure of Phase 1 should include cleaning out and refurbishing the existing sediment basin(s), as needed, and maintaining miscellaneous ditches, traps, and check dams, as needed.

3.0 PHASE 2 CDLF FACILITY PLAN (15A NCAC 13B .0537)

3.1 Regulatory Summary

The "2006 C&D Rules" emphasize vertical separation and minimum subgrade soil type requirements. The proposed C&D expansion meets or exceeds the 4-foot minimum vertical separation requirement to groundwater and bedrock, thus no liner or leachate collection system is required under these rules. Subgrade soil types that will be exposed via excavation and used in the compacted fill sections are anticipated to exhibit a mix of finer soil types, e.g., ML, MH, CL, CH, SM and mixed SM-ML classifications, based on site data, thus subgrade permeability is expected to be low, providing the soils are reworked and compacted (see **Section 6.0**).

3.2 Facility Drawings

3.2.1 Facility Layout

Drawings E1 and **E2** depict the base grades and final grades for Phase 2. The aerial limits are set to provide a minimum 200-foot buffer to the facility boundary, a 50-foot buffer to jurisdictional water bodies, per the rules that were in effect when the project initiated – this is an "existing" facility relative to the 2007 Solid Waste legislation, hence the original setback requirement applies for jurisdictional waters. Also shown in the Facility Plan (**Drawing S4**) are the locations of current and future soil borrow areas and potential future access routes. The Phase 2 footprint contains no identified floodplains or wetlands (adjacent areas with these features will be avoided), unstable areas or cultural resource areas that affect project development.

3.2.2 Operational Sequence

The Phase 2 footprint will be developed in its entirety as one "cell", including the base grading and S&EC measures. The operational sequence divided into three vertical phases of approximately 5-years duration. Subcells within the Phase 2 footprint may be constructed incrementally, as needed, using the dirt derived from the grading activities for the operation of the landfill, e.g., interim cover or final cover. Interior slopes will be maintained at 3H:1V, in accordance with Division requirements, while upper surfaces shall be graded to promote positive drainage, ideally at a 5% slope. Upon reaching final grades (**Drawing E2**), exterior slopes will be covered with an interim cover soil with vegetation or mulch and allowed to settle for 6 months; then the final cover section will be placed (see **Section 9.0**).

3.3 Facility Report

3.3.1 Waste Stream

The CDLF is permitted and managed separately from the recycling facility and transfer station. This report pertains specifically to the CDLF operation. Scale-house records indicate an average daily C&D disposal tonnage of 200 tons per day, operating 250 days per year, for approximately 50,000 tons per year (100,000 cubic yards per year). The populations served include all or portions of the counties listed below.

SELECTED COUNTY	2000 Pop[1]	2006 Pop[1]	Pop Growth[2]	% Grow	July 2009[3]	% Grow	July 2019[3]	% Grow	July 2029[3]	% Grow
BEAUFORT	44,958	46,346	1,388	3.1%	47,342	5.3%	49,045	9.1%	50,138	11.5%
BERTIE	19,757	19,355	-402	-2.0%	18,945	-4.1%	18,147	-8.1%	17,149	-13.2%
CHOWAN	14,150	14,664	514	3.6%	15,142	7.0%	15,707	11.0%	16,011	13.2%
CRAVEN	91,523	95,558	4,035	4.4%	98,661	7.8%	104,279	13.9%	108,160	18.2%
EDGECOMBE	55,606	52,644	-2,962	-5.3%	51,563	-7.3%	47,811	-14.0%	43,850	-21.1%
GREENE	18,974	20,833	1,859	9.8%	21,378	12.7%	24,057	26.8%	26,728	40.9%
HALIFAX	57,370	55,606	-1,764	-3.1%	54,707	-4.6%	53,321	-7.1%	51,486	-10.3%
HYDE	5,826	5,511	-315	-5.4%	5,426	-6.9%	5,292	-9.2%	5,090	-12.6%
JONES	10,398	10,318	-80	-0.8%	10,512	1.1%	10,680	2.7%	10,766	3.5%
LENOIR	59,619	58,172	-1,447	-2.4%	58,083	-2.6%	57,053	-4.3%	55,711	-6.6%
MARTIN	25,546	24,396	-1,150	-4.5%	24,112	-5.6%	22,968	-10.1%	21,755	-14.8%
NASH	87,385	92,220	4,835	5.5%	94,871	8.6%	103,245	18.1%	111,136	27.2%
NORTHAMPTON	22,086	21,524	-562	-2.5%	21,544	-2.5%	21,330	-3.4%	21,003	-4.9%
PAMLICO	12,934	13,097	163	1.3%	13,236	2.3%	13,702	5.9%	13,930	7.7%
PITT	133,719	146,403	12,684	9.5%	154,430	15.5%	175,690	31.4%	196,602	47.0%
TYRRELL	4,149	4,240	91	2.2%	4,334	4.5%	4,384	5.7%	4,379	5.5%
WASHINGTON	13,723	13,360	-363	-2.6%	13,243	-3.5%	12,589	-8.3%	11,821	-13.9%
WAYNE	113,329	114,930	1,601	1.4%	116,281	2.6%	121,958	7.6%	127,160	12.2%
WILSON	73,811	77,468	3,657	5.0%	79,574	7.8%	85,835	16.3%	91,905	24.5%
	2000 Pop	**2006 Pop**	**Pop Growth**	**% Grow**	**July 2009**	**% Grow**	**July 2019**	**% Grow**	**July 2029**	**% Grow**
MULTI-COUNTY SERVICE AREA	864,863	886,645	21,782	2.5%	903,384	4.5%	947,093	9.5%	984,780	13.9%
STATE OF NORTH CAROLINA	8,046,813	8,860,341	813,528	10.1%	9,348,744	16.2%	10,744,214	33.5%	12,167,409	51.2%

[1]Source data: 2006 Certified County Population Estimates, North Carolina State Demographics, North Carolina State Data Center, http://demog.state.nc.us/

[2]All growth is relative to 2000 Census Data

[3]Source data: Projected Annual County Population Totals (for years given), North Carolina State Demographics, North Carolina State Data Center, http://demog.state.nc.us/

3.3.2 Landfill Capacity

The volumetric analysis for Phase 2 (see **Appendix 2**) indicates an estimated 964,000 cubic yards of airspace, which includes interim cover soils but excludes final cover. Based on an estimated 50,000 tons of C&D per year with an assumed 3% annual increase in C&D intake, the projected operational life for Phase 2 is between 9 (minimum) and 15 (maximum) years. Since the waste stream and compaction density is expected to vary, the projected operational capacity may vary – based on the current volume projection and waste projection, the airspace should last for two or three 5-year permitting cycles.

3.3.3 Special Engineering Features

No seeps, springs, soft ground or other deleterious conditions were identified in the site characterization studies. As such, no special engineering features are required.

4.0 HYDROGEOLOGIC INVESTIGATIONS (15A NCAC 13B .0538)

The following sections are adapted from the October 2002 Site Suitability study for Phase 2; that investigation included sufficient test boring and laboratory data to meet the requirements for the Design Hydrologic report, discussed below.

4.1 Site Hydrogeologic Report

4.1.1 Local and Regional Geology

The site is located in the central Coastal Plain physiographic and geologic province of North Carolina. Available geologic mapping[1] places the site within the Tertiary (Miocene) age Yorktown Formation, approximately twenty miles west of the Suffolk Scarp – the dividing line between Quaternary age surficial deposits (to the east) and Tertiary age surface deposits (to the west), located at approximately 25 feet above mean sea level. The site is also located approximately twenty-four miles east of the Surry Scarp, which delineates higher ground underlain by Cretaceous (and older) units exposed south and west of Pitt County. The site is located entirely within the Tar-Pamlico River basin, draining south toward Grindle Creek, a major tributary to the Tar River.

Published literature indicates that upland areas throughout the region are underlain by relatively thin Quaternary surficial deposits (not differentiated on the state-wide map).[2] The surficial formation is characterized in the literature as stratified fluvial deposits, containing interlayered low permeability and high permeability horizons. The thickness of the aquifer ranges from 3 to 180 feet (average thickness of 35 feet near the site) – thickening eastward – with an estimated average hydraulic conductivity values ranging up to 29 feet per day. The surficial aquifer is also characterized as exhibiting less than 50 percent sand, hence lower hydraulic conductivity, west of a line that roughly coincides with the Suffolk Scarp. These observations were confirmed by the local area study and site specific reconnaissance, whereas the surficial deposits (deemed the uppermost aquifer) consist of poorly stratified sand and clay layers, which were found to exhibit an average thickness of 12 feet (varying up to 30 feet), underlain by the Yorktown Formation with a distinct fossil-marker bed of turritellas (gastropods) and a color change from tan-white (upper sands) to dark gray-green. On-site field hydraulic conductivity values were measured in the range of 0.028 ft/day to 0.667 ft/day.

---

1 North Carolina Geological Map, Scale 1:62,500, NC Geological Survey, 1985.

2 Hydrogeologic Framework of the North Carolina Coastal Plain Aquifer System, U.S. Geological Survey Open File Report 87-690, USGS.

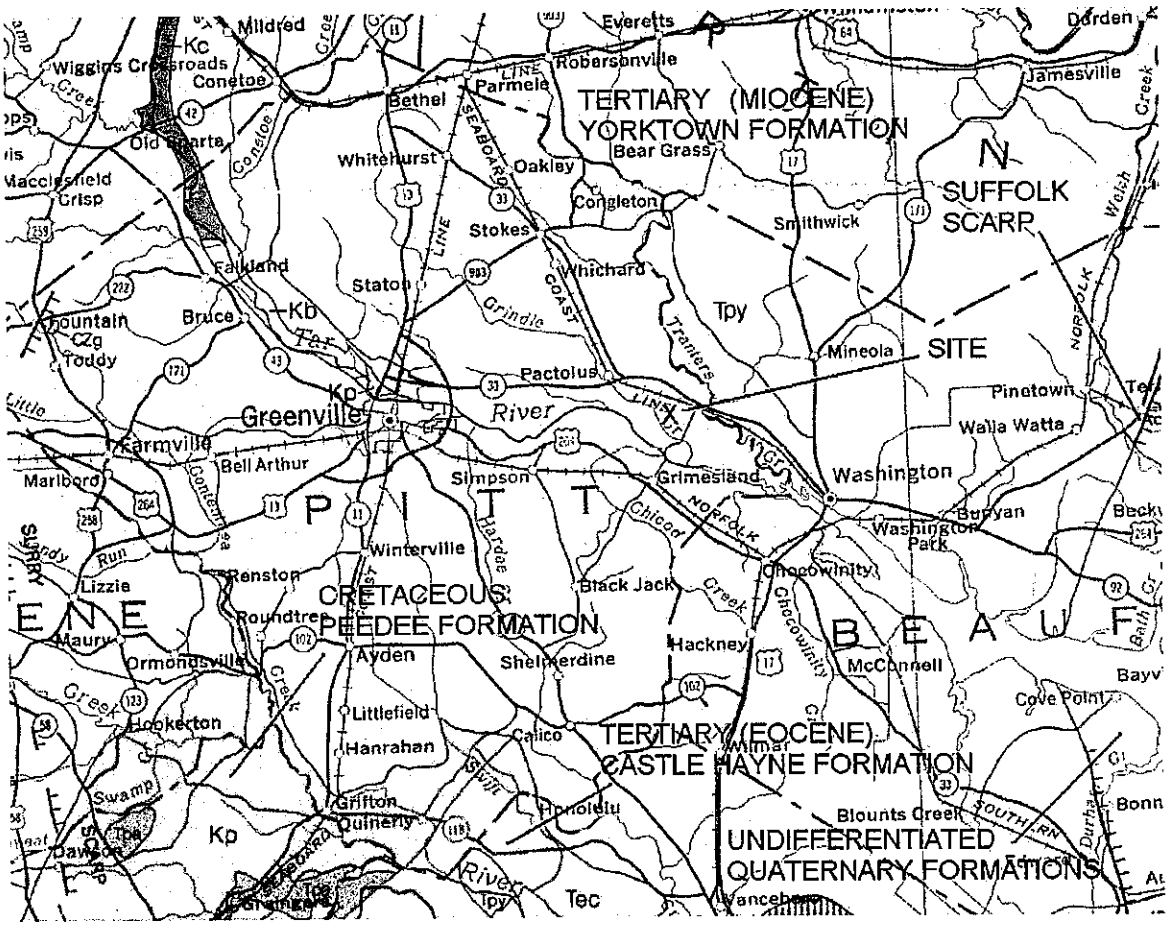

Figure 2 – North Carolina Geologic Map Excerpt

The major regional aquifers beneath the Coastal Plain, near the City of Greenville, NC, include the Yorktown Formation, the deeper Eocene-age Castle Hayne Formation (limestone) and underlying Cretaceous-age units, i.e. the Pee Dee and Black Creek Formations.[3] The Yorktown is characterized as marine sediments varying in thickness to 60 feet (thickest within Pitt County is in the northwest corner). The Castle-Hayne is localized to the southern and eastern portions of Pitt County (and further east) but is represented to be less than 30 feet in thickness everywhere in the county.

The Paleocene-age Beaufort Formation is mentioned in the literature, stratigraphically located between the Castle-Hayne and the deeper Cretaceous units, but the Beaufort does not outcrop. The Pee Dee and Black Creek Formations outcrop along the Tar River

3 Brown, P.M., Geology and Ground Water Resources in the Greenville Area, North Carolina, Bulletin Number 73, prepared cooperatively by the North Carolina Department of Conservation and Development and the United States Geological Survey, 1959.

approximately eight miles west of the site (in Greenville, NC), and the Cretaceous-age Cape Fear Formation outcrops approximately eight miles further upstream (west of the site). Based on regional data,[4] typical depths of the Cretaceous units in proximity to the site are in excess of 90 feet (see **Table 1B**). All are considered to be viable aquifers with variable water quality.

Basement rocks in the region consist of pre-Mesozoic crystalline rocks of igneous and metamorphic origin, which underlie the sediments of the Coastal Plain near the site at depths in excess of 1000 feet, based on available water well data (see Footnote 4) and published data.[5] West of the Suffolk Scarp the projected surface of the crystalline basement slopes at 0.4% (2000 feet in 90 miles), east of the Suffolk Scarp the surface of the basement slopes at 1.4% (8000 feet in 110 miles), with a maximum depth of 10,000 feet at Hatteras. The basement complex likely resembles the crystalline rocks exposed in the Piedmont, complete with various contacts, jointing, and other tecto-structural features, e.g. folds and faults. Several transform faults in the basement complex have been recognized by characteristic deformation features within the overlying late-Mesozoic and early Tertiary sediments.[6]

These relicts of Triassic-age tectonism (active throughout the Mesozoic era) are strike-slip faults with vertical rotation, oriented approximately with the alignments of the Tar, Neuse and Cape Fear Rivers. The most conspicuous feature produced by these faults, visible on the North Carolina Geologic Map, is the "up-thrown block" that occurs between the Cape Fear and Neuse Rivers (well to the south of the site). Within this area, the Yorktown has been all but eroded away, exposing the older Tertiary and Cretaceous sediments much further east than observed south of the Cape Fear or north of the Neuse. These faults are not active, and the region is not within a Seismic Impact Zone[7].

Heavy ground water extraction by water supply wells in the region has been considered as a probable cause for lowered potentiometric levels within the regional aquifers (noticeable over several decades) and localized ground subsidence.[8] High capacity wells

---

4 DENR Monitoring Well Database (interactive), North Carolina DENR Division of Water Resources, Ground Water Branch, viewed at web site http://www.dwr.ehnr.state.nc.us.

5 Lawrence and Hoffman, Geology of the Basement Rocks Beneath the North Carolina Coastal Plain, Bulletin 95, North Carolina Geological Survey, 1993.

6 Brown, P.M., and others, Wrench-style Deformation of Rocks of Cretaceous and Paleocene Age, North Carolina Coastal Plain, Special Publication 5, NCGS, Raleigh, NC, 1977.

7 EPA/600/R-95/051, RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Landfill Facilities, 1995, including Seismic Intensity Capable Faults Map

8 Land Subsidence Information, NC DENR Division of Water Resources - Ground Water Branch, unpublished, reviewed on-line at www.dwr.ehnr.state.nc.us

are used to supply drinking for the cities of Greenville and Washington. The Division of Water Resources data do not indicate how far the zone of influence around the wells extends with respect to subsidence, but the subsidence probably extends not more than a few miles from the respective wells. No high capacity production wells are located within two miles of the subject site, based on the findings of the local area study. It is not anticipated that the site could affect these wells, or that the ground water extraction at these locations could affect the site.

Daniels, *et al.*, discusses drainage characteristics and ground water movement within the surficial deposits of the Coastal Plain.[9] By examining in numerous soil samples for the presence of iron-oxide staining (various hues of red and yellow, e.g. goethite) and gley coloration (gray, blue-gray or green-gray pigmentation resulting from reduced iron compounds contained in water-logged soils beneath the surface, often accompanied by the formation of a sticky clay layer), along with various geochemical and pedologic properties, water movement characteristics within certain near surface soil horizons can be determined. Gleyed sands and sand-clay horizons were observed in the drilling and test pits for the subject site, typically at depths of 7 to 12 feet, usually with a sharp near horizontal demarcation with the overlying iron-oxide pigmented soils.

This work suggests that the presence of gley colors relatively near the surface within the Coastal Plain (as in other areas) results from very slow to no movement of water, i.e. "stagnant" ground water conditions. Conditions that produce gleyed beds, whether sand or clay, do not often change, as would be expected with the introduction of oxygen-rich meteoric water from the surface. The implications are that surficial aquifers function independently as reservoirs of infiltrated meteoric water, with relatively shallow discharge to streams and little recharge to the deeper aquifers. As discussed in the Site Suitability Report, the subject site is isolated hydraulically and from human activities. It is not likely that the landfill will affect (or be affected by) regional activities.

4.1.2 Field Reconnaissance

4.1.2.1 Topographic Setting and Drainage – Generally, the land slopes to the south between US 264 (existing near El. 25) and Grindle Creek (existing near El. 10). Site mapping (see **Drawings S2** and **S4**) shows a subtle drainage divide or "rise" (the term "ridge" implies topography too steep for this context) within the center of Phase 2

---

9 Daniels, R.B., and E.E. Gamble, W.H. Wheeler, J.W. Gilliam, E.H. Whiser, C.W. Welby, Water Movement Surficial Coastal Plain Sediments, Inferred from Sediment Morphology, Technical Bulletin No. 243, North Carolina Agricultural Experiment Station, North Carolina State University, Raleigh, NC, December 1978.

footprint, in the eastern portion of the site. This feature divides surface flow between small tributaries located to the east and west of the Phase 2 area. These minor tributaries exhibit distinct channels and a perennial aquifer discharge. Both streams exist in relatively deep swales, several feet lower than the majority of the site. These features are expected to control drainage within the uppermost sandy aquifer. Mean ground elevations within the Phase 2 site occur between El. 16 to El. 18, with maximum ground elevations between El. 19 to El. 20 near the central portions of the site, sloping gently toward the streams where typical elevations occur near El. 12 to 14. The streams are generally incised and channels typically occur 3 to 4 feet lower than the bank; channel widths are typically in the range of 3 to 5 feet, water depths are typically 1 to 3 feet deep.

4.1.2.2 Springs, Seeps and Ground Water Discharge Features

Two on-site streams, situated on the east-to-south and west sides of the Phase 2 footprint originate on the site and converge south of the site. These streams, in turn, converge with larger streams that originate less than a mile east of the site and flow south to Grindle Creek. The streams are fed in part by seeps and springs located along the banks of these features within the property boundary, many of which are too small to discern, which discharge from the uppermost aquifer. Some of the streams could be older man-made drainage features. The smaller upland drainage features are recharged by a fairly small watershed area and could be prone to seasonality. There is apparent "run-on" to the site in the northwest corner (from the US 264 right-of-way) but there is no "run-on" to the Phase 2 footprint area.

An upward vertical gradient exists of the upper and lower aquifers beneath within portions the site, as seen by the piezometer couplets at B-6/6A and B-8/8A (see Table 6). Downward gradients are seen within the central and northern portions of the site, the upward gradients are located near the streams, indicating discharge conditions. Changes in the gradient direction indicate seasonality. These conditions are typical of the region and similar to the Phase 1 site. The Phase 2 site is surrounded on the down gradient side by intercepting streams (not the case with the entirety of Phase 1). Based on the presence of the confining layer – more pronounced in the southern, down gradient portion of the Phase 2 site – it appears that offsite migration within the uppermost aquifer is unlikely.

4.1.3 Test Borings/Piezometers

Test borings and hand auger borings performed in December 2001 and January 2002 are shown on **Figure S5**. The test borings, labeled as the "B" series borings on the site map, were extended to depths varying from 15 to 70 feet, penetrating the several of the major

lithologic and hydrologic units mapped in the region. Test boring data are summarized on **Table 1A**. The deeper subsurface data were supplemented by three relatively shallow hand auger borings. **Figure S5** also shows site topography and the locations of the hydrogeologic cross sections (discussed later in this text). The soil test borings were sampled with standard penetration test techniques (ASTM D- 1586). Soil samples were visually classified by an experienced geologist, and laboratory testing was performed to confirm the field classifications.

All of the B-series borings were converted to standpipe piezometers for long-term ground water level observation. All test borings were grouted to the surface; some e.g., B-1s/2d, B-5 and B-6, may have application as future monitoring wells (with the installation of locking steel covers). There are 34 piezometers and two surface streams serving as ground water observation points within the 89.5-acre addition to the facility boundary. There are 23 piezometers within/near the Phase 2 footprint, which covers approximately 20 acres. A ground water potentiometric map, discussed in a later section, has been prepared from these data. Test boring records are presented in **Appendix III** of the **October 2002 Site Suitability report**.

4.1.4 Laboratory Geotechnical Testing

4.1.4.1 Laboratory Analysis - Table 2 presents a summary of laboratory test data for the Phase 2 test borings. Laboratory data are presented in **Appendix IV** of the **October 2002 Site Suitability report**. The laboratory test program consists of the following:

Triaxial Shear Strength, CU - undisturbed	D4767-95	2
Triaxial Shear Strength, CU - remolded	D4767-95	2
Flexible wall permeability - undisturbed	D5084	2
Flexible wall permeability - remolded	D5084	2
Standard Proctor Compaction	D698	2
Grain Size w/Hydrometer	D422, D1140	12
Atterberg Limits	D4318	12
Natural Moisture	D2216	12
One-Dimensional Consolidation	D2435	2

The soils were classified in the laboratory according the Unified Soil Classification System (USCS). These descriptions were matched to the boring logs to verify the visual soil classifications. Supplemental laboratory testing included standard Procter moisture-density tests, triaxial-cell hydraulic conductivity tests on undisturbed and remolded samples, triaxial shear strength and one-dimensional consolidation tests.

Soil Descriptions – Within the eastern portion of the site (the proposed CDLF footprint), soils within the upper 5 to 8 feet of the surface are generally classified as low to medium plasticity clayey silt (CL-ML) and silty sand (SM). Occasional pockets of clean well graded sand (SW) were encountered in the near subsurface. Within the western portion of the site, the proposed borrow site, soils generally consist of clean, well graded sands and silty sands, with relatively little clay. These sediments appear to be a relict stream channel, whereas the more clayey soils are likely channel-bank deposits.

Below a typical depth of 12 to 17 feet exists a layer of clayey silt (ML) and plastic clay (CL-CH), which appears to be continuous over the site and varies in thickness to approximately 15 feet, or more. This layer was previously identified as a partial confining layer during the Phase 1 site investigation. Below depths of 35 feet exist layered silty and clayey sands (SM and SM-ML), which locally are cemented. The soils became very clayey (CL and ML) below depths of approximately 50 feet.

Undisturbed Samples – Shelby tube samples were procured from test borings B-1, B-8, and B-10s and subjected to laboratory triaxial permeability, shear strength and consolidation testing. The near-surface soils consist of normally consolidated fluvio-marine sediments, where potential settlement is a concern relative to vertical separation. There appears to be a low likelihood of deep-seated instability and/or excessive settlement. Settlement and stability calculations based on these data are presented in **Appendix 7 (Volume 2)** of this report.

Bulk Samples – Representative bulk samples were procured from the upper 5 feet the surface at test borings B-2 and B-8. These samples were remolded and subjected to laboratory triaxial permeability tests. Permeability values on the order of 6.5×10^{-6} cm/sec were obtained for both samples. The bulk samples are considered to be representative of the shallower soils within the eastern portion of the site.

Effective Porosity – In keeping with Division requirements, the effective porosity was estimated from the grain size distribution analysis using a ternary diagram, originally developed by the US Geological Survey for estimating specific yields in porous aquifers. It has been demonstrated (in the literature) that the specific yield is tied to the effective porosity, the Division has adopted the practice of using specific yield (effective porosity) in the hydraulic gradient calculations (see **Section 4.1.8**). Two sample populations are apparent – the more permeable upper sands exhibit effective porosity values on the range of 7% to 22% (average of 12%), while the less permeable silty clay of the confining unit exhibits effective porosity values in the range of 1% to 5% (average of 3%). The effective porosity calculations are presented in **Appendix 5** and summarized on **Table 2**.

4.1.4.2 Formation Descriptions - The various geologic formations have been discussed in Section 5.0 of the October 2002 Site Suitability report. **Section 4.1.4.4** discusses subunits or layers identified in the near-surface geology that comprises an uppermost aquifer (sand), a partial confining unit (silt-clay), and a deeper regional aquifer (variably silty and partly cemented sand). Depths and permeability characteristics identified in the site specific studies are discussed in the following sections.

4.1.4.3 Field Hydrologic Testing - Table 3 presents a summary of field hydrogeological properties, based on falling head slug tests. Values of assumed total and effective porosity, aquifer thickness and descriptions of the various hydrogeological units based on the laboratory classification data are also presented in Table 3, along with calculated conductivity values. Each piezometer was developed prior to testing using a downhole pump or bailer until clear water was obtained. Static water level measurements were made at the beginning of each slug test. Table 7 presents calculated ground water gradients and velocities at each piezometer.

The slug tests were conducted by placing a pressure transducer at the bottom of the piezometer and allowing a buoyant plastic "slug" of a known volume, placed below the water level in the bore hole casing, to come to equilibrium. The change in piezometric head in response to the "slug" was measured until static equilibrium was re-established. A Hermit 1000C data logger was used to measure the rate of influx until water level equilibrium was achieved. The slug test data was analyzed according to both the Hvorslev and the Bouwer-Rice procedures, using commercially available software. The slug test data and permeability calculations are presented in **Appendix VI** of the **October 2002 Site Suitabilty report.**

4.1.4.4 Hydrogeologic Units – Table 3 presents the field hydraulic conductivity values (Bouwer-Rice) shown relative to the aquifer units defined for the site. **Table 2** presents laboratory conductivity data for the partial confining unit. Based on these data, the representative depths and conductivity values relative to each unit vary as follows:

Unit	Unit Description	Typical Depths, ft	Representative Hydraulic Conductivity (cm/sec)	(ft/day)
AU-1	Surficial Aquifer (Quaternary)	0 - 14	4.79E-04 to 3.25E-03	9.21 to 1.36 Average 5.95
CU-1	Soft Silt-Clay (Yorktown)	14 - 35	3.03E-05 to 2.22E-04	0.63 to 0.09 Average 0.36

AU-2	Dense Silty Sand (Yorktown)*	35 - 50	2.57E-04	0.73
CU-2	Dense Clayey Sand (Beaufort)	50+	5.25E-06	0.015**

* Alternatively identified as Castle Hayne, based on the literature

** Based on the Phase 1 site studies

From these data an order of magnitude difference in conductivity between Aquifer Unit 1 and Confining Unit 1 can be seen. Likewise, an order of magnitude difference can be seen between the lower units. While the difference in conductivity is not large, it is considered significant for modeling the site. The data can be biased due, in part, to the tendency for slug tests to measure hydraulic properties within a relatively narrow zone of influence around the piezometer.

All units exhibit variability with respect to clay content, and it is likely that the upper fluvial sediments are cross-bedded, which potentially leads to "dead-end" pore volumes and decreased effective porosity. Conversely, the upper reaches of the Yorktown have been reworked, which might lead to inconsistencies in measured properties. The "slug" test used to characterize the various formations is prone to influence by localized subsurface conditions, e.g. sand pockets, and piezometer construction, these tests are industry-standard and considered to yield reasonable representative results, sufficient for aquifer characterization and ground water modeling.

4.1.4.5 Dispersivity Characteristics – An important consideration regarding the ability to effectively monitor the site is the nature of the surficial aquifer. A concern revolves around how much dispersion would take place in the shallow and relatively sandy uppermost aquifer should a release of contaminants occur and how closely spaced must the monitoring wells be to detect such a release. This concern was addressed in the **April 2001 Design Hydrogeologic** report for **Phase 1** with respect to the distance of the regional ground water discharge feature (Grindle Creek) beyond the southwest property line. Such is not the case with Phase 2, whereas smaller tributaries provide a localized (on-site) discharge feature for the uppermost aquifer.

Appendix 5 presents a discussion of contaminant transport characteristics, along with an analytical solution to the two-dimensional advection-dispersion equation.[10] This solution assumes uniform, isotropic, and homogenous conditions within the flow regime (Darcy's

[10] Walton, W.C., Principles of Ground Water Engineering, Lewis Publishers, Inc., Chelsea, Michigan, 1991.

law applies). At a given point in space within the flow field (the prospective monitoring well location) and at time zero, the concentration of a solute of interest is assumed to be zero. The mathematical solution assumes no sorption, retardation, or degradation of the solute, e.g. the solute is "conservative" by not reacting with the host media or other solutes in the aquifer system. The model does consider aquifer thickness, porosity, and both longitudinal and transverse diffusion/dispersivity coefficients.

This aquifer system is characterized by lower hydraulic conductivity values than would be expected for a sandy aquifer (10^{-5} cm/sec) and low ground water velocities (0.008 ft/day). The effective hydraulic conductivity is due to cross-bedding and clayey horizons contained within the surficial aquifer. Low velocities are caused by the low conductivity and fairly flat ground water gradients. According to published literature, these conditions place the system in a regime where molecular diffusion is the controlling factor in contaminant transport, rather than mechanical dispersion.[11] The solution verifies that an approximate monitoring well spacing of 300 feet is adequate to detect a potential release of contaminants into the ground water. The **Water Quality Monitoring Plan** presented in **Appendix 6** reflects this analytical solution.

4.1.5 Other Investigative Tools

No specialized techniques or other testing methods were required or this investigation, but a number of test pits were excavated in advance of the borings to verify the consistency of soil conditions between Phases 1 and 2, and several hand auger borings, designated by an "A" following the boring number, were used for a detailed evaluation of soil types and ground water flow trends within the uppermost aquifer (**see Table 8**).

4.1.6 Stratigraphic Cross Sections

Drawings X1 and **X2** present generalized subsurface profiles prepared from the test boring and laboratory data, which indicate the hydrogeologic and lithologic units for this site. The stratigraphy at the site has been assigned to hydrogeologic units as follows: two aquifers, upper and lower (Units 1 and 2 Aquifers) and two confining layers, upper and lower (Units 1 and 2 Confining Layers). Typical of the coastal plain, the site stratigraphy within the upper 25 feet beneath the surface is defined by a distinct boundary between recent fluvial sediments (tan-yellow and white cross-bedded sands and clays) and deeper marine sediments (dark green silty sands and clays, often with cemented zones and shell hash).

---

11 Fetter, C.W., Contaminant Hydrogeology, Macmillian Publishing Company, New York, 1993.

The uppermost marine sediments have been identified as the Miocene-age Yorktown formation based on the fossil assemblage, yet the presence of glauconite (a dark green-black mica, related to biotite, which forms in deep marine environments)[12] in the deeper sediments suggests other possible formations mapped in the region, e.g., Castle Hayne, Beaufort, Pee Dee, or the Black Creek. Specific studies of index fossils were not performed to distinguish these formations, but a comparative study of water well data in the region (see Footnote 4) indicates that the on-site borings likely encountered the Castle Hayne and/or the Beaufort, in addition to the Yorktown.

Unit 1 Aquifer – Soils within the upper 5 to 8 feet below the surface consist of recent to Pliocene-age fluvial sediments, likely associated with former shorelines and/or estuaries of the Tar River and/or Grindle Creek. Pockets of buff-white, well graded sand (SW), with thicknesses of 15 feet, indicate former channel migration. Correlation of test borings and hand augers to earlier studies for Phase 1 indicates a relatively shallow, tan-yellow clay layer existing at depths between 16 to 24 inches, extending to depths of 36 to 48 inches. Cross-bedding is likely; the clay layer is present at most (but not all) test locations within the eastern portion of the site (not a true confining layer). The clay, sampled at B-2 and B-8, exhibits a laboratory permeability of 10^{-6} cm/sec **(Table 2)**.

The silty sands and clean sands within the upper 10 to 14 feet are considered to be the uppermost aquifer. The water table typically occurs at 4 to 7 feet below the ground surface within this unit in the eastern portion of the site (typically shallower within the lower lying western portion of the site). Several piezometers were completed to a depth of 15 feet. Based on these data (Table 3) the hydraulic conductivity for this unit varies on the order of 10^{-3} cm/sec to 10^{-4} cm/sec.

Unit 1 Confining Layer – Below a depth of 12 to 17 feet exist sandy silt grading downward to plastic clay, which collectively vary in thickness from approximately 15 to 25 feet. The top of this layer is distinguished by a dark green-gray color, characteristic of marine sediments, and heavy shell hash, including whole turritellas (a snail-like marine mollusk). These strata represent the top of the Yorktown formation. The clay layer is present in every boring and exhibits a stiff, moist "gumbo" consistency, that is, the clay is easily molded into a thread of less than 1/8-inch diameter and maintains this level of plasticity for repeated remolding over several minutes.

---

12 Hurlbut, Jr., C.S., and C. Klein, Manual of Mineralogy (after J.D. Dana), 19th ed., J.W. Wiley & Sons, New York, 1977.

Laboratory permeability testing on relatively undisturbed samples (see **Table 3** and **Appendix IV**), taken at B-1 from a depth of 11 feet and at B-10 from a depth of 14 feet, indicate hydraulic conductivity values of 1.5 x 10^{-7} cm/sec and 4.6 x 10^{-7} cm/sec, respectively. This unit has been identified as the top of the Yorktown Formation – marine clay of Miocene age – which predates the numerous sea level fluctuations associated with glacial activity (elsewhere) during the Pleistocene. The top of the confining unit, marked by the turritella -rich fossil assemblage, appears to be sculpted by channelized water during the multiple estuarine ingresses and regresses of the para-glacial period (see Figure F5). At some borings, there is a sandy transition layer, sometimes with the marker fossils (B-1d), but the clay layer is deeper or absent to the west of the footprint (B-30) and the marker bed is absent. Considering the flat potentiometric gradient and upward vertical gradient (discussed later), vertical ground water migration potential relative to the confining layer is limited.

Unit 2 Aquifer – Below depths of 35 to 45 feet exist relatively dense silty sands and clayey sands (SM and SM-ML), which locally are cemented. These soils contain variable amounts of glauconite (a type of mica found in deep marine sediments, distinguished by a green-black "speckled" color), and scattered pelecypod shell hash (including modern-type clams). The deeper sediments were often cemented, giving firm resistance to the drilling equipment. Occasional cemented shell hash concretions were encountered in the split spoon sampling, some of which resemble the distinctive pelecypod-mold structure of the Castle-Hayne formation. The concretions were not widely encountered and might represent reworked sediments derived from the older formation. A piezometer completed within this unit (MW-1d) indicates in-situ hydraulic conductivity values on the order of 10^{-6} cm/sec, while other piezometers within Phase 1 indicated conductivity values on the order of 10^{-4} to 10^{-5} cm/sec (see **Table 3**). This unit is 25 to 30 feet thick, based on the data.

Unit 2 Confining Layer – The deeper sediments (possible Castle-Hayne or Beaufort) became very clayey below depths of approximately 50 feet, but otherwise resembled the soils described in the overlying aquifer. This unit was encountered in test boring B-1d, extended to a depth of 80 feet. While the actual thickness cannot be determined, piezometer "slug test" data indicate a hydraulic conductivity on the order of 10^{-4} to 10^{-5} cm/sec (see Table 3). An earlier slug test for a nearby piezometer in Phase 1 (B-9) indicated an in-situ conductivity value on the order of 10^{-6} cm/sec. Published data indicates that confining units exist

between the Yorktown and Castle Hayne formations and between the Castle Hayne and the underlying Beaufort formation. Based on the projected depth of the Castle Hayne in this region, and the observation of pelecypod-mold concretions in the split spoon samples, it is likely that the test boring encountered this confining layer. The presence of glauconite (not typically associated with the Castle Hayne) might indicate the deeper Beaufort formation.

4.1.7 Water Table Information

4.1.7.1 Short-Term Water Levels - Table 4 presents a summary of short-term ground water levels observed at the end of drilling of the B-series piezometers and stabilized readings obtained after a period of one to fourteen days after completion of the piezometers.

4.1.7.2 Long-Term Water Levels - Table 5 presents a summary of long-term water level observations at the piezometers and nearby monitoring wells. Data for the B-series piezometers go back to November 2000. This table reflects water level elevation data acquired over a period covering more than one year for on-site data and back to November 2000 for the nearby Phase 1 monitoring well network. These data provide the basis for the ground water potentiometric surface map (**Drawing E1**), discussed in **Section 4.1.7.3** and shown on the hydrogeologic cross sections (**Drawings X1** and **X2**).

4.1.7.3 Maximum Long-Term Seasonal High Water Table – Historical climatic data from the National Weather Service,[13] discussed in the **October 2002 Site Suitability** report, provides a basis for comparing observations at on-site piezometers with historic data from the Phase 1 monitoring well network to estimate maximum long-term seasonal high water levels. A parameter of interest is the Palmer Hydrological Drought Severity Index (PHDI), compiled for 105 years of weather records. The PHDI represents an overall moisture balance within a region of interest, compiled from multiple weather stations for average precipitation, temperature (PET effects), leaf indices (growing season), wind velocities, and solar radiation. The cyclical data are shown on a time line (see Figure 3), with times of drought shown as negative values and wet times shown as positive. The relative duration of a drought or wet cycle correlates to the availability of moisture to recharge the ground water. Pitt County is located in Region 7 of the North Carolina climate network, which includes the eastern Coastal Plain.

---

13 Time Bias Corrected Divisional Temperature-Precipitation-Drought Index, (TD-9640) March 1994, National Oceanic and Atmospheric Administration, periodic updates available on-line at www.ncdc.noaa.gov.

The PMDI data indicate that climatic moisture conditions were near normal to wet or the last several years. Exceptions occur during the latter portion of 1993 and 1994, which experienced prolonged dry spells that classify as moderate drought conditions. Brief dry spells occurred during the latter part of 1997 and the early part of 1999. Mild to moderate wet conditions were experienced during the period from mid-1996 through early 1997, in part contributed to Hurricane Fran and generally high precipitation patterns during that time. Moderate to severe wet conditions resulted from the well documented "el Nino" winter of 1997-98, when record warm temperatures and high rainfall was recorded throughout the southeastern United States.[14] A notable wet spell, more pronounced than "el Nino" – previously considered as a recent climatic standard – occurred in late 2003 through early 2004, which was experienced by the on-site monitoring wells.

[14] National Oceanic and Atmospheric Administration, NESDIS Press Release, March 9, 1998.

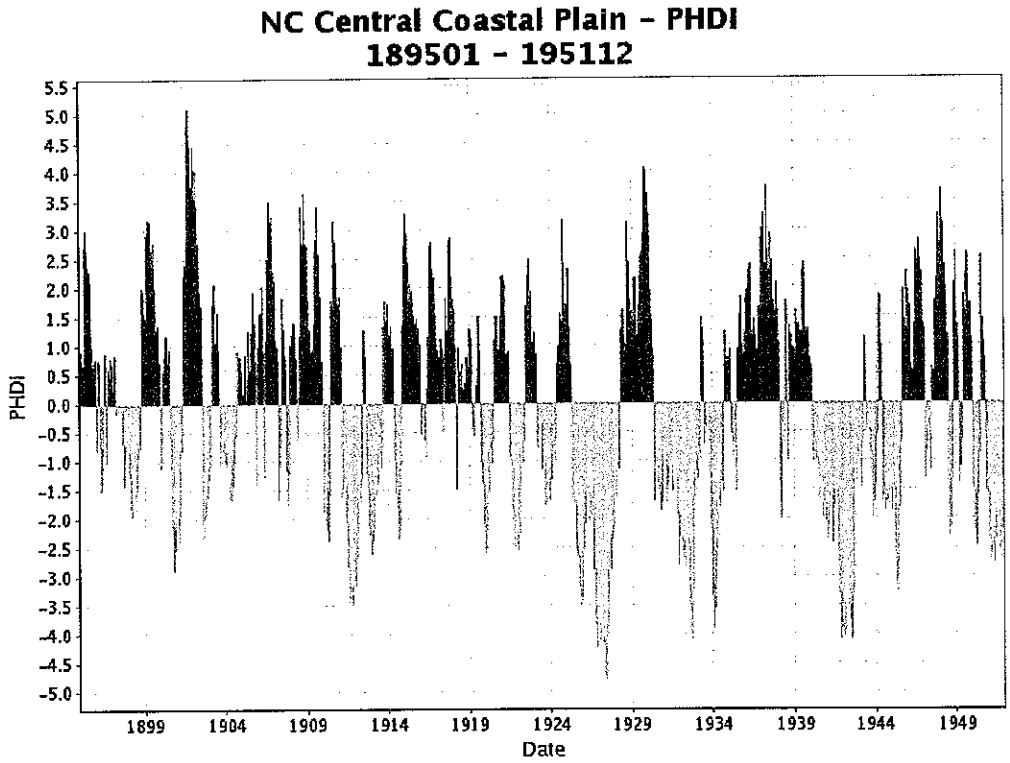

Figure 3A – Palmer Hydrologic Drought Index 1895 – 1951

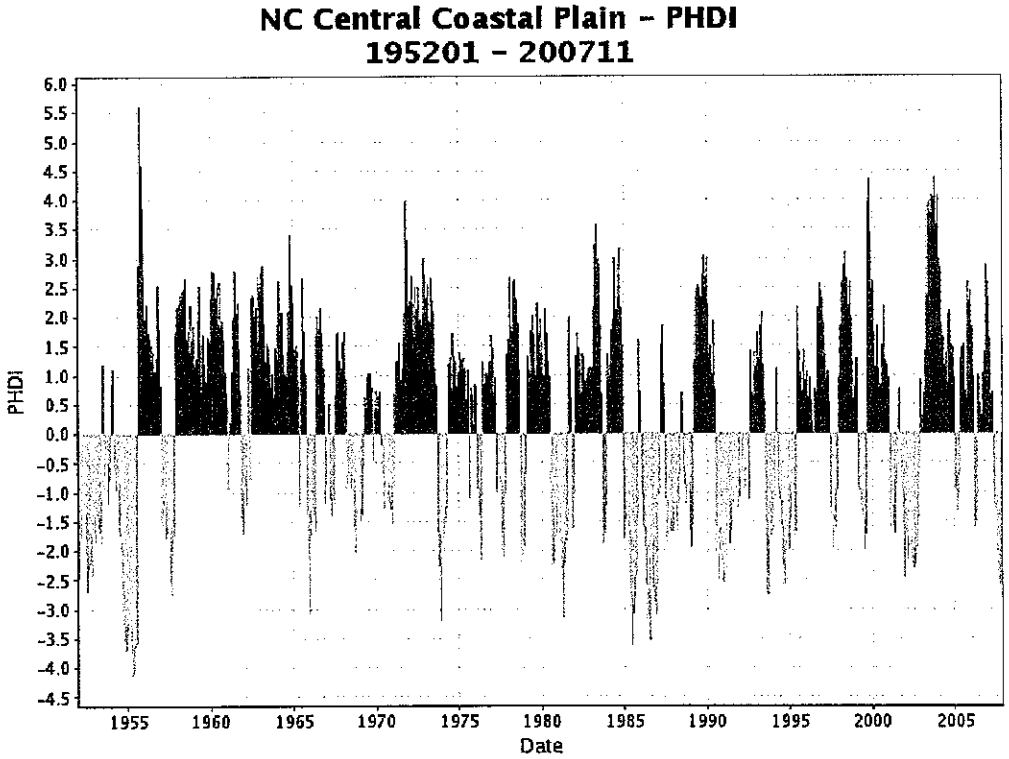

Figure 3B – Palmer Hydrologic Drought Index 1952 - 2007

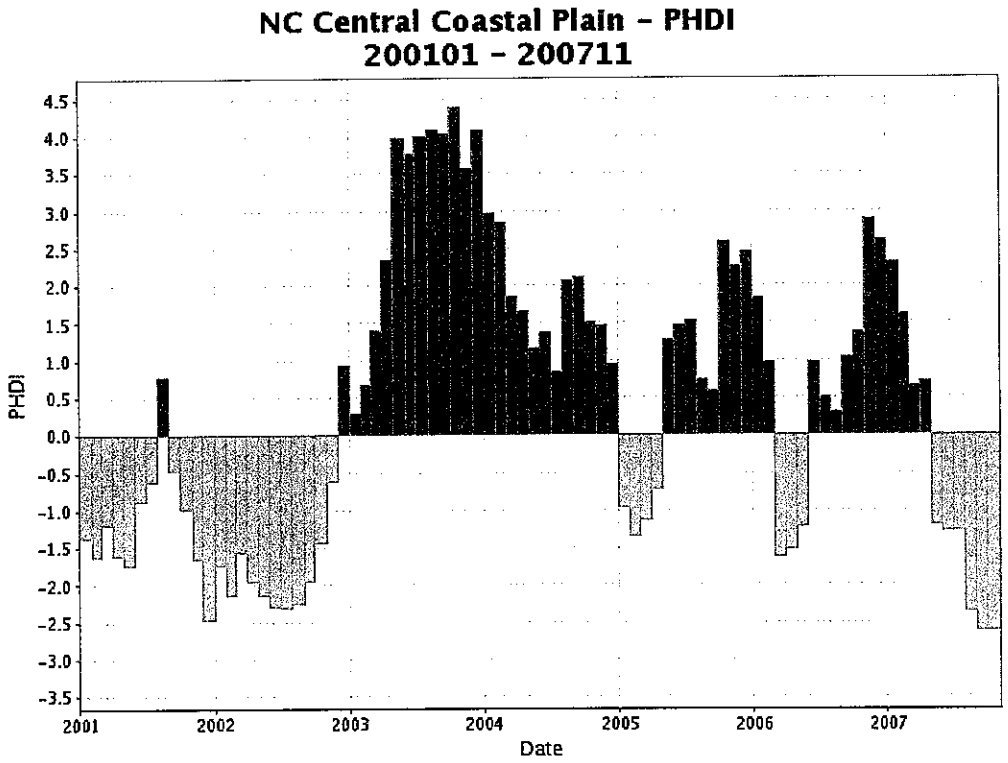

Figure 3C – Palmer Hydrologic Drought Index 2001 - 2007

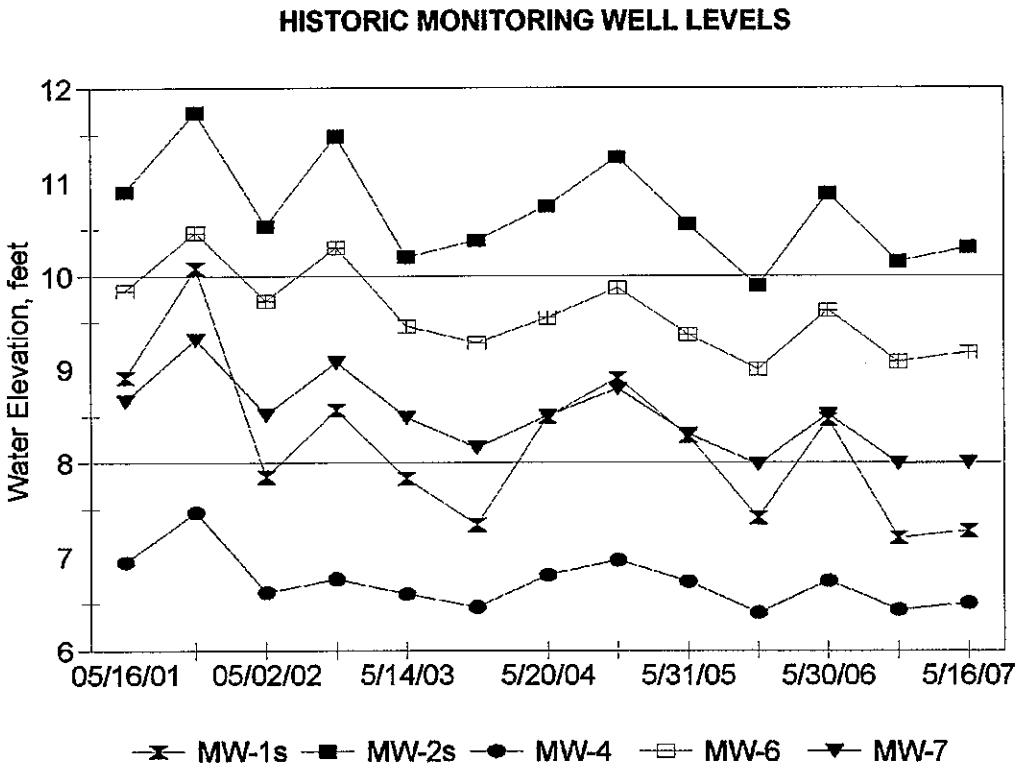

Figure 4 – Monitoring Well Hydrograph 2001 - 2007

Comparison with on-site water level observations indicates a fair correlation between the climatologic trends and the observed water levels. Peak monitoring well levels generally occur during May and November 2001 (Figure 4). The documented state-wide wet spell of 2003-04 (Figure 3C) is reflected by a trough in the monitoring well hydrograph, but the water levels responded over the following year (2004), whereas a peak occurred in the November 2004 observations. Following that, the monitoring wells reflect the general drying of the climate – with normal seasonal fluctuation – as state-wide drought conditions set in. Several factors pertaining to past and recent site development have the potential to affect ground water levels, discussed in **Section 4.1.7.4**.

Test Boring	Hydro Unit	Shallowest Max. Elev.	Deepest Min. Elev.	Observed Difference	Average Difference
MW-1s	AU-1	13.71	10.83	2.88	
MW-2s	AU-1	11.55	9.56	1.99	
MW-4	AU-1	12.02	10.74	1.28	
MW-5	AU-1	11.80	10.47	1.33	
MW-6	AU-1	11.03	9.57	1.46	
MW-7	AU-1	11.42	9.98	1.44	
MW-8	AU-1	11.85	10.63	1.22	
MW-9s	AU-1	12.52	9.11	3.41	1.88
MW-1d	AU-2	12.52	11.12	1.40	
MW-2d	AU-2	9.85	9.11	0.74	
MW-9d	AU-2	10.21	10.21	--	1.07
B-1s	AU-1	16.38	14.38	2.00	
B-2	AU-1	16.04	13.31	2.73	
B-3	AU-1	16.71	12.96	3.75	
B-4	AU-1	17.50	13.86	3.64	
B-5	AU-1	16.76	14.08	2.68	
B-5A	AU-1	19.16	17.03	2.13	
B-6	AU-1	16.99	13.76	3.23	
B-6A	AU-1	16.57	16.04	0.53	
B-7	AU-1	14.33	12.38	1.95	
B-8	AU-1	14.18	11.82	2.36	
B-8A	AU-1	14.00	12.71	1.29	
B-9	AU-1	13.30	11.15	2.15	
B-10	AU-1	14.53	11.71	2.82	
B-12	AU-1	12.62	11.90	0.72	

B-13	AU-1	13.40	12.26	1.14	
B-15s	AU-1	13.25	12.26	0.99	
B-16	AU-1	14.82	12.97	1.85	
B-17s	AU-1	14.65	13.44	1.21	
B-18	AU-1	15.40	13.80	1.60	
B-19	AU-1	15.99	14.22	1.77	
B-20	AU-1	15.25	13.80	1.45	
B-21	AU-1	15.72	13.80	1.92	
B-22	AU-1	14.34	13.08	1.26	
B-23s	AU-1	12.96	9.84	3.12	
B-24	AU-1	14.20	12.95	1.25	
B-25	AU-1	15.33	13.02	2.31	
B-27	AU-1	15.26	13.68	1.58	
B-29	AU-1	14.80	13.26	1.54	1.91
B-11	CU-1	11.91	10.75	1.16	
B-14	CU-1	13.70	12.77	0.93	
B-15d	CU-1	12.05	10.97	1.08	
B-17d	CU-1	13.71	12.56	1.15	
B-23d	CU-1	12.76	11.45	1.31	
B-26	CU-1	14.59	13.68	0.91	
B-28	CU-1	12.76	10.92	1.84	
B-30	CU-1	16.23	13.08	3.15	1.70
B-1d	AU-2	14.59	13.68	0.91	0.91

These data provide a sufficient basis for determining the Maximum Long-Term Seasonal High (MLSH) ground water levels for the site, discussed below. The summary table presents the maximum and minimum water levels observed from May 2001 through November 2007. Considering the monitoring wells, the average difference between the maxima and minima within wells completed in the uppermost aquifer (AU-1) is 1.88 feet, and within the deeper aquifer (AU-2) the difference is 1.07 feet. Within the Phase 2 test borings with piezometers completed in AU-1, the difference in the maxima and minima is 1.85 feet, during a period from December 2001 to June 2002. The difference in test borings with piezometers completed in AU-2 is 0.91 feet. Thus, while the data in Phase 2 cover a shorter time period, the difference in maximum and minimum values is virtually the same in both aquifer units. That, and the correlation with climatic trends, establishes the maximum values observed in Phase 2 during 2001-2003 as representative of the maximum long-term seasonal high water levels, without further adjustment.

4.1.7.4 Factors That Influence Water Table – Conditions at the site are conducive to high infiltration of surface water (upper aquifer recharge) and poor evapotranspiration characteristics. The site is nearly flat and cultivated, and surface depressions result in localized impoundments. Poor drainage originally necessitated the use of shallow drainage ditches to facilitate the former agricultural activities. Man-made influences include shallow drainage ditches (discussed earlier in the context of surface streams) existing to the east, west, and south of the Phase 2 footprint. These features tend to provide stabilizing effect on water level fluctuation, whereas the differences between the maximum and minimum observed water levels are generally less than 2 feet across the site. Changes in land use from agricultural and forest (which promotes high infiltration) to industrial uses (including the landfill, roadways, and appurtenances) tends to reduce infiltration and promote more runoff. This may have an irreversible affect on local ground water levels but not regional ground water.

High ground water conditions persisting into the autumn months are not unusual due to low ET, caused by poor vegetative cover and cover crop wilting. The available data suggest that the upper aquifer is not "flashy", taking weeks or months to fully respond to climatic changes. It should be noted that during the period from 2001 to 2003, heavy beaver activity (surface impoundments) was noted along the tributary to the west of the Phase 2 footprint, which caused higher ground water readings in the western portion of the Phase 2 site than would have occurred due to climatic response. The impoundments have since been removed, but the Phase 2 footprint was not affected by these conditions.

4.1.8 Horizontal and Vertical Flow Dimensions

Drawings X1 and **X2** present generalized hydrogeologic cross-sections that show the horizontal and vertical extent of the uppermost aquifer (AU-1) and ground water flow characteristics. Ground water movement through this formation is unconfined porous media. Recharge within the Phase 2 footprint occurs along most of the surface, with discharge from the surficial aquifer occurring along the on-site streams. A relatively slow horizontal flow occurs in the AU-1 aquifer (ranging 0.002 to 0.737 ft/day, average 0.245 ft/day), due in part to relatively flat gradients that reflect a subdued expression of the surface topography. A partial confining unit (CU-1) provides a lower boundary to the uppermost aquifer, although some slow horizontal flow and recharge to the lower aquifer (AU-2) is expected. Artesian pressures within the deeper aquifer limit potential contaminant migration through the confining layer. The cross sections show a horizontal flow within the deep aquifer, (calculated velocity of 0.075 ft/day). Flow calculations are presented on **Tables 6** and **7**. Refer to the following detailed discussion.

Table 6 shows an upward vertical gradient between the upper and lower portions of the unconfined surficial aquifer (AU-1), as seen by the couplets at B-6/6A and B-8/8A. Upward gradients were determined between the upper aquifer (AU-1) and lower aquifer (AU-2) during the site characterization for Phase 1. Data at the couplet B-1s/1d show a downward gradient, which suggests differing conditions in the northern portion of the site – test borings indicate a sandier horizon at the elevation of the silt-clay confining unit detected at other locations. Temporal changes in the gradient direction likely reflect seasonality. The data indicate down ward gradients within the uppermost aquifer over much of the Phase 2, except as noted above.

Table 7 presents horizontal ground water gradient data and velocity calculations for various piezometers, arranged according to Hydrogeologic Units: Aquifer Units (A.U.) And Confining Units (C.U.). Calculated horizontal ground water flow velocities are based on field hydraulic conductivity data at the various piezometers (**Table 3**) and the horizontal gradients developed from the potentiometric contours shown on **Drawing E1**. Ground water velocities vary within the various Hydrogeologic Units, as follows:

Hydrogeologic Unit	Average Horizontal Ground Water Velocity, ft/day
A.U. 1	0.245
C.U. 1*	0.0011
A.U. 2	0.075
C.U. 2*	0.0003

*Determined in the Phase 1 site characterization

4.1.9 Ground Water Contour Maps

Drawing E1 shows ground water potentiometric contours based on Maximum Long-Term Seasonal High water level observations discussed in **Section 4.1.7.3**. made in March 2001. Ground water flow is generally toward the south, toward Grindle Creek and its tributaries that flank the higher ground of the site. A local divide surface drainage and ground water flow between the southeast and southwest directions. The potentiometric contours reflect a subdued expression of the surface topography, characteristic of the Coastal Plain. The potentiometric contours make a smooth transition to the unnamed tributaries. There are localized "high areas" in which the water levels are elevated due to variation in subsurface conditions and/or artesian pressure. These areas are reflected as closed contours on the potentiometric map.

4.1.10 Test Location Map

Drawing S5 shows the locations of test borings/piezometers and pre-existing monitoring wells used for this investigation.

4.1.11 Local Well and Water Use Information

A potable well survey conducted in 2000 in conjunction with the Phase 1 site characterization (**Drawing S1**). A handful of domestic wells were identified – most of the region is served by municipal water supply. No down gradient ground water wells or significant ground water users identified within a one-mile radius. A public well exists near the Pactolus cross-roads, some 2 miles west of (and upgradient of) the facility.

4.1.12 Special Geologic Considerations

No unusual geologic features have been determined which would affect the ground water flow or the ability to effectively monitor the site, including faults, mines or dikes. Site conditions appear typical of the North Carolina Coastal Plain region and similar to that determined for the adjacent Phase 1 site. Some consideration should be given to the presence of background metals in the natural geochemistry, discussed below.

Background metals – Some common inorganic constituents have been detected in the monitoring wells for Phase 1, going back to pre-disposal background sampling conducted in 2001. Detected inorganic constituents have been associated with regional background geochemistry, i.e., these are naturally occurring inorganic compounds, the detection of which can be directly attributed to turbidity (suspended and dissolved solids), that have been noted elsewhere in sampling programs in the Coastal Plain. The background sampling event (pre-disposal) of 5/16/01 detected the following constituents:

		Maximum detected concentration, mg/l	2L standard mg/l
Chromium	MW-1d, 1s, 2d, 2s, 4, 7	0.085	0.05
Lead	MW-2s, 4	0.029	0.015
Cobalt	MW-2s	0.019	NA
Vanadium	MW-1d, 2s	0.124	NA
Zinc	MW-1d, 2s	0.099	2.1

Later sampling events have detected concentrations of arsenic and barium, also believed to be associated with background geochemistry (noted during high turbidity events).

The Geochemical Atlas of North Carolina[15] provides graphical summary data for several inorganic constituents, based on the National Uranium Resource Evaluation (NURE) database. These data include stream sediment and ground water samples collected ca. 1970s. Not all inorganic constituents of interest are represented for all regions, but those of potential interest within the Coastal Plain region follow:

Constituent	Ground Water	Stream Sediment
Alkalinity	>3	0.38
Aluminum	440 ppb	64,000 ppm
Bromine	>160 ppb	
Chlorine	30,000 ppb	
Conductivity	>500 umho/cm	>180 umho/cm
Fluorine	200 – 400 ppb	
Iron		200K – 400K ppm
Manganese	200 ppb	250 ppm
Uranium	0.025 ppm	3 ppm
Vanadium	0.062 ppb	45 – 90 ppm

4.1.13 Summary Report

Hydrogeologic conditions at the C&D Landfill, Inc., site are viewed as a short segmented, closed-loop hydrologic cycle, with recharge occurring over a majority of the site and on-site discharge occurring at local streams. Ground water flow is generally toward the south, with the regional discharge feature (Grindle Creek) located beyond the property line to the southwest of Phase 1, but Phase 2 and most of Phase 1 is surrounded by smaller tributaries and deep drainage ditches that drain the uppermost aquifer, i.e., a loose sand layer extending to an average depth of 12 feet (varying to 30 feet in places) that blankets the site above a silt-clay confining unit. There are currently no development or ground water users in the down gradient direction.

The confining layer separates the uppermost aquifer from a deeper regional aquifer (contained within the Yorktown formation). The regional aquifer exhibits mildly artesian pressure that exerts an upward vertical gradient beneath much of the site. Conditions at the site are typical of the Coastal Plain region, except that ground water levels are deeper than would be expected based on local topography. The surficial aquifer is recharged through normal precipitation, ground water migration from the east. Based on an analytical solution to the two-dimensional advection-dispersion equation for contaminant transport, the site can be effectively monitored by a 300-foot well spacing in the uppermost aquifer. Both upper and lower aquifers need to be monitored, although the deeper regional aquifer has been monitored at a reduced frequency.

---

15 Available on-line at http://www.geology.enr.state.nc.us/NUREgeochem/geochem2.htm

4.2 Design Hydrogeologic Report – CDLF Phase 2

A single hydrogeologic investigation was performed to satisfy the requirements of both the site suitability investigation and the design hydrogeologic evaluation, relative to the Phase 2 expansion, shown on **Drawing S5.** The test boring program described in **Section 4.1.3** indicates 34 piezometers and two surface streams serving as ground water observation points within the 89.5-acre addition to the facility boundary. There are 23 piezometers within/near the Phase 2 footprint, which covers approximately 20 acres.

4.2.1 Ground Water Monitoring System Design

4.2.1.1 Aquifer Characteristics – Site geology has been described as a multiple layer system **(Section 4.1.6)** with an upper sand serving as the uppermost aquifer (Unit AU-1), comprised of Pleistocene fluvial sediments, underlain at depths varying from 12 to 30 feet by deep marine silt-clay that serves as a partial confining layer with thicknesses varying from 10 to 15 feet (Unit CU-1). Hydraulic conductivity values vary on the order of 10^{-3} to 10^{-4} cm/sec within the upper sands and on the order of 10^{-4} to 10^{-5} cm/sec within the partial confining unit. The stratigraphy is considered a "leaky aquifer", whereas the conductivities differ by relatively little (an order of magnitude) and the silt-clay is relatively sandy in places. However, there is an upward vertical gradient, which suggests a degree of confinement due to the silt-clay layer. Beneath the confining layer exists confined, porous silty and clayey sand (AU-2), with conductivity values on the order of 10^{-4} cm/sec, and another confining unit (CU-2) with conductivity values on the order of 10^{-6} cm/sec. The data suggest transitional boundaries between the units. Ground water discharge from the uppermost aquifer (AU-1) occurs along surface streams that surround the Phase 2 site.

4.2.1.2 Relative Point of Compliance – Selection of monitoring well locations for compliance monitoring of the uppermost aquifer is based on an understanding of hydrogeological conditions presented in this report. North Carolina solid waste Rule .1631 (a)(2)(B), pertaining to MSW facilities (extended to CDLFs by Division policy) makes a provision for the relevant point of compliance to be located no more than 150 feet from the waste boundary (relative to a 200 foot buffer) but at least 50 feet within the facility boundary. Division policy has been to require the compliance wells for CDLFs to be located within approximately 75-100 feet of the waste boundary, or approximately half the distance between the edge of waste and the compliance boundary. Based on the site studies, it appears that this spacing for compliance wells is appropriate for this facility. Based on the advection-dispersion calculations performed for Phase 1, a well spacing of no more than 300 feet in the down gradient direction is appropriate.

4.2.1.3 Monitoring Plan Amendments – Based on the foregoing discussion, amendments to the Sampling and Analysis Plan (**Appendix 6**) consist of eight new compliance wells in the uppermost aquifer (AU-1), one of which is a shallow/deep couplet to monitor the deeper aquifer (AU-2), and one upgradient background well in the upper unit (AU-1). No new surface water sampling is proposed. The existing monitoring plan for Phase 1 will be amended with the new wells, which are shown on **Drawing MP1**.

Proposed Well	Nearest Piezometer	Ground Elevation	Top of Yorktown Fm. Confining Unit	Est'd Screen Interval Depth (bgs) and Elev.*	Est'd High Water Elevation (msl)
MW-9A	B-19	19	13.3' (El. 0.9)	5 – 15' (El. 14 to 4)	13.80 to 15.99
MW-10	B-24	14	13.3' (El. 3.4)	5 – 15' (El. 9 to -1)	12.95 to 14.20
MW-11	B-15S	13	15.5' (El. 2.1)	10 – 20' (El. 3 to -7)	12.26 to 13.40
MW-12	B-11	15	10.9' (El. 4.3)	5 – 15' (El. 14 to 1)	10..75 to 11.91
MW-13	B-12	14	17.9' (El. -1.2)	10 – 20' (El. 4 to -6)	11.90 to 12.62
MW-14S	B23S*	13.90	13.0' (El. 0.9)	15 – 20' (El. -1.1 to -6.1)	9.84 to 12.96
MW-14D	B23D*	14.54	12.7' (El. 1.8)	35 – 40' (El. -20.5 to -25.5)	11.45 to 12.76
MW-15	B-17S	15	13.0' (El. 4.0)	5 – 15' (El. 8 to -2)	13.44 to 14.65
MW-17	B-7	16	17.0' (El. 1.3)	10 – 20' (El. 6 to -4)	11.82 to 14.33

*Utilize Existing Borings B-23S and D, although these have 5-foot screens
All others shall have 10-foot screens, situated just below the top of the Yorktown, i.e., drilling depths and screen intervals shall be adjusted as needed during installation. All wells shall be 2" PVC with 0.010" screen slotted screen opening, embedded in filter sand and grouted to surface with locking steel cover. It is writer's intention to bail all wells for pre-sampling purge (no dedicated pumps).

4.2.2 Rock Core Information – Not Applicable

4.2.3 Estimated Long-Term Seasonal High Water Table

Section 4.1.7 provides a detailed description of historic water level data, including wells pertaining to the CDLF. These data were used to estimate a maximum long-term seasonal high potentiometric surface, presented in **Drawing E1**. The potentiometric contours were used, in turn, to verify that a minimum of 4 feet of vertical separation exists to the proposed base grades of CDLF Phase 2.

4.2.4 Bedrock Contour Map – Not Applicable

4.2.5 Hydrogeologic Cross Sections

Drawings X1 and **X2** present generalized hydrogeologic cross-sections that depict the horizontal and vertical extent of the upper most aquifer (Units AU-1) and ground water flow characteristics (discharge areas vs. recharge areas). The cross sections show the vertical separation between the maximum long-term seasonal high potentiometric surface and the proposed CDLF Phase 2 base grades.

4.2.6 Ground Water Flow Regime

A description of ground water flow paths, horizontal and vertical gradients, flow rates, and recharge/discharge areas required by this rule are provided in **Sections 4.1.4.4, 4.1.6, 4.1.8, and 4.2.1.1**. These sections provide a sufficient basis for establishing the ground water monitoring plan amendments.

4.2.7 On-site Soils Report

The CDLF Phase 2 grading plan involves cuts up to 2 – 3 feet below existing ground surfaces – within a relatively small area in the southern end of Phase 2 – and fills on the order of 2 – 4 feet. Much of the base grades will exist near existing ground surfaces. Based on numerous test pits, hand augers, and test borings, soils within the upper 2 feet beneath existing ground surfaces are expected to meet the soil-type requirements (typically SM classifications) of the 2006 C&D Rules. Ample soil resources exist on-site and within adjacent land – over 100 acres with a NCDENR mining permit under the same ownership – available for construction and operations. A close inspection will be required during base grade construction to verify that the required soil types are present within the upper 2 feet beneath finished subgrades (see the **CQA Plan** in **Volume 2**).

4.2.8 Certification

This is to certify that all borings that intersect the water table at this site have been constructed and maintained as permanent monitoring wells or shall be abandoned in accordance with the provisions of 15A NCAC 02C .0113.

Signed _____
Printed G. DAVID GARRETT
Date FEBRUARY 19, 2008

NORTH CAROLINA LICENSED SEAL 983 GEOLOGIST G. DAVID GARRETT

Not valid unless this document bears the seal of the above-named licensed professional.

5.0 ENGINEERING PLAN 1
5.1 Engineering Report 1
5.1.1 Analytical Methods 1
5.1.2 Critical Conditions 1
5.1.3 Technical References 2
5.1.4 Location Restriction Demonstrations 2
5.2 Construction Materials and Practices 2
5.3 Design Hydrogeologic Report 3
5.4 Engineering Drawings 3
5.4.1 Existing Conditions 3
5.4.2 Grading Plan 3
5.4.3 Stormwater Segregation 3
5.4.4 Final Cap System 3
5.4.5 Temporary and Permanent S&EC 3
5.4.6 Vertical Separation 4
5.4.7 Other Features 4
6.0 CONSTRUCTION REQUIREMENTS 5
6.1 Horizontal Separation 5
6.1.1 Property Lines 5
6.1.2 Residences and Wells 5
6.1.3 Surface Waters 5
6.1.4 Existing Landfill Units 5
6.2 Vertical Separation 5
6.2.1 Settlement 5
6.2.2 Soil Consistency 6
6.3 Survey Control Benchmarks 6
6.4 Location Coordinates 6
6.5 Landfill Subgrade 6
6.5.1 Subgrade Inspection Requirement 6
6.5.2 Division Notification 6
6.5.3 Vertical Separation Compliance 7
6.6 Special Engineering Features 7
6.7 Sedimentation and Erosion Control 7
7.0 CONTRUCTION QUALITY ASSURANCE 8
7.1 Purpose 8
7.1.1 Definitions 8
7.1.1.1 Construction Quality Assurance (CQA) 8
7.1.1.2 Construction Quality Control (CQC) 8
7.1.1.3 CQA Certification Document 8
7.1.1.4 Discrepancies Between Documents 9
7.1.2 Responsibilities and Authorities 9
7.1.2.1 Owner 9
7.1.2.2 Engineer 9
7.1.2.3 Contractor 9
7.1.2.4 CQA Testing Firm 9

7.1.3 Control vs. Records Testing 10
7.1.3.1 Control Testing 10
7.1.3.2 Record Testing 10
7.1.4 Modifications and Amendment 10
7.1.5 Miscellaneous 10
7.1.5.1 Units 10
7.1.5.2 References 10
7.2 CQA Plan 10
7.2.1 Responsibilities and Authorities 10
7.2.1.1 Compaction Criteria 11
7.2.1.2 Testing Criteria 11
7.2.1.3 Material Evaluation 11
7.2.1.4 Subgrade Approval 11
7.2.2 General Earthwork Construction 11
7.2.2.1 Construction Monitoring 11
7.2.2.2 Control Tests 12
7.2.2.3 Record Tests 12
7.2.2.4 Record Test Failure 12
7.2.2.5 Judgment Testing 12
7.2.2.6 Deficiencies 13
7.2.2 Inspection Activities 13
7.2.3.1 Material Approval 13
7.2.3.2 Final Cover Systems Installation 14
7.2.3.3 Deficiencies 15
7.3 CQA Meetings 15
7.3.1 Project Initiation CQA Meeting 15
7.3.2 CQA Progress Meetings 15
7.3.3 Problem or Work Deficiency Meetings 16
7.4 Documentation and Reporting 16
7.4.1 Periodic CQA Reports 17
7.4.2 CQA Progress Reports 17
7.4.3 CQA Photographic Reporting 18
7.4.4 Documentation of Deficiencies 18
7.4.5 Design and/or Technical Specification Changes 18
2.7 FINAL CQA REPORT 18
2.8 STORAGE OF RECORDS 19
8.0 OPERATION PLAN 22
8.1 General Conditions 22
8.1.1 Facility Description 22
8.1.2 Geographic Service Area 22
8.1.3 Hours of Operation 22
8.1.4 Personnel Training and Certification 22
8.1.5 Utilities 22
8.1.6 Equipment Requirements 23
8.1.7 Safety 23
8.2 CONTACT INFORMATION 23

8.2.1 Emergencies 23
8.2.2 C&D Landfill, Inc./EJE Recycling, Inc. 23
8.2.3 North Carolina Department of Environment and Natural Resources 24
8.3 Facility Operation Drawings 24
8.4 Waste Acceptance Criteria 24
8.4.1 Permitted Wastes 24
8.4.2 Asbestos 25
8.4.4 Wastewater Treatment Sludge 25
8.5 Waste Exclusions 25
8.6 Waste Handling Procedures 25
8.6.1 Waste Receiving and Inspection 26
8.6.2 Disposal of Rejected Wastes 27
8.6.3 Waste Disposal Procedures 27
8.5.3.1 Access 27
8.6.3.2 General Procedures 27
8.6.3.3 Special Wastes: Asbestos Management 28
8.7 Cover Material 29
8.7.1 Periodic Cover 29
8.7.2 Final Cover 29
8.7.3 Unacceptable Waste Contingency 30
8.7.3.1 Hot Loads Contingency Plan 30
8.7.3.2 Hazardous Waste Contingency Plan 30
8.7.4 Severe Weather Contingency 31
8.7.4.1 Ice Storms 31
8.7.4.2 Heavy Rains 31
8.7.4.3 Electrical Storms 31
8.7.4.4 Windy Conditions 31
8.7.4.5 Violent Storms 32
8.8 Spreading and Compaction 32
8.9 Vector Control 32
8.10 Air Criteria and Fire Control 32
8.10.1 Air Quality Criteria 32
8.10.2 Fire Control 32
8.11 Access and Safety 33
8.10 Access and Safety 33
8.11.1 Access Control 33
8.11.1.1 Physical Restraints 33
8.11.1.2 Security 33
8.11.1.3 All-Weather Access 33
8.11.1.4 Traffic 33
8.11.1.5 Anti-Scavenging Policy 33
8.11.2 Signage 33
8.11.3 Communications 34
8.12 Sedimentation Erosion Control 34
8.13 Drainage Control and Water Protection 34
8.14 Survey for Compliance 34

8.14.1 Height Monitoring 34
8.14.2 Annual Survey 34
8.15 Operating Record and Recordkeeping 35
8.16 Annual Reporting 36
9.0 CLOSURE AND POST-CLOSURE 37
9.1 Summary of Regulatory Requirements 37
9.1.1 Final Cap 37
9.1.2 Construction Requirements 37
9.1.3 Alternative Cap Design 37
9.1.4 Division Notifications 37
9.1.5 Required Closure Schedule 37
9.1.6 Recordation 38
9.2 Closure Plan 38
9.2.1 Final Cap Installation 38
9.2.1.1 Final Elevations 38
9.2.1.2 Final Slope Ratios 38
9.2.1.3 Final Cover Section 38
9.2.1.4 Final Cover Installation 39
9.2.1.5 Final Cover Vegetation 40
9.2.1.6 Documentation 40
9.2.2 Maximum Area/Volume Subject to Closure 41
9.2.3 Closure Schedule 41
9.2.4 Closure Cost Estimate 41
9.2.4 Closure Cost Estimate 41
9.3 Post-Closure Plan 42
9.3.1 Monitoring and Maintenance 42
9.3.1.1 Term of Post-Closure Care 42
9.3.1.2 Maintenance of Closure Systems 42
9.3.1.3 Landfill Gas Monitoring 42
9.3.1.4 Ground Water Monitoring 42
9.3.1.5 Record Keeping 42
9.3.1.6 Certification of Completion 42
9.3.2 Responsible Party Contact 44
9.3.3 Planned Uses of Property 44
9.3.4 Post-Closure Cost Estimate 44
10.0 MONITORING PLAN 45
10.1 Summary of Regulatory Requirements 45
10.2 Ground Water Monitoring 45
10.2.1 Monitoring System Requirements 45
10.2.2 Background Water Quality 46
10.2.3 Point of Compliance Water Quality 46
10.2.4 Sampling and Analysis Procedures 46
10.2.5 Detection-phase Monitoring Parameters 46
10.2.6 Sampling Frequency 47
10.2.7 Water Level Elevations 47
10.2.8 Reporting 47

10.2.9 Source Demonstration 47
10.2.10 Monitoring Well Design 47
10.2.11 Monitoring Well Layout 47
10.2.12 Alternative Monitoring Systems 47
10.2.13 Assessment Monitoring 47
10.3 Surface Water Monitoring 48
10.4 Gas Control Plan 48
10.4.1 Regulatory Limits 48
10.4.2 Monitoring Program 48
10.4.3 Corrective Action 48
10.5 Waste Acceptance 48
10.6 Plan Preparation and Certification 49
11.0 FINANCIAL ASSURANCE 50

REFER TO THE VOLUME1 TABLE OF CONTENTS FOR A GUIDE TO THE GEOLOGICAL ASPECTS OF THE FACILITY PLAN

TABLES *Refer to the in-text tables referenced by page number*

7A CQA Testing Schedule for General Earthwork 20

7B CQA Testing Schedule for Drainage and Final Cover 21

7C CQA Testing Schedule for Compacted Soil Barrier 21

9A Estimated Final Closure Costs for Phase 2 41

9B Post-Closure Monitoring and Maintenance Schedule 43

9C Estimated Post-Closure Costs for Phase 2 44

11A Annual Post-Closure Cost Projection for 30 Years 51

11B Post-Closure Cost Projection Indexed to Inflation 52

DRAWINGS *Refer to the rolled drawing set that accompanies this report*

APPENDICES – VOLUME 2

7 Stability and Settlement Calculations

8 Sedimentation and Erosion Control Calculations

9 Operation Plan Information

- 9A Facility Plan Maps
- 9B Waste Screening Form
- 9C Emergency and Other Useful Contacts
- 9D Fire Notification Form

10 Financial Assurance Documents

5.0 ENGINEERING PLAN (15A NCAC 13B .0539)

5.1 Engineering Report

This section of the report describes the physical aspects of the facility design, with emphasis on waste containment and environmental control systems, based on the hydrogeologic data discussed in **Section 4.0**. The design was prepared by a qualified Professional Engineer, who is licensed to practice in North Carolina and is familiar with the requirements of the North Carolina Division of Waste Management (Division) rules. The design of CDLF Phase 2 is set to provide approximately 9 years of capacity, in keeping with rules. Also, in keeping with the intent of the **2006 C&D Rules**, there is no liner or leachate collection system proposed for this facility since the site meets the rule requirements for soil types present within two feet below planned base grades, and there is at least 4 feet of vertical separation between the waste and seasonal high ground water and/or bedrock, (see **Rule .0540 (2)**). The planned base grades and outer slopes will have maximum slope ratios of 3H:1V, which have been demonstrated to be stable.

5.1.1 Analytical Methods

The facility design incorporates elements that are consistent with Division rules and guidelines, as well as sound engineering practice. Various analyses used in the design of the facility include evaluations of soil conditions, i.e., the consistency of subgrade soils and the availability of suitable soils for constructing stable embankments and other earthen structures (discussed below), and ground water characteristics, i.e., flow directions and seasonal water depth fluctuations (discussed in **Section 4.0**). Soil properties testing used to facilitate these evaluations included grain size analysis, shear strength, consolidation, and compaction characteristics (see **Appendix 5**). Stability and settlement of foundation soils were considered in setting base grades, as was outer slope stability for the final cover system (see **Appendix 7**). Other analyses included a detailed evaluation of S&EC and storm water management systems (see **Appendix 8**).

5.1.2 Identified Critical Conditions

Based on the nature of the soils within the Phase 2 footprint and the understanding of geologic conditions within the region (and the site), no inherent foundation stability or long-term settlement problems are anticipated. Some considerations that are both generic to landfills and specific to the on-site soils, learned through practical experience with the construction and operation of Phase 1, are discussed below.

- On-site soils are typically sandy, whereas fine grained soils that meet the soil-type requirements for the upper two (2) feet beneath the base grade elevations are available but often difficult to obtain in the region. Required soil types for the upper two (2) feet of base grades include SM, SC, ML, MH, CL, and CH. Borrow site selection and a field evaluation of the soils during construction (i.e., the CQA program, see Section 7) will be critical to assure the subgrade construction complies with the rule requirements.

- Soil compaction is dependent on both compaction effort (i.e., the right equipment) and working within the correct range of near-optimum moisture (**Section 5.2**).

- Properly compacted embankments are expected to be stable. Outer slope stability (relative to final cover) will also rely on adequate compaction and observation of proper slope ratios, due to the strength considerations.

- Another consideration is significant soil erosivity, which is counteracted with good cover construction practices and vegetative cover. The on-site soils have moderate field capacity and poor nutrient value, which may require additional effort to establish vegetation. These conditions pose operational considerations but require no special design accommodations.

5.1.3 Technical References

Calculations found in **Appendix 7** are referenced within the various analyses.

5.1.4 Location Restriction Demonstrations

The site was granted a Site Suitability determination in accordance with **15A NCAC 13B .0531** *et seq.* based on work completed in 2003-04, i.e., the site characteristics were determined suitable for a C&D landfill. Relative to **Rule .0536** pertaining to C&D landfills, the site has no disqualifying conditions with respect to zoning, setbacks from residences or potable wells, historic or cultural sites, state or nature preserves, 100-year floodplains, wetlands (except as discussed in **Section 3.3.3**), water supply watersheds, or endangered species. Documentation pertaining to these site selection criteria is found in **Appendix II** in the October 2002 **Site Suitability Report**.

5.2 Construction Materials and Practices

Based on the Design Hydrogeologic investigation (see **Section 4.0**), on-site soils available for embankment and subgrade construction consist chiefly of variably silty sand (i.e., Unified Soil Classification System classifications of SM and SM-ML) with silty clay (CL) and clayey silt (ML). These soils meet the requirements for the upper two feet beneath the landfill subgrade referenced in **15A NCAC 13B .0540 (2)** (see **Section 6.0**). The soils exhibit adequate compaction characteristics and shear strength (when properly compacted) to build stable embankments and subgrades that will not undergo excessive settlement – subject to the caveats discussed in **Section 5.1.2** (see above). Some selective use of soils and/or field evaluation will be required to place the correct soil types within the upper two (2) beneath the subgrade elevations.

Good construction practices for embankments and subgrades include compaction using steel-wheel rollers, sheep foot rollers, and/or smooth-drum rollers of sufficient weight – not dozers – making a minimum numbers of passes (typically three to five passes) in two perpendicular directions in order to achieve the desired strength properties for stability. Past experience at the site indicates that material selection (i.e., avoiding soils that are

excessively wet or exhibit excess organic debris content) and/or blending soils to negate the effects of wet or slick soils will produce satisfactory results. The targeted compaction criterion is 95% of standard Proctor maximum dry density (**ASTM D-698**). Critical embankment and subgrade areas should be tested to ensure proper compaction in accordance with the criteria outlined in the CQA Plan (**Section 7.0**).

5.3 Design Hydrogeologic Report

Refer to **Section 4.0** of this report.

5.4 Engineering Drawings

Refer to the rolled plan set that accompanies this report. All relevant criteria required by the rules (except as noted) are depicted on the plans.

5.4.1 Existing Conditions

See **Drawings S1 – S5**.

5.4.2 Grading Plan

See **Drawing E1**.

5.4.3 Stormwater Segregation

See **Drawing E1** – while this rule requirement pertains to separation of stormwater runoff from leachate (i.e., a lined landfill), in order to reduce generated leachate volumes, good practices for water management include maintaining slopes with positive drainage (always directed toward approved stormwater control measures), facilitated by an orderly waste placement sequence, shown on this drawing.

5.4.4 Final Cap System

See **Drawing E2** for final contours and **Drawing EC2** for final cover cross-section and details.

5.4.5 Temporary and Permanent S&EC

See **Drawing E1** for temporary sedimentation and erosion control (S&EC) measures and **Drawing EC1** for final measures. A separate S&EC plan submittal to NC DENR Division of Land Quality has been made. Minor design revisions to the S&EC plan, if any, resulting from the Division of Land Quality review will be incorporated during construction and shown on "as-built" drawings for the Permit to Operate application.

5.4.6 Vertical Separation

See **Drawing E1** for base grades relative to ground water; also see cross section **Drawings X1 – X2**.

5.4.7 Other Features

This rule pertains to liners and leachate collection systems, if proposed (none are).

6.0 CONSTRUCTION PLAN REQUIREMENTS (15A NCAC 13B .0540)

This section demonstrates compliance of the facility design for CDLF Phase 1A with the requirements of the **2006 C&D Rules, 15A NCAC 13B .0531** ***et seq.*** Reference is made to the construction plan set and various appendices, in which the calculations are presented.

6.1 Horizontal Separation

The following regulatory criteria are addressed in project drawings specified below. Refer to the rolled plan set that accompanies this report.

6.1.1 Property Lines

The minimum setback to property lines is 200 feet (**Drawings S4, S5 and E1**).

6.1.2 Residences and Wells

The minimum setback to residences and wells is 500 feet (**Drawings S1 – S3**).

6.1.3 Surface Waters

The minimum setback to surface waters is 50 feet (**Drawings S4, S5 and E1**).

6.1.4 Existing Landfill Units

The minimum setback to Phase 1 C&D landfill is 100 feet (**Drawing S4**). The Phases are separated by a small stream with associated wetlands – essentially these are separate disposal units for monitoring purposes. The planned expansion (Phase 2) is cross-gradient from Phase 1 relative to local and regional ground water flow. Phase 2 is not expected to impact either operations or monitoring of Phase 1, nor vice-versa.

6.2 Vertical Separation

6.2.1 Settlement

Maximum waste thicknesses are approximately 70 feet; the waste density is approximately 0.5 tons/cubic yard. Foundation soils are very medium stiff, normally consolidated silty sand, sandy silt and/or clayey sand and silt (all marine deposits). Settlement calculations (see **Appendix 7**) indicate maximum post-construction settlements on the order of 8 inches, or less. Based on the grading plan (**Drawing E1**), settlements of this magnitude will not decrease the vertical separation to less than 4 feet, nor will strains adversely affect the engineered subgrade.

6.2.2 Soil Consistency

Based on the laboratory data (see **Section 4.1.4**), a majority of the on-site soils generally classify as silty sands (SM), silt (ML) or dual classify as sand-silt (SM-ML). A relatively small fraction of the near surface soils consist of low plasticity silty clay (CL), and there are minor high plasticity silty clay (MH-CH) soil types present. These soil types will be present either in-situ or within compacted subgrades, meeting the requirements of **Rule .0540 (2) (b)** for the upper two feet beneath the subgrade. No modification of the soils, i.e., admixtures, will be required to meet this rule requirement, but reworking to blend the soils to a more uniform consistency and proper compaction may be required to mitigate isolated pockets of highly granular soils. For new base grade fill sections, proper soil selection will be required. The soil types shall be documented in the CQA program.

6.3 Survey Control Benchmarks

A permanent benchmark has been established by Burgess Land Surveying, P.A., of Wilson, NC. The benchmark is tied into the North Carolina State Plan (NCSP) coordinate system. The NCSP coordinates of the benchmark are as follows:

N 596,356.5642
E 1,119,904.2133
El. 955.43

6.4 Site Location Coordinates

The latitude and longitude coordinates of the center of the site are approximately:

N 35.3477,
E -81.9504.

6.5 Landfill Subgrade

6.5.1 Subgrade Inspection Requirement

The Owner/Operator shall have the Phase 1A subgrade inspected by a qualified engineer or geologist upon completion of the excavation, in accordance with **Rule .0534 (b)** and **Rule .0539**. Said inspection is required by the Division to verify that subgrade conditions are consistent with expected conditions based on the Design Hydrogeologic Report.

6.5.2 Division Notification

The Owner/Operator shall notify the Division at least 24 hours in advance of the subgrade inspection.

6.5.3 Vertical Separation Compliance

The subgrade inspection shall verify to the Division that the minimum vertical separation requirements are met and that required subgrade soil types are present.

6.6 Special Engineering Features

This section of the rules generally pertains to liners and leachate collection systems, if any are present (none will be).

6.7 Sedimentation and Erosion Control

The sedimentation and erosion control structures described elsewhere in this report (see **Appendix 8**) have been designed to accommodate the 25-year, 24-hour storm event, per the North Carolina Sedimentation Pollution Control Law (**15A NCAC 04**). A separate plan has been prepared and submitted to the NC DENR Division of Land Resources, Land Quality Section, and is depicted in the construction plan set (see **Drawings E1 and EC3**). Existing sediment basins for Phase 1 shall be cleaned out and upgraded as needed; new sediment basins shall be constructed for Phase 2.

7.0 CONTRUCTION QUALITY ASSURANCE (15A NCAC 13B .0541)

7.1 General Provisions

This Construction Quality Assurance (CQA) Plan has been prepared to provide the Owner, Engineer, and CQA Testing Firm – operating as a coordinated team – the means to govern the construction quality and to satisfy landfill certification requirements under current solid waste management regulations. The CQA program includes both a quantitative testing program (by a third-party) and qualitative evaluation of construction materials to assure that the construction meets the desired performance criteria, i.e., sufficient strength and permeability. Variations in material properties and working conditions may require minor modification of handling and placement techniques throughout the project. Close communication between the various parties is paramount. It is anticipated that the early stages of the construction activities will require more attention by the CQA team, i.e., the Contractor, Engineer, Owner and CQA Testing Firm.

7.1.1 Definitions

7.1.1.1 Construction Quality Assurance (CQA) – In the context of this CQA Plan, Construction Quality Assurance is defined as a planned and systematic program employed by the Owner to assure conformity of the final cover system installation with the project drawings and the project specifications. CQA is provided by the CQA Testing Firm as a representative of the Owner and is independent from the Contractor and all manufacturers. The CQA program is designed to provide confidence that the items or services brought to the job meet contractual and regulatory requirements and that the final cover will perform satisfactorily in service.

7.1.1.2 Construction Quality Control (CQC) – Construction Quality Control refers to actions taken by manufacturers, fabricators, installers, and/or the Contractor to ensure that the materials and the workmanship meet the requirements of the project drawings and the project specifications. The manufacturer's specifications and quality control (QC) requirements are included in this CQA Manual by reference only. A complete updated version of each manufacturer's QC Plan for any Contractor-supplied components shall be incorporated as part of the Contractor's CQC submittal. The Owner and/or the Engineer shall approve the Contractor's QC submittal prior to initial construction. Contractor submittals may be (but us not required to be) incorporated into the final CQA certification document at the Owner's discretion.

7.1.1.3 CQA Certification Document – The Owner and/or the Engineer will prepare a certification document upon completion of construction, or phases of construction. The Owner will submit these documents to the State Solid Waste Regulators (SC DHEC). The CQA certification report will include relevant testing performed by the CQA Testing Firm, including field testing used to verify preliminary test results and/or design assumptions, records of field observations, and documentation of any modifications to the design and/or testing program. An "as-built" drawing (prepared by/for the Owner), showing competed contours, shall be included. The Certification Document may be

completed in increments, i.e., as several documents, as respective portions of the final cover are completed. Section 2 discusses the documentation requirements.

7.1.1.4 Discrepancies Between Documents – The Contractor is instructed to bring discrepancies to the attention of the CQA Testing Firm who shall then notify the Owner for resolution. The Owner has the sole authority to determine resolution of discrepancies existing within the Contract Documents (this may also require the approval of State Solid Waste Regulators). Unless otherwise determined by the Owner, the more stringent requirement shall be the controlling resolution.

7.1.2 Responsibilities and Authorities

The parties to Construction Quality Assurance and Quality Control include the Owner, Engineer, Contractor, CQA Testing Firm (i.e., a qualified Soils Laboratory).

7.1.2.1 Owner – The Owner is C&D Landfill, Inc., who operates and is responsible for the facility. The Owner or his designee is responsible for the project and will serve as liaison between the various parties.

7.1.2.2 Engineer – The Engineer (a.k.a. the "Design Engineer") is responsible for the engineering design, drawings, and project specifications, regulatory affairs, and communications coordinator for the project for the final cover system. The Engineer represents the Owner and coordinates communications and meetings as outlined in **Section 7.3**. The Engineer shall also be responsible for proper resolution of all quality issues that arise during construction. The Engineer shall prepare the CQA certification documents, with input from the Owner, the CQA Testing Firm and the Owner's Surveyor. The Engineer shall be registered in the State of North Carolina.

7.1.2.3 Contractor – The Contractor is responsible for the construction of the subgrade, earthwork, and final cover system. The Contractor is responsible for the overall CQC on the project and coordination of submittals to the Engineer. Additional responsibilities of the Contractor include compliance with North Carolina Sedimentation and Erosion Control rules.

Qualifications – The Contractor qualifications are specific to the construction contract documents and are independent of this CQA Manual.

7.1.2.4 CQA Testing Firm – The CQA Testing Firm (a.k.a. Soils Laboratory) is a representative of the Owner, independent from the Contractor, and is responsible for conducting geotechnical tests on conformance samples of soils, paper mill residuals, and aggregates used in structural fills and the final cover system. The Owner will pay for the services of the Soils Laboratory. Periodic site visits shall be coordinated with the Contractor.

Qualifications – The CQA Testing Firm (Soils Laboratory) will have experience in the CQA aspects of the construction and testing of landfill final cover systems, and be

familiar with ASTM and other related industry standards. The Soils CQA Laboratory will be capable of providing test results within 24 hours or a reasonable time after receipt of samples, depending on the test(s) to be conducted, as agreed to at the outset of the project by affected parties, and will maintain that standard throughout the construction.

7.1.3 Control vs. Records Testing

7.1.3.1 Control Testing – In the context of this CQA plan, Control Tests are those tests performed on a material prior to its actual use in construction to demonstrate that it can meet the requirements of the project plans and specifications. Control Test data may be used by the Engineer as the basis for approving alternative material sources.

7.1.3.2 Record Testing – Record Tests are those tests performed during or after the actual placement of a material to demonstrate that its in-place properties meet or exceed the requirements of the project drawings and specifications.

7.1.4 Modifications and Amendment

This document was prepared by the Engineer to communicate the basic intentions and expectations regarding the quality of materials and workmanship. Certain articles in this document may be revised with input from all parties, if so warranted based on project specific conditions. No modifications will be made without the Engineer's approval.

7.1.5 Miscellaneous

7.1.5.1 Units – In this CQA Plan, and through the plans and specifications for this project, all properties and dimensions are expressed in U.S. units.

7.1.5.2 References – This CQA Plan includes references to the most recent version of the test procedures of the American Society of Testing and Materials (ASTM) and/or the Geosynthetic Research Institute (GRI), as applicable. **Appendix A** contains a list of these procedures.

7.2 Inspection, Sampling and Testing

The requirements of the General Earthwork (perimeter embankments and subgrade) and Final Cover Systems (soil barrier, vegetative cover, storm water management devices) differ with respect to continuous or intermittent testing and oversight. The following two sections are devoted to the specific requirements of each work task.

7.2.1 General Earthwork

This section outlines the CQA program for structural fill associated with perimeter embankments, including sedimentation basins, and general grading of the subgrade. Issues to be addressed include material approval, subgrade approval, field control and record tests, if any, and resolution of problems.

7.2.1.1 Compaction Criteria – All material to be used as compacted embankment shall be compacted to a minimum of **95% of the Standard Proctor Maximum Dry Density (ASTM D-698)**, or as approved by the Engineer or designated QC/QA personnel. Approval is based on visual evaluation for consistency with project specification and objectives. Such material evaluations may be performed either during material handling, i.e., delivery to or upon receipt at the landfill, or from existing stockpiles and/or the soil borrow site. Borrow soils shall be evaluated by the Engineer and QC/QA personnel prior to placement on the work site.

7.2.1.2 Testing Criteria – Periodic compaction (moisture-density) testing requirements are imposed on the structural fill, although compaction and testing requirements may not be as stringent as that required for the final cover construction. Initial compaction testing shall be in accordance with the project specifications. The Engineer may recommend alternative compaction testing requirements based on field performance. Additional qualitative evaluations shall be made by the Contractor Superintendent and the Engineer to satisfy the performance criteria for placement of these materials.

CQA monitoring and testing will not be "full-time" on this project. Rather, the CQA Testing Firm will test completed portions of the work at the Contractor's or Owner's request. The CQA Testing Firm may be called upon to test final cover and/or compacted structural fill at any time, ideally scheduling site visits to optimize his efforts. The Engineer will make an inspection at least monthly, more often as needed (anticipated more often in the initial stages of new construction).

7.2.1.3 Material Evaluation – Each load of soil will be examined either at the source, at the stockpile area, or on the working face prior to placement and compaction. Any unsuitable material, i.e., that which contains excess moisture, insufficient moisture, debris or other deleterious material, will be rejected from the working face and routed to another disposal area consistent with its end use. Materials of a marginal natural, i.e., too dry or too wet, may be stockpiled temporarily near the working face for further evaluation by designated QC/QA personnel. The Contractor may blend such materials with other materials (in the event of dryness) or dry the materials (in the event of excess moisture).

7.2.1.4 Subgrade Approval – Designated QC/QA personnel shall verify that the compacted embankment and/or subgrade are constructed in accordance with the project specifications prior to placing subsequent or overlying materials.

7.2.2 General Earthwork Construction

7.2.2.1 Construction Monitoring – The following criteria apply:

A. Earthwork shall be performed as described in the project specifications. The Construction Superintendent has the responsibility of assuring that only select materials are used in the construction, discussed above.

B. Only materials previously approved by the Engineer or his designee shall be

used in construction of the compacted embankment. Unsuitable material will be removed and replaced followed by re-evaluation to the satisfaction of the Engineer and retesting, as may be required.

C. All required field density and moisture content tests shall be completed before the overlying lift of soil is placed – as applicable. The surface preparation (e.g. wetting, drying, scarification, compaction etc.) shall be completed before the Engineer (or his designate) will allow placement of subsequent lifts.

D. The CQA Testing Firm and/or the Engineer shall monitor protection of the earthwork, i.e., from erosion or desiccation during and after construction.

7.2.2.2 Control Tests – The control tests, as shown on **Table 7A**, will be performed by the CQA Testing Firm prior to placement of additional compacted embankment.

7.2.2.3 Record Tests – The record tests, as shown on **Table 7A**, will be performed by the CQA Testing Firm during placement of compacted embankment. The CQA Testing Firm may propose and the Engineer may approve an alternative testing frequency. Alternatively, the Engineer may amend the testing frequency, without further approval from the regulatory agency, based on consistent and satisfactory field performance of the materials and the construction techniques.

7.2.2.4 Record Test Failure – Failed tests shall be noted in the construction report, followed by documentation of mitigation. Soils with failing tests shall be evaluated by the Engineer (or his designee), and the soils shall either be recompacted or replaced, based on the Engineer's judgment. Recompaction of the failed area shall be performed and retested until the area meets or exceeds requirements outlined in the specifications.

7.2.2.5 Judgment Testing – During construction, the frequency of control and/or record testing may be increased at the discretion of the CQA Testing Firm when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas will be considered when:

- Rollers slip during rolling operation;
- Lift thickness is greater than specified;
- Fill material is at an improper moisture content;
- Fewer than the specified number of roller passes is made;
- Dirt-clogged rollers are used to compact the material;
- Rollers may not have used optimum ballast;
- Fill materials differ substantially from those specified; or
- Degree of compaction is doubtful.

7.2.2.6 Deficiencies – The CQA Testing Firm will immediately determine the extent and nature of all defects and deficiencies and report them to the Owner and Engineer. The CQA Testing Firm shall properly document all defects and deficiencies – this shall be more critical on the final cover construction, although this applies to structural fill, as well. The Contractor will correct defects and deficiencies to the satisfaction of the Owner and Engineer. The CQA Testing Firm shall perform retests on repaired defects.

7.2.3 Final Cover Systems

This section outlines the CQA program for piping, drainage aggregate, geotextiles, compacted soil barrier layer, and the vegetative soil layer of the final cover system, as well as the related erosion and sedimentation control activities. Issues to be addressed include material approval, subgrade approval, field control and record tests, if any, and resolution of problems.

7.2.3.1 Material Approval – The Engineer and/or the CQA Testing Firm shall verify that the following materials (as applicable) are provided and installed in accordance with the project drawings, specifications, and this CQA Manual. In general, the Contractor shall furnished material specification sheets to the Engineer for review and approval. In certain cases, materials furnished by the Contractor may need to meet the Owner's requirements, in which case the Owner shall approve of the materials with the Engineer's concurrence. The materials approval process may involve the submittals furnished by the Owner, (for documentation purposes) in the event that the Owner decides to furnish certain materials.

A. High Density Polyethylene (HDPE) Pipe

(1) Receipt of Contractor's submittals on HDPE pipe.

(2) Review of submittals for HDPE pipe for conformity to the project specifications.

B. Corrugated Polyethylene (CPE) Pipe

(1) Receipt of Contractor's submittals on CPE pipe.

(2) Review of submittals for CPE pipe for conformity to the project specifications.

C. Aggregates (Verify for each type of aggregate)

(1) Receipt of Contractor's submittals on aggregates.

(2) Review of submittals for aggregates for conformity to the project specifications.

(3) Verify that aggregates in stockpiles or at borrow sources conform to the project specifications. A quarry testing certification will be sufficient.

(4) Perform material evaluations in accordance with **Table 7B**.

D. Vegetative Soil Layer

(1) Review the proposed source of vegetative soil layer for conformance with the project specifications.

(2) Perform material evaluations in accordance with **Table 7C**.

E. Compacted Barrier Layer

(1) Review the proposed source material for compacted barrier layer for conformance with the project specifications.

(2) Conduct material control tests in accordance with **Table 7C**.

F. Erosion and Sedimentation Control

(1) Receipt of Contractor's submittals on erosion and sedimentation control items (including rolled erosion control products and revegetation).

(2) Review of submittals for erosion and sedimentation control items for conformity to the project specifications.

7.2.3.2 Final Cover Systems Installation – The CQA Testing Firm, in conjunction with the Engineer, will monitor and document the construction of all final cover system components for compliance with the project specifications. Monitoring for the components of the final cover system includes the following:

- Verify location of all piping;
- Monitoring for minimum vertical buffer between field equipment and piping;
- Monitoring thickness and moisture-density of the final cover layers and verification that equipment does not damage the compacted barrier layer or other components; and
- Monitoring that erosion and sedimentation control items are properly installed.

7.2.3.3 Deficiencies – The CQA Testing Firm and/or the Engineer will immediately determine the extent and nature of all defects and deficiencies and report them to the Owner. The CQA Testing Firm and/or the Engineer shall properly document all defects and deficiencies. The Contractor will correct defects and deficiencies to the satisfaction of the Engineer. The CQA Testing Firm and/or the Engineer shall observe all retests on repaired defects.

7.3 CQA Meetings

Effective communication is critical toward all parties' understanding of the objectives of the CQA program and in resolving problems that may arise that could compromise the ability to meet those objectives. To that end, meetings are essential to establish clear, open channels of communication. The frequency of meetings will be dictated by site conditions and the effectiveness of communication between the parties.

7.3.1 Project Initiation CQA Meeting

A CQA Meeting will be held at the site prior to placement of the compacted barrier layer. At a minimum, the Engineer, the Contractor, and representatives of the CQA Testing Firm and of the Owner will attend the meeting. The purpose of this meeting is to begin planning for coordination of tasks, anticipate any problems that might cause difficulties and delays in construction, and, above all, review the CQA Manual to all of the parties involved.

During this meeting, the results of a prior compaction test pad will be reviewed, and the project specific moisture-density relationships and it is very important that the rules regarding testing, repair, etc., be known and accepted by all. This meeting should include all of the activities referenced in the project specifications. The Engineer shall document the meeting and minutes will be transmitted to all parties.

7.3.2 CQA Progress Meetings

Progress meetings will be held between the Engineer, the Contractor, a representative of the CQA Testing Firm, and representatives from any other involved parties. Meeting frequency will be, at a minimum, once per month during active construction or more often if necessary during critical stages of construction (i.e., initial stages of final cover). These meetings will discuss current progress, planned activities for the next week, and any new business or revisions to the work. The Engineer will log any problems, decisions, or questions arising at this meeting in his periodic reports. Any matter requiring action, which is raised in this meeting, will be reported to the appropriate parties. The Engineer will document these meetings and minutes will be transmitted to affected parties.

7.3.3 Problem or Work Deficiency Meetings

A special meeting will be held when and if a problem or deficiency is present or likely to occur. At a minimum, the Engineer, the Contractor, the CQA Testing Firm, and representatives will attend the meeting from any other involved parties. The purpose of the meeting is to define and resolve the problem or work deficiency as follows:

- Define and discuss the problem or deficiency;
- Review alternative solutions; and
- Implement an action plan to resolve the problem or deficiency.

The Engineer will document the meeting; minutes will be transmitted to all affected parties.

7.4 Documentation and Reporting

An effective CQA plan depends largely on recognition of which construction activities should be monitored and on assigning responsibilities for the monitoring of each required activity. This is most effectively accomplished and verified by the documentation of quality assurance activities. The CQA Testing Firm will provide documentation to address quality assurance requirements. Monitoring will not be continuous and full-time, although the CQA Testing Firm representative (typically this is a Soil Technician) and the Engineer will make frequent and periodic visits to inspect and/or test the work. Both parties shall keep records of their visits and observations.

The Soils Technician will visit the site periodically (e.g., once per week) to document activities during placement of the structural fill and during final cover construction. Site visits by the CQA Testing Firm shall be coordinated between the Contractor and the CQA Testing Firm. The Engineer will make monthly site visits during these critical stages to review the work.

The Construction Superintendent or his representative shall be present on-site daily and shall keep a record of the general construction progress, noting specifically any problems or inconsistencies that need to be brought to the Owner's attention. The specifics of the Contractor's records will not be spelled out, but at a minimum, daily or weekly progress records shall be kept and made available to the Owner upon request.

The CQA Testing Firm will provide the Owner (or his designee) with periodic progress reports including signed descriptive remarks, data sheets, and logs to verify that required CQA activities have been carried out. These reports shall also identify potential quality assurance problems. The CQA Testing Firm will also maintain at the job site a complete file of project drawings, reports, project specifications, the CQA Plan, periodic reports, test results and other pertinent documents. The Owner shall furnish a location to keep this record file. Occasional documentation by the Contractor and the Engineer will be kept in the record file.

7.4.1 Periodic CQA Reports

The CQA Testing Firm representative's reporting procedures will include preparation of a periodic report that will include the following information, where applicable:

- A unique sheet number for cross referencing and document control;
- Date, project name, location, and other identification;
- Data on weather conditions;
- A Site Plan showing all proposed work areas and test locations;
- Descriptions and locations of ongoing construction;
- Descriptions and specific locations of areas, or units, of work being tested and/or observed and documented;
- Locations where tests and samples were taken;
- A summary of test results (as they become available, in the case of laboratory tests);
- Calibration or recalibration of test equipment, and actions taken as a result of recalibration;
- Off-site materials received, including quality verification documentation;
- Decisions made regarding acceptance of units of work, and/or corrective actions to be taken in instances of substandard quality;
- Summaries of pertinent discussions with the Contractor and/or Engineer;
- The Technician's signature.

The periodic report must be completed by the end of each Technician's visit, prior to leaving the site. This information will keep at the Contractor's office and reviewed periodically by the Owner and Engineer. The CQA Testing Firm on a weekly basis should forward copies of the Periodic CQA Reports electronically to the Engineer. Periodic CQA Reports shall be due to the Engineer no later than Noon on the next working day (typically Monday) following the end of a work week (typically Friday). If a periodic visit is postponed or cancelled, that fact should be documented by the CQA Testing Firm and noted in the next periodic report.

7.4.2 CQA Progress Reports

The Engineer will prepare a summary progress report each month, or at time intervals established at the pre-construction meeting. As a minimum, this report will include the following information, where applicable:

- Date, project name, location, and other information;
- A summary of work activities during the progress reporting period;
- A summary of construction situations, deficiencies, and/or defects

occurring during the progress reporting period;

- A summary of all test results, failures and retests, and
- The signature of the Engineer.

The Engineer's progress reports must summarize the major events that occurred during that week. This report shall include input from the Contractor and the CQA Testing Firm. Critical problems that occur shall be communicated verbally to the Engineer immediately (or as appropriate, depending on the nature of the concern) as well as being included in the Periodic CQA Reports.

7.4.3 CQA Photographic Reporting

Photographs shall be taken by the CQA Testing Firm at regular intervals during the construction process and in all areas deemed critical by the CQA Testing Firm. These photographs will serve as a pictorial record of work progress, problems, and mitigation activities. These records will be presented to the Engineer upon completion of the project. Electronic photographs are preferred, in which case the electronic photos should be forwarded to the Engineer (the CQA Testing Firm shall keep copies, as well). In lieu of photographic documentation, videotaping may be used to record work progress, problems, and mitigation activities. The Engineer may require that a portion of the documentation be recorded by photographic means in conjunction with videotaping.

7.4.4 Documentation of Deficiencies

The Owner and Engineer will be made aware of any significant recurring nonconformance with the project specifications. The Engineer will then determine the cause of the non-conformance and recommend appropriate changes in procedures or specification. When this type of evaluation is made, the results will be documented, and the Owner and Engineer will approve any revision to procedures or specifications.

7.4.5 Design and/or Technical Specification Changes

Design and/or project specification changes may be required during construction. In such cases, the Contractor will notify the Engineer and/or the Owner. The Owner will then notify the appropriate agency, if necessary. Design and/or project specification changes will be made only with the written agreement of the Engineer and the Owner, and will take the form of an addendum to the project specifications. All design changes shall include a detail (if necessary) and state which detail it replaces in the plans.

7.5 FINAL CQA REPORT

At the completion of each major construction activity at the landfill unit, or at periodic intervals, the CQA Testing Firm will provide final copies of all required forms, observation logs, field and laboratory testing data sheets, sample location plans, etc., in a certified report. Said report shall include summaries of all the data listed above. The Engineer will provide one or more final reports, pertinent to each portion of completed

work, which will certify that the work has been performed in compliance with the plans and project technical specifications, and that the supporting documents provide the necessary information. The Engineer will provide Record Drawings, prepared with input from the Owner's Surveyor, which will include scale drawings depicting the location of the construction and details pertaining to the extent of construction (e.g., depths, plan dimensions, elevations, soil component thicknesses, etc.). All final surveying required for the Record Drawings will be performed by the Owner's Surveyor.

At a minimum, the items shown below shall be included in the Final CQA Report(s). Note that some items may not be applicable to all stages of the project.

FINAL CQA REPORT GENERAL OUTLINE (FINAL COVER SYSTEM)

1.0 Introduction
2.0 Project Description
3.0 CQA Program
3.1 Scope of Services
3.2 Personnel
4.0 Earthwork CQA
5.0 Final Cover System CQA
6.0 Summary and Conclusions
7.0 Project Certification

Appendices

A Design Clarifications/Modifications
B Photographic Documentation
C CQA Reporting
  C1. CQA Reports
  C2. CQA Meeting Minutes
D Earthwork CQA Data
  D1. CQA Test Results - Control Tests
  D2. CQA Test Results - Record Tests
E Final Cover System CQA Data
  E1. Manufacturer's Product Data and QC Certificates
  E2. CQA Test Results - Drainage Aggregate
  E3. CQA Test Results - Vegetative Soil Layer
  E4. CQC Test Results - Pressure Testing of HDPE Piping
F Record Drawings
  F1. Subgrade As Built
  F2. Vegetative Soil Layer As Built

7.6 STORAGE OF RECORDS

All handwritten data sheet originals, especially those containing signatures, will be stored in a secure location on site. Other reports may be stored by any standard method, which will allow for easy access. All written documents will become property of the Owner.

TABLE 7A
CQA TESTING SCHEDULE FOR GENERAL EARTHWORK

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
CONTROL TESTS:		
Consistency Evaluation	Visual[1]	Each Material
RECORD TESTS:		
Lift Thickness	Direct Measure	Each compacted lift
In-Place Density	ASTM D 2922[2]	20,000 ft^2 per lift
Moisture Content	ASTM D 3017[3]	20,000 ft^2 per lift

Notes:

1. To be performed by Contractor Superintendent, Engineer, or CQA Testing Firm.
2. Optionally use ASTM D 1556, ASTM D 2167, or ASTM D 2937. For every 10 nuclear density tests perform at least 1 density test by ASTM D 1556, ASTM D 2167, or ASTM D 2937 as a verification of the accuracy of the nuclear testing device.
3. Optionally use ASTM D 2216, ASTM D 4643, or ASTM D 4959. For every 10 nuclear density-moisture tests, perform at least 1 moisture test by ASTM D 2216, ASTM D 4643, or ASTM D 4959 as a verification of the accuracy of the nuclear testing device.

TABLE 7B
CQA TESTING SCHEDULE FOR DRAINAGE AND FINAL COVER

COMPONENT	PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
RECORD TESTS:			
Coarse Aggregate:	Confirm Gradation	Visual	5,000 CY[1]
Vegetative Soil Layer: (In-Situ Verification)	Visual Classification	ASTM D 2488	1 per acre
	Layer Thickness	Direct measure	1 per acre

Notes:

1. A quarry certification is acceptable for aggregate from a commercial quarry. If a byproduct is used, i.e., crushed concrete aggregate, the gradation test frequency may be adjusted based on project specific conditions. The Engineer shall approve all materials and alternative test frequencies.

TABLE 7C
CQA TESTING SCHEDULE FOR COMPACTED SOIL BARRIER

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
RECORD TESTS:		
Lift Thickness	Direct measure	4 per acre per lift
Permeability	ASTM D5084[1]	1 per acre per lift
In-Place Density	ASTM D 2922[2]	4 per acre per lift
Moisture Content	ASTM D 3017[3]	4 per acre per lift

Notes:

1. Optionally use ASTM D6391.
2. Optionally use ASTM D 1556, ASTM D 2167, or ASTM D 2937. For every 10 nuclear density tests perform at least 1 density test by ASTM D 1556, ASTM D 2167, or ASTM D 2937 as a verification of the accuracy of the nuclear testing device.
3. Optionally use ASTM D 2216, ASTM D 4643, or ASTM D 4959. For each 10 nuclear moisture tests, perform at least 1 moisture test by ASTM D 2216, ASTM D 4643, or ASTM D 4959 as a verification of the accuracy of the nuclear testing device.

8.0 OPERATION PLAN (15A NCAC 13B .0542)

8.1 General Conditions

This Operations Plan was prepared for C&D Landfill, Inc., Phase 2 to provide landfill personnel with an understanding of relevant rules and how the Design Engineer assumed that the facility would be operated. While deviations from the operation plan outlined here may be acceptable, significant changes should be reviewed and approved by the Design Engineer and/or regulatory personnel.

8.1.1 Facility Description

The landfill entrance is located at 802 Recycling Lane, accessed from US 264. The scales and office are located near the front gate, which is the only means of accessing the site by the public. After crossing the scales, incoming loads are directed either to the Recycling Yard or to the working face of the C&D disposal unit. Tires and LCID are recycled in specific areas shown on the Facility Plan Map (see **Drawing S4**).

8.1.2 Geographic Service Area

The current service area authorized by the Pitt County Commissioners includes a multi-county area (see Section 3.3). The facility receives C&D from commercial haulers, contractors, and private individuals. The recycling facility and MSW transfer station receive other wastes, which are segregated from the C&D and managed in separate areas. The operator will be responsible for knowing his customer base and waste stream characteristics, such that the approved service area is observed.

8.1.3 Hours of Operation

The landfill is open to the public from 7 AM to 4 PM on Monday – Friday and 7 AM to 12 PM on Saturday. All current operations for the C&D landfill are within those hours.

8.1.4 Personnel Training and Certification

NC DENR Division of Waste Management rules require that a certified Operator be present on-site at all times during operations. As many of the facility staff as practical will receive Operations Specialist training from a credible organization, e.g., SWANA. Certificates will be posted prominently in the scale house, and certifications will be kept up-to-date.

8.1.5 Utilities

Electrical power, water, telephone, and restrooms are provided at the scale house.

8.1.6 Equipment Requirements

The Facility will maintain on-site equipment required to perform the necessary landfill activities. Periodic maintenance of all landfill equipment, and minor and major repair work will be performed at designated maintenance zones outside of the landfill.

8.1.7 Safety

All aspects of the C&D Landfill, Inc., operation were developed with the health and safety of the landfill's operating staff, customers, and neighbors in mind. The Owner or General Manager of the facility is the designated Site Safety Officer and is responsible for the safe operation of the facility in keeping with Occupational Safety and Health Administration (OSHA) requirements. Regular safety meetings with staff (minimum one per month) shall be conducted.

Safety equipment to be provided includes (at a minimum) equipment rollover protective cabs, seat belts, audible reverse warning devices, hard hats, safety shoes, and first aid kits. Landfill personnel will be encouraged to complete the American Red Cross Basic First Aid Course with CPR. Safety for customers will be promoted by the Operator and his staff knowing where the equipment and customer vehicles are moving at all times. Radio communications between the scale house and the field staff will help keep track of the location and movement of customers.

8.2 CONTACT INFORMATION

8.2.1 Emergencies

For fire, police, or medical/accident emergencies dial 911.

A partial listing Emergency and other Useful Contacts, published on the NC DENR Division of Waste Management web site, is provided in **Appendix 9C**.

All correspondence and questions concerning the operation of the C&D Landfill should be directed to the appropriate County staff and/or State personnel listed below.

8.2.2 C&D Landfill, Inc. / EJE Recycling, Inc.

Mr. Judson Whitehurst, Owner
Mr. Wayne Bell, General Manager
C&D Landfill, Inc.
802 Recycling Lane
Greenville, North Carolina 27834

Tel 252-752-8274
Fax 252-752-9016

- Construction and Demolition Debris Waste: (Waste or debris from construction, remodeling, repair, or demolition operations on pavement or other structures);

- Land Clearing and Inert Debris Waste: (yard waste, stumps, trees, limbs, brush, grass, concrete, brick, concrete block, uncontaminated soils and rock, untreated and unpainted wood, etc.);

- Other Wastes as approved by the NC DENR Solid Waste Section.

In addition, the special wastes, i.e., asbestos (see **Section 8.3.2**) may also be accepted at this facility. Municipal solid waste (MSW) will be routed to the on-site transfer station. Animal carcasses may be disposed on the working face or within a special designated area, subject to immediate covering with waste.

8.4.2 Asbestos

C&D Landfill, Inc., may dispose of asbestos within a designated area within the normal footprint, only if the asbestos has been processed, packaged and transported in accordance with State and Federal (40 CFR 61) regulations. Handling asbestos requires advance arrangements between the hauler and the landfill and special placement techniques (see (**Section 8.5.3.3**).

8.4.4 Wastewater Treatment Sludge

WWTP sludge may **not** be disposed in the C&D Landfill, per Division rules. WWTP sludge may be used as a soil conditioner to enhance the final cover, upon receipt of permission from the Division, to be applied at agronomic rates.

8.5 Waste Exclusions

No municipal solid waste (MSW), hazardous waste as defined by 15A NCAC 13A .0102, or hazardous waste from conditionally exempt small quantity generators (CESQG waste), or liquid waste will be accepted. No drums or industrial wastes shall be accepted. No tires, batteries, polychlorinated biphenyl (PCB), electronic devices (computer monitors), medical wastes, radioactive wastes, septage, white goods, yard trash, fluorescent lamps, mercury switches, lead roofing materials, transformers, of CCA treated wood shall be disposed. No pulverized or shredded C&D wastes may be accepted.

The Facility will implement a waste-screening program, described in **Section 8.6** below, to control these types of waste. The reader is directed to **Solid Waste Rule .0542 (e)** for further exclusions.

8.6 Waste Handling Procedures

In order to assure that prohibited wastes are not entering the landfill facility, screening programs have been implemented at the landfill. Waste received at both the scale house

entrance and waste taken to the working face is inspected by trained personnel. These individuals have been trained to spot indications of suspicious wastes, including: hazardous placards or markings, liquids, powders or dusts, sludges, bright or unusual colors, drums or commercial size containers, and "chemical" odors. Screening programs for visual and olfactory characteristics are an ongoing part of the landfill operation.

8.6.1 Waste Receiving and Inspection

All incoming vehicles must stop at the scale house located near the entrance of the facility, and visitors are required to sign-in. All waste transportation vehicles shall be uncovered prior to entering the scales to facilitate inspection; all incoming loads shall be weighed and the content of the load assessed. The scale attendant shall request from the driver of the vehicle a description of the waste it is carrying to ensure that unacceptable waste is not allowed into the landfill.

Signs informing users of the acceptable and unacceptable types of waste shall be posted at the entrance near the scale house. The attendant shall visually check the vehicle as it crosses the scale. A camera mounted over the scales may facilitate this activity. Any suspicious loads will be pulled aside for a more detailed inspection prior to leaving the scale house area. Loads with unacceptable materials will be required to be recovered (with a tarp) and turned away from the facility. Wastes generated from outside of the service area will be turned away.

Once passing the scales, the vehicles containing C&D wastes are routed to the working face. **Vehicles shall be selected for random screening a minimum of three times per week.** The selection of vehicles for screening might be based on unfamiliarity with the vehicle/driver or based on the driver's responses to interrogation about the load content.

Selected vehicles shall be directed to an area of intermediate cover adjacent to the working face where the vehicle will be unloaded and the waste shall be carefully spread using suitable equipment. An attendant trained to identify wastes that are unacceptable at the landfill shall inspect the waste discharged at the screening site. The Operator shall use the **Waste Screening Form** (see **Appendix 9B**) to document the waste screening activities. If no unacceptable waste is found, the load will be pushed to the working face and incorporated into the daily waste cell.

- If unacceptable waste is found, including, the load will be isolated and secured via soil berms, barricades or cordons. Unacceptable wastes that are non-hazardous will be removed from the C&D area and reloaded onto the delivery vehicle for removal from the facility.

- For unacceptable wastes that are hazardous, the Hazardous Waste Contingency Plan outlined in **Section 8.6.3** will be followed.

The hauler is responsible for removing unacceptable waste from the landfill property. The rejection of the load shall be noted on the **Waste Screening Form**, along with the

identification of the driver and vehicle. A responsible party to the load generator or hauler shall be notified that the load was rejected. The generator or hauler may be targeted for more frequent waste screening and/or banished from delivering to the facility, depending on the nature of the violation of the waste acceptance policy. If the violation is repetitive or severe enough, State and/or County authorities may be notified.

8.6.2 Disposal of Rejected Wastes

Attempts will be made to inspect waste as soon as it arrives in order to identify the waste hauler; ideally, the hauler can be stopped from leaving the site and the rejected materials reloaded onto the delivery vehicle. Non-allowed materials that are found in the waste during sorting or placement, i.e., after the delivery vehicle has left the site, shall be taken to the on-site Transfer Station.

Small quantities of garbage (chiefly food containers) will inevitably wind up in the C&D waste stream from job sites. These may be disposed with the C&D wastes as long as the materials are non-liquid and non-hazardous. If large quantities of garbage, "black bags" or any prohibited wastes are detected, the Operator shall be responsible for removing these materials and placing them into the Transfer Station at the earliest practical time.

8.6.3 Waste Disposal Procedures

8.6.3.1 Access – The location of access roads during waste placement will be determined by operations personnel in order to reflect waste placement strategy.

8.6.3.2 General Procedures – Waste transportation vehicles will arrive at the working face at random intervals. There may be a number of vehicles unloading waste at the same time, while other vehicles are waiting. In order to maintain control over the unloading of waste, only a certain number of vehicles will be allowed on the working face at a time. The working face superintendent and/or equipment operator(s), who will serve as 'spotters', will determine the actual number. This procedure will be used in order to minimize the potential of unloading unacceptable waste and to control disposal activity.

Operations at the working face will be conducted in a manner that will encourage the efficient movement of transportation vehicles to and from the working face, and to expedite the unloading of waste. At no time during normal business hours will the working face be left unattended. Scale house and field staff shall be in constant communication regarding incoming loads and the movement of vehicles on the site, irrespective of facility vehicles or private vehicles. It is the responsibility of the working face superintendent to know where each vehicle in the facility is located and what they are doing at all times.

The use of portable signs with directional arrows and portable traffic barricades will facilitate the unloading of wastes to the designated disposal locations. These signs and barricades will be placed along the access route to the working face of the landfill or

other designated disposal areas that may be established. The approaches to the working face will be maintained such that two or more vehicles may safely unload side by side. A vehicle turn-around area large enough to enable vehicles to arrive and turn around safely with reasonable speed will be provided adjacent to the unloading area. The vehicles will back to a vacant area near the working face to unload. Upon completion of the unloading operation, the transportation vehicles will immediately leave the working face. Personnel will direct traffic as necessary to expedite safe movement of vehicles.

Waste unloading at the landfill will be controlled to prevent disposal in locations other than those specified by site management. Such control will also be used to confine the working face to a minimum width, yet allow safe and efficient operations. The width and length of the working face will be maintained as small as practical in order to maintain the appearance of the site, control windblown waste, and minimize the amount of required periodic cover.

Normally, only one working face will be active on any given day, with all deposited waste in other areas covered by either periodic or final cover, as appropriate. The procedures for placement and compaction of solid waste include: unloading of vehicles, spreading of waste into 2 foot lifts, and compaction on relatively flat slopes (i.e., 5H: IV max.) using a minimum number of three full passes. Depending on the nature of the wastes and long-term volume analysis of in-situ density, the waste placement geometry and compaction procedures may require adjustment to optimize airspace.

8.6.3.3 Special Wastes: Asbestos Management – Asbestos will arrive at the site in vehicles that contain only the asbestos waste and only after advance notification by the generator and if accompanied by a proper NC DMV transport manifest. Once the hauler brings the asbestos to the landfill, operations personnel will direct the hauler to the designated asbestos disposal area. Operations personnel will prepare the designated disposal area by leveling a small area using a dozer or loader. Prior to disposal, the landfill operators will stockpile cover soil near the designated asbestos disposal area. The volume of soil stockpiled will be sufficient to cover the waste and to provide any berms, etc. to maintain temporary separation from other landfill traffic.

Once placed in the prepared area, the asbestos waste will be covered with a minimum of 18 inches of daily cover soil placed in a single lift. The surface of the cover soil will be compacted and graded using a tracked dozer or loader. The landfill compactor will be prohibited from operating over asbestos disposal areas until at least 18 inches of cover are in-place. The landfill staff will, with record the approximate location and elevation of the asbestos waste once cover is in-place. The Owner/Operator will then review pertinent disposal and location information to assure compliance with regulatory requirements and enter the information into the Operating Record. Once disposal and recording for asbestos waste is completed, the disposal area may be covered with waste. No excavation into designated asbestos disposal areas will be permitted.

8.7 Cover Material

8.7.1 Periodic Cover

At the completion of waste placement each week or sooner if the area of exposed waste exceeds one acre in size, a 6 inch layer of earthen material will be placed over the exposed waste. This periodic cover is intended to control vectors, fire, odors, and blowing debris. Alternative periodic cover may consist of ground LCID, WWTP sludge (with permission from the Division) and/or other non-C&D waste materials.

8.7.2 Final Cover

Exterior slopes shall be closed upon reaching final grades in increments throughout the operation of the facility. The permitted final cover for Phase 2 consists of a minimum of 18 inches of compacted soil cover (minimum 10^{-5} cm/sec permeability requirement), overlain by 18 inches of vegetation support soil. An interim soil cover (at least 12 inches in thickness) may be placed on exterior slopes that have attained final grade and left for no more than 20 days without temporary vegetation, until an area of approximately 2 to 3 acres is ready to be closed simultaneously. Alternative final cover designs are allowed by the 2006 C&D rules. Future consideration shall be given to alternative covers, in the interest of meeting the permeability requirements for the compacted soil barrier. Future submittals may be prepared for review by the Division.

All final soil cover shall be spread in at least two uniform lifts (maximum of 12 inches before compaction), and all soils shall be compacted by "tracking" with dozers or other equipment. All disturbed soils shall be vegetated with a seed mix that is suitable to climatic conditions (see construction plans) within 20 days following completion of the grading. All seeded areas should be provided with lime, fertilizer and straw mulch. An emulsified tack may be required to prevent wind damage. Other stabilization treatments, e.g., curled wood matting of synthetic slope stabilization blankets may be employed.

At the operator's discretion, wood mulch may be spread evenly over the final surfaces to provide nutrient (without immediate vegetation); this treatment can be allowed to remain until the wood mulch undergoes partial decomposition, as long as the slopes are stable (not eroding). This allows the operator some flexibility is establishing vegetation at optimum times of the year. The operator shall ensure that all protective measures are functioning prior to placing soil on exterior slopes.

If settlement occurs after the cover is placed, the cover shall be fortified with additional soil. In the case of extreme settlement (unlikely), the old cover can be stripped and the affected area built up with waste prior to replacing the cover. Long-term post-closure maintenance is phased in incrementally, as such, final cover maintenance (erosion repair, reseeding as needed). The sedimentation and erosion control criteria that govern the final closure (final reclamation) of this facility are performance-based; some trial and error may be required, but the goal is to protect the adjacent water bodies and buffers throughout the operational and post-closure periods.

8.7.3 Unacceptable Waste Contingency

8.7.3.1 Hot Loads Contingency Plan – In the event of a "hot" load attempting to enter the landfill, the scale house staff will turn away all trucks containing waste that is suspected to be hot, unless there is imminent danger to the driver. The vehicle will be isolated away from structures and other traffic and the fire department will be called. The vehicle will not be allowed to unload until the fire is out. If a hot load is detected on the working face, then the load will be treated as a fire condition (see **Section 8.9.2**), whereas the load will be spread as thin as possible and cover soil will be immediately placed on the waste to extinguish the fire. Other traffic will be redirected to another tipping area (away from the fire), or other waste deliveries may be suspended until the fire is out. The fire will be monitored to ensure it does not spread. If the fire cannot be controlled, the fire department will be notified and the area cleared of non-essential personnel.

8.7.3.2 Hazardous Waste Contingency Plan – In the event that identifiable hazardous waste or waste of questionable character is detected at the scales or in the landfill, appropriate protective equipment, personnel, and materials will be employed as necessary to protect the staff and public. Hazardous waste identification may be based on (but not limited to) strong odors, fumes or vapors, unusual colors or appearance (e.g., liquids), smoke, flame, or excess dust. The fire department will be called immediately in the event a hazardous material is detected. An attempt will be made to isolate the wastes in a designated area where runoff is controlled, preferably prior to unloading, and the vicinity will be cleared of personnel until trained emergency personnel (fire or haz-mat) take control of the scene.

Staff will act prudently to protect personnel but no attempt will be made to remove the material until trained personnel arrive. A partial listing of Emergency and Other Useful Contacts is found in **Appendix 9C**. The Owner/Operator is encouraged to compile a list of regional **Hazardous Waste Responders** and disposal firms – these are available on the **NC Division of Waste Management** Hazardous Waste Section web site – and keep it handy in the event of an incident. These firms have the training and equipment to deal with hazardous materials, as needed.

The Operator will notify the Division (see **Section 8.2.3**) that an attempt was made to dispose of hazardous waste at the landfill. If the vehicle attempting disposal of such waste is known, attempts will be made to prevent that vehicle from leaving the site until it is identified (license tag, truck number driver and/or company information) or, if the vehicle leaves the site, immediate notice will be served on the owner of the vehicle that hazardous waste, for which they have responsibility, has been disposed of at the landfill.

The landfill staff will assist the Division as necessary and appropriate in the removal and disposition of the hazardous waste (acting under qualified supervision) and in the prosecution of responsible parties. If needed, the hazardous waste will be covered with on-site soils, tarps, or other covering until such time when an appropriate method can be implemented to properly handle the waste. The cost of the removal and disposing of the hazardous waste will be charged to the owner of the vehicle involved. Any vehicle

owner or operator who knowingly dumps hazardous waste in the landfill may be barred from using the landfill or reported to law enforcement authorities. Any hazardous waste found at the scales or in the landfill that requires mitigation under this plan shall be documented by staff using the **Waste Screening Form** provided in **Appendix 9B**. Records of information gathered as part of the waste screening programs will be maintained throughout the operational life of the facility.

8.7.4 Severe Weather Contingency

Unusual weather conditions can directly affect the operation of the landfill. Some of these weather conditions and recommended operational responses are as follows.

8.7.4.1 Ice Storms – An ice storm can hinder access to the landfill, prevent movement or placement of periodic cover, and, thus, may require closure of the landfill until the ice is removed or has melted and the access roads are passable without risk to personnel of the side slopes cover.

8.7.4.2 Heavy Rains – Exposed soil surfaces can create a muddy situation in some portions of the landfill during rainy periods. The control of drainage and use of crushed stone (or recycled aggregates) on unpaved roads should provide all-weather access for the site and promote drainage away from critical areas. In areas where the aggregate surface is washed away or otherwise damaged, aggregate should be replaced. Intense rains can affect newly constructed drainage structures such as swales, diversions, cover soils, and vegetation. After such a rain event, inspection by landfill personnel will be initiated and corrective measures taken to repair any damage found before the next rainfall.

8.7.4.3 Electrical Storms – The open area of a landfill is susceptible to the hazards of an electrical storm. If necessary, landfill activities will be temporarily suspended during such an event. To promote the safety of field personnel, refuge will be taken in buildings or in rubber-tire vehicles.

8.7.4.4 Windy Conditions – High winds can create windblown wastes, typically paper and plastic, but larger objects have been known to blow in extreme circumstances. Operations should be suspended if blowing debris becomes a danger to staff, after the working face is secured. The proposed operational sequence minimizes the occurrence of unsheltered operations relative to prevailing winds. If this is not adequate during a particularly windy period, work will be temporarily shifted to a more sheltered area.

When this is done, the previously exposed face will be immediately covered with daily cover. Soil cover shall be applied whenever windblown wastes become a problem. Staff shall patrol the perimeter of the landfill periodically, especially on windy days, to remove windblown litter from tress and adjacent areas. Windscreens of various sorts have been used with mixed success at other facilities in the region. Good planning is essential on the operator's part to be prepared for windy conditions.

8.7.4.5 Violent Storms – In the event of a hurricane, tornado, or severe winter storm warning issued by the National Weather Service, landfill operations should be temporarily suspended until the warning is lifted. Daily cover will be placed on exposed waste and buildings and equipment will be properly secured. In the event of eminent danger to staff, personal safety shall take precedence over concerns regarding the waste or equipment.

8.8 Spreading and Compaction of Waste

The working face shall be restricted to the smallest possible area; ideally, the maximum working face area with exposed waste shall be one-quarter to one-half acre. Wastes shall be compacted as densely as practical. Appropriate methods shall be employed to reduced wind-blown debris including (but not limited to) the use of wind fences, screens, temporary soil berms, and periodic cover. Any wind-blown debris shall be recovered and placed back in the landfill and covered at the end of each working day.

8.9 Vector Control

Steps shall be employed to minimize the risk of disease carrying vectors associated with the landfill (e.g., birds, rodents, dogs, mosquitoes). The C&D wastes should be mostly inert and not attractive to animals, but care should be taken to bury animal carcasses or other putrescible wastes that are admitted to the landfill (subject to the waste screening procedures). Operations should be conducted to avoid pools of standing water in and around the disposal area.

8.10 Air Quality Criteria and Fire Control

8.10.1 Air Quality Criteria

Appropriate measures will be taken to control fugitive emissions (dust) that might be generated during dry seasons. Water shall be sprinkled on roads and other exposed soil surfaces as needed to control dust. No open burning of any waste shall be allowed.

8.10.2 Fire Control

The possibility of fire within the landfill or a piece of equipment must be anticipated in the daily operation of the landfill. A combination of factory installed fire suppression systems and/or portable fire extinguishers shall be operational on all heavy pieces of equipment at all times. Brush fires of within the waste may be smothered with soil, if combating the fire poses no danger to the staff. The use of water to combat the fire is allowable, but soil is preferable. For larger or more serious fire outbreaks, the local fire department will respond. In the event of any size fire at the facility, the Owner shall contact NC DENR Division Waste Management personnel immediately and complete a **Fire Notification Form (Appendix 9D)**, which will be placed in the Operating Record.

8.11 Access and Safety

8.11.1 Access Control

Access to the C&D Landfill is required for the following reasons:

1. Prevention of unauthorized and illegal dumping of waste materials,
2. Trespassing, and possible injury resulting from such, is discouraged,
3. The risk of equipment theft or vandalism is greatly reduced.

Access to active areas of the landfill will be controlled by a combination offences and natural barriers, such as the creeks, and strictly enforced operating hours. A landfill attendant will be on duty at all times when the facility is open for public use to enforce access restrictions.

8.11.1.1 Physical Restraints – The site will be accessed by the existing entrance along Laurel Hill Drive. Scales and a scale house are provided near the entrance. All waste will be weighed prior to being placed in the landfill. The entrance gates will be securely locked during non-operating hours.

8.11.1.2 Security – Frequent inspections of gates and fences will be performed by landfill personnel. Evidence of trespassing, vandalism, or illegal operation will be reported to the Owner.

8.11.1.3 All-Weather Access – The on-site roads will be paved or otherwise hardened and maintained for all-weather access.

8.11.1.4 Traffic – The Operator shall direct traffic to a waiting area, if needed, and onto the working face with safe access to an unloading site is available. Once a load is emptied, the delivery vehicle will leave the working face immediately.

8.11.1.5 Anti-Scavenging Policy – The removal of previously deposited waste by members of the public (or the landfill staff) is strictly prohibited by the Division for safety reasons. The Operator shall enforce this mandate and discourage loitering after a vehicle is unloaded. No persons that are not affiliated with the landfill or having business at the facility (i.e., customers) shall be allowed onto or near the working face.

8.11.2 Signage

A prominent sign containing the information required by the Division shall be placed just inside the main gate. This sign will provide information on operating hours, operating procedures, and acceptable wastes. Additional signage will be provided within the landfill complex to distinctly distinguish access routes. Restricted access areas will be clearly marked and barriers (e.g., traffic cones, barrels, etc.) will be used.

8.11.3 Communications

Visual and radio communications will be maintained between the C&D landfill and the landfill scale house and field operators. The scale house has telephones in case of emergency and for the conduct of day-to-day business. Emergency telephone numbers are displayed in the scale house.

8.12 Sedimentation and Erosion Control

Measures depicted in the approved S&EC plan (see construction plans) shall be installed and maintained throughout the operational life of the facility and into the post-closure period (see Section 9.0). Measures to curtail erosion include vegetative cover and woody mulch as ground cover. Measures to control sedimentation include stone check dams in surface ditches, sediment traps and basins. The key to compliance with Sedimentation and Erosion Control rules is vegetative cover. A rule of thumb is that all exposed soils, regardless of whether they are inside or outside the disposal area, should be covered as soon as possible, not to exceed 20 days after any given area is brought to final grade.

8.13 Drainage Control and Water Protection

Coupled with the measures and practices intended to comply with the S&EC rules, steps to protect water quality include diverting surface water ("run-on") away from the disposal area, allowing no impounded water inside the disposal area, and avoiding the placement of solid waste into standing water. The facility is obligated by law not to discharge pollutants into the waters of the United States (i.e. surface streams and wetlands). Any conditions the Operator suspects might constitute a discharge should be brought to the immediate attention of the Engineer, who in turn, may prescribe mitigation and/or may need to contact proper regulatory authorities.

8.14 Survey for Compliance

8.14.1 Height Monitoring

The landfill staff will monitor landfill top and side slope elevations on a weekly basis or as needed to ensure proper slope ratios and to ensure the facility is not over-filled. This shall be accomplished by use of a surveyor's level and a grade rod. When such elevations approach the grades shown on the Final Cover Grading Plan, the final top-of-waste grades will be staked by a licensed surveyor to limit over-placement of waste.

8.14.2 Annual Survey

The working face shall be surveyed on an annual basis to verify slope grades and to track the fill progression. In the event of problems (slope stability, suspected over-filling), more frequent surveys may be required at the request of the Division.

8.15 Operating Record and Recordkeeping

The following related to the C&D landfill shall be maintained in an operating record:

A Waste inspection records (on designated forms); fire notification forms, as needed;

B Daily tonnage records - including source of generation;

C Quantity, location of disposal, generator, and special handling procedures employed for all special wastes disposed of at the site;

D List of generators and haulers that have attempted to dispose of restricted wastes;

E Employee training procedures and records of training completed;

F All ground water quality monitoring and surface water quality information including:

1. Monitoring well construction records;
2. Sampling dates and results;
3. Statistical analyses; and
4. Results of inspections, repairs, etc.

G All closure and post-closure information, where applicable, including:

1. Testing;
2. Certification; and
3. Completion records.

H Cost estimates for financial assurance documentation.

I Annual topographic survey of the active disposal phase intended to determine volume consumption.

J Records of operational problems or repairs needed at the facility, e.g., slope maintenance, upkeep of SE&C measures, other structures (excluding equipment)

K Daily rainfall records (via on-site rain gauge).

The Owner or his designee will keep the operating record up to date. Daily logbooks may be used for some items. Records shall be presented upon request to DWM for inspection. A copy of this Operations Manual shall be kept at the landfill and will be available for use at all times.

8.16 ANNUAL REPORTING

Reporting requirements for the C&D Landfill include a summary of waste intake by type and tonnage, and disposal practice. The Division requires an **Annual Report** be submitted, detailing the waste intake in tonnage. New rules for C&D landfills require an annual survey to determine slope, height, and volume (see **Section 8.13**). The reporting requirements include a map prepared by a licensed surveyor.

9.0 CLOSURE AND POST-CLOSURE (15A NCAC 13B .0543)

9.1 Summary of Regulatory Requirements

9.1.1 Final Cap

The final cap design for Phase 2 shall conform to the minimum requirements of the Solid Waste Rules, i.e., the compacted soil barrier layer shall exhibit a thickness of 18 inches and a field permeability of not more than 1.0×10^{-5} cm/sec. The overlying vegetative support layer shall exhibit a thickness of 18 inches. See **Drawing E2** for final contours and **Drawing EC2** for final cover cross-section and details.

9.1.2 Construction Requirements

Final cap installation shall conform to the approved plans (see accompanying plan set), inclusive of the approved Sedimentation and Erosion Control Plan (see **Section 6.7** and **Appendix 8**). The CQA plan must be followed (see **Section 7.0**) and all CQA documentation must be submitted to the Division. Post-settlement surface slopes must not be flatter than 5% (on the upper cap) and not steeper than 25% (on the side slopes). Per the **2006 C&D Rules**, a gas venting system is required for the cap. A passive venting system will be specified, which will consist of a perforated pipe in crushed stone-filled trench – installed just below the final cap soil barrier layer – with a tentative minimum vent spacing of three vents per acre. **Drawing EC3** shows the gas vent system details.

9.1.3 Alternative Cap Design

The **2006 C&D Rules** make a provision for an alternative cap design, to be used in the event that the permeability requirements for the compacted soil barrier layer cannot be met. Past experience indicates that on-site soils may not meet the required field permeability of not more than 1.0×10^{-5} cm/sec, as supported by the laboratory data for the soils discussed in **Section 4.0**. Tentative final closure plans have assumed that on-site soils will be used for the compacted barrier layer – alternative cap designs may be researched and submitted for Division approval at a future time.

9.1.4 Division Notifications

The Operator shall notify the Division prior to beginning closure of any final closure activities. The Operator shall place documentation in the Operating Record pertaining to the closure, including the CQA requirements and location and date of cover placement.

9.1.5 Required Closure Schedule

The Operator shall close the landfill in increments as various areas are brought to final grade. The final cap shall be placed on such areas subject to the following:

- No later than 30 days following last receipt of waste;

- No late that 30 days following the date that an area of 10 acres or greater is within 15 feet of final grades;
- No later than one year following the most recent receipt of waste if there is remaining capacity.

Final closure activities **shall be completed within 180 days** following commencement of the closure, unless the Division grants extensions.

Upon completion of closure activities for each area (or unit) the Owner shall notify the Division in writing with a **certification by the Engineer** that the closure has been completed in accordance with the approved closure plan and that said documentation has been placed in the operating record.

9.1.6 Recordation

The Owner shall record on the title deep to the subject property that a CDLF has been operated on the property and file said documentation with the Register of Deeds. Said recordation shall include a notation that the future use of the property is restricted under the provision of the approved closure plan.

9.2 Closure Plan

The following is a tentative closure plan for CDLF Phase 2, based on the prescribed operational sequence and anticipated conditions at the time of closure.

9.2.1 Final Cap Installation

9.2.1.1 Final Elevations – Final elevation of the landfill shall not exceed those depicted on Drawing E2 when it is closed, subject to approval of this closure plan. The elevations shown include the final cover. A periodic topographic survey shall be performed to verify elevations.

9.2.1.2 Final Slope Ratios – All upper surfaces shall have at least a 5 percent slope, but not greater than a 10 percent slope. The cover shall be graded to promote positive drainage. Side slope ratios shall not exceed 3H:1V. A periodic topographic survey shall be performed to verify slope ratios.

9.2.1.3 Final Cover Section – The terms "final cap" and "final cover" are used interchangeably. The final cover will subscribe to the minimum regulatory requirement for C&D landfills:

- An 18-inch thick compacted soil barrier layer (CSB), i.e., the "infiltration layer," with a hydraulic conductivity not exceeding 1×10^{-5} cm/sec, overlain by

- An 18-inch thick "topsoil" or vegetated surface layer (VSL), i.e., the "erosion layer."

9.2.1.4 Final Cover Installation – All soils shall be graded to provide positive drainage away from the landfill area and compacted to meet applicable permeability requirements. Suitable materials for final cover soil shall meet the requirements defined above. Care shall be taken to exclude rocks and debris that would hinder compaction efforts. The surface will then be seeded in order to establish a good stand of vegetation.

Test Pad – Whereas the lab data indicate that the required permeability is attainable, the ability to compact the materials in the field to achieve the required strength and permeability values shall be verified with a field trial involving a test pad, to be sampled with drive tubes and laboratory density and/or permeability testing, prior to full-scale construction. The materials, equipment, and testing procedures should be representative of the anticipated actual final cover construction. The test pad may be strategically located such that the test pad may be incorporated into the final cover.

Compacted Barrier – Materials shall be blended to a uniform consistency and placed in two loose lifts no thicker than 12 inches and compacted by tamping, rolling, or other suitable method – the targeted final thickness is 18 inches minimum. A thicker compacted barrier is acceptable. The cover shall be constructed in sufficiently small areas that can be completed in a single day (to avoid desiccation, erosion, or other damage), but large enough to allow ample time for testing without hindering production. The Contractor shall take care not to over-roll the cover such that the underlying waste materials would pump or rut, causing the overlying soil layers to crack – adequate subgrade compaction within the upper 36 inches of waste materials and/or the intermediate cover soil underlying the final cover is critical. All final cover soils shall be thoroughly compacted through the full depth to achieve the required maximum permeability required by Division regulations of 1.0×10^{-5} cm/sec, based on site-specific test criteria (see below). Compaction moisture control is essential for achieving adequate strength and permeability.

Vegetated Surface Layer – Materials shall be blended and placed in two loose lifts no thicker than 12 inches and compacted by tamping, rolling, or other suitable method – the targeted final layer thickness is 18 inches minimum per the design criteria. A thicker soil layer is acceptable. A relatively high organic content is also desirable. The incorporation of decayed wood mulch or other organic admixtures (WWTP sludge, with advance permission from the Division) is encouraged to provide nutrient and enhanced field capacity. These surface materials are not subject to a permeability requirement, thus no testing will be specified. Care should be taken to compact the materials sufficiently to promote stability and minimize erosion susceptibility, but not to over-compact the materials such that vegetation would be hindered. Following placement and inspection of the surface layer, seed bed preparation, seeding and mulching should follow immediately. The work should be scheduled to optimize weather conditions, if possible.

Inspection and Testing – Soils for the barrier layer are subject to the testing schedule outlined in the Construction Quality Assurance plan (see **Section 7.0**). The proposed testing program includes a minimum of one permeability test per lift per acre and four nuclear density gauge tests per lift per acre, to verify compaction of the compacted barrier layer. The moisture-density-permeability relationship of the materials has been established by the laboratory testing (discussed elsewhere in this report). The Contractor shall proof roll final cover subgrade materials (i.e., intermediate cover), which consist of essentially the same materials as the compacted barrier layer (without the permeability requirements), to assure that these materials will support the final cover.

9.2.1.5 Final Cover Vegetation – Seedbed preparation, seeding, and mulching shall be performed accordance the specifications provided in the Construction Plans (see **Drawing EC2**), unless approved otherwise (in advance) by the Engineer). In areas to be seeded, fertilizer and lime typically should be distributed uniformly at a rate of 1,000 pounds per acre for fertilizer and 2,000 pounds per acre for lime, and incorporated into the soil to a depth of at least 3 inches by disking and harrowing. The incorporation of the fertilizer and lime may be a part of the cover placement operation specified above. Distribution by means of an approved seed drill or hydro seeder equipped to sow seed and distribute lime and fertilizer at the same time will be acceptable. Please note that the seeding schedule varies by season.

All vegetated surfaces shall be mulched with wheat straw and a bituminous tack. Areas identified as prone to erosion mat be secured with curled-wood excelsior, installed and pinned in accordance with the manufacturer's recommendations. Certain perimeter channels will require excelsior or turf-reinforcement mat (TRM), as specified in the Channel Schedule. Alternative erosion control products may be substituted with the project engineer's prior consent. All rolled erosion control materials should be installed according to the generalized layout and staking plan found in the Construction Plans or the manufacturer's recommendations.

Irrigation for landfill covers is not a typical procedure, but consideration to temporary irrigation may be considered if dry weather conditions prevail during or after the planting. Care should be taken not to over-irrigate in order to prevent erosion. Collected storm water will be suitable for irrigation water. Maintenance of the final cover vegetation, described in the Post-Closure Plan (see below), is critical to the overall performance of the landfill cover system.

9.2.1.6 Documentation – The Owner shall complete an "as-built" survey to depict final elevations and to document any problems, amendments or deviations from the Construction Plan drawings. Records of all testing, including maps with test locations, shall be prepared by the third-party CQA testing firm. All materials pertaining to the closure shall be placed in the Operational Record for the facility. Whereas the closure will be incremental, special attention shall be given to keeping the closure records separate from the normal operational records.

9.2.2 Maximum Area/Volume Subject to Closure

The largest anticipated area that will require final closure at any one time is 2 acres – the total area of Phase 2 is approximately 23 acres. Intermediate cover shall be used on areas that have achieved final elevations until the final cover is installed – it will be more cost effective to close the landfill in 2 to 3 are increments. Based on the volumetric analysis (**Appendix 3**), the planned volume of Phase 2 is 964,000 cubic yards. Please note that much of Phase 1 shall be closed under **Solid Waste Rule 0.510**.

9.2.3 Closure Schedule

Refer to the requirements outlined in **Section 9.1.5** (above).

9.2.4 Closure Cost Estimate

The foregoing cost estimate is considered suitable for the **Financial Assurance** requirements (see **Section 11.0**).

TABLE 9A
ESTIMATED FINAL CLOSURE COSTS FOR PHASE 2 (in 2007 dollars)

Final Cover* – 23 acres	140,481 c.y.	@	$4 / cubic yard	$561,924
Establish Vegetation	23 acres	@	$1,800 per acre	$ 41,400
Storm Water Piping**	650 LF	@	$20.00 / LF	$ 13,000
Erosion Control Stone**	40 tons	@	$20.00 / ton	$ 8,000
Testing and Surveying	Estimated 15 percent of above			$ 93,648
Contingency	Estimated 15 percent of above			$ 93,648
Total Construction Cost (if contracted out)				**$811,621**

C&D Landfill, Inc., plans to complete the closure work using in-house forces. The costs shown above are for a third-party contractor to complete the work. Some additional costs for equipment rental may be required if C&D Landfill, Inc., performs the work. Please note that the final closure work will be performed incrementally, thus spreading out the costs over the life of the project.

*Includes soil work for regulatory requirements of the 2006 C&D Rules, i.e., a minimum of 18 inches of compacted soil barrier (max. permeability of 1×10^{-5} cm/sec) and 18 inches of topsoil (total soil thickness is 36 inches). For the compacted soil barrier, use a shrinkage factor of 15%.

**Preliminary estimates, subject to verification.

9.3 Post-Closure Plan

9.3.1 Monitoring and Maintenance

9.3.1.1 Term of Post-Closure Care – The facility shall conduct post-closure care for a minimum of 30 years after final closure of the landfill, unless justification is provided for a reduced post-closure care period. The post-closure care period may be extended by the Division if necessary to protect human health and the environment.

9.3.1.2 Maintenance of Closure Systems – Inspections of the final cover systems and sediment and erosion control (S&EC) measures shall be conducted quarterly. Maintenance will be provided during post-closure care as needed to protect the integrity and effectiveness of the final cover. The cover will be repaired as necessary to correct the effects of settlement, subsidence, erosion, or other events. Refer to the **Post Closure Monitoring and Maintenance Schedule** (below).

9.3.1.3 Landfill Gas Monitoring – The presence of gas is not anticipated during the post-closure period, due to the inert nature of the wastes. Gas monitoring will be conducted for the first five years following the closure of Phase 1A via sampling the head-space in monitoring wells with an Organic Vapor Analyzer (OVA), or similar equipment, during routine sampling events and continual monitoring in on-site buildings via a gas detection meter. After five years, if no explosive gas is detected, the landfill gas monitoring will be discontinued. If gas is detected at the sampling points at any time, the Division will be notified and an evaluation of protective measures will be performed.

9.3.1.4 Ground Water Monitoring – Groundwater monitoring will be conducted under the current version of the approved Sampling and Analysis Plan (see **Section 10.2**). This plan will be reviewed periodically and may change in the future. Approximately one year prior to the landfill reaching permitted capacity, the facility will submit post-closure monitoring and maintenance schedules, specific to the ground water monitoring. Procedures, methods, and frequencies will be included in this plan. This future plan, and all subsequent amendments, will be incorporated by reference to this document.

9.3.1.5 Record Keeping – During the post closure period, maintenance and inspection records, i.e., a **Post Closure Record**, shall be kept as a continuation of the **Operating Record** that was kept during the operational period. The Post Closure Record shall include future inspection and engineering reports, as well as documentation of all routine and non-routine maintenance and/or amendments. The Post Closure Record shall include the ground water and gas monitoring records collected for the facility.

9.3.1.6 Certification of Completion – At the end of the post-closure care period the facility manager shall contact the Division to schedule an inspection. The facility manager shall make the Post Closure Record available for inspection. A certification that the post-closure plan has been completed, signed by a North Carolina registered professional engineer, shall be placed in the operating/post closure record. C&D Landfill, Inc., shall maintain these records indefinitely.

TABLE 9B
POST-CLOSURE MONITORING AND MAINTENANCE SCHEDULE

Activity	Frequency Yrs. 1 - 5	Frequency Yrs. 6-15	Frequency Yrs. 16-30
General - Inspect access gates, locks, fences, signs, site security	Quarterly	Quarterly	Quarterly
Maintain access roads, monitoring well access	As needed	As needed	As needed
Final Cover Systems/Stability - Inspect cap and slope cover for erosion, sloughing, bare spots in vegetation, make corrections as needed (1)	Quarterly	Semi-Annually	Annually
Storm Water/Erosion Control Systems - Inspect drainage swales and sediment basin for erosion, excess sedimentation (1)	Quarterly	Semi-Annually	Annually
Mow cover vegetation and remove thatch	Semi-Annually	Annually	None (2)
Inspect vegetation cover and remove trees	Annually	Annually	Annually
Landfill Gas Monitoring	Semi-Annually	None (3)	None (3)
Ground Water Monitoring System - Check well head security, visibility (4)	Semi-Annually	Semi-Annually	Annually

Notes:

1. Inspect after every major storm event, i.e., 25-year 24-hour design storm
2. Dependent on vegetation type, periodic mowing may be required
3. Discontinue if no detections occur in monitoring wells or on-site buildings
4. See current Ground Water Sampling and Analysis Plan

9.3.2 Responsible Party Contact

C&D Landfill, Inc.
Mr. Judson Whitehurst, Owner
Mr. Wayne Bell, General Manager
C&D Landfill, Inc.
802 Recycling Lane
Greenville, North Carolina 27834

Tel 252-752-8274
Fax 252-752-9016

9.3.3 Planned Uses of Property

Currently, there is no planned use for the landfill area following closure. The closed facility will be seeded with grass to prevent erosion. Any post-closure use of the property considered in the future will not disturb the integrity of the final cover or the function of the monitoring systems unless necessary (and to be accompanied by repairs or upgrades). Future uses shall not increase the potential threat to human health and the environment.

9.3.4 Post-Closure Cost Estimate

The following cost estimate is considered suitable for the **Financial Assurance** requirements. Refer to the 30-year cost projection (see **Section 10.0**).

TABLE 9C
ESTIMATED POST-CLOSURE COSTS FOR PHASE 1A (in 2007 dollars)

Annual Events	Units		Unit Cost	Cost/ Event	Annual Costs
Reseeding/mulching and erosion repair (Assume 5% cap, once per year)	1.15	ac.	$1,600	$1,840.00	$1,840.00
Mow final cap (twice per year)	23	ac.	$25	$575.00	$1150.00
Ground Water (semi-annual, 16 wells)	16	ea.	$400	$6,400.00	$12,800.00
Surface Water (semi-annual, 3 locations)	3	ea.	$350	$1,050.00	$2,100.00
Water quality analysis and reporting	1	ea.	$2500	$2500.00	$5000.00
Engineering inspection (annual basis)	1	ea.	$3,500	$3,500.00	$3,500.00
Maintain storm water conveyances	1	ea.	$2,000	$2,000.00	$2,000.00
Maintain access roads, gates, buildings	1	ea.	$1,000	$1,000.00	$1,000.00

10.1 Summary of Regulatory Requirements

C&D landfills must implement a detection phase monitoring program for ground water and surface water. Normally, this includes an up gradient background well and several down gradient (or cross gradient) compliance wells, along with several strategically placed surface water sampling locations (with up gradient and down gradient coverage). The placement of the wells is to be based on the hydraulic and topographic characteristics of the site, determined in the site investigations (see Section 4.0). Compliance wells are placed at a "review boundary" located approximately half the distance to the "compliance boundary," which is normally established 50 feet inside the facility boundary, or 150 feet from the waste boundary at a C&D landfill.

Detection phase monitoring for all landfills includes semi-annual sampling and analysis for ensuring compliance with North Carolina ground water standards, i.e., **15A NCAC 2L .0300** (the "2L rules"). The detection phase sampling list includes organic constituents on the Appendix 1 list [1] (i.e., volatiles and semi-volatiles that are analyzed by US-EPA Method 8260 and the eight RCRA metals), key indicator parameters (measured in the field), and – new for the **2006 C&D Rules** – several additional constituents (mercury, manganese, sulfate, iron, alkalinity, and total dissolved solids). Assuming no detects of ground water constituents that exceed a 2L standard, the term of detection phase monitoring runs for the operational life of the facility plus the post-closure period (minimum of 30 years beyond closure). Should one or more detected constituents exceed a 2L standard, the facility must undergo an expanded assessment monitoring program to determine the source, extent, and rate of contaminant migration, plus an evaluation of potential human receptors and/or other environmental impacts.

The **Sampling and Analysis Plan** (discussed below and found within **Appendix 6**), considers both present and anticipated future needs of the assessment monitoring program, with respect to surface water sampling and strategic placement of monitoring wells, but the program described herein stands alone for detection phase monitoring for the C&D landfill.

10.2 Ground Water Monitoring

The following discusses the rationale behind planned amendments to the detection phase monitoring program for the C&D landfill, reflected in the **Sampling and Analysis Plan** (see **Appendix 6**). The format of the SAP is consistent with that used for numerous Division-accepted landfill monitoring programs.

10.2.1 Monitoring System Requirements

The Design Hydrogeologic studies (see **Section 4.2**) indicate a radial ground water flow pattern toward the south, southwest, and southeast. This flow pattern reflects surface

[1] 40 CFR Part 258

topography along a gentle ridge, surrounded on three sides by surface streams (i.e., ground water receptors). Based on site topography and hydrogeologic conditions, predominant ground water flow direction to the south (toward Grindle Creek), with loose to medium dense sandy surficial soils serving as the uppermost (unconfined) aquifer (**Unit 1**), which exists above a variably thick, clayey partial confining layer (**Unit 2**). A deeper, regional (confined) aquifer (**Unit 3**) exists beneath the partial confining unit, exhibiting a pronounced upward vertical gradient beneath much of the site.

The placement of wells for the CDLF should focus on the upper sand layer (**Unit 1**), keeping in mind that the regional discharge point (Grindle Creek) is off-site, separated by a distance of several hundred feet. The interstitial land is old-family farm land is not likely to be developed. Regional municipal water is typically supplied to residences and other consumers throughout the area. However, the distance to the off-site ground water discharge point was considered in determining an appropriate monitoring well spacing in the original studies for Phase 1. An advection-dispersion calculation was made to determine a well spacing around the landfill perimeter that would likely intercept a release of contaminants from the landfill.

Applying these principles to the similar geologic conditions at Phase 2, a well spacing of approximately 300 to 400 feet appears appropriate. Please refer to **Section 4.2.1.3 (Volume 1)** for a discussion of new well depths and screen intervals and refer to the **Sampling and Analysis Plan (Appendix 6)** for detailed discussion of sampling and analysis protocols. New wells are shown on Drawing MP-1.

10.2.2 Background Water Quality

Low concentrations of metals also have been detected on occasion at the facility background well, MW-2, including cadmium, lead, and zinc (see **Section 4.1.12**).

10.2.3 Point of Compliance Water Quality

The 2L ground water standards are applicable for the compliance boundary, tempered with background water quality data.

10.2.4 Sampling and Analysis Procedures

Industry accepted protocols (also consistent with Division guidelines)[2] are discussed in the **Sampling and Analysis Plan** (see **Appendix 6**).

10.2.5 Detection-phase Monitoring Parameters

The sampling parameters consist of the **EPA Appendix I** list of organic constituents and metals, modified by the **2006 C&D Rules**.

---

[2] NC DENR Division of Waste Management Guidance Document, Ground Water Sampling for Construction and Demolition, Closed or Industrial Landfills, http://www.wastenotnc.org/swhome/enviro_monitoring.asp

10.2.6 Sampling Frequency

The detection phase sampling frequency shall be semi-annually.

10.2.7 Water Level Elevations

During each sampling event, water levels shall be measured from the top-of-casing at each monitoring well.

10.2.8 Reporting

Data analysis and reporting, consistent with Division requirements, are described in the **Sampling and Analysis Plan** (see **Appendix 6**).

10.2.9 Source Demonstration

In the event of the detection of a ground water constituent that exceeds a 2L standard, an evaluation may be made in accordance with Division policy to determine the source, e.g., sampling error, laboratory contamination, extenuating circumstances (improper repairs to a well or incidental spill near a well). Typically, such evaluations are accompanied by re-sampling and, if appropriate, correction of conditions that may have lead to the detection. If such demonstrations cannot be made, the landfill might be considered as the source.

10.2.10 Monitoring Well Design

Wells shall be (and currently are) designed in accordance with **15A NCAC 2C**.

10.2.11 Monitoring Well Layout

The layout takes advantage of topographic features, the shape of the top of the confining unit (as indication of buried former channels), regional flow conditions and access considerations within the generally flat terrain.

10.2.12 Alternative Monitoring Systems

None are proposed at this time.

10.2.13 Assessment Monitoring

Requirements of assessment monitoring, if required, are outlined in **Rule .0545** of the **2006 C&D Rules**. If such conditions exist in the future at the CDLF that requires assessment monitoring, a plan will be prepared for review by the Division. It is not anticipated at this time that future assessment activities will be required.

10.3 Surface Water Monitoring

Surface water monitoring should (and does) focus on the unnamed tributaries shown to be shallow ground water discharge features to the east, west, and south of the Phase 2 footprint. An existing surface sampling location between Phases 1 and 2 (SW-2), shown on **Drawing MP-1**, is sufficient to monitor both CDLF units. The streams that converge near SW-2 emanate adjacent to the Phase 2 footprint – on both sides – and do not present upgradient monitoring opportunities. Actually, this is an ideal monitoring condition, whereas all the surface water monitored in the stream at SW-2 originates on-site.

10.4 Gas Control Plan

10.4.1 Regulatory Limits

Division rules specify an explosive gas limit of 25% of the Lower Explosive Limit (LEL) (5% methane in standard atmosphere) within occupied structures and 100% LEL at the facility boundary.

10.4.2 Monitoring Program

Conditions at the C&D landfill are not conducive to the formation of explosive gases in significant concentrations that would approach the regulatory thresholds for action – the C&D wastes are typically non-putrescible and the disposal units are located well away from on-site buildings and the facility boundary. Gas detectors are located within the facility buildings. No pipelines or trenches exist nearby to serve as potential conduits for landfill gas migration.

Plans are to augment the gas monitoring program for the C&D unit by periodic sampling of the headspace in the normally sealed ground water monitoring wells – landfill gas often migrates through the unsaturated porous zones above the ground water – and continuing to monitor the buildings. In the unlikely event that explosive gas should be detected at these locations, the gas-monitoring plan will be expanded to include soil-gas monitoring near the facility boundary in the direction of occupied structures.

10.4.3 Corrective Action

Corrective action to control gas migration, if any is required, might consist of additional passive venting and/or active gas recovery. The likelihood of such measures ever being required is remote – this issue is addressed in the interest of compliance with the rules.

10.5 Waste Acceptance

Monitoring of the waste intake is addressed in the **Operations Plan** (see **Section 8.0**). The plan calls for routine waste screening and record keeping with respect to waste types, sources, and haulers.

10.6 Plan Preparation and Certification

This monitoring plan for the C&D Landfill, Inc., disposal units has been prepared by, or under the responsible charge of, one or more North Carolina Licensed Geologists or Professional Engineers. The individual signature and seal below attests to compliance with this rule requirement.

Signed _____

Printed G DAVID GARRETT

Date FEBRUARY 19, 2008

NORTH CAROLINA LICENSED SEAL 983 GEOLOGIST G. DAVID GARRETT

Not valid unless this document bears the seal of the above-named licensed professional.

11.0 FINANCIAL ASSURANCE

The **2006 C&D Rules** require that Owners/Operators demonstrate financial assurance for closure and post-closure activities. Typically, for local government-owned facilities, said demonstration is based on a local government test. For private facilities, the posting of a performance bond or insurance policy is typically acceptable to the Division.

Cost estimates for closure of CDLF Phase 1A and post-closure activities for the entire C&D landfill are presented in **Sections 9.2.4** and **9.3.4**, respectively. The following is a detailed analysis of the closure and post closure costs, based on the preceding, all in 2007 dollars, projected over the anticipated life of the landfill (Phase 1A) and 30 years of post-closure care. Please refer to **Tables 11A** and **11B** (following).

Table 11A shows the post-closure costs projected as future values over the 30-year period. Table 11B shows the annual decrease in the annual financial assurance obligation due to the expenditures of prior years, assuming no increased liabilities for unforeseen events, e.g., assessment monitoring. Based on this analysis, maximum post-closure cost liabilities are realized at the time of closure – these liabilities decrease with time and, thus, the amount of the post-closure instrument should be reduced over time. The closure costs will be realized far enough into the future that these costs may be recalculated to account for inflation on a periodic basis (which has not been done here). Thus, the whole financial assurance instrument should be recalculated periodically, say every five years at a minimum, or ideally on an annual basis. The posted amount (bond, insurance, etc.) should be adjusted accordingly on a periodic basis.

SUMMARY OF CLOSURE AND POST-CLOSURE COST

1.	Final Closure Construction (see **Table 9A**)	$811,634
2.	Projected Post-Closure Costs (see **Table 11A**) (adjusted for inflation, with 10% contingency)	$1,067,864
	TOTAL CLOSURE/POST-CLOSURE COST	**$1,700,984**

Owners/Operators must complete the demonstration (e.g., irrevocable performance bond, letter of credit, insurance policy, other fiduciary instrument) by **August 1, 2008**, in accordance with the **2006 C&D Rules**. Said documentation shall be furnished by the deadline and will be included as a future amendment to this report (see **Appendix 10**).

TABLE 11A (see Table 9C)
ANNUAL POST-CLOSURE COST PROJECTION FOR 30-YEARS

Year	Reseed and Repair Erosion	Mowing Cap	Monitor GW Quality	Monitor SW Quality	WQ Analysis Report	Annual & Engineering Inspection	Maintain stormwater controls	Maintain infra structure	Major repairs allow 10% contingency	Projected annual cost in 2007 dollars
1	$1,600	$1,150	$12,800	$2,100	$5,000	$3,500	$2,000		$2,595	$30,745
2	$1,600	$1,150	$12,800	$2,100	$5,000	$3,500	$2,000		$2,595	$30,745
3	$1,600	$1,150	$12,800	$2,100	$5,000	$3,500	$2,000		$2,595	$30,745
4	$1,600	$1,150	$12,800	$2,100	$5,000	$3,500	$2,000		$2,595	$30,745
5	$1,600	$1,150	$12,800	$2,100	$5,000	$3,500	$2,000	$1,000	$2,595	$31,745
6		$1,150	$12,800	$2,100	$5,000	$3,500			$2,595	$27,145
7		$1,150	$12,800	$2,100	$5,000	$3,500			$2,595	$27,145
8		$1,150	$12,800	$2,100	$5,000	$3,500			$2,595	$27,145
9		$1,150	$12,800	$2,100	$5,000	$3,500			$2,595	$27,145
10	$1,600	$1,150	$12,800	$2,100	$5,000	$3,500	$2,000	$1,000	$2,595	$31,745
11		$1,150	$12,800	$2,100	$5,000	$3,500			$2,595	$27,145
12		$1,150	$12,800	$2,100	$5,000	$3,500			$2,595	$27,145
13		$1,150	$12,800	$2,100	$5,000	$3,500			$2,595	$27,145
14		$1,150	$12,800	$2,100	$5,000	$3,500			$2,595	$27,145
15	$1,600	$1,150	$12,800	$2,100	$5,000	$3,500	$2,000	$1,000	$2,595	$31,745
16		$1,150	$12,800	$2,100	$5,000	$3,500			$2,595	$27,145
17		$1,150	$12,800	$2,100	$5,000	$3,500			$2,595	$27,145
18		$1,150	$12,800	$2,100	$5,000	$3,500			$2,595	$27,145
19		$1,150	$12,800	$2,100	$5,000	$3,500			$2,595	$27,145
20	$1,600	$1,150	$12,800	$2,100	$5,000	$3,500	$2,000	$1,000	$2,595	$31,745
21		$1,150	$12,800	$2,100	$5,000	$3,500			$2,595	$27,145
22		$1,150	$12,800	$2,100	$5,000	$3,500			$2,595	$27,145
23		$1,150	$12,800	$2,100	$5,000	$3,500			$2,595	$27,145
24		$1,150	$12,800	$2,100	$5,000	$3,500			$2,595	$27,145
25	$1,600	$1,150	$12,800	$2,100	$5,000	$3,500	$2,000	$1,000	$2,595	$31,745
26		$1,150	$12,800	$2,100	$5,000	$3,500			$2,595	$27,145
27		$1,150	$12,800	$2,100	$5,000	$3,500			$2,595	$27,145
28		$1,150	$12,800	$2,100	$5,000	$3,500			$2,595	$27,145
29		$1,150	$12,800	$2,100	$5,000	$3,500			$2,595	$27,145
30	$1,600	$1,150	$12,800	$2,100	$5,000	$3,500	$2,000	$1,000	$2,595	$31,745
SUM	$16,000	$34,500	$384,000	$63,000	$150,000	$105,000	$20,000	$6,000	$77,850	$856,350
					TOTAL ALL CATEGORIES 2007 DOLLARS				$778,500	
					Annualized Contingency (10% / # years)				$2,595	

TABLE 11B (see Table 11A)
POST-CLOSURE COST PROJECTION INDEXED TO INFLATION

Year	Total Annual Cost in 2007 dollars	Inflated Cost (actually spent) w/ annual inflation rate =	Expenditure to date at end of prior year 1.4%	Final assurance requirement at beginning
1	$30,745	$31,175	$31,175	$1,067,874
2	$30,745	$31,612	$62,787	$1,036,698
3	$30,745	$32,054	$94,842	$1,005,086
4	$30,745	$32,503	$127,345	$973,032
5	$31,745	$34,030	$161,375	$940,529
6	$27,145	$29,506	$190,882	$906,498
7	$27,145	$29,920	$220,801	$876,992
8	$27,145	$30,338	$251,140	$847,072
9	$27,145	$30,763	$281,903	$816,734
10	$31,745	$36,480	$318,383	$785,971
11	$27,145	$31,631	$350,014	$749,491
12	$27,145	$32,073	$382,087	$717,860
13	$27,145	$32,522	$414,609	$685,787
14	$27,145	$32,978	$447,587	$653,264
15	$31,745	$39,106	$486,693	$620,286
16	$27,145	$33,908	$520,601	$581,180
17	$27,145	$34,382	$554,983	$547,273
18	$27,145	$34,864	$589,847	$512,890
19	$27,145	$35,352	$625,199	$478,027
20	$31,745	$41,921	$667,120	$442,675
21	$27,145	$36,349	$703,468	$400,754
22	$27,145	$36,857	$740,326	$364,405
23	$27,145	$37,373	$777,699	$327,548
24	$27,145	$37,897	$815,596	$290,174
25	$31,745	$44,939	$860,535	$252,278
26	$27,145	$38,965	$899,500	$207,339
27	$27,145	$39,511	$939,011	$168,373
28	$27,145	$40,064	$979,075	$128,863
29	$27,145	$40,625	$1,019,699	$88,799
30	$31,745	$48,174	$1,067,874	$48,174
SUM	$856,350	$1,067,874		

The foregoing demonstrates a justifiable reduction in post-closure care financial obligations over time – as the funds are spent – which may be used to modify the future Financial Assurance demonstration, i.e., the local government test, on a periodic basis.

The annual inflation is based on an assumed Consumer Price Index (CPI), which is subject to verification.