Permit No.	Scan Date	DIN
1809	**August 24, 2011**	**14913**

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August 22, 2011
Solid Waste Section
Asheville Regional Office

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August 19, 2011

Mr. Larry Frost
Environmental Engineer
North Carolina Department of Environment and Natural Resources
Division of Waste Management, Solid Waste Section—Permitting Branch
Asheville Regional Office
2090 US Highway 70
Swannanoa, North Carolina 28778

Subject: Duke Energy Carolinas, LLC
Marshall Steam Station Flue Gas Desulfurization (FGD) Residue Landfill Phase 1, Cell 1
Permit Number: 18-09
Permit Amendment (Renewal)
Catawba County, North Carolina

Dear Mr. Frost:

On behalf of Duke Energy Carolinas, LLC (Duke), Altamont Environmental, Inc. (Altamont), is providing the enclosed information for the permit amendment (renewal) of the Permit to Operate for the Marshall Steam Station Flue Gas Desulfurization (FGD) Residue Landfill, Phase 1, Cell 1, Permit No. 18-09. The landfill is located at Duke's Marshall Steam Station, near Terrell, in Catawba County.

The current Permit to Operate was issued on November 21, 2006. In Attachment 3 of the permit, Conditions of the Permit, General Facility Conditions, item 7 states:

> *This permit is subject to review on November 21, 2011, pursuant to 15A NCAC 13B .0201(e). No later than August 21, 2011, the owner or operator shall submit to the Solid Waste Section an amendment to the permit or a permit modification, as applicable. Duke Energy Corporation, Marshall Steam Station shall submit an amendment to this permit pursuant to 15A NCAC 13B .0504 for any subsequent phase of development.*

In accordance with this permit requirement, the following information is submitted:

- Enclosure 1—A revised landfill operations plan: *Landfill Operations Plan, Duke Energy Carolinas, LLC—Marshall Steam Station, Flue Gas Desulfurization (FGD) Residue Landfill, Phase 1, Cell 1, Catawba County, North Carolina, Permit No. 18-09, August 19, 2011*, prepared by Altamont Environmental, Inc.
- Enclosure 2—Financial Assurance Cost Estimate—The financial assurance cost estimate for the closure, post-closure, and potential assessment and corrective action costs associated with the Marshall Steam Station Flue Gas Desulfurization (FGD) Residue Landfill, Phase 1, Cell 1 and Cell 2. This document was prepared by Altamont Environmental, Inc.

- Enclosure 3—A revised Groundwater Sampling and Analysis Plan: *Groundwater Monitoring Sampling and Analysis Plan, Marshall Steam Station, Flue Gas Desulfurization (FGD) Residue Landfill, Phase 1, Cell 1, Permit No. 18-09*, August 19, 2011, prepared by Altamont Environmental, Inc.
- Enclosure 4—Marshall FGD Landfill Permit Modification—Letter from Mr. Dan Brewer, P.E., WSP-Sells to Ms. Donna Burrell, Duke Energy, dated August 19, 2011. WSP-Sells has prepared the following drawings showing the completion of Cell 1 in the event that Duke decides to complete and close Cell 1 without the construction of Cell 2.
    - Phasing Diagrams (PD-1 through PD-8)
    - Cell 1 Leachate Collection & Removal System Drawing No. MM6451.00-0003.001
    - Cell 1 and Cell 2 Details, Drawing No. MM6451.00-0007.001
    - Cell 1 Final Configuration, Drawing No. MM6451.00-0005.001
    - Gas Venting System Plan, Drawing No. MM6451.00-0002.001
    - Final Closure Details, Drawing No. MM6451.00-0001.001
    - Erosion Control Details, Drawing No. MM6451.01-0004.001

  The previously submitted design drawings (prepared by WSP-Sells and submitted in the Construction Plan Application [Volumes One and Two], December 15, 2005 revised through March 30, 2006) were developed considering that construction of Cell 2 would begin prior to closure of Cell 1.

Duke plans to continue to operate Phase 1, Cell 1 of the landfill as described in the enclosed documents and requests that a Permit to Operate be issued for an additional five years of operations for Phase 1, Cell 1.

Please feel free to contact me with any questions or comments related to this information.

Sincerely,

ALTAMONT ENVIRONMENTAL, INC.

William M. Miller

William M. Miller, P.E.

Enclosures:

Enclosure 1—*Landfill Operations Plan, Duke Energy Carolinas, LLC—Marshall Steam Station, Flue Gas Desulfurization (FGD) Residue Landfill Phase 1, Cell 1, Catawba County, North Carolina, Permit No. 18-09, August 19, 2011.*

Enclosure 2—Financial Assurance Cost Estimate, Marshall Steam Station Flue Gas Desulfurization (FGD) Residue Landfill, Permit 18-09, Cell 1 and Cell 2

Enclosure 3—*Groundwater Monitoring Sampling and Analysis Plan, Marshall Steam Station, Flue Gas Desulfurization (FGD) Residue Landfill, Phase 1, Cell 1, Permit No. 18-09, August 19, 2011.*

Enclosure 4—Marshall FGD Landfill Permit Modification—Letter from Mr. Dan E. Brewer, P.E., WSP-Sells to Ms. Donna Burrell, Duke Energy, dated August 19, 2011, including the following drawings:

- Phasing Diagrams (PD-1 through PD-8)
- Cell 1 Leachate Collection & Removal System Drawing No. MM6451.00-0003.001
- Cell 1 and Cell 2 Details, Drawing No. MM6451.00-0007.001
- Cell 1 Final Configuration, Drawing No. MM6451.00-0005.001
- Gas Venting System Plan, Drawing No. MM6451.00-0002.001
- Final Closure Details, Drawing No. MM6451.00-0001.001
- Erosion Control Details, Drawing No. MM6451.01-0004.001

cc: Duke Energy Carolinas, LLC—Marshall Steam Station
8320 East NC Highway 150
Terrell, North Carolina 28682
Attn: Donna Burrell

Duke Energy Carolinas, LLC
Post Office Box 1006
Charlotte, NC 28201-1006
Attn: Ed Sullivan, P.E. Mail Code EC13K

Duke Energy Carolinas, LLC
Post Office Box 1006
Charlotte, NC 28201-1006
Attn: Chris Ussery Mail Code EC10C

Landfill Operations Plan

Duke Energy Carolinas, LLC—Marshall Steam Station
Flue Gas Desulfurization (FGD) Residue Landfill Phase 1, Cell 1
Catawba County, North Carolina

Permit No. 18-09

August 19, 2011

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Solid Waste Section
Asheville Regional Office

Prepared for:
Duke Energy Carolinas, LLC
526 South Church Street
Charlotte, North Carolina 28202

Prepared by:
Altamont Environmental, Inc.
231 Haywood Street
Asheville, North Carolina 28801

Landfill Operations Plan

Duke Energy Carolinas, LLC—Marshall Steam Station
Flue Gas Desulfurization (FGD) Residue Landfill Phase 1, Cell 1
Catawba County, North Carolina

Permit No. 18-09

August 19, 2011

Prepared for:
Duke Energy Carolinas, LLC
526 South Church Street
Charlotte, North Carolina 28202

ALTAMONT ENVIRONMENTAL, INC.
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NORTH CAROLINA PROFESSIONAL SEAL 17661 ENGINEER WILLIAM M. MILLER

William M. Miller, P.E.
Altamont Environmental, Inc.
North Carolina Professional Engineering Firm No. C-2185

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Tables

Table 1—15A NCAC 13B .0505 Operational Requirement Cross-Reference Table
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Appendix A—Dust Control Plan
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1—Permit to Operate
2—Groundwater Sampling and Analysis Plan (dated August 19, 2011)

1.0 General Facility Operations

1.1 Overview

The purpose of this Operations Plan is to provide a plan for the safe and efficient operations of the Marshall Steam Station (Marshall) Flue Gas Desulfurization (FGD) Residue Landfill (Marshall FGD Landfill). This Operations Plan presents the operational requirements for: 1) General Facility Operations; 2) Operations Management; 3) Erosion and Sedimentation Control; and 4) Vegetation Management, along with guidance for Landfill Closure and Required Regulatory Submittals. This Operations Plan was prepared consistent with 15A NCAC 13B .0505 Operational Requirements for Sanitary Landfills rules. Table 1 provides a cross-reference between the 15A NCAC 13B .0505 requirements and the applicable section in this Operations Plan.

The Marshall FGD Landfill is owned and operated by Duke Energy Carolinas, LLC (Duke). The landfill is located in Catawba County, North Carolina on Duke property, northwest of the Marshall plant and to the west of the Marshall Ash Basin.

1.2 Contact Information

Correspondence and questions concerning the operation of the Marshall FGD Landfill should be directed to the appropriate entity as follows:

<u>Owner</u>

Duke Energy Carolinas, LLC—Marshall Steam Station
8320 East NC Highway 150, Terrell, North Carolina 28682
(828) 478-7820
Facility Contact: Ms. Donna Burrell

<u>State Regulatory Agency</u>

North Carolina Department of Environment and Natural Resources
Division of Waste Management, Solid Waste Section
Asheville Regional Office
2090 US Highway 70, Swannanoa, North Carolina 28778
(828) 296-4500
Environmental Engineer: Larry Frost

1.3 Safety

Landfill operations at the Marshall FGD Landfill were developed considering the health and safety of the facility's operating staff. The operating staff is provided with site-specific safety training prior to landfill operations, and on-site activities are to be conducted according to the applicable sections of Duke's Safe Work Practices.

1.4 Access and Security Requirements

The Marshall FGD Landfill is located entirely within Duke property. Security for the site is currently in place, consisting of fencing, gates, berms, wooded buffers, and security check stations. Unauthorized vehicle access to the site is prevented around the landfill property by woods, fencing, gates, and stormwater conveyance features.

The access road to the site is of all-weather construction and will be maintained in good condition. Potholes, ruts, and debris on the road(s) will receive immediate attention in order to avoid damage to vehicles.

1.5 Operating Hours

The Marshall FGD Landfill is open seven days a week, as required.

1.6 Signs

A sign providing the landfill permit number, hours of operation, and a statement reading, "NO HAZARDOUS OR LIQUID WASTE PERMITTED," is posted at the site entrance and shall be maintained in good condition.

Directional signs are placed along the access road to the landfill and shall be maintained in good condition at all times.

Edge-of-waste markers are installed to delineate the edge of waste. These markers shall be maintained in good condition and remain visible at all times.

1.7 Training

Due to the diversity and nature of job tasks required at the Marshall FGD Landfill, personnel shall be adequately trained to handle facility operations and maintenance.

The Plant Materials Coordinator, who is generally responsible for landfill operations, shall have a general understanding of all the tasks required for site operations. Individuals performing the various tasks shall have adequate training for the site-specific tasks they are assigned. Duke shall provide a site-specific training program for facility personnel.

Noteworthy operations and maintenance tasks to be addressed in training include:

- Maintaining accurate records of waste loading (quantitative and qualitative)
- Operating requirements for stormwater segregation from exposed waste areas
- Operating and maintaining the leachate collection system (LCS)

All training will be documented and training records will be kept on-site. The Plant Materials Coordinator will complete operator training courses in accordance with the permit requirements.

1.8 Record Keeping

An operating record is to be maintained on-site and include the following:

- Leachate Collection System (LCS)—Line Cleanout and Camera Monitoring Documentation
- Stormwater Maintenance and Inspection Logs
- Erosion and Sedimentation Control Inspection Logs
- Periodic Landfill Inspection Logs
- Dust Control Monitoring Logs
- Groundwater Monitoring (and Sampling) Documentation
- Operations Plan

The above records are to be kept in the operating record for the active life of the Marshall FGD Landfill and the post-closure care period. Information contained in the operating record must be furnished upon request to the North Carolina Department of Environment and Natural Resources Division of Waste Management, Solid Waste Section (Division) or be made available for inspection by the Division. Additional records kept on-site should include:

- Facility permits
  - Solid waste facility permits
- Record of the amount of solid waste received summarized on a monthly basis based on scale records
- Documentation of LCS system performance observations
- Documentation of erosion and sedimentation control observations
- Regulatory agency inspection reports
- Permit-to-Construct Application
- Employee training program and records
- Landfill drawings and specifications

1.9 Design Drawings

A list of the landfill design drawings is provided in Table 2. The design drawings provide the location of landfill features, landfill construction details, and technical design and construction notes.

2.0 Operations Management

The primary objective of operations management at the Marshall FGD Landfill is to dispose of waste material in compliance with permit conditions while operating in a safe manner. Landfilling operations will generally proceed from the northwest towards the southeast. In general, landfilling operations in the cell will be limited to an exposed surface area of approximately two acres or less, at the operator's discretion, with waste in other areas covered with operational, intermediate, and interim cover as appropriate.

2.1 Waste Handling and Landfill Sequencing

2.1.1 Landfill Capacity

The Marshall FGD Landfill Phase I, Cell 1 was permitted to operate on November 21, 2006. The Cell 1 footprint consists of approximately 17.5 acres. The landfill began receiving waste in late fall 2006. The total available airspace volume of Cell 1, as shown on drawing MM6451.00-0005.001, Revision 1, is approximately 1.17 million cubic yards. This volume corresponds to 1,326,780 tons of capacity based on an average unit weight of 84.0 pounds per cubic foot. The expected annual quantity of waste to be placed in the landfill is 288,800 tons per year. This is based on design waste receipts of 950 tons per day for 304 operating days per year. The expected annual quantity of waste placement is from the Permit to Operate dated November 21, 2006.

Included below are the Actual Annual Quantities placed in the landfill for the first five years of operation (2006-2011).

The yearly periods listed below correspond to the period July 1 through June 30 for the respective year.

Year	Period	Actual Annual Quantity
Year 1	2006-2007	2,548 tons (Actual)
Year 2	2007-2008	22,273.96 tons (Actual)
Year 3	2008-2009	30,937.12 tons (Actual)
Year 4	2009-2010	125,032.39 tons (Actual)
Year 5	2010-2011	93,784.63 tons (Actual)

The remaining capacity of the landfill is 1,052,204 tons. Landfill sequencing is further described in Section 2.1.5.

2.1.2 Waste Acceptance, Disposal and Screening Requirements

The Marshall FGD Landfill can accept the following waste types:

- Marshall-generated gypsum
- Marshall-generated clarifier sludge
- Marshall-generated fly ash
- Marshall-generated bottom ash
- Marshall-generated construction and demolition debris (C&D) debris
- Duke-generated asbestos
- Allen Steam Station (Allen)-generated gypsum
- Allen-generated clarifier sludge

- Cliffside Steam Station (CSS)-generated gypsum
- CSS-generated clarifier sludge
- Marshall Mill Rejects (pyrites)

The landfill owner or operator shall notify the Division within 24 hours of attempted disposal of any wastes the landfill is not permitted to receive.

At a minimum, hazardous waste, yard trash, liquid wastes, regulated medical waste, sharps not properly packaged, polychlorinated biphenyls (PCB) waste as defined in 40 Code of Federal Regulations (CFR) 761, and wastes banned from disposal in North Carolina by General Statute 130A-309.10(f), must not be accepted at the landfill.

The removal of waste from the landfill is prohibited unless the owner or operator approves and the removal is not performed on the working face. Waste will be hauled and disposed of by dedicated and consistent operators from the waste source to the landfill.

2.1.3 Dust, Litter, Odor, and Vector Control

Litter, odors, and vectors are not anticipated to be a concern at the Marshall FGD Landfill. The waste placed in the landfill does not attract vectors, and windblown material is not anticipated to be a problem. Odors are typically not a problem at FGD residue landfills.

Dust control is addressed in the Dust Control Plan included as Appendix A. Generally, dust control measures will be implemented when necessary and will include at a minimum watering of dusty roads and exposed work areas. The gypsum surface typically generates a crust which reduces the dust potential for the gypsum. Additionally, final cover will be vegetated as soon as is practical in order to minimize the blowing of dust on-site.

2.1.4 Fire Control

No open burning shall be permitted at the Marshall FGD Landfill. There are no explosive gas concerns with gypsum, ash waste, mill rejects or asbestos waste; therefore the threat of fire is considered to be minimal.

Although it is unlikely, if a fire occurs at the landfill, the Station Control Room (phone number: 828-478-7521) shall be notified and equipment and stockpiled soil shall be provided to control accidental fires. Marshall Steam Station (MSS) will notify the local fire department, which will be immediately dispatched to assist with fire control. Any fire that occurs at the landfill shall be reported to the Division within 24 hours and a written notification will be submitted within 15 days by the Plant Materials Coordinator.

2.1.5 Landfill Sequencing

The Marshall FGD Landfill will be developed within the area shown on the Phasing Diagrams (Figures PD-1 through PD-8 [Cell 1 Phasing Diagrams]). A 200-foot buffer will be maintained around the entire perimeter of the landfill. A 500-foot buffer will be maintained from existing residences and water supply wells. The majority of the areas within the buffer will remain in its current condition.

2.1.6 Waste Placement

2.1.6.1 Gypsum, Ash, and Mill Rejects

A conveyor system transports the gypsum from the scrubber facility and stockpiles it adjacent to the Marshall FGD Landfill. The gypsum is then loaded onto dump trucks and hauled to the landfill active face. The ash (fly ash and bottom ash) and mill rejects are transported to the landfill in dump trucks. The waste is dumped from trucks and placed on the smallest active face practical. The waste is then spread and compacted using compactors and dozers in lifts no greater than 12 inches thick. Gypsum and fly ash shall be placed and compacted in accordance with requirements outlined in Section 2.1.7. Bottom ash and mill rejects shall be placed and compacted as densely as practical. In-place density testing is not required for bottom ash and mill rejects.

Waste will generally be placed from upslope to downslope, but as higher waste elevations are achieved, waste may be placed from downslope to upslope on the active face slopes as long as landfill surfaces are graded to allow for proper drainage and segregation. The waste placement surface will be graded to promote surface water runoff. Soil berms are to be constructed as necessary to divert run-on from entering the working face or allowing runoff to drain from active areas.

Loads of bottom ash and mill reject waste that exhibit higher moisture content than anticipated will be placed no closer than 50 feet from the active face in thin lifts and dozed into place. No waste shall be placed in areas of accumulated water.

Waste will be covered with intermediate, interim, and final soil cover as applicable in accordance with the following cover sections in this plan. Operational soil cover is not required provided the Dust Control Plan, included as Appendix A, is followed.

2.1.6.2 Clarifier Sludge

Clarifier sludge will be loaded onto dump trucks and hauled to the landfill active face. The waste will be end-dumped on the active face and allowed to dry, and mixed as necessary to expedite the drying process, before it is spread with a dozer. The clarifier sludge will be mixed in with ash or gypsum during the spreading operations in lifts no greater than 12 inches thick. The waste will be compacted in thin lifts as densely as practical with a dozer. Specific monitoring and in-place density testing for clarifier sludge is not required.

Loads of clarifier sludge waste that exhibit higher moisture content than anticipated will be placed no closer than 50 feet from the active face in thin lifts and dozed into place. No waste shall be placed in areas of accumulated water.

Waste will be covered with intermediate, interim, and final soil cover as applicable, in accordance with the following cover sections in this plan. Operational soil cover is not required provided the Dust Control Plan, included as Appendix A, is followed.

2.1.6.3 Asbestos

Asbestos waste shall be packaged in accordance with 40 CFR 61, and it shall be disposed of away from the working face or in an area not contiguous with other disposal areas. Separate areas shall be clearly marked so that asbestos is not exposed by future land disturbing activities. From lift to lift, asbestos disposal areas can be relocated, provided that records of the areas are maintained. Asbestos material shall be covered with six inches of non-asbestos-containing material (i.e., soil, ash, gypsum) within a 24-hour period. Refer to Section 2.1.8.1 for operational cover requirements and section 2.1.8.4 for intermediate cover requirements.

Asbestos material shall not be placed within 25 feet of the exterior slopes. Asbestos material shall be placed in relatively thin lifts limited to only a few feet thick. Asbestos material shall be compacted as

densely as practical and specific monitoring and in-place density testing for asbestos materials is not required.

2.1.6.4 C&D Waste

C&D waste will be brought in dump trucks and dumped on the active face of the landfill. Waste will be placed on the smallest active face as practical and compacted with a dozer as densely as practical. Specific monitoring and in-place density testing of C&D waste is not required. The location of the C&D waste will be noted in the operating record.

Compacted C&D waste will be covered with operational cover as described in Section 2.1.8.2.

An intermediate soil cover will be applied as necessary. Refer to Section 2.1.8.4 for intermediate cover requirements.

2.1.7 Compaction Requirements

Generally, waste and soil cover will be spread with a dozer in lifts no greater than 12 inches thick and compacted with a dozer.

Gypsum and fly ash are fine-grained materials that compact well during waste placement and resemble characteristics of natural soil placed in an engineered fill. Field testing of in-place density and moisture content shall be performed to monitor the compaction and moisture conditioning during waste placement. Waste shall be compacted to a minimum 95 percent of its Standard Proctor (ASTM D 698) maximum dry density. Compacted moisture content shall be plus or minus (±) 5 percent of optimum moisture content.

In-place density and moisture content testing shall be performed at a frequency of one test per 10,000 cubic yards of gypsum and/or fly ash placed. In-place density testing shall be performed using the Sand-Cone Method (ASTM D 1556), Nuclear Methods (ASTM D 6938), or the Drive-Cylinder Method (ASTM D 2937). Moisture content testing shall be performed using the Direct Heating Method (ASTM D 4959) or Nuclear Methods (ASTM D 6938).

In the event that an in-place density and moisture content test fails, the area of waste placement shall be reworked, reconditioned, and retested until the minimum compaction requirement is met. Density test locations shall be documented on a referenced grid system. Waste placement testing records shall be maintained with the on-site operations records.

Laboratory testing shall be performed at a frequency of one Standard Proctor test (ASTM D 698) for every 50,000 cubic yards of gypsum of ash waste placed. Laboratory testing records will be shall be maintained with the on-site operations records.

Specific monitoring and in-place density testing is not required for wastes other than gypsum and fly ash.

2.1.8 Cover Requirements

2.1.8.1 Operational Cover—Asbestos Material

At the end of each operating day, or at least once every 24-hour period while the site is in continuous operation, asbestos waste material that has been deposited in the Marshall FGD Landfill during the operating day or previous 24-hour period will be covered with at least 6-inches of non-asbestos-containing material, placed, and compacted by a dozer.

2.1.8.2 Operational Cover—C&D Wastes

When the C&D waste disposal area exceeds one-half acre, and at least weekly, the compacted C&D waste will be covered with a minimum of six inches of earthen material.

2.1.8.3 Operational Cover—Other Wastes

For wastes other than asbestos waste and C&D waste, the NC Department of Environment and Natural Resources (DENR) has waived operational cover requirements at other similar Duke landfill facilities provided the Dust Control Plan is followed. Refer to Appendix A—Dust Control Plan for dust control requirements.

2.1.8.4 Intermediate Cover

Areas that will not have waste placed for thirty days or more will be covered with a minimum of eight inches of intermediate soil cover and be placed and compacted by a dozer. Additionally, FGD residual, ash waste and mill rejects will be covered with an intermediate soil cover at the completion of each ten feet in vertical thickness.

In the event that operational cover has been applied to asbestos waste and C&D waste material and the area will not have waste placed for thirty days or more, additional soil cover will be placed and compacted by a dozer in order to provide a minimum of eight inches of intermediate soil cover. Areas where asbestos waste and C&D waste material has been placed and no additional asbestos waste and C&D waste has been placed for three months will be seeded with temporary seeding in accordance with Section 4.1.

2.1.8.5 Interim Cover

A 12-inch thick interim cover layer will be placed on areas where final grades have been reached or where placement will be inactive for 12 months or more. The interim cover material will be capable of supporting healthy vegetative cover. The areas will be seeded in accordance with the seeding specifications presented in Section 4.0. Seeding will be provided as necessary to stabilize the soil cover.

2.1.8.6 Final Cover

The final cover system for the Marshall FGD Landfill will be completed within 180 days following the beginning of closure activities unless otherwise approved by the Division.

The final cover will consist of a compacted interim soil cover (on top of the waste), 40-mil textured linear low density polyethylene (LLDPE) geomembrane liner, a geocomposite drainage layer, and minimum two feet of vegetative cover soil. The vegetative layer will consist of on-site soil suitable for maintaining grass cover and controlling erosion. Surface water that percolates through the vegetative layer and 18-inch thick compacted soil layer will drain through the geocomposite drainage layer. The final cover will be vegetated with native grasses within six months following closure.

See Closure/Post-Closure Plan in Appendix B for final cover specifications and maintenance and operations requirements.

2.2 Leachate and Stormwater Management

A leachate collection system (LCS) is in place to drain the leachate within the active cell to the downgradient stormwater storage basin. A 12-inch thick layer of operational cover is over the geomembrane liner and leachate collection and removal system.

Leachate and stormwater are collected in the stormwater storage basin and routed to the Marshall Ash Basin which discharges in accordance with the MSS plant's National Pollutant Discharge Elimination System (NPDES) permit.

2.3 Leachate Collection System (LCS)

The leachate collection system consists of a geonet/geotextile with a perforated collection/header piping system that drains to the stormwater storage basin. The slope on the geomembrane is positive to promote leachate transport from the collection system to the stormwater storage basin. The geonet is a polyethylene synthetic mesh that transmits leachate to the leachate collection pipe. The leachate collection header pipes drain directly to the stormwater storage basin where the stormwater riser pipe routes leachate and stormwater to the Marshall Ash Basin.

As waste placement proceeds, the leachate collection system will be modified as shown on shown on the design drawings.

2.3.1 LCS Maintenance

The maintenance of the leachate management system's physical facilities (consisting of high-density polyethylene [HDPE] piping and the stormwater storage basin) and records will be performed by or under the direct supervision of Duke. Visual observations of proper LCS system performance will be made monthly by Duke staff.

Clean-out pipes are located on the LCS leachate header pipes. LCS header pipes will be cleaned out by the use of a clean-out snake or high pressure water flushing at least once a year and remote-camera monitored at least once every five (5) years.

2.3.2 LCS Record Keeping and Sampling

Records will be maintained at MSS documenting the leachate line cleanout and camera monitoring.

Leachate from the LCS system is not sampled on a routine basis.

2.3.3 Contingency Plan

In the unlikely event that leachate cannot be drained to the active Marshall Ash Basin, leachate will be temporarily stored within the landfill until such time that draining operations to the active ash basin can be restored. In such an event, the Division shall be notified in writing, within 30 days, about the events and corrective actions taken.

2.4 Stormwater Collection and Conveyance

Non-contact stormwater runoff onto the landfill is prevented by diversion ditches around the landfill.

To improve operations, surface water should be diverted from the operational area. Excessive surface water at the working face creates difficulties for maneuvering equipment and prevents the operator from achieving maximum compaction of waste. To divert surface water runoff away from the working face, temporary diversion berms will be installed on the current lift, upslope of the working face and in other locations as dictated by the direction of grade. The area between the temporary berm and the working face should be limited to prevent excessive ponding. The soil cover in the areas beyond the diversion berms will be uniformly graded and compacted to prevent the formation of erosion channels. In the event that channels do form, the cover should be promptly repaired.

Stormwater collection and conveyance measures will be checked regularly and maintained such that necessary repairs can be made as early as practical.

2.4.1 Stormwater Discharge

The stormwater system at the landfill was designed to prevent the discharge of pollutants. Landfill operation shall not cause a discharge of pollutants into waters of the United States, including wetlands, that violates any requirement of the Clean Water Act, including, but not limited to NPDES requirements, pursuant to Section 402. In addition, under the requirements of Section 404 of the Clean Water Act, the discharge of dredged or fill material into waters of the state that would be in violation of the requirements shall not be allowed by landfill operations.

Operations at the landfill shall not cause the discharge of a non-point source of pollution to waters of the United States, including wetlands, that violates any requirement of an area-wide or statewide water quality management plan that has been approved under Section 208 or 319 of the Clean Water Act, as amended.

A jurisdictional wetland and stream are located to the west of the landfill. Maintenance of the stormwater system shall be performed to ensure these areas are not impacted by stormwater or sediment.

2.5 Stormwater Basin Maintenance Requirements

All stormwater features (i.e., diversion ditches, berms, riser, discharge pipe, etc.) associated with Cell 1 until final closure will be inspected and documented monthly for signs of damage, settlement, clogging, silt build-up or washouts. If necessary, repairs to stormwater control features will be made as early as practical.

2.6 Groundwater Monitoring Well Access Requirements

Groundwater monitoring wells are located around the landfill perimeter. A readily accessible, unobstructed, path shall be maintained so that monitoring wells may be accessed using four-wheel drive vehicles. Care must be taken around the wells to prevent any damage to the wells.

2.7 Landfill Gas Management

Marshall FGD Landfill waste consists of gypsum and ash waste, clarifier sludge, asbestos, C&D, and coal mill reject wastes. The majority of the waste stream will consist of FGD gypsum and ash. The remaining small portion of the waste stream will consist of the other aforementioned waste products. Duke does not anticipate that methane or hydrogen sulfide gas will be generated or that odor will be an issue during operations.

Duke proposes not to conduct landfill gas monitoring until the final cover is installed. A landfill gas venting system is provided as part of the engineered cover system.

3.0 Erosion and Sedimentation Control

Erosion and sedimentation control (E&SC) during operations consist of monitoring E&SC stormwater conveyance features and surface erosion.

3.1 E&SC Measures Monitoring and Maintenance

Adequate measures are to be practiced to prevent erosion in general accordance with E&SC measures included on Drawing No. MM6451.00-0005.001 (Cell 1 Final Configuration) and Drawing No. MM6451.01-0004.001 (Gypsum Landfill Erosion Control Details), both dated August 19, 2011.

Erosion control measures include:

- Disturbing as little area as practical at any one time for landfilling operations.
- Seeding/mulching of all disturbed areas commencing as soon as practically possible. Employing erosion netting or sod on steep slopes and other erosion prone areas.
- Use of earthen berms, hay bales, silt fences, riprap, or equivalent devices downgradient of disturbed areas, stockpiles, drainage pipe inlets and outlets, and at intervals along grassed waterways, until such time as permanent vegetation is established.
- Placement of riprap at the inlets and outlets of stormwater piping.

Prior to landfill closure, E&SC features will be checked monthly or at a minimum after every significant rainfall event. Sediment will be removed from structures to their original dimensions when conditions are warranted. Necessary repairs shall be made as soon as practical. Riprap-lined channel sections and outlet-protection aprons will be checked for washouts periodically. Riprap will be added to these areas as needed to maintain the integrity of the structure.

3.2 Surface Erosion Monitoring

Adequate erosion control measures shall be practiced to prevent silt from leaving the site. Channels will be inspected monthly or at a minimum after every significant rainfall event for sediment buildup.

Vegetative ground cover sufficient to control erosion must be provided within 15 working days or 90 calendar days upon completion of any phase of landfill development as per the North Carolina Erosion and Sedimentation Control Guidelines. Seedbed preparation, seeding, soil amendments, and mulching for the establishment of vegetative ground cover will be applied in accordance with North Carolina Erosion and Sedimentation Control Guidelines.

Slopes will be periodically checked for erosion and vegetative quality, fertilized, and mowed. A slope or portion thereof shall be identified as needing maintenance if it meets any one of the following conditions:

- Exposed waste on exterior slopes
- Areas of cracking, sliding, or sloughing
- Areas of seepage

Slopes identified as needing maintenance shall be repaired as soon as practical and as appropriate to correct deficiencies. Repair activities may include re-dressing the slope, filling in low areas, and/or seeding.

4.0 Vegetation Management

Within six months after final termination of disposal operations at the site, the area shall be stabilized with vegetation as required by design drawings and Closure/Post-Closure Plan (Appendix B). Temporary seeding will be applied as required.

Riprap, haybales, or other acceptable temporary methods of erosion control may be required until permanent cover is established. Mulching, until a vegetative cover is established, can stabilize areas where final grade has been reached. Soil mulching can be achieved using wood chips, straw, hay, asphalt emulsion, jute matting, and synthetic fibers. Mulches allow for greater water retention; reduce the amount of runoff; retain seeds, fertilizer, and lime in place; and improve soil moisture and temperature conditions.

4.1 Temporary Seeding

Temporary seeding will be applied as follows [source: *NC Erosion and Sediment Control Planning and Design Manual* (June 2006, Revised March 2009)]:

LATE WINTER TO EARLY SPRING

Seeds	Pounds Per Acre	Date of Planting
Rye (grain)	120	January 1 to May 1
Annual lespedeza (kobe)	50	January 1 to May 1

Note: Omit lespedeza when duration of temporary cover is not to extend beyond June.

SUMMER

Seeds	Pounds Per Acre	Date of Planting
German millet	40	May 1 to August 15

FALL

Seeds	Pounds Per Acre	Date of Planting
Rye (grain)	50	August 15 to December 31

Soil Amendments	Pounds Per Acre
Agricultural limestone	2,000
Fertilizer (10-10-10)	1,000
Mulch	4,000

Note: Soil amendments are for all-season temporary seeding applications.

4.2 Permanent Seeding

Permanent seeding will be applied as follows (source: NC *Erosion and Sediment Control Planning and Design Manual* [June 2006, Revised March 2009]):

Seeds	Pounds Per Acre	Date of Planting
Tall fescue	100	September 1 to April 15
Sericea lespedeza	15	September 1 to May 1
Kobe lespedeza	10	May 1 to September 1
Rye	40	August 15 to April 15

Soil Amendments	Pounds Per Acre
Agricultural limestone	4,000
Fertilizer (10-10-10)	1,000
Mulch	4,000

Note: Perform soil test to determine proper soil amendments; if not available, use the quantities above.

5.0 Landfill Closure

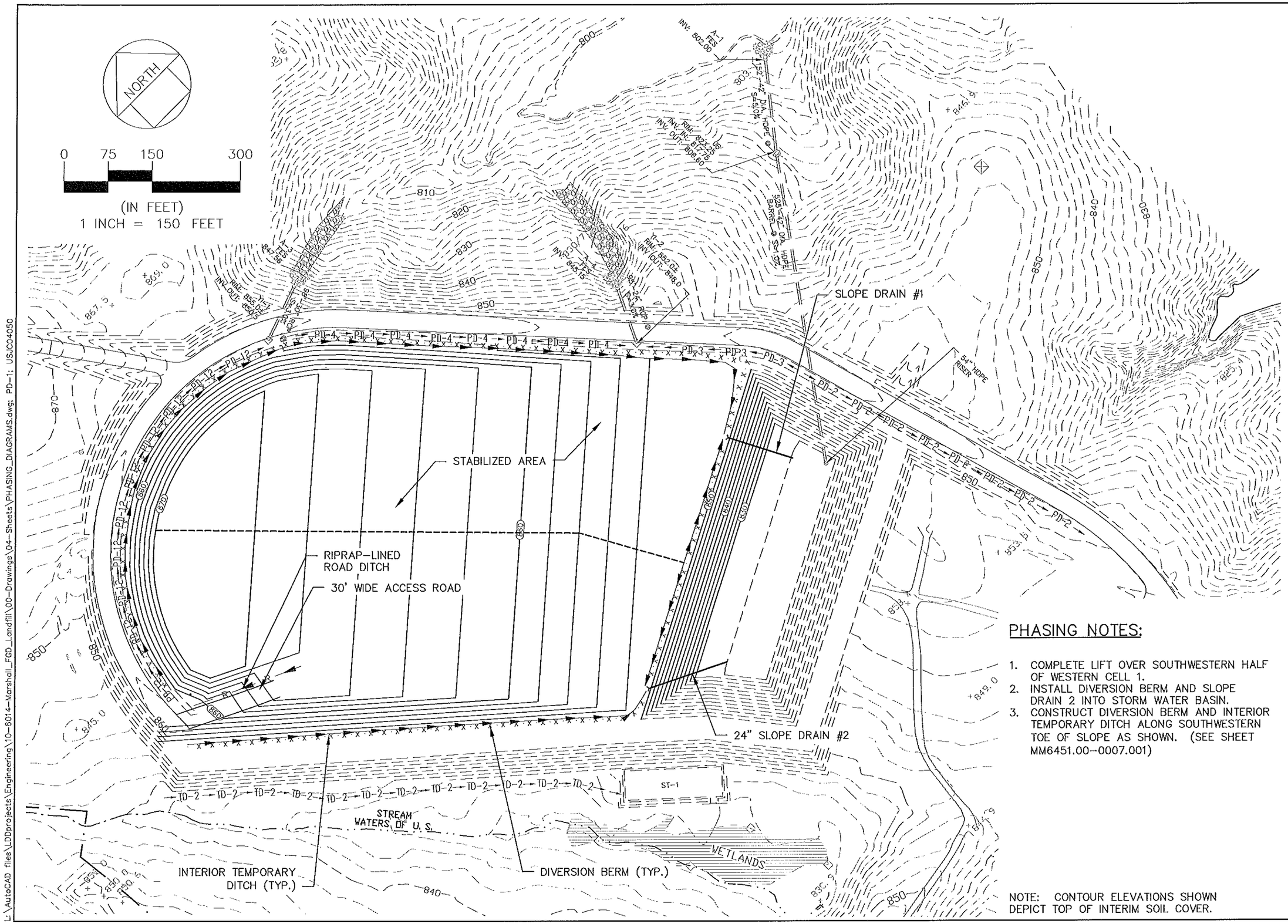
The Marshall FGD Landfill will be closed in accordance with the design drawings and Closure/Post-Closure Plan (Appendix B). The Closure/Post-Closure Plan outlines the sequence for closing the landfill and the post-closure maintenance activities. Closure is designed to minimize the need for long-term maintenance and to control the post-closure release of contaminants. Closure activities may be revised as appropriate for materials, specifications, technology advancements, or changes in regulations at the time the landfill is closed or in post-closure. In general, the landfill development is designed so that final cover can be established as soon as possible.

6.0 Required Regulatory Submittals

Submittal	Requirement	Reporting/Action Frequency
Groundwater Monitoring Reports	Maintain a record of all monitoring events and analytical data in accordance with the Groundwater Monitoring Plan. Reports of the analytical data for each water quality monitoring sampling event shall be submitted to DENR Division of Waste Management (DWM) in a timely manner.	Semiannually
Annual Tonnage Reports	Tons of waste received and disposed of in the landfill shall be reported to the DWM and to all counties from which waste was accepted on forms prescribed by the DWM. Refer to the Permit to Operate for annual reporting requirement information.	Annually Must submit no later than August 1 each year
10-Year Waste Management Plan	Per North Carolina G.S. 130A-309.09D (c), a 10-year waste management plan shall be developed for this landfill. The plan shall be updated at least every three years.	10-year plan updated every 3 years

FIGURES (PHASING DIAGRAMS)

PD-1 – PD-8 – CELL 1 PHASING DIAGRAMS (DEVELOPED AND PROVIDED BY WSP SELLS, DATED AUGUST 19, 2011)



PHASING NOTES:

1. COMPLETE LIFT OVER SOUTHWESTERN HALF OF WESTERN CELL 1.
2. INSTALL DIVERSION BERM AND SLOPE DRAIN 2 INTO STORM WATER BASIN.
3. CONSTRUCT DIVERSION BERM AND INTERIOR TEMPORARY DITCH ALONG SOUTHWESTERN TOE OF SLOPE AS SHOWN. (SEE SHEET MM6451.00--0007.001)

NOTE: CONTOUR ELEVATIONS SHOWN DEPICT TOP OF INTERIM SOIL COVER.

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CATAWBA COUNTY, NC PERMIT NO. 18-09

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REVISIONS	
8/13/21	UPDATED FOR CELL 1

PROJECT #: 10-6014 DATE: 8-12-11

DRAWN BY: JAC CHECKED BY: DEB

TITLE
PHASING PLAN

SHEET
PD-1

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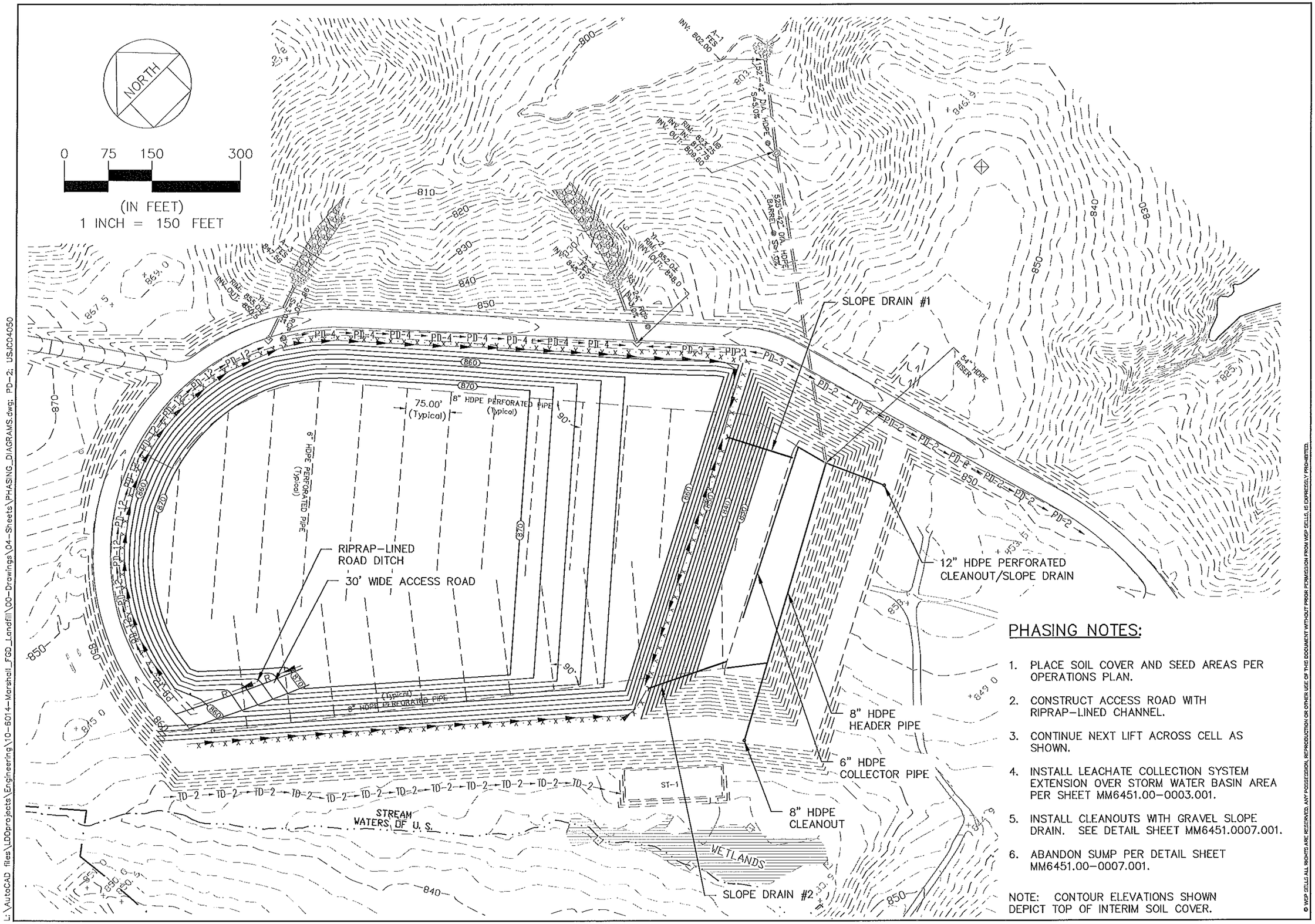

PHASING NOTES:

1. PLACE SOIL COVER AND SEED AREAS PER OPERATIONS PLAN.
2. CONSTRUCT ACCESS ROAD WITH RIPRAP-LINED CHANNEL.
3. CONTINUE NEXT LIFT ACROSS CELL AS SHOWN.
4. INSTALL LEACHATE COLLECTION SYSTEM EXTENSION OVER STORM WATER BASIN AREA PER SHEET MM6451.00-0003.001.
5. INSTALL CLEANOUTS WITH GRAVEL SLOPE DRAIN. SEE DETAIL SHEET MM6451.0007.001.
6. ABANDON SUMP PER DETAIL SHEET MM6451.00-0007.001.

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TITLE
PHASING PLAN

SHEET
PD-2

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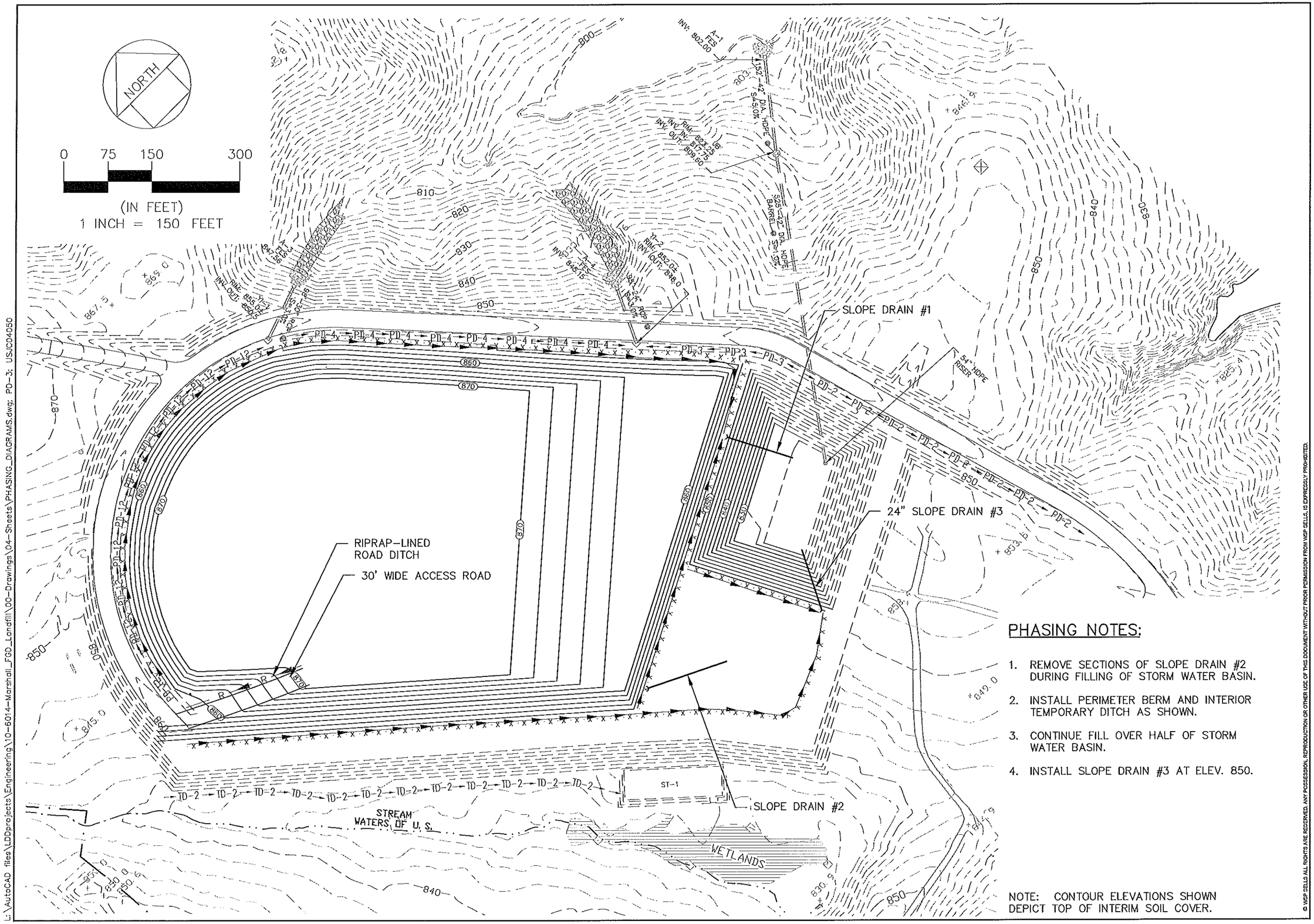

PHASING NOTES:

1. REMOVE SECTIONS OF SLOPE DRAIN #2 DURING FILLING OF STORM WATER BASIN.
2. INSTALL PERIMETER BERM AND INTERIOR TEMPORARY DITCH AS SHOWN.
3. CONTINUE FILL OVER HALF OF STORM WATER BASIN.
4. INSTALL SLOPE DRAIN #3 AT ELEV. 850.

NOTE: CONTOUR ELEVATIONS SHOWN DEPICT TOP OF INTERIM SOIL COVER.

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TITLE
PHASING PLAN

SHEET
PD-3

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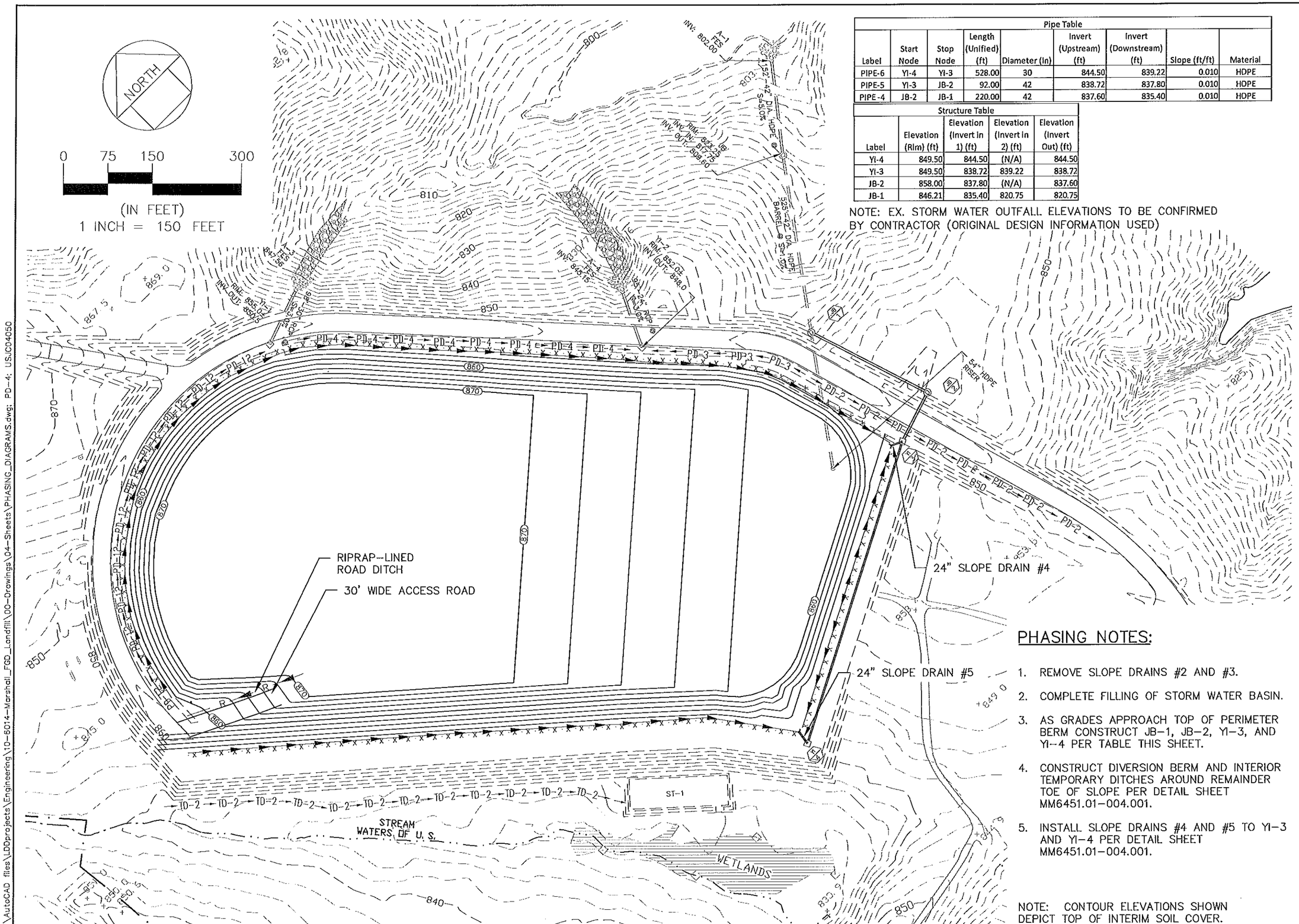

Pipe Table								
Label	Start Node	Stop Node	Length (Unified) (ft)	Diameter (in)	Invert (Upstream) (ft)	Invert (Downstream) (ft)	Slope (ft/ft)	Material
PIPE-6	YI-4	YI-3	528.00	30	844.50	839.22	0.010	HDPE
PIPE-5	YI-3	JB-2	92.00	42	838.72	837.80	0.010	HDPE
PIPE-4	JB-2	JB-1	220.00	42	837.60	835.40	0.010	HDPE

Structure Table				
Label	Elevation (Rim) (ft)	Elevation (Invert In 1) (ft)	Elevation (Invert In 2) (ft)	Elevation (Invert Out) (ft)
YI-4	849.50	844.50	(N/A)	844.50
YI-3	849.50	838.72	839.22	838.72
JB-2	858.00	837.80	(N/A)	837.60
JB-1	846.21	835.40	820.75	820.75

NOTE: EX. STORM WATER OUTFALL ELEVATIONS TO BE CONFIRMED BY CONTRACTOR (ORIGINAL DESIGN INFORMATION USED)

PHASING NOTES:

1. REMOVE SLOPE DRAINS #2 AND #3.
2. COMPLETE FILLING OF STORM WATER BASIN.
3. AS GRADES APPROACH TOP OF PERIMETER BERM CONSTRUCT JB-1, JB-2, YI-3, AND YI-4 PER TABLE THIS SHEET.
4. CONSTRUCT DIVERSION BERM AND INTERIOR TEMPORARY DITCHES AROUND REMAINDER TOE OF SLOPE PER DETAIL SHEET MM6451.01-004.001.
5. INSTALL SLOPE DRAINS #4 AND #5 TO YI-3 AND YI-4 PER DETAIL SHEET MM6451.01-004.001.

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TITLE
PHASING PLAN

SHEET
PD-4

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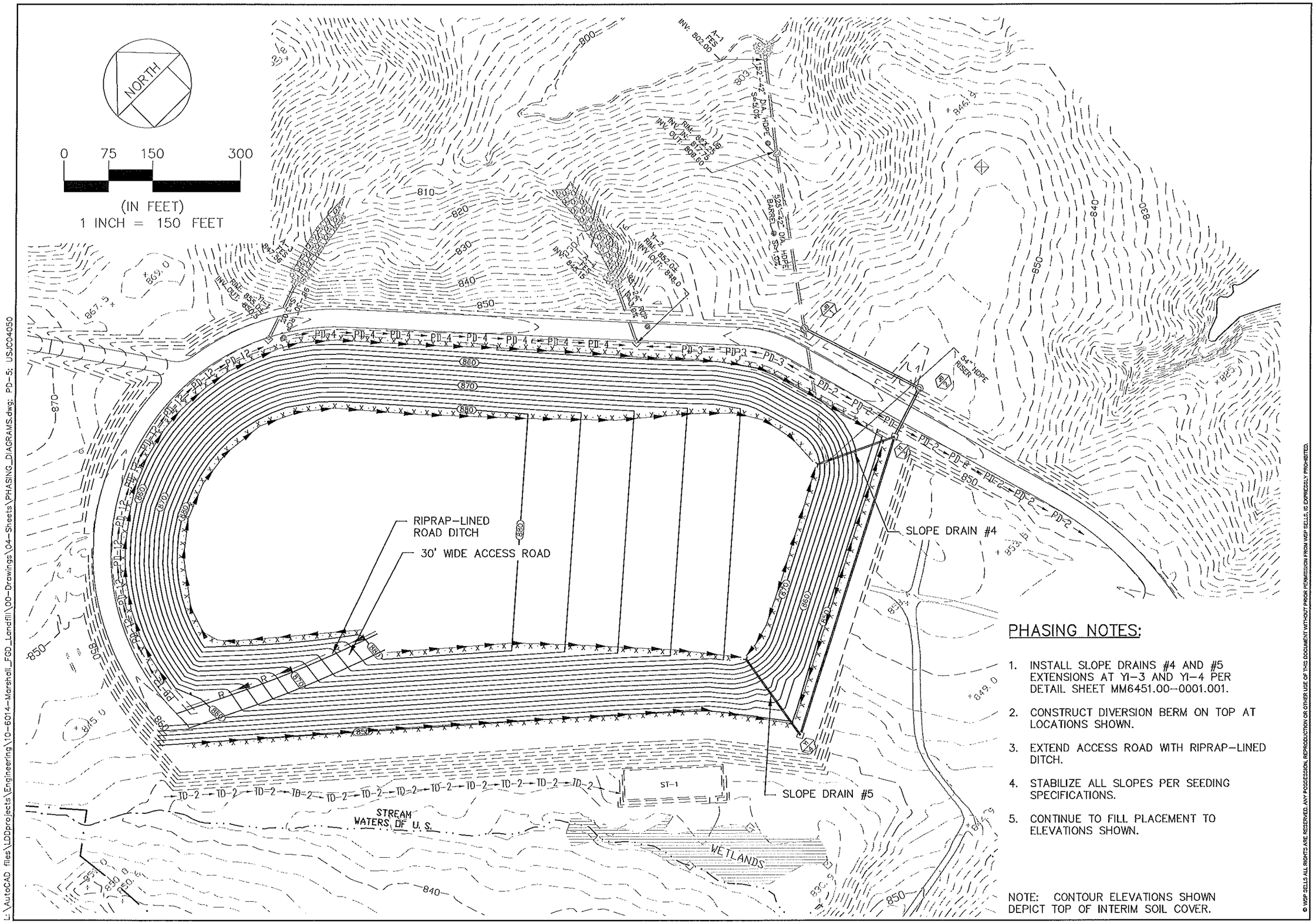

PHASING NOTES:

1. INSTALL SLOPE DRAINS #4 AND #5 EXTENSIONS AT YI-3 AND YI-4 PER DETAIL SHEET MM6451.00--0001.001.
2. CONSTRUCT DIVERSION BERM ON TOP AT LOCATIONS SHOWN.
3. EXTEND ACCESS ROAD WITH RIPRAP-LINED DITCH.
4. STABILIZE ALL SLOPES PER SEEDING SPECIFICATIONS.
5. CONTINUE TO FILL PLACEMENT TO ELEVATIONS SHOWN.

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TITLE
PHASING PLAN

SHEET
PD-5

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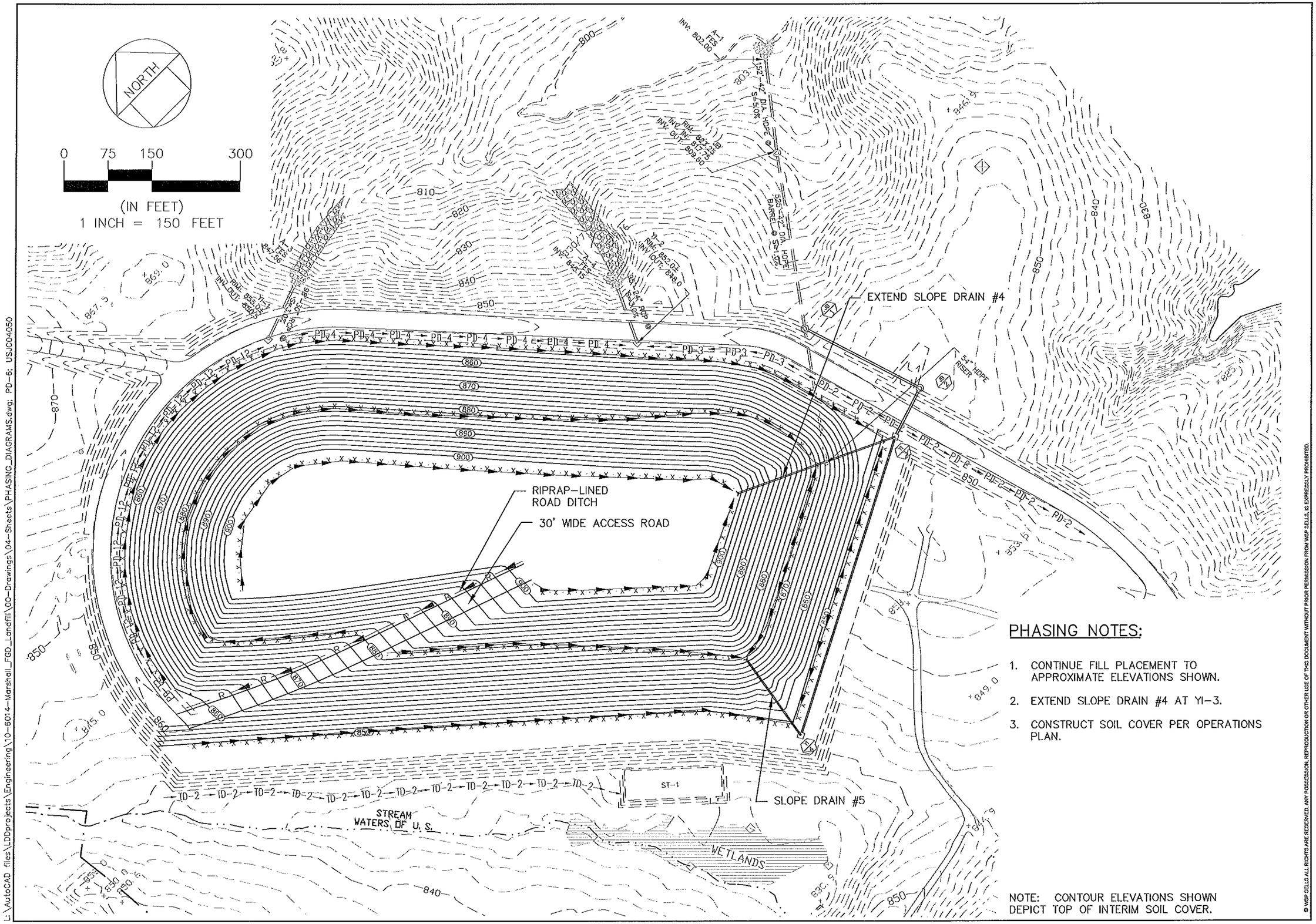

PHASING NOTES:

1. CONTINUE FILL PLACEMENT TO APPROXIMATE ELEVATIONS SHOWN.
2. EXTEND SLOPE DRAIN #4 AT YI-3.
3. CONSTRUCT SOIL COVER PER OPERATIONS PLAN.

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TITLE
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SHEET
PD-6

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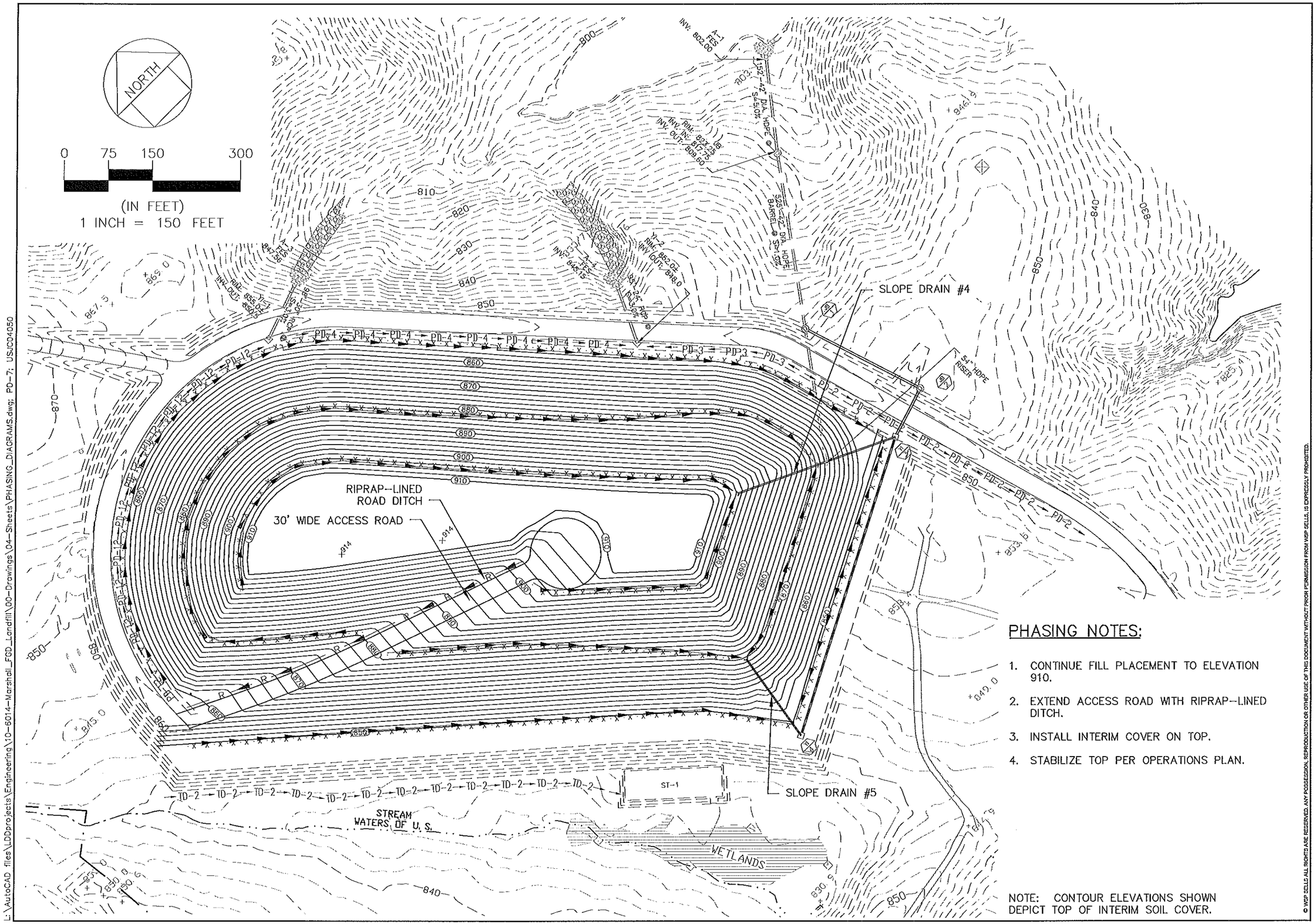

PHASING NOTES:

1. CONTINUE FILL PLACEMENT TO ELEVATION 910.
2. EXTEND ACCESS ROAD WITH RIPRAP--LINED DITCH.
3. INSTALL INTERIM COVER ON TOP.
4. STABILIZE TOP PER OPERATIONS PLAN.

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PROJECT #: 10-6014 DATE: 8-12-11
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TITLE
PHASING PLAN

SHEET
PD-7

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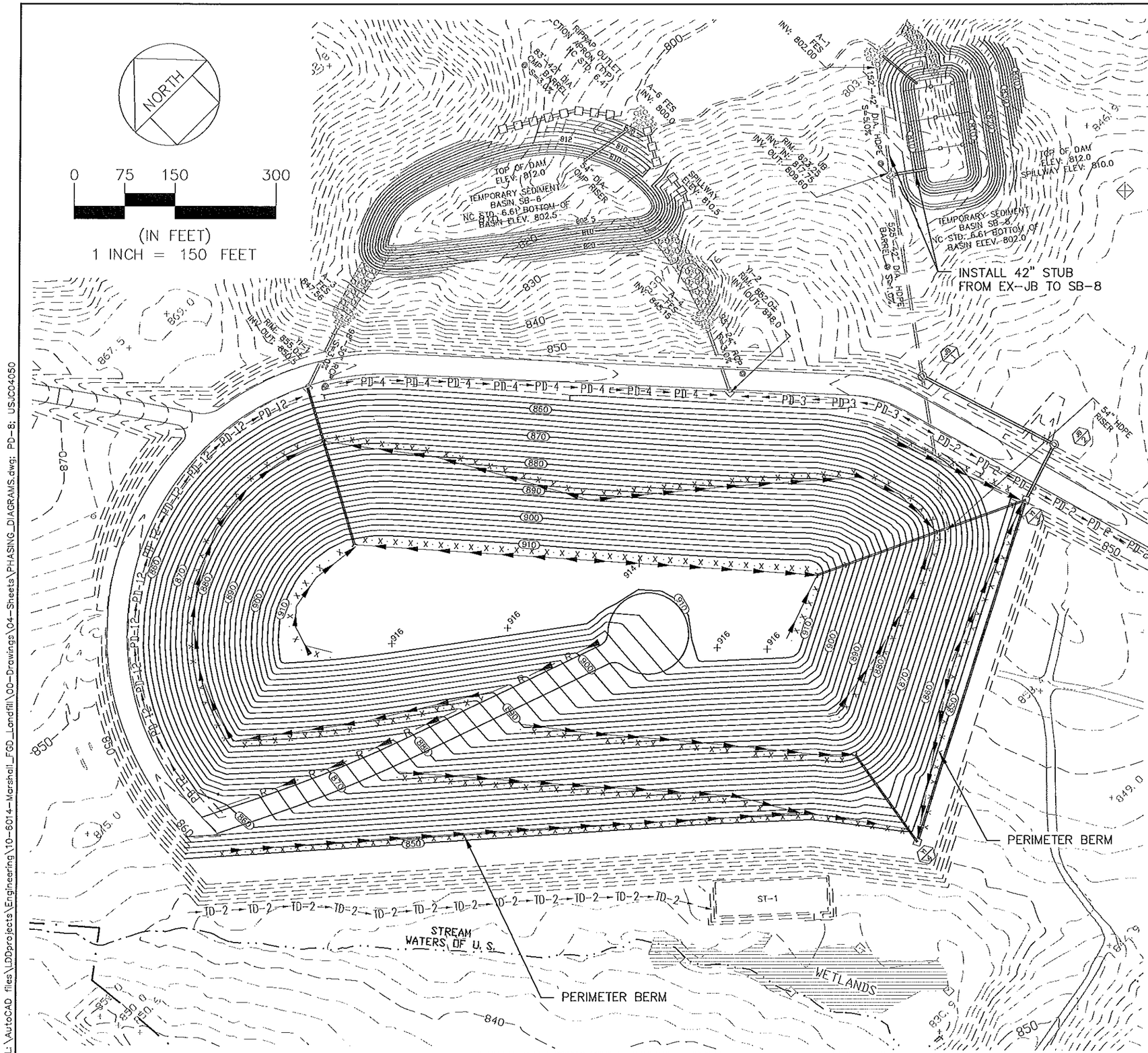

PHASING NOTES:

1. PREPARE FINAL COVER GEOMEMBRANE PLACEMENT.
2. REMOVE END SECTION OF 42 INCH PIPE AND INSTALL 42" STUB INTO SB-8.
3. UPDATE EROSION AND SEDIMENT CONTROL PERMIT. INSTALL SB-6 AND SB-8 PER SHEET MM6451.0005.001 AND MM6451.00-004.001.
4. REMOVE TEMPORARY DIVERSION BERMS AND INTERIOR DITCHES.
5. INSTALL GAS VENTING SYSTEM PER SHEET MM6451.00-0002.001.
6. INSTALL PERIMETER SOUTHEAST AND SOUTHWEST BERM AS SHOWN.
7. PLACE GEOMEMBRANE CAP.
8. GRADE FINAL COVER TO GRADES SHOWN.
9. INSTALL PERMANENT DIVERSION BERMS AND SLOPE DRAINS PER SHEET MM6451.00-0001.001.
10. STABILIZE COVER PER OPERATIONS PLAN.

NOTE: CONTOUR ELEVATIONS SHOWN DEPICT FINAL COVER GRADES.

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TITLE
CELL 1
FINAL CLOSURE

SHEET
PD-8

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TABLES

Table 1
15A NCAC 13B .0505 Operational Requirement Cross-Reference Table

15A NCAC 13B .0505 - Operational Requirements for Sanitary Landfills		Section Reference in Landfill Operations Plan
1.	Plan and Permit Requirements	
	a. Construction plans shall be approved and followed.	Original Permit to Construct issued April 12, 2006. Attachment 1 - Permit to Operate: Phase 1, Cell 1 issued November 21, 2006
	b. Specified monitoring and reporting requirements shall be met.	1.8 - Record Keeping 2.6 - Groundwater Monitoring Well Access Requirements 3.1 - E&SC Measures Monitoring and Maintenance 3.2 - Surface Erosion Monitoring
2.	Spreading and Compacting Requirements	
	a. Solid waste shall be restricted into the smallest area feasible.	2.1.6 - Waste Placement
	b. Solid waste shall be compacted as densely as practical into cells.	2.1.7 - Compaction Requirements
3.	Cover Requirements	
	a. Solid waste shall be covered after each day of operation, with a compacted layer of at least six inches of suitable cover or as specified by the Division.	2.1.8.1 - Operational Cover - Asbestos-Containing Material 2.1.8.2 - Operational Cover - C&D Waste 2.1.8.3 - Operational Cover - Other Wastes
	b. Areas which will not have additional wastes placed on them for 12 months or more, but where final termination of disposal operations has not occurred, shall be covered with a minimum of one foot of intermediate cover.	2.1.8.5 - Interim Cover
	c. After final termination of disposal operations at the site or a major part thereof, or upon revocation of a permit, the area shall be covered with at least two feet of suitable compacted earth.	2.1.8.6 - Final Cover
4.	Erosion Control Requirements	
	a. Adequate erosion control measures shall be practiced to prevent silt from leaving the site.	3.2 - Surface Erosion Monitoring
	b. Adequate erosion control measures shall be practiced to prevent excessive on-site erosion.	3.1 - E&SC Measures Monitoring and Maintenance
5.	Drainage Control Requirements	
	a. Surface water shall be diverted from the operational area.	2.4 - Storm Water Collection and Conveyance
	b. Surface water shall not be impounded over or in waste.	2.4 - Storm Water Collection and Conveyance
	c. Completed areas shall be adequately sloped to allow surface water runoff in a controlled manner.	2.4 - Storm Water Collection and Conveyance

Table 1
15A NCAC 13B .0505 Operational Requirement Cross-Reference Table

15A NCAC 13B .0505 - Operational Requirements for Sanitary Landfills		Section Reference in Landfill Operations Plan
6.	Vegetation Requirements	
	a. Within six months after final termination of disposal operations at the site or a major part thereof or upon revocation of a permit, the area shall be stabilized with native grasses.	2.1.8.6 - Final Cover 4.0 - Vegetation Management
	b. Temporary seeding will be utilized as necessary to stabilize the site.	4.1 - Temporary Seeding
7.	Water Protection Requirements	
	a. The separation distance of four feet between waste and water table shall be maintained unless otherwise specified by the Division in the permit.	NA - seperation from water table addressed during construction phase.
	b. Solid waste shall not be disposed of in water.	2.4 - Storm Water Collection and Conveyance
	c. Leachate shall be contained on site or properly treated prior to discharge. An NPDES permit may be required prior to the discharge of leachate to surface waters.	2.2 - Leachate and Stormwater Management 2.3 - Leachate Collection System (LCS)
8.	Access and Security Requirements	
	a. The site shall be adequately secured by means of gates, chains, berms, fences, and other security measures approved by the Division, to prevent unauthorized entry.	1.4 - Access and Security Requirements
	b. An attendant shall be on duty at the site at all times while it is open for public use to ensure compliance with operational requirements.	1.4 - Access and Security Requirements
	c. The access road to the site shall be of all-weather construction and maintained in good condition.	1.4 - Access and Security Requirements
	d. Dust control measures shall be implemented where necessary.	2.1.3 - Dust, Litter, Odor and Vector Control
9.	Sign Requirements	
	a. Signs providing information on dumping procedures, the hours during which the site is open for public use, the permit number and other pertinent information shall be posted at the site entrance.	1.6 - Signs
	b. Signs shall be posted stating that no hazardous or liquid waste can be received without written permission from the Division.	1.6 - Signs
	c. Traffic signs or markers shall be provided as necessary to promote an orderly traffic pattern to and from the discharge area and to maintain efficient operating conditions.	1.6 - Signs

Table 1
15A NCAC 13B .0505 Operational Requirement Cross-Reference Table

15A NCAC 13B .0505 - Operational Requirements for Sanitary Landfills		Section Reference in Landfill Operations Plan
10. Safety Requirements		
	a. Open burning of solid waste is prohibited.	2.1.4 - Fire Control
	b. Equipment shall be provided to control accidental fires or arrangements shall be made with the local fire protection agency to immediately provide fire-fighting services when needed.	2.1.4 - Fire Control
	c. Fires that occur at a sanitary landfill shall be reported to the Division within 24 hours and a written notification shall be submitted within 15 days.	2.1.4 - Fire Control
	d. The removal of solid waste from a sanitary landfill is prohibited unless the owner/operator approves and the removal is not performed on the working face.	2.1.2 - Waste Acceptance, Disposal and Screening Requirements
	e. Barrels and drums shall not be disposed of unless they are empty and perforated sufficiently to ensure that no liquid or hazardous waste is contained therein.	2.1.2 - Waste Acceptance, Disposal and Screening Requirements
11. Waste Acceptance and Disposal Requirements		
	a. A site shall only accept those solid wastes which it is permitted to receive. The landfill operator shall notify the Division within 24 hours of attempted disposal of any waste the landfill is not permitted to receive, including waste from outside the area the landfill is permitted to serve.	2.1.2 - Waste Acceptance, Disposal and Screening Requirements
	b. No hazardous or liquid waste shall be accepted or disposed of in a sanitary landfill.	2.1.2 - Waste Acceptance, Disposal and Screening Requirements
	c. Spoiled foods, animal carcasses, abattoir waste, hatchery waste, and other animal waste delivered to the disposal site shall be covered immediately.	2.1.2 - Waste Acceptance, Disposal and Screening Requirements
	d. Asbestos waste that is packaged in accordance with 40 CFR 61, which is adopted by reference in accordance with G.S. 150B-14(c), may be disposed of separate and apart from other solid wastes at the bottom of the working face or in an area not contiguous with other disposal areas, in either case, in virgin soil. Separate areas shall be clearly marked so that asbestos is not exposed by future land-disturbing activities. The waste shall be covered immediately with soil in a manner that will not cause airborne conditions. Copies of 40 CFR 61 may be obtained and inspected at the Division.	2.1.2 - Waste Acceptance, Disposal and Screening Requirements 2.1.6.3 - Asbestos (Waste Placement)
	e. Wastewater treatment sludges may only be used as a soil conditioner and incorporated into the final two feet of cover. Sludges shall be examined for acceptance by Waste Determination procedures in Rule .0103(e) of this Subchapter.	2.1.6.2 Clarifier Sludge
12. Miscellaneous Requirements		
	a. Effective vector control measures shall be applied to control flies, rodents, and other insects or vermin when necessary.	2.1.3 - Dust, Litter, Odor and Vector Control
	b. Appropriate methods such as fencing and diking shall be provided within the area to confine solid waste subject to be blown by the wind. At the conclusion of each day of operation, all windblown material resulting from the operation shall be collected and returned to the area by the owner or operator.	1.4 - Access and Security Requirements

Table 2
List of Design Drawings

Duke Drawing #	Title
M-6024-02.00	Cell 1 Excavation
M-6024-03.00	Cell 1 Profile and Sections
M-6024-04.00	Cell 1 Perimeter Road Realignment
M-6024-08.00	Cell 1 and Cell 2 Perimeter Road Sections
M-6024-09.00	Cell 1 and Cell 2 Perimeter Road Profile
MM6451.00-0002.001*	Gas Venting System Plan
MM6451.01-0001.001	Cell 1 Erosion and Sediment Control Plan
MM6451.01-0002.001	Cell 2 Erosion and Sediment Control Plan
MM6451.01-0003.001	Final Closure Erosion and Sediment Control Plan
MM6451.01-0004.001*	Gypsum Landfill Erosion Control Details
MM6451.00-0001.001*	Final Closure Details
MM6451.00-0003.001*	Cell 1 Leachate Collection and Removal System
MM6451.00-0004.001	Cell 1 Operational Cover Grading Plan
MM6451.00-0005.001*	Cell 1 Final Configuration
MM6451.00-0006.001	Cell 1 Stormwater Basin
MM6451.00-0007.001*	Cell 1 and Cell 2 Details
MM6451.00-0008.001	Cell 1 and Cell 2 Leachate Collection and Removal System
MM6451.00-0009.001	Cell 2 Landfill Excavation
MM6451.00-0010.001	Cell 2 Leachate Collection and Removal System
MM6451.00-0011.001	Cell 2 Operational Cover Grading Plan
MM6451.00-0012.001	Cell 2 Stormwater Basin
MM6451.00-0013.001	Cell 1 and Cell 2 Final Configuration
MM6451.00-0014.001	Cell 1 and Cell 2 Sections

Notes:

1. Unless otherwsie note, the design drawing is from the *Construction Plan Application* dated December 15, 2005.
2. * indicates design drawing revised August 19, 2011.

APPENDICES

APPENDIX A

DUST CONTROL PLAN

Dust Control Plan

Duke Energy Carolinas, LLC—Marshall Steam Station
Flue Gas Desulfurization (FGD) Residue Landfill Phase 1, Cell 1
Catawba County, North Carolina

Permit No. 18-09

August 19, 2011

Prepared for:
Duke Energy Carolinas, LLC
526 South Church Street
Charlotte, North Carolina 28202

Prepared by:
Altamont Environmental, Inc.
231 Haywood Street
Asheville, North Carolina 28801

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Figure

Figure 1—Landfill Operations Grid

Appendices

Appendix 1—Monitoring Worksheet

1.0 Introduction and Site Description

This Dust Control Plan is for the Marshall Steam Station (Marshall) Flue Gas Desulfurization (FGD) Residue Landfill (Marshall FGD Landfill) at Duke Energy Carolina's, LLC (Duke's) Marshall Steam Station (Marshall). This Plan provides dust control methods for managing dust emissions at the Marshall FGD landfill in addition to a monitoring program and corrective action response to contain coal combustion products (CCPs) to prevent dust nuisances to employees and the public. The monitoring program will aid Duke and the landfill operator in evaluating the dust control methods, or combination of dust control methods, that prove effective with site-specific conditions.

The Marshall FGD landfill, Phase 1, Cell 1 has an approximately 4.8-acre footprint, and is used primarily for CCP management. CCPs managed by the landfill primarily consist of FGD residue (i.e., gypsum, clarifier sludge), fly ash, bottom ash, and mill rejects. The landfill is also used for asbestos and construction and debris (C&D) waste management.

This Plan is included as a supplement to the *Operations Plan* for the Marshall FGD landfill.

2.0 Dust Control Methods

The primary potential source of dust emissions in the landfill is the active area of waste placement. These areas are at a higher risk for producing dust due to vehicular and equipment traffic and earthwork construction. Exterior landfill slopes are less of a dust control concern as they have operational, intermediate, or interim soil covers, which are vegetated as required in the *Operations Plan*. Operational, intermediate and interim soil covers are defined in the *Operations Plan*.

Dust emissions from the landfill can be controlled through a variety of dust control methods. Possible dust control methods are identified herein. Dust control methods may be characterized as products and/or applications, structural wind breaks and/or covers, and operational methods.

Dust control methods for the landfill area include, but are not limited to:

- Watering
- Establishing vegetative cover
- Mulching
- Structural controls consisting of:
  - Wind breaks (i.e., fencing and/or berms)
  - Temporary coverings (i.e., tarps)
- Spray applied dust suppressants consisting of, and not limited to:
  - Anionic asphalt emulsion
  - Latex emulsion
  - Resin in water
  - Polymer-based emulsion
  - Mineral mortar coatings (i.e., posi-shell)
- Calcium chloride
- Soil stabilizers (i.e., soil cements)
- Operational soil cover
- Modifying the active working area
- Modifying operations during dry and windy conditions

The operator may use, and is not limited to, combinations of these dust control methods or any method that is technically sound and environmentally acceptable to control dust for the specific site conditions. If the operator intends to use a dust control method not presented above, the proposed dust control method will be evaluated by Duke on a case-by-case basis to assess the effectiveness with specific site conditions. For the purposes of this Plan, operational soil cover will be defined as soil material applied at a suitable thickness to provide dust control, typically six inches in thickness. The effectiveness of the dust control methods implemented should be evaluated through a dust monitoring program outlined in Section 3.

Operational equipment generally consists of dump trucks, vibratory smooth drum roller, bulldozer, water truck, spray trailer, track hoe, and service truck. Operational equipment will be used to construct, install, apply, and/or repair dust control methods. The operator will make provisions to alleviate any on-site issues that arise when primary equipment is being maintained or is inoperable. Marshall contains multiple landfill

facilities, and the landfill operator will make provisions to have the necessary equipment to control multiple fugitive CCP dusting emission events.

3.0 Monitoring and Corrective Action Response

This section describes a dust monitoring program and suggests corrective action responses in case fugitive emissions are observed.

3.1 Monitoring

During landfill operations, a dust monitoring program will be implemented to evaluate the dust control measure performance and observe the areas for dust emissions. The dust monitoring program consists of performing visual observations of dust-prone areas, implementing dust-control measures, and monitoring existing and forecasted weather conditions.

Dust emissions can occur under many conditions. For the purposes of this Plan, dust emissions are characterized as fugitive emissions, where CCP dust is located outside the limit of landfill waste. This is most likely to occur during windy, dry, and hot weather conditions. Therefore, the operator will monitor both existing and forecasted weather conditions and use dust-control measures suited to the weather conditions. The dust-control measures shall be implemented prior to the forecasted weather conditions.

Equipment operators shall continuously observe the active face and other areas within the landfill limit for dust emissions. In addition, preventive dust-control measures should be observed and documented at least twice daily (morning and afternoon) when the landfill is in operation to evaluate the dust control measure performance. Additional observations may be necessary as site and weather conditions dictate. Observations will be documented using the attached "Monitoring Worksheet," or online database/worksheet, etc. To minimize continual maintenance of moisture-conditioned and spray-applied areas, the operator shall pay particular attention to these areas. Structural controls shall be observed to monitor that they are achieving their intended purpose. Observations in the landfill area may be made with reference to the grid system shown in the attached Figure 1.

Monitoring will be conducted during times when the landfill is in operations. The operator shall continue to provide necessary dust-control measures during periods when operations are inactive (i.e., outages, weekends, holidays). Operators are to establish appropriate measures so that dust emissions are not reasonably likely to occur during inactive operations periods when monitoring is not being conducted.

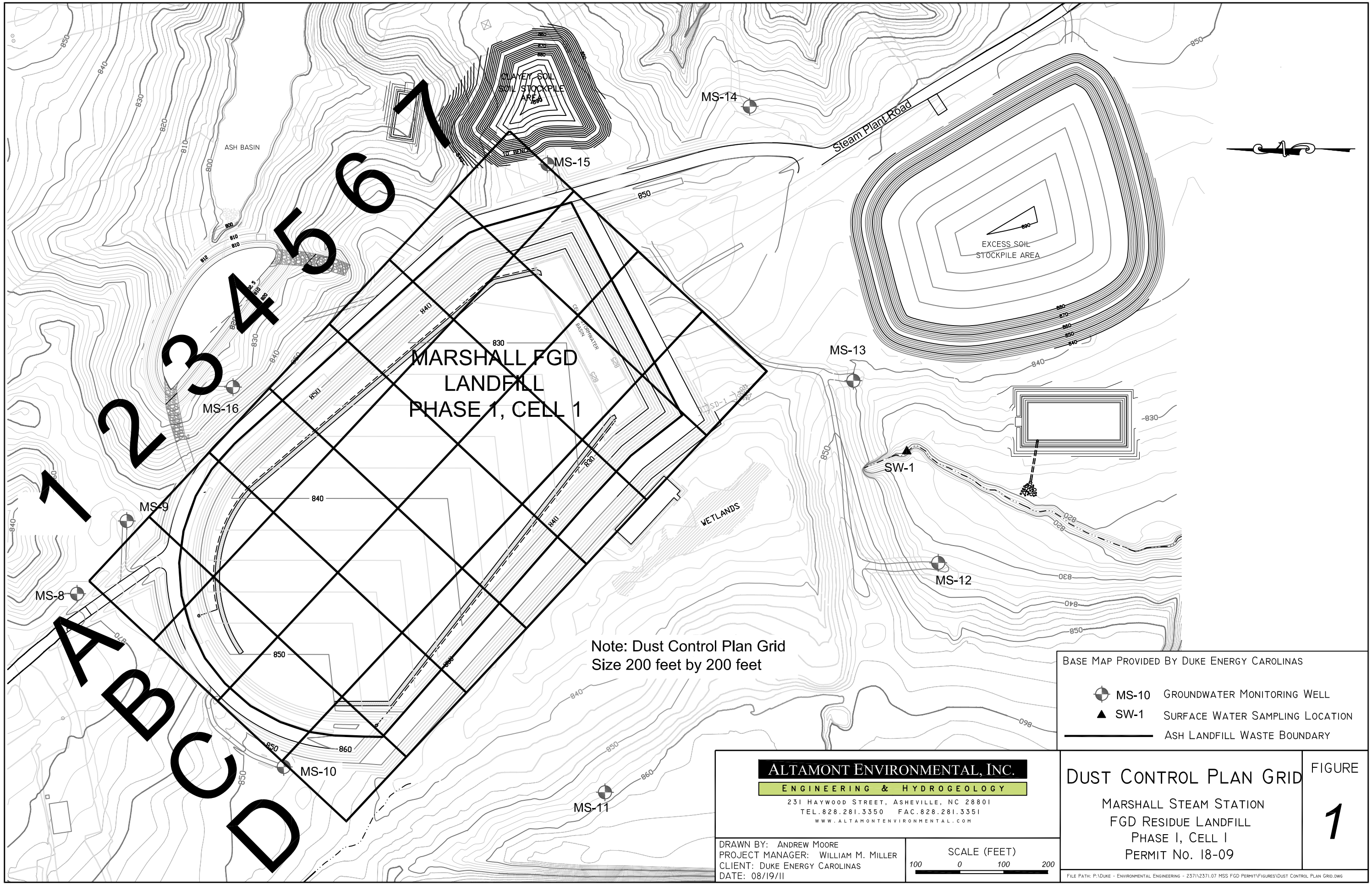
3.2 Corrective Action

If fugitive dust emissions are observed and observations indicate dust-control measures are not achieving their intended purpose, then appropriate corrective actions will be taken. Dust-control measures should be reapplied, repaired, or added, as necessary, to control dust emissions. The operator will construct, install, apply, and/or repair dust-control measures prior to the end of the work day to control dust emissions during non-operating hours. The operator will implement dust-control measures as preventive controls rather than in response to fugitive dust emissions.

4.0 Regulated Cover Requirements

The Marshall FGD landfill is permitted to accept non-CCP wastes including asbestos-containing material and C&D waste. Asbestos-containing material and C&D waste shall be placed in accordance with the approved Operations Plan and regulated cover requirements. In accordance with 40 CFR 61, asbestos material shall be covered with six inches of non-asbestos-containing material (i.e., soil, ash, gypsum) within a 24-hour period.

In accordance with Solid Waste Rules Section 15A NCAC 13B.0542, C&D waste shall be covered with six inches of earthen material (i.e., soil, ash, gypsum) whenever the disposal area exceeds one-half acre and at least once weekly.


1
2
3
4
5
6
7
A
B
C
D
CLAYEY SOIL STOCKPILE AREA
ASH BASIN
MS-14
MS-15
Steam Plant Road
EXCESS SOIL STOCKPILE AREA
MARSHALL FGD LANDFILL PHASE 1, CELL 1
MS-13
MS-16
MS-9
MS-8
SW-1
WETLANDS
MS-12
MS-10
MS-11
Note: Dust Control Plan Grid Size 200 feet by 200 feet
BASE MAP PROVIDED BY DUKE ENERGY CAROLINAS
MS-10 GROUNDWATER MONITORING WELL
SW-1 SURFACE WATER SAMPLING LOCATION
ASH LANDFILL WASTE BOUNDARY
ALTAMONT ENVIRONMENTAL, INC.
ENGINEERING & HYDROGEOLOGY
231 HAYWOOD STREET, ASHEVILLE, NC 28801
TEL.828.281.3350 FAC.828.281.3351
WWW.ALTAMONTENVIRONMENTAL.COM
DRAWN BY: ANDREW MOORE
PROJECT MANAGER: WILLIAM M. MILLER
CLIENT: DUKE ENERGY CAROLINAS
DATE: 08/19/11
SCALE (FEET)
100 0 100 200
DUST CONTROL PLAN GRID
MARSHALL STEAM STATION
FGD RESIDUE LANDFILL
PHASE 1, CELL 1
PERMIT NO. 18-09
FIGURE
1
FILE PATH: P:\DUKE - ENVIRONMENTAL ENGINEERING - 23711\23711.07 MSS FGD PERMIT\FIGURES\DUST CONTROL PLAN GRID.DWG

APPENDIX 1
DUST CONTROL PLAN MONITORING WORKSHEET

FGD Residue Landfill Phase 1, Cell 1
Permit No. 18-09

Dust Control Plan
Monitoring Worksheet

Marshall Steam Station
Terrell, North Carolina

Week:

Date/Time	Dust Control Method in Use	Effective Yes/No	Observation Location	Preventive or Corrective Action Taken Yes/No	Observations/comments including: weather conditions, wind speeds, precipitation, forecast, preventive or corrective actions taken (if needed), additional operational notes	Name of Observer

APPENDIX B

CLOSURE/POST CLOSURE PLAN

CLOSURE/POST CLOSURE PLAN

DUKE ENERGY

MARSHALL STEAM STATION

FLUE GAS DESULFURIZATION (FGD) GYPSUM LANDFILL, PHASE 1

CATAWBA COUNTY, NC

Prepared by:

Chas. H. Sells, Inc.
128 Overhill Drive, Suite 105
Mooresville, NC 28117

March 2004

NORTH CAROLINA PROFESSIONAL SEAL 17582 ENGINEER DAN E. BREWER

3/26/04

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2.3 Geocomposite 2
2.4 Vegetative Soil Layer 2
2.5 Gas Venting System 2

3.0 Post-Closure Maintenance.....2

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3.2 Erosion and Sediment Control 3
3.3 Final Cover 4
3.4 Gas Venting System 4
3.5 Groundwater Monitoring Wells 4

4.0 Post Closure Monitoring.....4

4.1 Groundwater 4
4.2 Surface Water 4

1.0 INTRODUCTION

The purpose of the Closure/Post-Closure Plan is to outline the sequence for closing the landfill phase and the post-closure maintenance activities for each phase. Closure is designed to minimize the need for long term maintenance and to control the post-closure release of contaminants. Closure activities may be revised as appropriate for materials, specifications, technology advances or changes in regulations at that time.

Phasing of landfill development is designed so that final cover can be established as soon as possible. The final cover will be constructed in stages as cells of the landfill reach final grade, at the end of the cell's life. Intermediate grading, that indicate the contours prior to development of adjacent cells, is shown on the Phasing Diagrams in the Operations and Maintenance Plan. The final landfill contours will have erosion control benches and side slopes at a maximum 6H:1V. The central portion of the landfill will have a minimum 10% slope. Complete closure of Phase 1 will encompass a gross waste volume (including cover soils) of approximately 2.19 million cubic yards. Final closure of the FGD residue landfill will commence when Duke Energy declares that no more waste will be accepted or as directed by NCDENR, Division of Waste Management, Solid Waste Section.

The owner or operator shall notify the Division that a notice of intent to close the FGD gypsum landfill has been placed in the operating record. Closure activities for the FGD gypsum landfill shall begin no later than 30 days after final receipt of waste unless otherwise approved by NCDENR.

The final cover system for a completed phase will be completed within 180 days following the beginning of closure activities unless otherwise approved by NCDENR. The final cover system for the closed phase will be certified by a professional engineer as being completed in accordance with the Closure Plan. Duke Energy shall record a notation on the deed to the landfill property stating that the property has been used as a landfill and its use is restricted under the Closure Plan approved by the NCDENR Division of Waste Management. NCDENR will be notified by Duke Energy of the closure completion, certification, deed notation and placement in the operating record.

Following closure operations, the landfill will be developed as a grassed area. If the landfill must be closed prior to reaching the final contours, the surface of the landfill will be sloped to a minimum grade of 5 percent and a maximum grade of 17 percent. A final cover will be established over the landfill in accordance with the Technical Specifications for Closure, Section 4.

2.0 FINAL COVER SYSTEM

2.1 Compacted Soil Layer

The compacted soil layer will consist of an 18-inch thick compacted soil layer directly above the gypsum waste. The compacted soil layer provides a smooth surface for the geomembrane and reduces the infiltration of water into the waste.

2.2 Geomembrane

The geomembrane is a 40-mil thick, textured linear low density polyethylene (LLDPE) material. The geomembrane provides a barrier layer that reduces leachate generation.

2.3 Geocomposite

The geocomposite is a non-woven geotextile/ HDPE geonet/ non-woven geotextile composite. The geocomposite provides a drainage layer for water that percolates through the vegetative soil layer. The geocomposite also reduces the build-up of water directly on top of the geomembrane. A perimeter toe drain is provided at the toe of the landfill slope to drain out water flowing through the geocomposite.

2.4 Vegetative Soil Layer

The vegetative layer will consist of 18 inches of general fill with a 6-inch thick topsoil layer suitable for establishing a grass cover. The soil will be spread in two lifts and lightly compacted with a dozer. This layer will protect the geomembrane from damage due to ultraviolet degradation, desiccation (drying), freeze-thaw, erosion and vectors. A mixture of fertilizer and seed will be applied to the surface which will rapidly establish a continuous dense cover of grass.

2.5 Gas Venting System

A gas venting system will be incorporated into the final cap configuration. A passive gas venting system will be required to remove gas that collects beneath the geomembrane cap. The gas venting system will consist of screened pipes encased in a gravel trench. The vents will be connected to the upper geomembrane cap by means of a geomembrane boot to retard surface water infiltration into the landfilled waste. The locations and quantity of vents are shown on the Gas Venting System Plan.

3.0 POST-CLOSURE MAINTENANCE

3.1 Post-Closure Period

Post closure maintenance of the facility after closure will be conducted for 30 years and consist of the following elements:

- Inspection and maintenance of final cover,
- Control of access, and
- Operation, inspection and maintenance of surface water and erosion/sedimentation control systems.

The post-closure care period may be decreased by the NCDENR Division of Waste Management if the owner or operator demonstrates that the decreased period is sufficient to protect human health and the environment. However, the post-closure care period may also be increased by the NCDENR Division of Waste Management if the Division determines that an increased period is required to protect human health and the environment.

Following completion of the post-closure care period of the FGD residue landfill, the owner or operator shall notify the NCDENR Division of Waste Management that a certification, by a registered professional engineer, verifying that post-closure care has been completed in accordance with the post-closure plan and has been placed in the operating record.

3.2 Erosion and Sediment Control

Surface water running off the landfill during and after a rainfall event will be collected and routed off the cover by erosion control benches. Surface water that flows towards the landfill from off-site uphill areas (run-on) will be intercepted and channeled away from the landfill and final cover surface by diversion ditches and perimeter berms.

Erosion will be controlled by vegetation, erosion control benches and run-on diversion. Vegetation will aid in reducing soil erosion. Benches break the velocity of sheet flow, control development of erosion features before they damage the final cover, and divert runoff into manageable flow volumes. Run-on diversion helps eliminate the source of erosion. Sediment laden runoff will be collected in the sediment basins.

All diversion ditches and erosion control benches shall be inspected quarterly for signs of wash-outs or siltation. Riprap channels and outlet protection aprons shall be inspected for wash-outs. Damaged areas shall be repaired as soon as possible.

The sediment basins shall be inspected after significant rainfall events. Sediment shall be removed when the sediment accumulates to one half the design depth.

Culverts and inlets shall be inspected quarterly for signs of damage, siltation buildup, settlement or clogging. Repairs shall be made as soon as possible.

3.3 Final Cover

The final cover shall be inspected quarterly for signs of settlement, erosion, vector damage and bare spots. The grass cover shall be mowed at least twice a year. Bare spots shall be re-vegetated with grass seed. Any deep-rooted or woody vegetation that may have established itself on the cover soil shall be removed so that the deep root growth will not penetrate the geomembrane. Areas exhibiting settlement shall be filled to provide positive drainage. Eroded areas shall be filled and reseeded as needed.

3.4 Gas Venting System

The gas venting system shall be inspected quarterly for signs of damage. Geomembrane connections to each vent shall also be inspected. Any damaged vents shall be repaired.

3.5 Groundwater Monitoring Wells

All groundwater monitoring wells shall be inspected during groundwater sampling events. Any damaged wells shall be repaired immediately. Access to the wells shall be maintained to provide all-weather access.

4.0 POST-CLOSURE MONITORING

Following closure of the landfill, a monitoring program will be implemented to monitor the quality of groundwater and surface water in the areas surrounding the landfill. The monitoring program will be in accordance with the State approved monitoring plan and will continue for a period of 30 years after final closure. The length of the post-closure care period may be decreased or increased by the NCDENR Division of Waste Management if the reduced period is sufficient or the lengthened period is necessary to protect human health and the environment. Following completion of the post-closure period, the owner or operator shall notify the Division that a certification signed by a registered professional engineer, verifying that the post-closure care has been completed in accordance with the post-closure plan, has been placed in the operating record.

4.1 Groundwater

The Groundwater Monitoring Plan will be continued semi-annually (or as required) after final closure. The results of the analytical testing will be submitted to NCDENR as directed in the Groundwater Monitoring Plan.

4.2 Surface Water

Surface water monitoring of the downgradient tributaries to Lake Norman will be continued after closure as required by the NCDENR Division of Waste Management. Surface water discharged from the sediment basins will be sampled and analyzed if required by the NPDES stormwater permit.

ATTACHMENTS

ATTACHMENT 1

PERMIT TO OPERATE
(LATER – PERMIT TO OPERATE WILL BE INSERTED WHEN ISSUED BY NCDENR)

ATTACHMENT 2

GROUNDWATER SAMPLING AND ANALYSIS PLAN
(LATER – WILL BE INSERTED AFTER APPROVAL BY NCDENR)

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WWW.ALTAMONTENVIRONMENTAL.COM

MEMORANDUM

To: Mr. Larry Frost, Environmental Engineer, North Carolina Department of Environment and Natural Resources, Division of Solid Waste

Date: August 19, 2011

Subject: Financial Assurance Cost Estimate - Marshall Steam Station Flue Gas Desulfurization (FGD) Residue Landfill, Permit 18-09, Cell 1 and Cell 2

On the behalf of Duke Energy Carolinas, LLC, (Duke), Altamont Environmental, Inc. (Altamont), is providing the financial assurance cost estimate for the closure, post-closure, and potential assessment and corrective action costs associated with the Duke Energy Carolinas, LLC, Marshall Steam Station Flue Gas Desulfurization (FGD) Residue Landfill, Cell 1 and Cell 2.

The following cost estimates are detailed in the attached tables:

- Closure cost estimate, $4,883,672 ($154,059 per acre), is provided in the attached Table 1.
- Post-closure cost estimate, $1,506,546 ($47,525 per year per acre) or $50,218 annually, are provided in the attached Table 2.
- Potential assessment and corrective action estimate was calculated to be $402,270 as shown in the attached Table 3. Only the costs associated with groundwater and surface water monitoring and maintenance are included with this cost estimate. North Carolina General Statute 130A-295.2 requires the permit holder to establish financial assurance sufficient to cover a minimum of three million dollars ($3,000,000) for potential assessment and corrective action at the facility. As the estimated costs are less than the required minimum, $3,000,000 is used for potential assessment and corrective action costs.

Table 4 provides the cost summary for the items described above. The total financial assurance cost estimate is $9,390,218.

The following design drawings, prepared by Chas. H. Sells, Inc. (now WSP-Sells, Inc.) for the construction of the landfill, were used to develop the cost estimate information:

- Final Closure Details—MM6451.00-0001.001 (dated March 24, 2004)
- Gas Venting System Plan—MM6451.00-0002.001 (dated March 24, 2004)
- Gypsum Landfill Final Closure Erosion & Sediment Control Plan—MM6451.01-003.001 (dated March 24, 2004)
- Gypsum Landfill Erosion Control Details—MM6451.01-004.001 (dated March 24, 2004)
- Cell 1 and Cell 2—Final Configuration—MM6451.00-0013.001 (dated December 15, 2005)

B size (11 inches by 17 inches) copies of these drawings are attached.

Altamont understands that the appropriate financial assurance mechanism will be provided by Duke once the cost estimate amount has been approved by the Division of Waste Management.

Tables

1. Closure Cost Estimate
2. Post-Closure Cost Estimate
3. Potential Assessment and Corrective Action Cost Estimate
4. Financial Assurance Cost Estimate Summary

Figures

Final Closure Details—MM6451.00-0001.001 (dated March 24, 2004)

Gas Venting System Plan—MM6451.00-0002.001 (dated March 24, 2004)

Gypsum Landfill Final Closure Erosion & Sediment Control Plan—MM6451.01-003.001 (dated March 24, 2004)

Gypsum Landfill Erosion Control Details—MM6451.01-004.001 (dated March 24, 2004)

Cell 1 and Cell 2—Final Configuration—MM6451.00-0013.001 (dated December 15, 2005)

TABLES

Table 1
Closure Cost Estimate
Duke Energy Carolinas, LLC
Marshall Steam Station Flue Gas Desulfurization (FGD) Residue Landfill
Permit No. 18-09
August 19, 2011

Item	Landfill Closure Tasks	Quantity	Unit	Cost	Total
1	**Demolition of Interim Cover Measures**	31.7	AC	$1,000	$31,700
2	**Fine Grading of Interim Cover**	31.7	AC	$3,800	$120,460
3	**Gas Venting System**				
	Passive Gas Vents and Trenching	30	EA	$15,833	$474,990
4	**Final Cover**				
	40-mil LLDPE Geomembrane	1,381,871	SF	$0.63	$870,579
	Geocomposite Drainage Layer	1,381,871	SF	$0.98	$1,354,234
	18" Protective Cover	153,541	SY	$2.00	$307,082
	6" Vegetative Cover	153,541	SY	$1.67	$256,413
5	**Stormwater Management**				
	Erosion Control Bench	6,307	LF	$20	$126,140
	Armored Channel	760	LF	$71	$53,960
	RCP Headwall	1	EA	$2,745	$2,745
6	**Final Landscaping**				
	Seeding, Fertilizing, and Mulching	31.7	AC	$1,800	$57,060
7	**Surveys**	31.7	AC	$1,400	$44,380
8	**Subtotal**				$3,699,743
9	**Mobilization (5% of Subtotal)**				$184,987
10	**Engineering Services, CQA/CQC (12% of Subtotal)**				$443,969
11	**Contingency (15% of Subtotal)**				$554,961
				TOTAL	**$4,883,660**

Notes:
1. "AC" means acres. The 31.7 acre area is for Cell 1 and Cell 2.
2. "EA" means each.
3. "SF" means square feet.
4. "SY" means square yards.
5. "LF" means linear feet.

Table 2
Post-Closure Cost Estimate
Duke Energy Carolinas, LLC
Marshall Steam Station Flue Gas Desulfurization (FGD) Residue Landfill
Permit No. 18-09
August 19, 2011

Item	Landfill Post-Closure Tasks	Quantity	Unit	Cost	Total
1	**Administration/Inspection/Recordkeepting**				
	Project Engineer (80 Hours/Year at $85/Hour)	30	YR	$6,800	$204,000
	Technician (40 Hours/Year at $60/Hour)	30	YR	$2,400	$72,000
	Clerical (8 Hours/Year at $50/Hour)	30	YR	$400	$12,000
2	**Maintenance**				
	Fencing, Gates, Signs, Etc.	30	YR	$1,000	$30,000
	Access Roads	30	YR	$2,000	$60,000
	Mowing ($100 per acre four time per year over 31.7 acres)	30	YR	$12,680	$380,400
	Stormwater Structures	30	YR	$5,000	$150,000
	Leachate Collection and System Maintenance	30	YR	$1,000	$30,000
	Final Cover System ($1,500 per acre)	30	YR	$11,888	$356,640
3	**Fees**				
	Annual Permit Fee	30	YR	$500	$15,000
4	**Subtotal**				$1,310,040
5	**Contingency (15% of Subtotal)**				$196,506
6	**30-Year Total**				**$1,506,546**

Notes:
1. "YR" means year.

Table 3
Potential Assessment and Corrective Action Cost Estimate
Duke Energy Carolinas, LLC
Marshall Steam Station Flue Gas Desulfurization (FGD) Residue Landfill
Permit No. 18-09
August 19, 2011

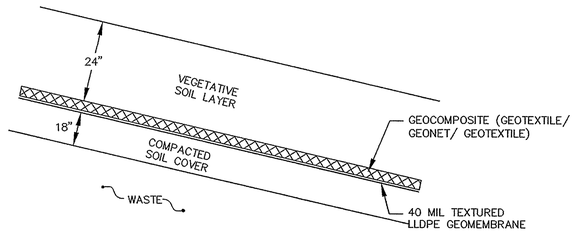
Item	Potential Assessment and Corrective Action Tasks	Quantity	Unit	Cost	Total
1	**Compliance Monitoring (Semiannual Groundwater Monitoring Reports)**				
	Staff Professional (16 Hours/Year at $105/Hour)	30	YR	$1,680	$50,400
	Technician (24 Hours/Year at $85/Hour)	30	YR	$2,400	$72,000
	Clerical (8 Hours/Year at $50/Hour)	30	YR	$400	$12,000
2	**Sampling and Laboratory Analysis**				
	Compliance Sampling for Nine Groundwater Monitoring Wells and One Surface Water Location (semiannual sampling)	60	Event	$2,760	$165,600
	H2S Sampling (semiannual sampling)	60	Event	$830	$49,800
3	**Subtotal**				$349,800
4	**Contingency (15% of Subtotal)**				$52,470
		30-Year Total			**$402,270**
		Minimum Financial Assurance Amount			**$3,000,000**

Notes:
1. "YR" means year.

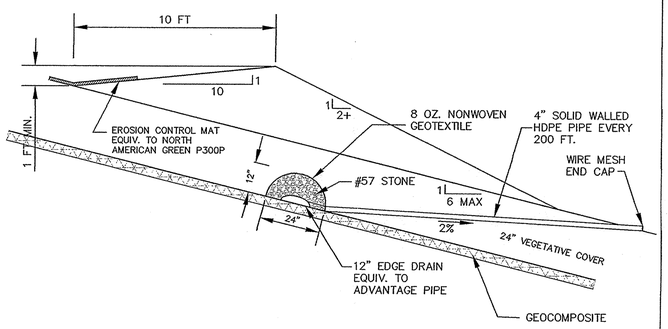
Table 4
Financial Assurance Cost Estimate Summary
Duke Energy Carolinas, LLC
Marshall Steam Station Flue Gas Desulfurization (FGD) Residue Landfill
Permit No. 18-09
August 19, 2011

Item		Total	30-Year Total Per Acre	Annual Cost
1	**Closure**	$4,883,660	$154,059	NA
2	**Post-Closure**	$1,506,546	$47,525	$50,218
3	**Potential Assessment and Remediation**	$3,000,000	NA	$100,000
	Total Estimated Costs	$9,390,206		

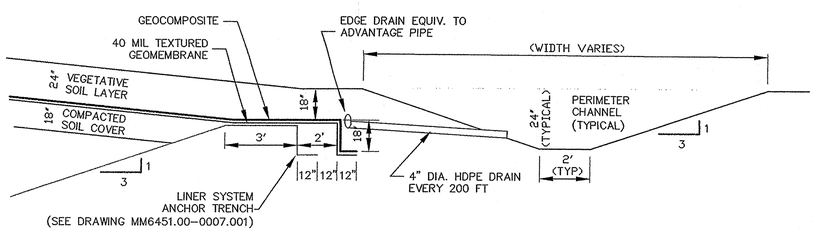
FIGURES



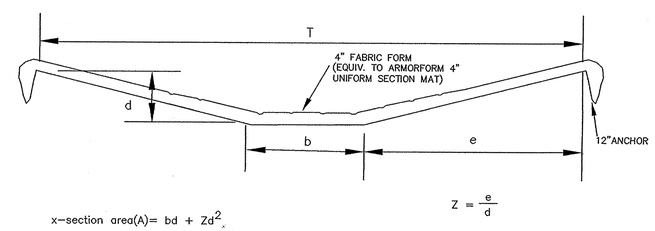
FINAL COVER SECTION
NTS



EROSION CONTROL BENCH
NTS



ANCHOR TRENCH DETAIL
NTS



$Z = \frac{e}{d}$

x-section area(A)= $bd + Zd^2$

top width (T) = b + 2dz

CHANNEL DATA BLOCK

CHANNEL DESIGNATION	USM SIZE	b	d	T	Z	LINER
AC-1	4"	3'	1'	13'	5	*ARMORFORM
AC-2	4"	1'	1'	7'	3	*ARMORFORM

*See Manufacturer's Literature

TYPICAL ARMORED CHANNEL SECTION
NTS

REFERENCES

CONSTRUCTION PLAN APPLICATION	MM6451.00-0000.001
GYPSUM LANDFILL FINAL CLOSURE DETAILS	MM6451.00-0001.001
GYPSUM LANDFILL GAS VENTING SYSTEM PLAN	MM6451.00-0002.001
GYPSUM LANDFILL CELL 1 EROSION & SEDIMENT CONTROL PLAN	MM6451.01-0001.001
GYPSUM LANDFILL CELL 2 EROSION & SEDIMENT CONTROL PLAN	MM6451.01-0002.001
GYPSUM LANDFILL FINAL CLOSURE EROSION & SEDIMENT CONTROL PLAN	MM6451.01-0003.001
GYPSUM LANDFILL EROSION CONTROL DETAILS	MM6451.01-0004.001
GYPSUM LANDFILL CELL 1 FINAL CONFIGURATION	MM6451.00-0005.001
GYPSUM LANDFILL CELL 1 & CELL 2 DETAILS	MM6451.00-0007.001
GYPSUM LANDFILL CELL 1 & CELL 2 FINAL CONFIGURATION	MM6451.00-0013.001

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NORTH CAROLINA PROFESSIONAL SEAL 17582 ENGINEER DAN E. BREWER
12/17/03

MARSHALL STEAM STATION FGD RESIDUE LANDFILL

CATAWBA COUNTY, NORTH CAROLINA

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REVISIONS

C	12/15/03	ISSUED FOR CPA
B	3/26/04	ISSUED FOR PERMIT REVIEW
A	3/24/04	ISSUED FOR DUKE REVIEW

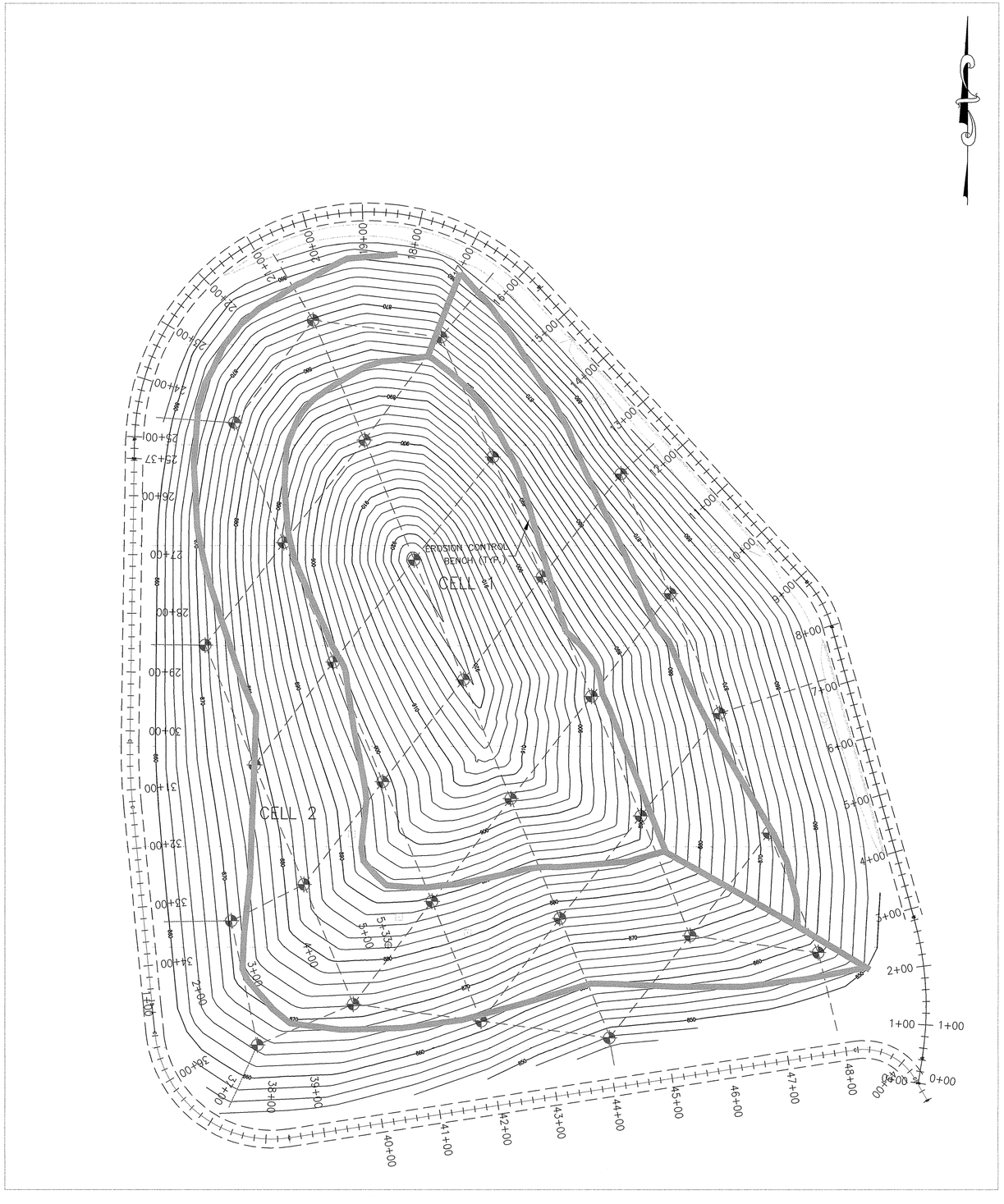
PROJECT #: 046003.001 DATE: 3/24/04

DRAWN BY: PB CHECKED BY: DB

TITLE
FINAL CLOSURE DETAILS

DOCUMENT NO:
MM6451.00-0001.001

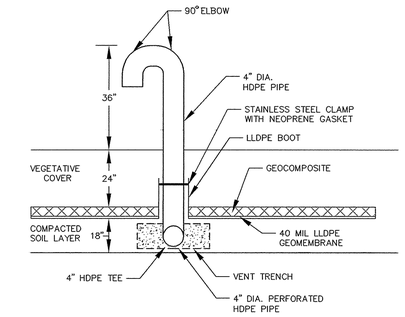
ERN: FHS00050



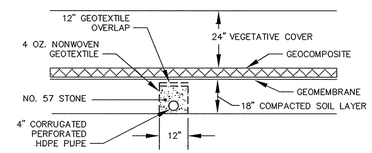
GRAPHIC SCALE

100 0 50 100 200 400

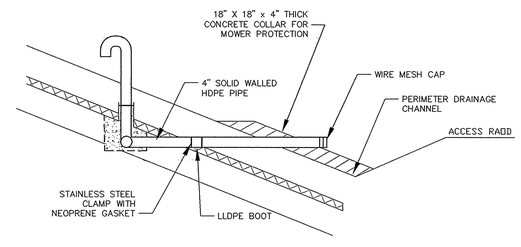
(IN FEET)
1 inch = 100 ft.



TYPICAL GAS VENT
NTS



GAS VENTING TRENCH
NTS



GAS CONDENSATE LINE
NTS

LEGEND:

- GAS VENT
- GAS VENTING TRENCH
- CONDENSATE LINE

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3/26/04

MARSHALL STEAM STATION FGD RESIDUE LANDFILL

CHARLOTTE, NORTH CAROLINA

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REVISIONS

B	3/26/04	ISSUED FOR PERMIT REVIEW
A	3/24/04	ISSUED FOR DUKE REVIEW

PROJECT #: 046003.001 DATE: 3/24/04

DRAWN BY: PB CHECKED BY: DB

TITLE
GAS VENTING SYSTEM PLAN

DOCUMENT NO:
MM6451.00-0002.001

ERN: FHS00051

Vicinity Map Not to Scale

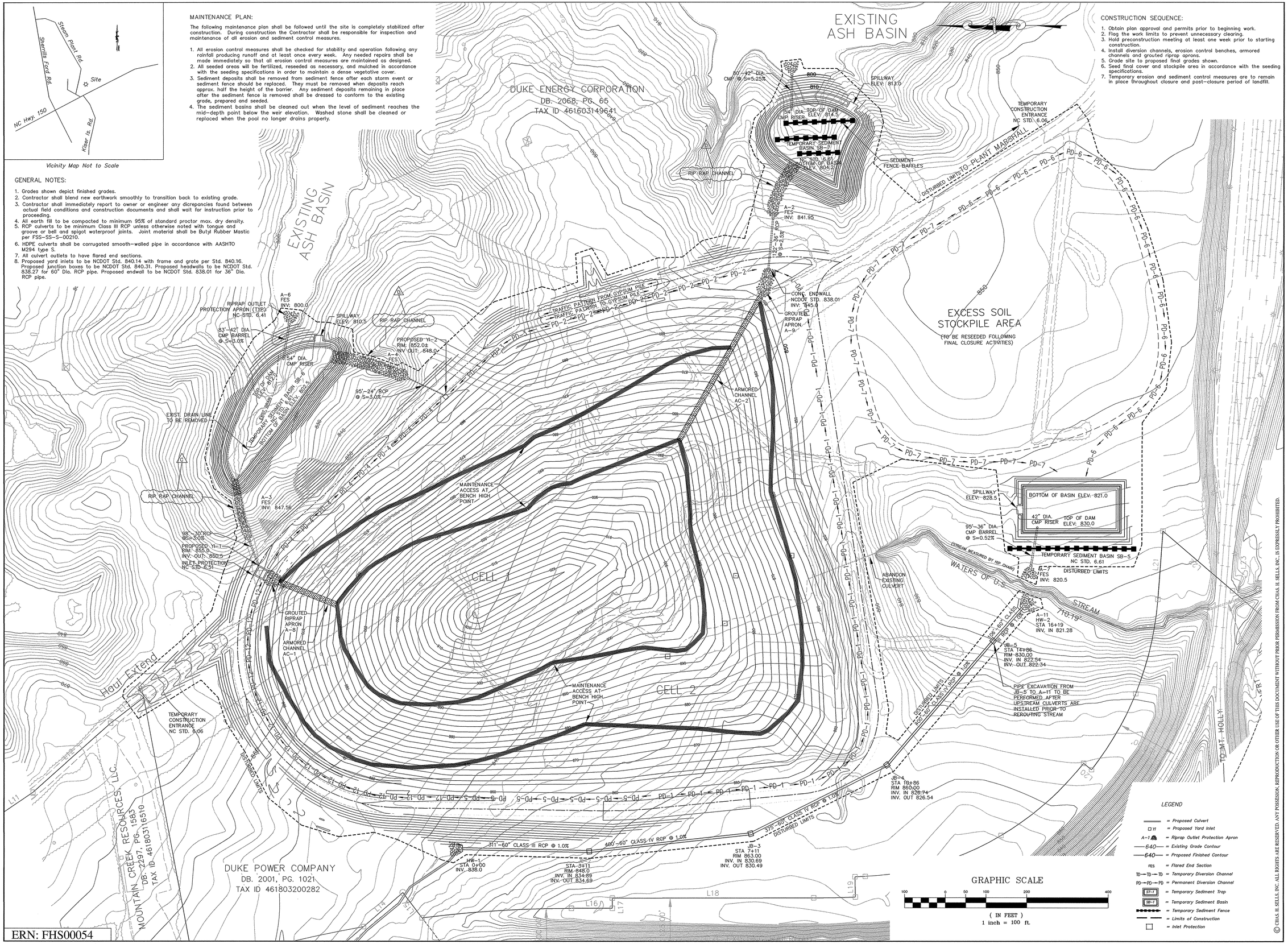
MAINTENANCE PLAN:

The following maintenance plan shall be followed until the site is completely stabilized after construction. During construction the Contractor shall be responsible for inspection and maintenance of all erosion and sediment control measures.

1. All erosion control measures shall be checked for stability and operation following any rainfall producing runoff and at least once every week. Any needed repairs shall be made immediately so that all erosion control measures are maintained as designed.
2. All seeded areas will be fertilized, reseeded as necessary, and mulched in accordance with the seeding specifications in order to maintain a dense vegetative cover.
3. Sediment deposits shall be removed from sediment fence after each storm event or sediment fence should be replaced. They must be removed when deposits reach approx. half the height of the barrier. Any sediment deposits remaining in place after the sediment fence is removed shall be dressed to conform to the existing grade, prepared and seeded.
4. The sediment basins shall be cleaned out when the level of sediment reaches the mid-depth point below the weir elevation. Washed stone shall be cleaned or replaced when the pool no longer drains properly.

GENERAL NOTES:

1. Grades shown depict finished grades.
2. Contractor shall blend new earthwork smoothly to transition back to existing grade.
3. Contractor shall immediately report to owner or engineer any dicrepancies found between actual field conditions and construction documents and shall wait for instruction prior to proceeding.
4. All earth fill to be compacted to minimum 95% of standard proctor max. dry density.
5. RCP culverts to be minimum Class III RCP unless otherwise noted with tongue and groove or bell and spigot waterproof joints. Joint material shall be Butyl Rubber Mastic per FSS-SS-S-00210.
6. HDPE culverts shall be corrugated smooth-walled pipe in accordance with AASHTO M294 type S.
7. All culvert outlets to have flared end sections.
8. Proposed yard inlets to be NCDOT Std. 840.14 with frame and grate per Std. 840.16. Proposed junction boxes to be NCDOT Std. 840.31. Proposed headwalls to be NCDOT Std. 838.27 for 60" Dia. RCP pipe. Proposed endwall to be NCDOT Std. 838.01 for 36" Dia. RCP pipe.



CONSTRUCTION SEQUENCE:

1. Obtain plan approval and permits prior to beginning work.
2. Flag the work limits to prevent unnecessary clearing.
3. Hold preconstruction meeting at least one week prior to starting construction.
4. Install diversion channels, erosion control benches, armored channels and grouted riprap aprons.
5. Grade site to proposed final grades shown.
6. Seed final cover and stockpile area in accordance with the seeding specifications.
7. Temporary erosion and sediment control measures are to remain in place throughout closure and post-closure period of landfill.

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11/10/04

MARSHALL STEAM STATION GYPSUM LANDFILL

CATAWBA COUNTY, NORTH CAROLINA

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REVISIONS

D	11/10/04	PER OWNER COMMENTS
A	3/26/04	ISSUED FOR PERMIT REVIEW

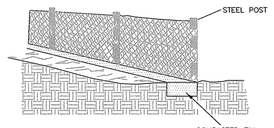
PROJECT #: 046003.001 DATE: 3/24/04

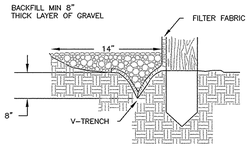
DRAWN BY: DB CHECKED BY: DB

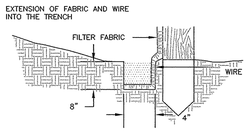
TITLE
GYPSUM LANDFILL
FINAL CLOSURE
EROSION & SEDIMENT
CONTROL PLAN

DOCUMENT NO:
MM6451.01-0003.001

ERN: FHS00054







GENERAL NOTES:

1. FILTER FABRIC FENCE SHALL BE A MINIMUM OF 30" IN WIDTH AND SHALL HAVE A MINIMUM OF 6 LINE WIRES WITH 12" STAY SPACING.
2. WOVEN FILTER FABRIC BE USED WHERE SILT FENCE IS TO REMAIN FOR A PERIOD OF MORE THAN 30 DAYS.
3. STEEL POSTS SHALL BE 5'-0" IN HEIGHT AND BE OF THE SELF-FASTENER ANGLE STEEL TYPE.
4. WASHED STONE SHALL BE USED TO BURY SKIRT WHEN SILT FENCE IS USED ADJACENT TO A CHANNEL, CREEK OR POND.
5. TURN SILT FENCE UP SLOPE AT ENDS.
6. WHEN FABRIC IS USED WITH WIRE MESH 8' CENTERED POSTS MAY BE USED.

MAINTENANCE NOTES:

1. FILTER BARRIERS SHALL BE INSPECTED BY THE FINANCIALLY RESPONSIBLE PARTY OR HIS AGENT IMMEDIATELY AFTER EACH RAINFALL AND AT LEAST DAILY DURING PROLONGED RAINFALL. ANY REPAIRS NEEDED SHALL BE MADE IMMEDIATELY.
2. SHOULD THE FABRIC DECOMPOSE OR BECOME INEFFECTIVE PRIOR TO THE END OF THE EXPECTED USABLE LIFE AND THE BARRIER STILL IS NECESSARY, THE FABRIC SHALL BE REPLACED PROMPTLY.
3. SEDIMENT DEPOSITS SHOULD BE REMOVED AFTER EACH STORM EVENT OR SILT FENCE SHOULD BE REPLACED. THEY MUST BE REMOVED WHEN DEPOSITS REACH APPROX. HALF THE HEIGHT OF THE BARRIER. ANY SEDIMENT DEPOSITS REMAINING IN PLACE AFTER THE SILT FENCE IS REMOVED SHALL BE DRESSED TO CONFORM TO THE EXISTING GRADE, PREPARED AND SEEDED.

INSTALLATION DETAIL OF SEDIMENT FENCE

DETAIL #1

SEEDING MIXTURE	RATE (lb/acre)
Tall Fescue	*100*
Sericea Lespedeza	*30*
Kobe Lespedeza	*10*

SEEDING NOTES

After Aug. 15 use unscarified sericea seed. Where periodic mowing is planned or a neat appearance is desired, omit sericea and increase Kobe lespedeza to 40 lb/acre. To extend spring seeding dates into June, add 15 lb/acre hulled Bermudagrass. However, after mid-Apr. it is preferable to seed temporary cover.

NURSE PLANTS

Between May 1 and Aug. 15, add 10 lb/acre German millet or 15 lb/acre Sudangrass. Prior to May 1 or after Aug. 15 add 40 lb/acre rye (grain).

SEEDING DATES

	Best	Possible
Fall:	*Aug. 25 – Sept. 15*	*Aug. 20 – Oct. 25*
Late Winter:	*Feb. 15 – Mar. 21*	*Feb. 1 – Apr. 15*

Fall is best for tall fescue and late winter for lespedeza. Overseeding of Kobe lespedeza over fall-seeded tall fescue is very effective.

SOIL AMENDMENTS

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

MULCH

Apply Erosion Control Blanket per manufacturer's recommendations.

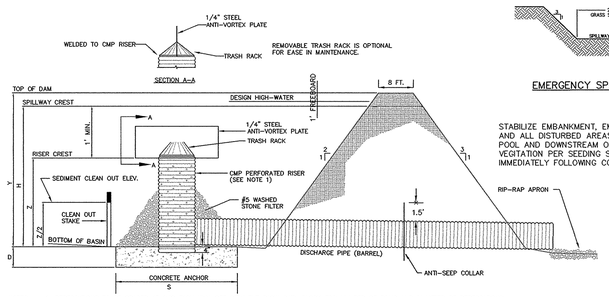
MAINTENANCE

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

Reference: Table 6.11 i from NC Erosion and Sediment Control Planning and Design Manual, 1988.

SEEDING SPECIFICATIONS

DETAIL #3



EMERGENCY SPILLWAY SECTION
NTS

STABILIZE EMBANKMENT, EMERGENCY SPILLWAY AND ALL DISTURBED AREAS ABOVE THE SEDIMENT POOL AND DOWNSTREAM OF THE BASIN WITH VEGITATION PER SEEDING SPECIFICATIONS IMMEDIATELY FOLLOWING CONSTRUCTION.

NOTES: 1. PERFORATIONS TO BE SPACED 4" O/C EACH WAY. SEE SEDIMENT BASIN DATA BLOCK FOR NUMBER OF ROWS AND DIAMETER OF PERFORATIONS.
2. EMERGENCY SPILLWAY TO HAVE 0.5' DESIGN DEPTH WITH 1' FREEBOARD PROVIDED. SEE SEDIMENT BASIN DATA BLOCK FOR MSL ELEVATIONS.

SEDIMENT BASIN DATA BLOCK

CELL EXCAVATION	BASIN DESIGNATION	TOP OF DAM WIDTH	SPILLWAY LENGTH	SPILLWAY ELEV.	SURFACE AREA	BASIN DIMENSIONS	TOP OF DAM ELEV.	CLEANOUT ELEV.	BOTTOM BASIN ELEV.	RISER DIA.	RISER CREST ELEV.	RISER HEIGHT	BARREL DIA.	BARREL LENGTH	BARREL OUTLET ELEV.	ANTI-FLOTATION ANCHOR DIMS.	PERFORATIONS
CELL 1	SB-4	8'	N/A	N/A	43,059 SF	* 101'±x426'±x6'	850.0± MSL	826.0± MSL	823.0± MSL	54"	829.0± MSL	6.0'	42"	467'+/-	818.33 ± MSL	6'x6'x1.5'	8 ROWS 1" DIA.
CELL 1	SB-5	8'	20'	828.5± MSL	29,400 SF	120'x245'x7.5'	830.0± MSL	824.0± MSL	821.0± MSL	42"	827.0 ±MSL	6.0'	36"	95'+/-	820.5 ± MSL	6'x6'x1.25'	6 ROWS 1" DIA.
CELL 2	SB-6	8'	20'	810.5± MSL	43,355 SF	IRREGULAR S.A.	812.0 ± MSL	805.5 ± MSL	802.5 ± MSL	54"	808.5 ±MSL	6.0'	42"	83'+/-	800.0 ± MSL	6'x6'x1.5'	7 ROWS 1" DIA.
CELL 2	SB-7	8'	20'	813.0 ± MSL	33,818 SF	IRREGULAR S.A.	814.5 ± MSL	807.7 ± MSL	804.2 ± MSL	54"	811.2 ±MSL	7.0'	42"	80'+/-	800.0 ± MSL	6'x6'x1.75'	6 ROWS 1" DIA.

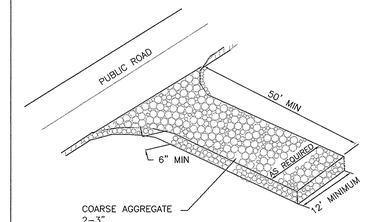
* SB-4 SHALL HAVE IRREGULAR SURFACE AREA AS SHOWN ON PLAN. SURFACE AREA SHOWN IS TAKEN AT ELEVATION 830, ONE FOOT ABOVE CREST OF RISER ELEVATION.

RISER TYPE SEDIMENT BASIN

DETAIL #6

NOTES:

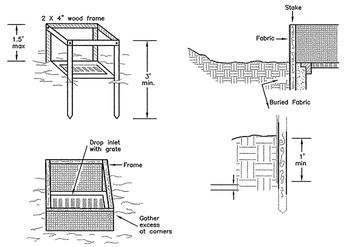
a. GRAVEL PAD TO BE 12'x 50' AND 6" THICK MINIMUM
b. TURNING RADIUS SUFFICIENT TO ACCOMMODATE LARGE TRUCKS IS TO BE PROVIDED (SEE COORDINATE DATA DRAWING).
c. ENTRANCE(S) SHOULD BE LOCATED TO PROVIDE FOR MAXIMUM UTILITY BY ALL CONSTRUCTION VEHICLES.
d. MUST BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR DIRECT FLOW OF MUD ONTO STREETS. PERIODIC TOPDRESSING WITH STONE SILL BE NECESSARY; KEEP SOME HANDY.
e. ANY MATERIAL WHICH STILL MAKES IT ONTO THE ROAD MUST BE CLEANED UP IMMEDIATELY.



NOTES: APPLICABLE AT ALL POINTS OF INGRESS & EGRESS UNTIL SITE IS STABILIZED, FREQUENT CHECKS OF THE DEVICE AND TIMELY MAINTENANCE MUST BE PROVIDED.

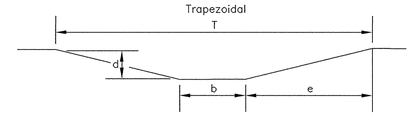
TEMPORARY CONSTRUCTION ENTRANCE

DETAIL #9



FABRIC INLET PROTECTION

DETAIL #4



x-section area(A)= bd + Zd^2
top width (T) = b + 2dz
$Z = \frac{e}{d}$

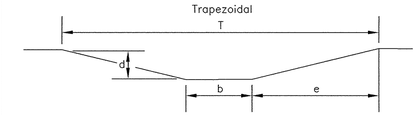
GRASS LINED CHANNEL DATA BLOCK

CHANNEL DESIGNATION	b	d	T	Z
PD-6, PD-7	2'	2'	14'	3
TD-2	3'	2'	15'	3
TD-1	6'	2.5'	21'	3

NOTE: ALL CELL 1 CHANNELS TO RECEIVE STRAW WITH NET TEMPORARY CHANNEL LINER EQUIVALENT TO NORTH AMERICAN GREEN S75. ALL CHANNELS TO RECEIVE TALL FESCUE GRASS LINER INSTALLED PER SEEDING SPECIFICATIONS (SEE DETAIL #2).

CROSS SECTION GEOMETRY OF CELL 1 GRASS-LINED DIVERSION CHANNELS

DETAIL #7



x-section area(A)= bd + Zd^2
top width (T) = b + 2dz
$Z = \frac{e}{d}$

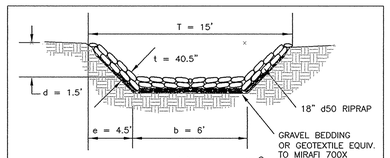
GRASS LINED CHANNEL DATA BLOCK

CHANNEL DESIGNATION	b	d	T	Z
PD-8, PD-9, PD-10, PD-11	2'	1.0'	8'	3
TD-3, PD-2, PD-3, PD-4, PD-5, PD-12	2'	2'	14'	3
PD-1	3'	2'	15'	3

NOTE: CHANNELS PD-8, PD-9 & PD-11 TO RECEIVE SYNTHETIC MAT TEMPORARY CHANNEL LINER EQUIVALENT TO NORTH AMERICAN GREEN P300N. ALL REMAINING CHANNELS TO RECEIVE STRAW WITH NET TEMPORARY CHANNEL LINER EQUIVALENT TO NORTH AMERICAN GREEN S75. ALL CHANNELS TO RECEIVE TALL FESCUE GRASS LINER INSTALLED PER SEEDING SPECIFICATIONS (SEE DETAIL #2).

CROSS SECTION GEOMETRY OF CELL 2 & FINAL CLOSURE GRASS-LINED DIVERSION CHANNELS

DETAIL #8



x-section area(A)= bd + Zd^2
top width (T) = b + 2dz
$Z = \frac{e}{d} = 3$

NOTES:
CHANNELS SHALL BE 18" d50 RIPRAP, dmax = 27", t=40.5".

TRAPEZOIDAL RIPRAP CHANNELS

DETAIL #10

SEEDING MIXTURE	RATE (lb/acre)
Species	*200 (4-5/1,000ft^2)*
Tall Fescue	

NURSE PLANTS

Between May 1 and Aug. 15, add 10 lb/acre Sudangrass or 10 lb/acre German millet. Prior to May 1 or after Aug. 15 add 40 lb/acre rye (grain).

SEEDING DATES

Best: August 25 – October
Possible: February – April 15

Avoid seeding from Nov. to Jan. If seeding must be done at this time, add 40lb/acre rye grain and use a channel lining that offers maximum protection.

SOIL AMENDMENTS

Apply lime and fertilizer according to soil tests, or apply 4,000 lb/acre ground agricultural limestone and 1,000 lb/acre 10-10-10 fertilizer. Operate tillage equipment across the waterway.

MULCH

Use jute, excelsior matting, or other effective channel lining material to cover the bottom of channels and ditches, and staple securely. The lining should extend above the highest calculated depth of flow. On channel side slopes above this height, and in drainages not requiring temporary linings, apply 4,000 lb/acre grain straw and anchor straw by stapling netting over the top.

Mulch and anchoring materials must not be allowed to wash down slopes where they can clog drainage devices.

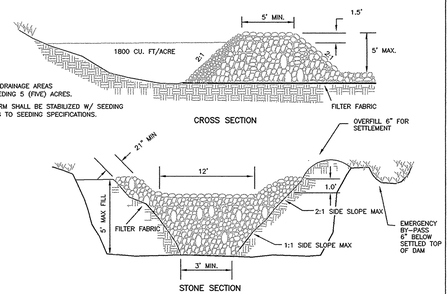
MAINTENANCE

Inspect and repair mulch frequently. Refertilize in late winter of the following year; use soil tests or apply 150 lb/acre 10-10-10. Mow regularly to a height of 2-4 inches.

Refer to Appendix 8.02 for botanical names.

GRASS-LINED DITCH SEEDING SPECIFICATIONS

DETAIL #2



NOTES:
1. USE FOR DRAINAGE AREAS NOT EXCEEDING 5 (FIVE) ACRES.
2. EARTH BERM SHALL BE STABILIZED W/ SEEDING ACCORDING TO SEEDING SPECIFICATIONS.

CROSS SECTION

STONE SECTION

SEDIMENT TRAP DATA BLOCK

CELL EXCAVATION	TRAP DESIGNATION	WEIR LENGTH	WEIR ELEV.	TRAP DIMENSIONS	TOP OF DAM ELEV.	CLEANOUT ELEV.	BOTTOM BASIN ELEV.
CELL 1	ST-2	12'	832.5± MSL	50'x175'	834.0± MSL	831.0±MSL	829.5± MSL
CELL 2	ST-3	6'	818.5± MSL	56'x112'	820.0± MSL	817.0±MSL	815.5 ± MSL
CELL 2	ST-4	6'	828.5± MSL	64'x128'	830.0± MSL	827.0±MSL	825.5± MSL

MAINTENANCE

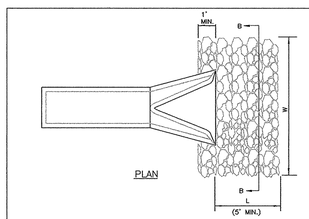
INSPECT TEMPORARY SEDIMENT TRAPS AFTER EACH PERIOD OF SIGNIFICANT RAINFALL. REMOVE SEDIMENT AND RESTORE TRAP TO ITS ORIGINAL DIMENSIONS WHEN THE SEDIMENT HAS ACCUMULATED TO ONE-HALF THE DESIGN DEPTH OF THE TRAP. PLACE THE SEDIMENT THAT IS REMOVED IN A DESIGNATED DISPOSAL AREA AND REPLACE THE CONTAMINATED PART OF THE GRAVEL FACING.

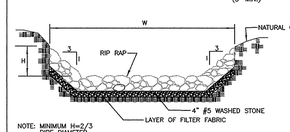
CHECK THE STRUCTURE FOR DAMAGE FROM EROSION OR PIPING. PERIODICALLY CHECK THE DEPTH OF THE SPILLWAY TO ENSURE IT IS A MINIMUM OF 1.5 FT. BELOW THE LOW POINT OF THE EMBANKMENT. IMMEDIATELY FILL ANY SETTLEMENT OF THE EMBANKMENT TO SLIGHTLY ABOVE DESIGN GRADE. ANY RIP RAP DISPLACED FROM THE SPILLWAY MUST BE REPLACED IMMEDIATELY.

STABILIZE THE EMBANKMENT AND ALL DISTURBED AREAS ABOVE THE SEDIMENT POOL AND DOWNSTREAM FROM THE TRAP IMMEDIATELY AFTER CONSTRUCTION WITH SEEDING.

GRAVEL AND RIP RAP FILTER BASIN

DETAIL #5





NOTE: MINIMUM H=2/3 PIPE DIAMETER

SECTION B-B

NOTES:

1. CLASS OR MEDIAN SIZE OF RIPRAP, LENGTH, WIDTH AND DEPTH OF APRONS PER THE OUTLET PROTECTION APRON DATA BLOCK BELOW.
2. RIPRAP SHOULD EXTEND UP BOTH SIDES OF THE APRON AND AROUND THE END OF THE PIPE OR CULVERT AT THE DISCHARGE OUTLET AT A MAXIMUM SLOPE OF 2:1 AND A HEIGHT NOT LESS THAN TWO THIRDS THE PIPE DIAMETER OR CULVERT HEIGHT.
3. THERE SHALL BE NO OVERFLOW FROM THE END OF THE APRON TO THE SURFACE OF THE RECEIVING CHANNEL. THE AREA TO BE PAVED OR RIPRAPPED SHALL BE UNDERCUT SO THAT THE INVERT OF THE APRON SHALL BE AT THE SAME GRADE (FLUSH) WITH THE SURFACE OF THE RECEIVING CHANNEL. THE APRON SHALL HAVE A CUTOFF OR TOE WALL AT THE DOWNSTREAM END.
4. THE WIDTH OF THE END OF THE APRON SHALL BE EQUAL TO THE BOTTOM WIDTH OF THE RECEIVING CHANNEL. MAXIMUM TAPER TO RECEIVING CHANNEL 5:1
5. ALL SUBGRADE FOR STRUCTURE TO BE COMPACTED TO 90% MODIFIED PROCTOR.
6. THE PLACING OF FILL, EITHER LOOSE OR COMPACTED IN THE RECEIVING CHANNEL SHALL NOT BE ALLOWED.
7. NO BENDS OR CURVES IN THE HORIZONTAL ALIGNMENT OF THE APRON WILL BE PERMITTED.

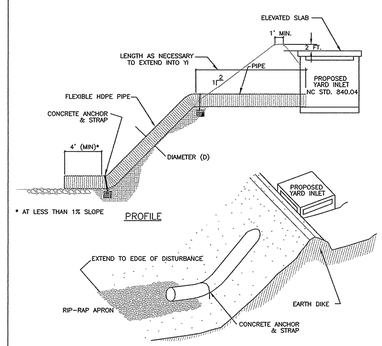
OUTLET PROTECTION APRON DATA BLOCK

APRON A-1 DATA CELL 1	APRON A-2 DATA FINAL CLOSURE	APRON A-3 DATA CELL 2	APRON A-4 DATA CELL 2	APRON A-5 DATA CELL 2	APRON A-6 DATA CELL 2
RIPRAP d50 = 12" dmax = 18" t = 27" L = 26 FT. W = 29.5 FT. H = 28"	RIPRAP d50 = 12" dmax = 18" t = 27" L = 29 FT. W = 32 FT. H = 24"	RIPRAP d50 = 12" dmax = 18" t = 27" L = 24 FT. W = 26.5 FT. H = 20"	RIPRAP d50 = 6" dmax = 9" t = 13.5" L = 12 FT. W = 13.5 FT. H = 28"	RIPRAP d50 = 12" dmax = 18" t = 27" L = 30 FT. W = 33.5 FT. H = 28"	RIPRAP d50 = 12" dmax = 18" t = 27" L = 26 FT. W = 29.5 FT. H = 28"
APRON A-7 DATA CELL 1	***APRON A-8 DATA FINAL CLOSURE**	***APRON A-9 DATA FINAL CLOSURE**	**APRON A-10 DATA CELL 2**	**APRON A-11 DATA CELL 2**	**APRON A-12 DATA CELL 2**
RIPRAP d50 = 12" dmax = 18" t = 27" L = 22 FT. W = 25.5 FT. H = 28"	RIPRAP d50 = 6" dmax = 9" t = 13.5" L = 17 FT. W = 19.5 FT. H = 20"	RIPRAP d50 = 12" dmax = 18" t = 27" L = 20 FT. W = 23 FT. H = 24"	RIPRAP d50 = 12" dmax = 18" t = 27" L = 30 FT. W = 33.5 FT. H = 28"	RIPRAP d50 = 12" dmax = 18" t = 27" L = 36 FT. W = 41 FT. H = 40"	RIPRAP d50 = 6" dmax = 9" t = 13.5" L = 14 FT. W = 15.5 FT. H = 12"

*APRONS A-8 & A-9 TO BE GROUTED WITH CONCRETE

RIPRAP APRON AT PIPE OUTLETS

DETAIL #9



CONSTRUCTION SPECIFICATIONS:

1. THE TOP OF THE EARTH DIKE OVER THE INLET PIPE AND THOSE DIKES CARRYING WATER TO THE PIPE SHALL BE AT LEAST 1 FOOT HIGHER AT ALL POINTS THAN THE TOP OF THE INLET PIPE.
2. THE PIPE SHALL BE FLEXIBLE WITH WATER TIGHT CONNECTING BANDS. FLEXIBLE PIPE SHOULD BE STAKED ON EITHER SIDE.
3. A RIP RAP APRON SHALL BE PROVIDED AT THE OUTLET, IF EMPTYING INTO A DISTURBED AREA.
4. THE SOIL AROUND AND UNDER THE INLET PIPE AND ENTRANCE SECTION SHALL BE HAND TAMPED IN 4" LIFTS TO THE TOP OF THE EARTH DIKE.
5. FOLLOW-UP INSPECTION AND ANY NEEDED MAINTENANCE SHALL BE PERFORMED AFTER EACH STORM BY THE CONTRACTOR.
6. CONCRETE ANCHOR TO BE 8" CMU FILLED WITH CONCRETE. STRAP TO BE 1-INCH GALVANIZED STEEL ANCHORED IN CONCRETE.

DRAIN DESIGNATION	PIPE DIAMETER
SD-1	18"

FLEXIBLE PIPE SLOPE DRAIN

DETAIL #11

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NORTH CAROLINA PROFESSIONAL SEAL 17582 ENGINEER DAN E. BREWER 4/14/04

MARSHALL STEAM STATION GYPSUM LANDFILL

CATAWBA COUNTY, NORTH CAROLINA

REVISIONS

B	4/14/04	REV. PER NCDENR COMMENTS
A	3/26/04	ISSUED FOR PERMIT REVIEW

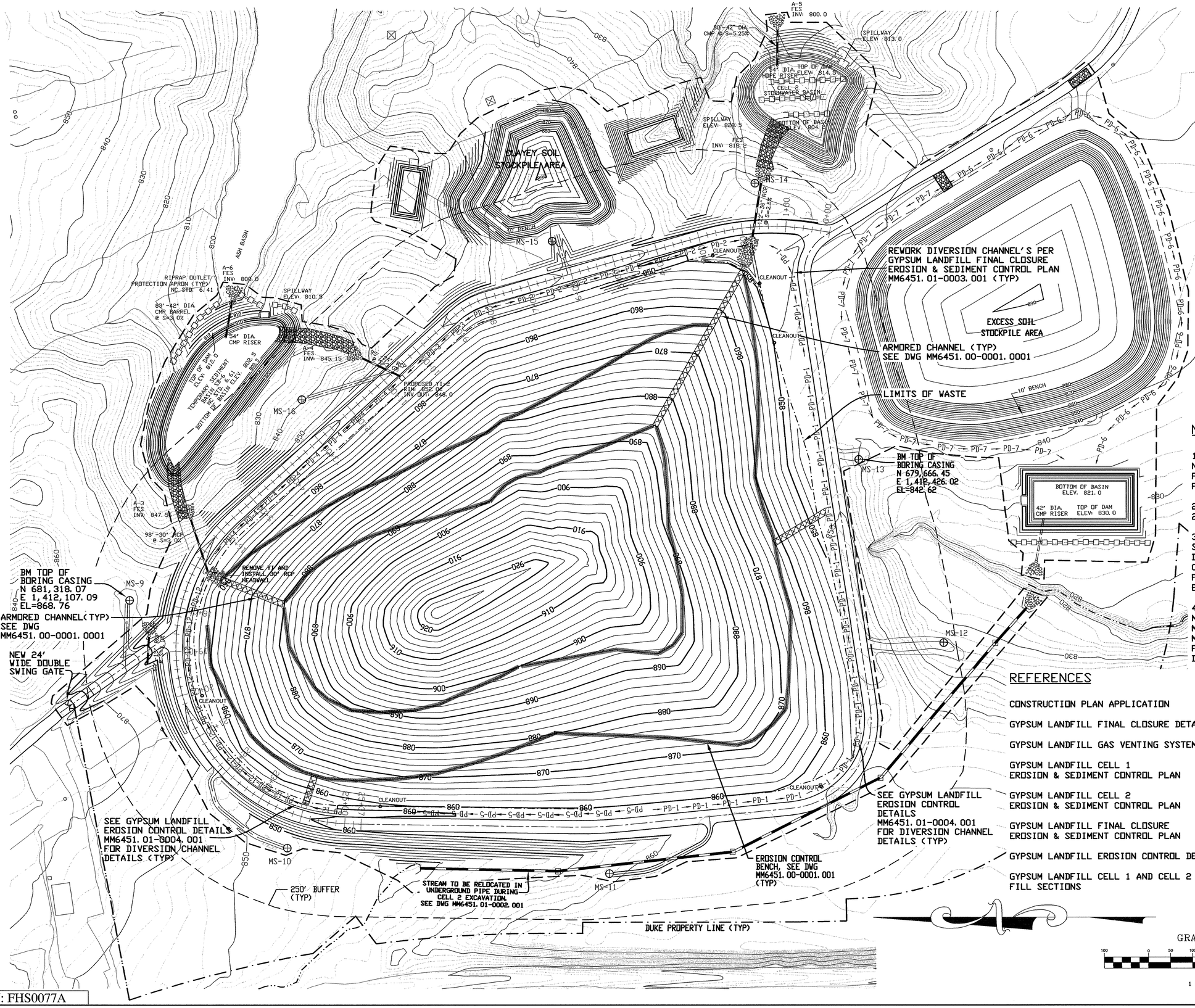
PROJECT #: 046003.001 DATE: 3/24/04

DRAWN BY: DB CHECKED BY: DB

TITLE
GYPSUM LANDFILL
EROSION CONTROL
DETAILS

DOCUMENT NO:
MM6451.01-0004.001

ERN: FHS00055



LEGEND

- = Existing Storm Pipe
- = Proposed Storm Pipe
- YI = Proposed Yard Inlet
- A-1 = Riprap Outlet Protection Apron
- 640 = Existing Grade Contour
- 640 = Proposed Finished Contour
- FES = Flared End Section
- TD = Temporary Diversion Channel
- PD = Permanent Diversion Channel
- ST-1 = Temporary Sediment Trap
- SB-1 = Temporary Sediment Basin
- = Temporary Sediment Fence
- = Limits of Construction
- = Inlet Protection
- LCRS = Leachate Collection & Removal System

NOTES:

1. HORIZONTAL DATUM IS NAD 27 (1927), N.C. STATE PLANE COORDINATES, US FEET.
2. VERTICAL DATUM IS NGVD 29 (1929), US FEET.
3. REFER TO EROSION AND SEDIMENT CONTROL PLAN DRAWING, AND EROSION CONTROL DETAILS DRAWING FOR STORM WATER RUNOFF AND EROSION CONTROL MEASURES.
4. SEE DRAWING'S MM6451.00-0001.001, MM6451.00-0002.001 AND MM6451.01-0003.001 FOR FINAL CLOSURE PLANS AND DETAILS.

REFERENCES

CONSTRUCTION PLAN APPLICATION	MM6451.00-0000.001
GYPSUM LANDFILL FINAL CLOSURE DETAILS	MM6451.00-0001.001
GYPSUM LANDFILL GAS VENTING SYSTEM PLAN	MM6451.00-0002.001
GYPSUM LANDFILL CELL 1 EROSION & SEDIMENT CONTROL PLAN	MM6451.01-0001.001
GYPSUM LANDFILL CELL 2 EROSION & SEDIMENT CONTROL PLAN	MM6451.01-0002.001
GYPSUM LANDFILL FINAL CLOSURE EROSION & SEDIMENT CONTROL PLAN	MM6451.01-0003.001
GYPSUM LANDFILL EROSION CONTROL DETAILS	MM6451.01-0004.001
GYPSUM LANDFILL CELL 1 AND CELL 2 FILL SECTIONS	MM6451.00-0014.001

GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)
1 inch = 100 ft.

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 17582 DAN E. BREWER 12/15/05

MARSHALL STEAM STATION FGD RESIDUE LANDFILL

CATAWBA COUNTY, NORTH CAROLINA

REVISIONS

A	12/15/05	ISSUED FOR CPA

PROJECT #: 046003.001 DATE: 12/15/05

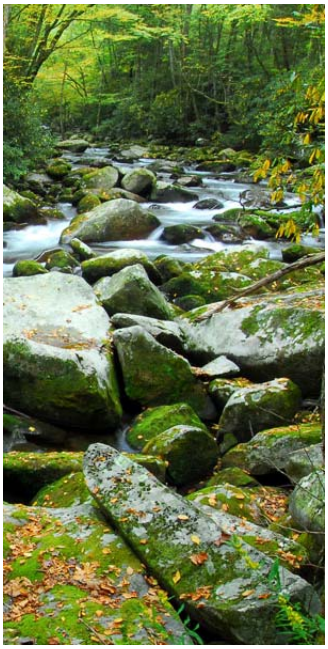
DRAWN BY: DC CHECKED BY: DB

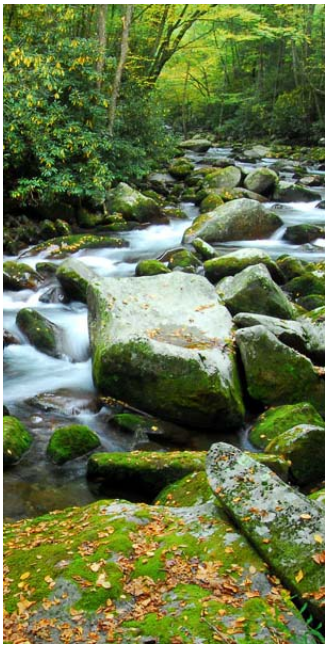
TITLE

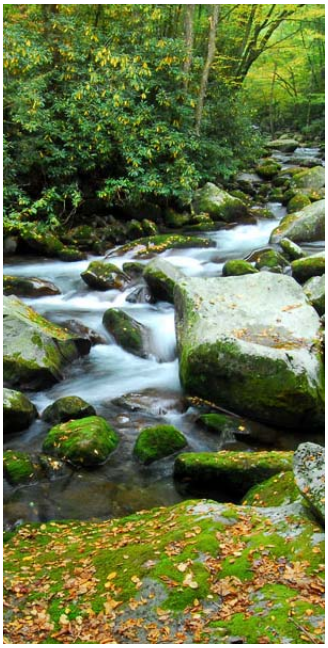
Cell 1 And Cell 2 - Final Configuration

DOCUMENT NO: MM6451.00-0013.001

ERN: FHS0077A







ALTAMONT ENVIRONMENTAL, INC.

ENGINEERING & HYDROGEOLOGY

Groundwater Sampling and Analysis Plan

Marshall Steam Station
Flue Gas Desulphurization (FGD) Residue Landfill
Phase 1, Cell 1
Permit No. 18-09

August 19, 2011

Prepared for
Duke Energy Carolinas, LLC
Marshall Steam Station
Catawba County, NC
Project Number: 2371.1101

Prepared by
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Groundwater Sampling and Analysis Plan

Marshall Steam Station
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Phase 1, Cell 1
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August 19, 2011

NORTH CAROLINA PROFESSIONAL SEAL 17661 ENGINEER WILLIAM M. MILLER

William M. Miller, P.E.
Altamont Environmental, Inc.
Engineering Firm No. C-2185

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2. Sample Parameters, Analytical Methods, and Detection Limits
3. Sample Containers, Preservatives, and Holding Times

Appendices

A. Monitoring Well Construction Records

1.0 Program Description

1.1 Scope of Work

This Groundwater Sampling and Analysis Plan is designed to guide the monitoring efforts that are used to evaluate the effects of the Marshall Steam Station Flue Gas Desulfurization (FGD) Residue Landfill, Phase 1, Cell 1, on the groundwater in the area. This plan has been prepared according to the guidelines set forth by the North Carolina Department of Environment and Natural Resources (DENR) Water Quality Guidance Document for Solid Waste Facilities (SW-1001-87), and by the Environmental Protection Agency (EPA) in "Interim Guidelines and Specifications for Preparing Quality Assurance Plans" (QAMS-500/80), and documents the methodologies of field sampling, record-keeping protocols, data quality objectives, and data validation procedures that will be used in this program.

1.2 Background and Site Hydrogeological Description

Marshall Steam Station (Marshall) is located in Catawba County, on Highway NC 150, just west of Lake Norman. The station is owned and operated by Duke Energy Carolinas, LLC (Duke). Marshall is located in the Piedmont physiographic region. Figure 1 shows the location of the plant and the location of the FGD landfill, Phase 1, Cell 1.

The Marshall Steam Station has a generating capacity of 2,090 megawatts (MW) of electric power by the combustion of coal. Therefore, the Marshall station generates enough electricity to power over one-and-a-half million homes.

The FGD Residue Landfill will consist of two cells. When completed, the landfill footprint will contain approximately 31.9 acres. Construction of Cell 1 was completed in 2006, and a Permit to Operate was issued on November 21, 2006. Duke has not requested a Permit to Construct for Cell 2.

Cell 1 has a footprint of approximately 14.8 acres. In general the landfill is permitted to receive industrial wastes generated by Duke at Marshall and at other Duke facilities. The waste received at the FGD residue landfill consists primarily of gypsum. The FGD residue is conveyed to the landfill site by truck, where the material is spread and compacted.

The landfill was constructed with a leachate collection and removal system and an engineered liner system to prevent impacts to groundwater. When closed, the completed landfill will receive an engineered cover system to minimize infiltration.

The FGD landfill is located entirely on Duke property, northwest of the Marshall station and to the west of the Marshall Ash Basin. The landfill is located to the east of a north-south trending railroad line. . Located to the west of this railroad line is Sherrill's Ford Road, which also runs north-south along a surface water divide. Located between the landfill footprint and the railroad line is a surface water drainage feature. This feature drains to the south, to an intermittent stream that drains to Lake Norman. There is a topographic divide running north-northwest through the landfill footprint, along Steam Plant Road. Surface drainage to the west of Steam Plant Road drains to the surface drainage feature and surface drainage to the east of Steam Plant Road drains to the Marshall Ash Basin.

As described in the site hydrogeological study (Hydrogeological Study FGD Scrubber Landfill, Duke Power--Marshall Steam Station, Terrell, North Carolina, S&ME Project No: 1264-02-578, May 30, 2003), the subsurface conditions in the landfill area consist of residual soils and partially to fully weathered rock (saprolite) , which have formed by the in-place weathering of the parent rock. As is typical in the groundwater systems located in the Piedmont region, groundwater at the landfill site occurs within the

residuum and saprolite under unconfined aquifer conditions. The predominant discharge areas for groundwater in the landfill area are expected to be the drainage feature and the ash basins located to the east of the landfill.

The subsurface conditions at the landfill were described by S&ME as follows:

- Residuum: Beneath the ground surface, residual material consisting of silts, silty clays, clayey silts, and silty sands. Sandy silts were found at depths ranging from 2.5 to 14 feet below ground surface.
- Saprolite: Saprolite material was found at depths ranging from 13.5 feet to 68.5 feet below ground surface. This material is a product of weathered bedrock, consisting of silts to clayey silts and sandy silts to silty sands, having a Standard Penetration Test (SPT) resistance of 50 blows per foot or more.
- Partially Weathered Rock: This material is defined as material exhibiting SPT resistances in excess of 100 blows per foot. This material was found at depths ranging from 25.5 feet to 90 feet below ground surface.
- Bedrock: Bedrock was found at depths ranging from 25.5 feet to 79.5 feet. When sampled, this material was classified as granite, schist, and gneiss. Horizontal to high-angle fractures were found in the upper ten feet of the bedrock areas. Many fractures were found to be iron stained, indicating flow of water into the fractures.

1.3 Well Locations and Installation

Groundwater and surface water conditions at the landfill are monitored using nine groundwater monitoring wells and one surface water sampling location. Monitoring well locations and construction information are provided in Table 1. The locations of these wells are shown on Figure 2. Monitoring well MS-8 will be used as the background well for this sampling program.

The wells were constructed of two-inch diameter polyvinyl chloride (PVC) well screen and casing. The well screens were placed where they would intercept the aquifer and have slot sizes of 0.010 inch. The screen lengths are shown in Table 1.

The wells were installed by a well driller registered in North Carolina in accordance with applicable DENR regulations. The locations of the wells and the elevations of the tops of the casings were surveyed under the direction of a Professional Surveyor, licensed in North Carolina.

Figure 3 shows a typical construction diagram for the wells. All wells are equipped with dedicated bladder-type pump systems. Well construction records for the existing wells are included in Appendix A.

A brief description of the monitoring locations and their monitoring function is provided below.

<u>Monitoring Well MS-8—Background Well</u>

Monitoring well MS-8 will be used as a background monitoring well. This well is located approximately 250 feet north of the landfill, on the west side of Steam Plant Road. This well is screened to monitor groundwater in the saprolite layer.

<u>Monitoring Well MS-9</u>

This existing well is located north of the landfill. This well is screened to monitor groundwater in the saprolite layer.

<u>Monitoring Well MS-10</u>

This well is located west of the landfill. This well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-11

This well is located west of the landfill. This well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-12 (Formerly Designated as Well OW-3)

This well is located south of the landfill. This well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-13 (Formerly Designated as Well MS-6)

This well is located south of the landfill. The well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-14 (Formerly Designated as Well B-5)

This well is located to the southeast of the landfill. This well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-15 (Formerly Designated as Well B-4)

This well is located to the east of the landfill. This well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-16

This well is located to the northeast of the landfill. This well is screened to monitor groundwater in the saprolite layer.

1.4 Surface Water Sample Location

A surface water sample will be collected from location SW-1. This surface water sampling location is located south of the landfill, between wells MS-12 and MS-13, as shown on Figure 2. The North Carolina State Plane coordinates and elevation for this sampling location are shown in Table 1.1.

1.5 Monitoring Frequency

The wells and surface water sample location will be sampled semiannually in March and September.

1.6 Parameters

The parameters to be sampled and analyzed, units of measure, methods, and detection limits are presented in Table 2.

1.7 Data Quality Objectives

The overall Quality Assurance (QA) objective is to ensure that reliable data of known and acceptable quality are provided. All measurements will be documented to yield results that are representative of the groundwater and surface water quality. Data will be calculated and reported in units as required by DENR.

The analytical QA objectives for precision, accuracy, and completeness have been established by the laboratories in accordance with EPA or other accepted agencies for each measurement variable, where possible. The objectives are outlined in the Duke Energy Analytical Laboratory Procedures Manual and are available upon request.
Detection limits for the water analyses presented in Table 2 are generally specified by the analytical methods. As stated above, appropriate methods have been selected to meet applicable standards for groundwater quality. Instances may occur, however, in which the condition of the sample will not allow

detection of the desired limits for various parameters either because of matrix interference or high analyte concentrations requiring sample dilution. The laboratory(s) will provide sufficient documentation with each data package to notify reviewers about any analytical problems with the data, if needed.

2.0 Sampling Procedures

2.1 Sampling Equipment

Development, purging, and sampling equipment are selected to ensure materials are compatible with the sample parameters and comply with state and federal regulatory requirements for sampling. Positive-gas-displacement fluorocarbon resin bladder pumps are installed in each monitoring well and are dedicated purging and sampling systems.

2.1.1 Equipment Cleaning Procedures

Dedicated sampling equipment has been installed in each monitoring well. In the event non-dedicated equipment is used between wells, equipment will be cleaned before and after use in each well in accordance with standard EPA-approved cleaning procedures for field equipment. This standard is outlined in the *Standard Operating Procedures and Quality Assurance Manual*, Engineering Support Branch, EPA Region IV, February 1, 1991.

2.2 Groundwater Sampling

2.2.1 Development of Wells

All nine wells addressed in this sampling plan have been developed. If new wells are installed they will be developed before they are samples.

After installation of new wells, and prior to initial sampling, the monitoring wells will be developed. Development removes silt that has settled into the bottom of the well following installation, and removes fine silt and clay particles from the well screen and sandpack surrounding the screen. Well development is necessary to eliminate potential clogging and enhance well performance. Development involves removing an estimated ten or more well volumes from the well using a positive-gas-displacement fluorocarbon resin bladder pump with up-and-down agitation to loosen particles from the well screen. After development of a well, a true well depth is recorded, referenced to the top of well casing (TOC).

2.2.2 Groundwater Level and Total Depth Measurements

Water level measurements are collected and recorded to determine the groundwater elevations, determine groundwater flow direction, and to calculate the volume of standing water in the well. All monitoring wells have been surveyed to determine the elevation of the TOC. All depth and water level measurements are referenced to the TOC and recorded to the nearest one-hundredth of a foot.

Water level measurements are made with an electronic measuring device consisting of a spool of dual conductor wire and sensor. When the sensor comes in contact with water, the circuit is closed and a meter light and/or buzzer is attached to the spool to signal the contact. The sensor is lowered further until it rests on the bottom of the well to determine the total depth of the well reference to the TOC. The depth and water level measurements are used to verify that the well has not filled with silt and to calculate the volume of water in the well. The volume of well water (in gallons) is calculated using the following equation:

$$V = h * \pi r^2 * (7.48052 \text{ gal/ft}^3)$$

where V = volume of water in the well screen and casing (gallons)
h = height of standing water (feet) = total well depth - water level
r = radius of well casing (feet)

In dedicated sampling systems, an accurate well depth is determined, as indicated above, after development of the well and prior to installation of the dedicated bladder pump. The well depth, water level measurement, and calculated well volume are recorded on the Groundwater Monitoring Data Sheet (Figure 4).

2.2.3 Well Purging and Sampling

The selection of purging technique is dependent on the hydrogeologic properties of the aquifer and hydraulic characteristics of each well. Hydraulic conductivity, water column, well volume, screen length, and other information are evaluated to select the purging technique to acquire groundwater representative of the aquifer conditions. The Groundwater Monitoring Data Sheet (Figure 4) is used to record purging methods and measurements.

A multi-parameter water quality monitoring instrument is used to measure field stabilization or indicator parameters for determining representative groundwater during purging. These instruments measure pH, specific conductance, temperature, dissolved oxygen (DO), and oxidation-reduction potential (ORP). Instrument calibration must be performed and documented before and after each sampling event. The pH subsystem will be calibrated with two pH standards (pH 7.0 and 4.0) bracketing the expected groundwater pH. The specific conductance subsystem will be calibrated using two standards bracketing the expected groundwater conductivity. Calibration results will be recorded on a Field Sampling Calibration Form (Figure 5).

Various well purging techniques are described below. Currently, all wells are fitted with dedicated pumps. The purging method utilized at any particular well will be selected after considering the characteristics of the well and the purging method(s) used during previous sampling events.

<u>Conventional Purging</u>

This technique entails removing one equivalent well volume and measuring the indicator parameters (temperature, pH, and specific conductance). When the parameters have stabilized to within ±0.2 pH units and ±10% for temperature and conductivity over three to five well volumes, representative groundwater has been achieved for sampling. It is acceptable to begin sampling after five complete well volumes have been removed, even when indicator parameters have not stabilized. Groundwater is pumped into a graduated container to measure the volume of water purged. Under normal rates of recovery, samples should be collected immediately after purging, in accordance with EPA guidelines.

For low-yield wells, incapable of yielding three to five well volumes in a reasonable amount of time (e.g., 2 hours or less), groundwater is purged to the elevation of the pump intake while measuring indicator parameters. Typically, low-yield wells are evacuated to dryness one time and sampled when sufficient water level recovery occurs.

<u>Low-Flow Purging</u>

Low-flow purging and sampling are appropriate when the recharge rate of the well approximates or equals the discharge rate of the pump with minimal drawdown of the water column (≤ 1 foot).

During low-flow purging and sampling, groundwater is pumped into a flow-through chamber at flow rates that minimize or stabilize water level drawdown within the well. Indicator parameters are measured over time (usually at five-minute intervals). When parameters have stabilized within ±0.2 pH units and ±10% for temperature, conductivity, and DO, and ±10 milli-Volts (mV) for ORP over three consecutive readings, representative groundwater has been achieved for sampling. Turbidity is

not included as a stabilization parameter, but turbidity levels of 10 nephelometric turbidity units (NTU) or less should be targeted.

Modified Low-Flow Purging

This technique is considered a viable option particularly in the Piedmont region due to clay soils where water level drawdown cannot be stabilized while pumping.

When the well recharge rate is less than the pump discharge rate, excessive drawdown (> 1 foot) of the water column occurs and mixes with stagnant water located above the screened interval. One equivalent well volume is removed initially before measuring indicator parameters. Frequently, removal of the initial well volume reduces the hydraulic head and allows for matching of the recharge rate with the pumping rate, providing stabilization of drawdown. Indicator parameters should be measured, at five-minute intervals, using a flow-through chamber attached to a multi-parameter water quality instrument. When parameters have stabilized to within ±0.2 pH units, ±10% for temperature, conductivity, and DO, and ±10 mV for ORP over three consecutive readings, representative groundwater has been achieved for sampling. Turbidity is not included as a stabilization parameter, but turbidity levels of 10 NTU or less should be targeted.

Very Low Yield Well Purging

This technique provides the best option for wells that historically purge to dryness and do not sufficiently recharge to provide adequate volume for sample collection. The volume of the pumping system (i.e., the pump bladder, tubing, and flow-through chamber) is calculated for removal. Two volumes will be removed by the pumping system if pumping occurs at the lowest possible rate (≤ 100 milliliters per minute [mL/min]). Indicator parameters will be measured and recorded initially, and then sample collection will begin.

2.2.4 Sample Collection

After representative groundwater has been obtained by purging and the indicator parameters have stabilized, sampling may begin. Sampling personnel must wear new, clean, disposable, non-powdered latex gloves during sample collection for each well. Samples are collected in the order of the volatilization sensitivity of the parameters:

- Metals
- Sulfate and chloride
- Nitrate
- Total dissolved solids

All pertinent notations, water-level measurements, removed well volumes, and indicator parameters are documented on the Groundwater Monitoring Data Sheet.

2.2.5 Sample Containers, Volume, Preservative, and Holding Time

All sample containers supplied by the laboratory for the collection of groundwater samples are new and precleaned, as approved by EPA procedures appropriate for the parameters of interest. Table 3 summarizes the sample containers, sample volume, preservation procedures, and holding times required for each type of sample and parameter. Sample containers are kept closed until used. All sample containers are provided by Duke or vendor laboratories.

2.3 Surface Water Sampling

Surface water samples are collected using techniques and equipment that preserve characteristics of the water body being investigated and minimizes the chance for sample contamination. Typically, samples are collected by grab or peristaltic pump.

When filling a sample container by grab, always use new, clean, non-powdered latex gloves. Grasp the sample container by the lower half and position the container opening to face upstream. When using a peristaltic pump to collect a surface water sample, position the intake opening above the stream bottom to minimize the potential for collecting sediment. Run the pump for several minutes to ensure representative water is being collected after positioning the intake opening.

2.4 Sample Tracking

The Chain-Of-Custody (COC) program allows for tracing the possession and handling of individual samples from the time of field collection through laboratory analysis and report preparation. Samples are pre-logged prior to sample collection. This process assigns a unique tracking number for each sample and generates corresponding labels. An example of the COC Record is provided as Figure 6.

2.5 Sample Labeling

Sample containers are pre-labeled and organized prior to field activities as part of the pre-sampling staging process. As samples are actually collected, the sampling personnel write the following information directly on the label: sampling date and time, and initials of sample collector. This information is also recorded on the Groundwater Monitoring Data Sheet (Figure 4) and the COC Record (Figure 6).

2.6 Field Documentation

Field documentation from each sampling event is recorded on the Groundwater Monitoring Data Sheets, the Field Sampling Calibration Form, and the Chain-of-Custody Record. These loose-leaf sheets are arranged in sequential order and filed by project and date. Additionally, a Groundwater Sampling Site Checklist (Figure 7) is completed indicating information of the monitoring well such as proper identification (ID) tag, condition of protective casing and pad. Field notations are made during the course of the field work to document the following information:

- Identification of well
- Well depth
- Static water level depth and measurement technique
- Presence of immiscible layers and detection method
- Well yield—high or low
- Purge volume or pumping rate
- Sample identification numbers
- Well evacuation procedure/equipment
- Sample withdrawal procedure/equipment
- Date and time of collection

- Types of sample containers used
- Identification of replicates or blind samples
- Preservative(s) used
- Parameters requested for analysis
- Field analysis data and methods
- Sample distribution and transporter
- Field observations during sampling event
- Name of sample collector(s)
- Climatic conditions including estimate of air temperature

All recorded entries are made in indelible ink. Errors should be corrected by drawing one line through the error, initialing and dating the correction, and starting a new entry on the next line (if necessary).

2.7 Chain-of-Custody Record

The chain-of-custody (COC) Record (Figure 6) accompanies the sample(s), traces sample possession from time of collection to delivery to the laboratory(s), and clearly identifies which sample containers have been designated for each requested parameter. The record includes the following types of information:

- Sample identification number
- Signature of collector
- Date and time of collection
- Sample type (e.g., groundwater, immiscible layer)
- Identification of well
- Number of containers
- Parameters requested for analysis
- Preservative(s) used
- Signature of persons involved in the chain of possession
- Inclusive dates of possession

2.8 Sample Custody, Shipment, and Laboratory Receipt

For the purpose of these procedures, a sample is considered in custody if it is:

- In actual possession of the responsible person
- In view, after being in physical possession
- Locked or sealed in a manner so that no one can tamper with it, after having been in physical custody; or in a secured area, restricted to authorized personnel

All samples are maintained in the custody of the sampling crew during the sampling event. At the end of each sampling day and prior to the transfer of the samples off-site, COC entries are completed on the COC

for all samples. Upon transfer of custody, the COC form is signed by a sampling crew member, including the date and time. If outside vendor laboratories are utilized, samples are delivered to these facilities by Duke personnel or courier.

All COC forms received by the laboratory(s) are signed and dated by the respective supervising scientist(s) or their designee (at the Duke Energy lab), or the laboratory sample custodian (at vendor labs) immediately following receipt by the laboratory.

The analysts at the laboratory(s) maintain a sample-tracking record that will follow each sample through all stages of laboratory processing. The sample tracking records show the date of sample extraction or preparation, and analysis. These records are used to determine compliance with holding time limits during lab audits and data validation.

Custody procedures followed by Duke laboratory personnel are described in detail in the Duke Energy Laboratory Services Procedures Manual.

3.0 Analytical Procedures

The main analytical laboratory used in this program is the Duke Energy Laboratory Services Laboratory, which has North Carolina Drinking Water (NC37804) and Wastewater (#248) Certifications. The organizational structure and staff qualifications of the laboratory are discussed in its generic Quality Assurance Program (QAP). The QAP and Laboratory Services Procedures Manual are available for review upon request.

Vendor laboratories that meet EPA and North Carolina certification requirements may be used for analyses which cannot be performed in-house.

The analytical procedures are listed in Table 2. Indicator parameters are measured in the field according to *Duke Energy Scientific Services Section Quality Assurance Plan and Procedure 3210*.X.[1]

4.0 Internal Quality Control Checks

Internal laboratory quality control (QC) checks used by the laboratories are described in their generic QAP and procedures manual. The laboratories demonstrate the ability to produce acceptable results using the methods specified.

Internal quality control checks for sampling procedures and laboratory analyses will be conducted with each sampling event. These checks will consist of the preparation and submittal of field blanks, trip (travel) blanks, and/or field replicates for analysis of all parameters at frequencies described in the laboratory(s) procedures manuals. Equipment rinsate blanks for laboratory-cleaned equipment will be collected quarterly.

The field QC blanks and replicates may be included as internal QC checks are described as below. The specific type and number of blanks used may vary depending on the sampling event and will be determined by the Duke field sampling personnel:

- Field Blanks: A field blank consists of a sample container filled in the field with organic-free, deionized, or distilled water prepared and preserved in the same manner as the samples. The field blank is transported to the laboratory with the samples and analyzed along with the field samples for the constituents of interest to check for contamination imparted to the samples by the sample container, preservative, or other exogenous sources.
- Trip Blanks: A trip (travel) blank is a sample container filled with organic-free water in the laboratory that travels unopened with the sample bottles. It is returned to the laboratory with the field samples, and analyzed along with the field samples for parameters of interest.
- Field Replicates: A field replicate is a duplicate sample prepared at the sampling locations from equal portions of all sample aliquots combined to make the sample. Both the field replicate and the sample are collected at the same time, in the same container type, preserved in the same way, and analyzed by the same laboratory as a measure of sampling and analytical precision.
- Equipment Blanks: If non-dedicated equipment is used between wells, it is recommended that equipment blanks be collected. The field equipment is cleaned following documented cleaning protocols. An aliquot of the final control rinse water is passed over the cleaned equipment directly into a sample container and submitted for analyses.

[1] "X" indicates the most current revision of the procedure.

5.0 Validation of Field Data Package

The field data package includes all of the field records and measurements developed by the sampling team personnel. The field data package validation procedure consists of the following:

- A review of field data contained on the Groundwater Monitoring Data Sheet for completeness
- Verification that equipment blanks, field blanks, and trip blanks were properly prepared, identified, and analyzed
- A check of the Field Sampling Calibration Form for equipment calibration and instrument conditions
- A review of the Chain-Of-Custody Record for proper completion, signatures of field personnel and the laboratory sample custodian, dates, and for verification that the correct analyses were specified.

6.0 Validation of Laboratory Data

The laboratory will perform a validation review of the submitted samples and analytical results to ensure that the laboratory QA/QC requirements are acceptable.

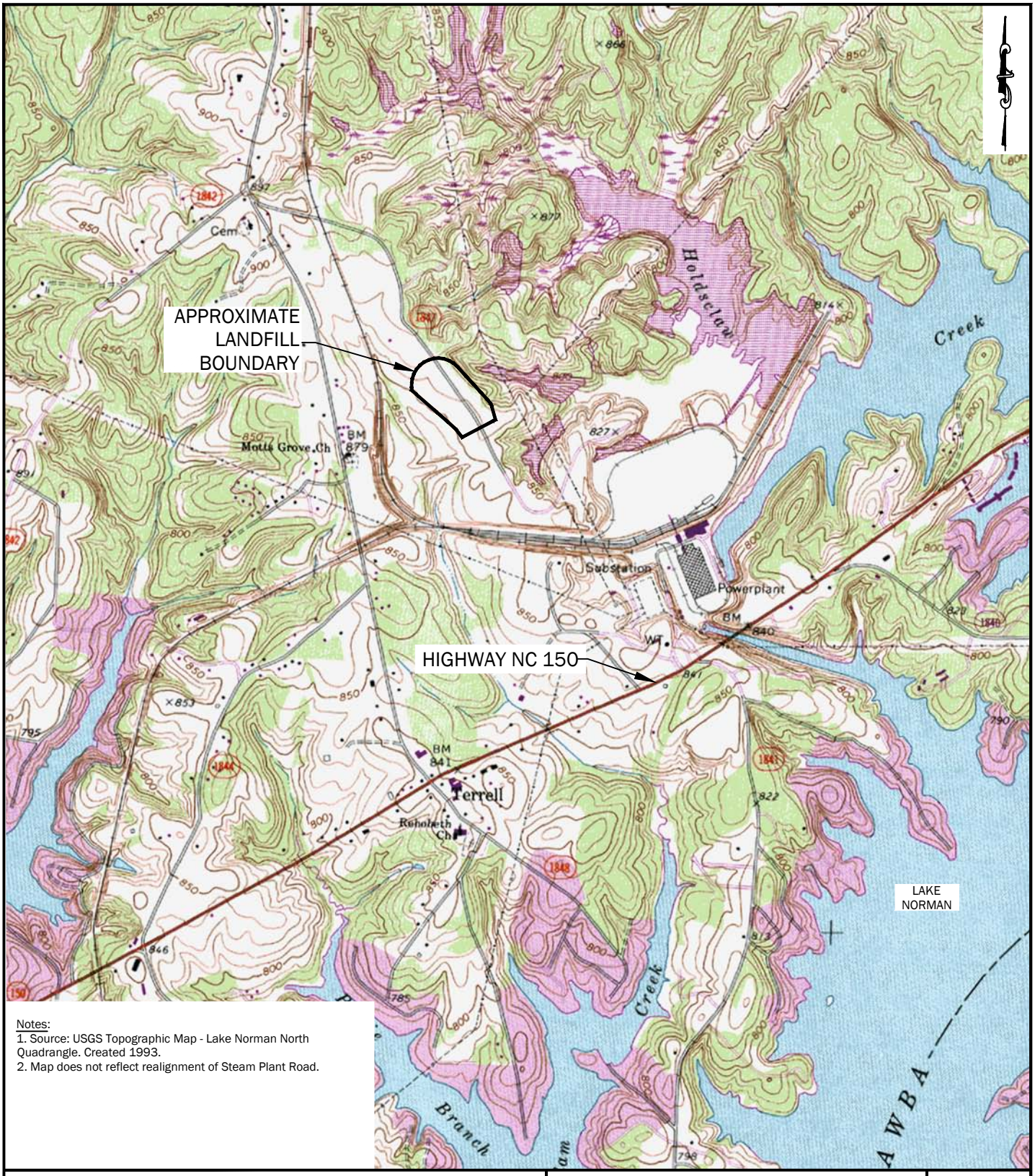
7.0 Report Submittal

A report of monitoring results will be submitted to the DENR Division of Waste Management (DWM) within 90 days following the date of sampling. The report submittal will consist of the following:

- Environmental Monitoring Reporting Form (DENR Form)
- Table of Detections and Discussion of 2L Exceedances
- Groundwater Elevation Contour Map
- Electronic Data Deliverable (EDD) in Excel Format

DENR will be notified in the event that vendor lab analyses have not been completed within this time frame. All Groundwater Monitoring Data Sheet, Field Calibration Forms, Chain-of-Custody Records, Laboratory(s) QA data, and Data Validation Checklists are kept on file by Duke and are available upon request.

FIGURES



Notes:
1. Source: USGS Topographic Map - Lake Norman North Quadrangle. Created 1993.
2. Map does not reflect realignment of Steam Plant Road.

ALTAMONT ENVIRONMENTAL, INC.
ENGINEERING & HYDROGEOLOGY
231 HAYWOOD STREET, ASHEVILLE, NC 28801
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WWW.ALTAMONTENVIRONMENTAL.COM

SITE LOCATION MAP

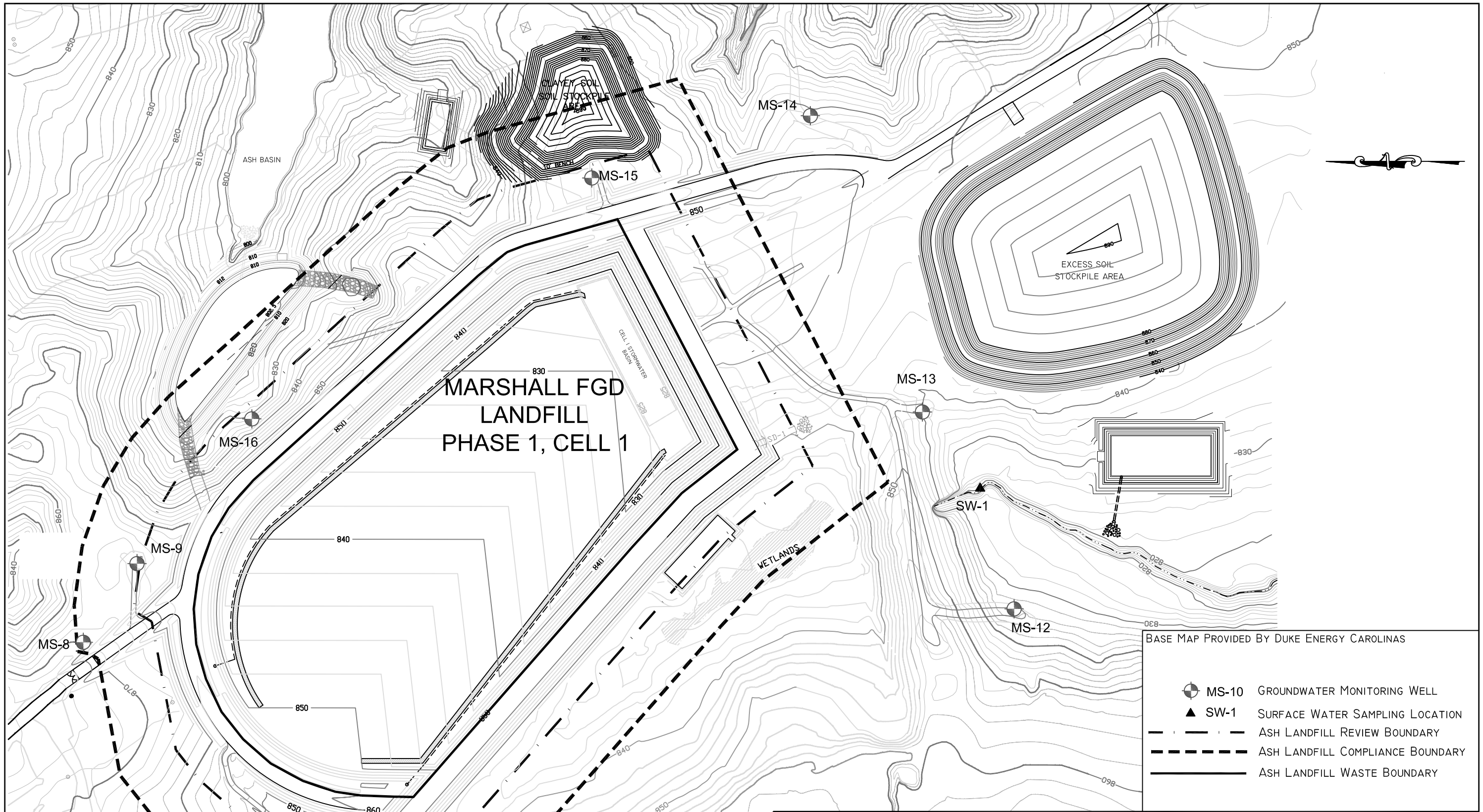
MARSHALL STEAM STATION
FGD RESIDUE LANDFILL
PHASE I, CELL I
PERMIT NO. 18-09

FIGURE
1

DRAWN BY: ANDREW MOORE
PROJECT MANAGER: WILLIAM M. MILLER
CLIENT: DUKE ENERGY CAROLINAS
DATE: 08/11/11

SCALE (FEET)
1000 0 1000 2000

FILE PATH: P:\DUKE - LF GROUNDWATER REPORTS -2369\2369.06 MSS FGD LF\FIGURES\SITE LOCATION MAP.DWG



BASE MAP PROVIDED BY DUKE ENERGY CAROLINAS

MS-10 GROUNDWATER MONITORING WELL
SW-1 SURFACE WATER SAMPLING LOCATION
ASH LANDFILL REVIEW BOUNDARY
ASH LANDFILL COMPLIANCE BOUNDARY
ASH LANDFILL WASTE BOUNDARY

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DRAWN BY: ANDREW MOORE
PROJECT MANAGER: WILLIAM M. MILLER
CLIENT: DUKE ENERGY CAROLINAS
DATE: 08/19/11

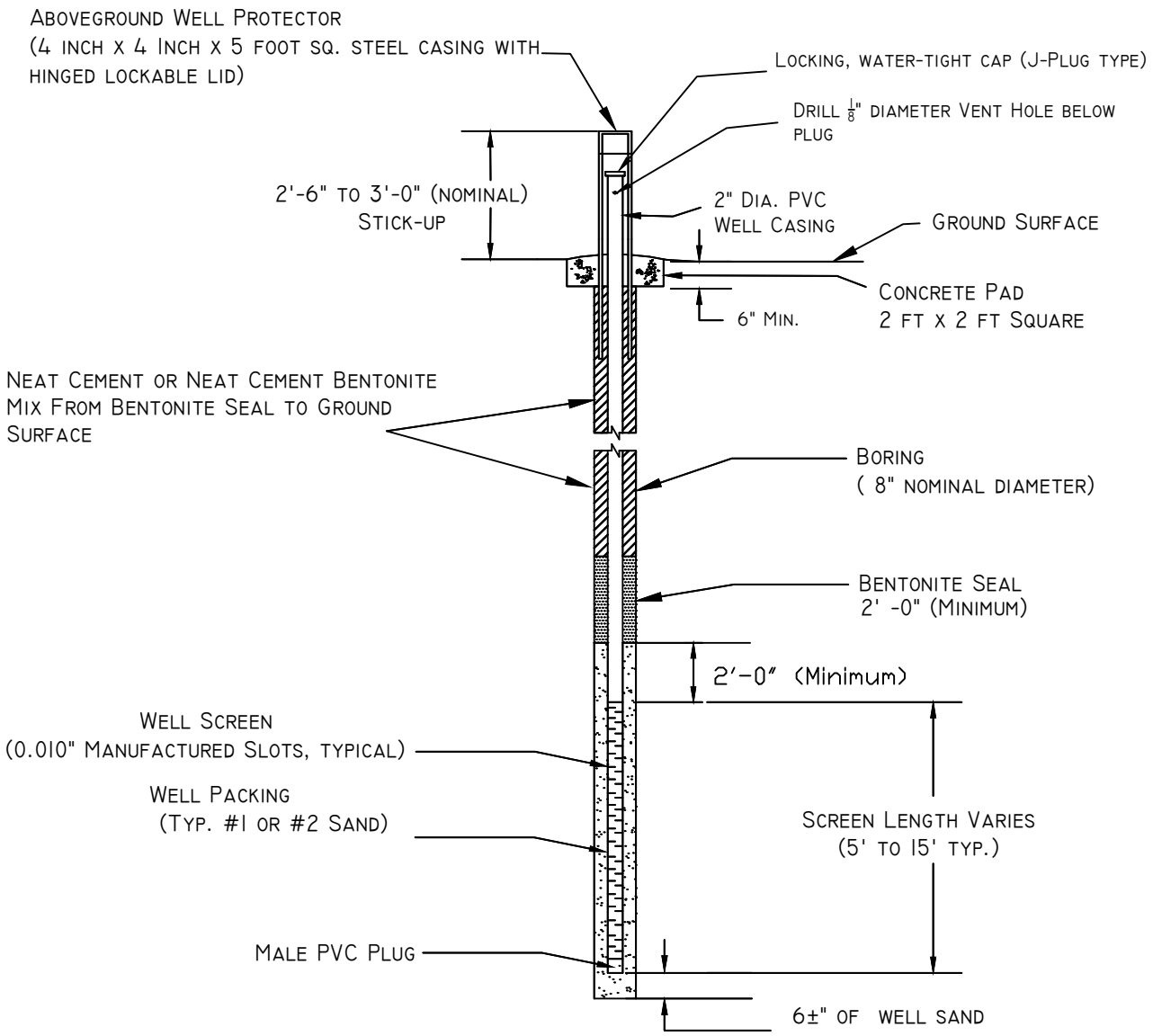
SCALE (FEET)
100 0 100 200

SAMPLE LOCATIONS

MARSHALL STEAM STATION
FGD RESIDUE LANDFILL
PHASE 1, CELL 1
PERMIT NO. 18-09

FIGURE
2

FILE PATH: P:\DUKE - LF GROUNDWATER REPORTS -2369\2369.06 MSS FGD LF\2011\MARCH SAMPLING\FIGURES\MSS FGD LF.DWG



Typical Well Construction Details
(no scale)

Information provided by Duke Energy Carolinas

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TYPICAL MONITORING WELL CONSTRUCTION DETAILS

FIGURE 3

DRAWN BY: ANDREW MOORE
PROJECT MANAGER: WILLIAM M. MILLER
CLIENT: DUKE ENERGY CAROLINAS
DATE: 8/15/11

NO SCALE

File Path: P:\Duke - Environmental Engineering - 2371\2371.11 Landfill SAPs\2371.1101 MSS FGD\Figure 3 Typical MW-2004.dwg

DUKE ENERGY

GROUNDWATER MONITORING DATA SHEET FOR CONVENTIONAL SAMPLING

LOCATION:	MARSHALL STEAM STATION	**PROCEDURE NO:**	**3175.0**
PROJECT NAME:	FGD LANDFILL GROUNDWATER	**WATER LEVEL METER SERIAL #:**	46641
SAMPLING DATE(s):	☑ 22-Mar-2011 ☐ ☐ ☐	**PRODUCT LEVEL METER SERIAL #:**	N/A

MONITORING WELL NUMBER: MS-8 **FIELD CREW:** **LDC, RLW**

PERMIT # **18-09** **TOC Elev.:** 872.34

WELL DIAMETER (in)	WELL DEPTH (ft)	–	DEPTH TO WATER (ft)	=	WATER COLUMN (ft)	X	CONVERSION FACTOR	=	WELL VOLUME (gal)
2	51.58	–	44.72	=	6.86	X	0.1631	=	**1.12**

SCREEN Length (ft)	**10**		
FROM	**41.58**	**TO**	**51.58**

MIDDLE OF WETTED SCREEN (FT TOC)	**48.2**
PUMP INTAKE DEPTH (FT TOC)	**50.6**

SAMPLING EQUIPMENT	QED PUMP	**PURGE METHOD**	Conventional

VOLUME 1.12 (gal)	CUMULATIVE VOLUME (gal)	COMPLETE EVACUATION (YES/NO)	☑ TEMP (deg C)	☑ SPECIFIC COND. (umho/cm)	☑ pH (SU)	TURBIDITY (NTU)	☐ ORP (mV-NHE)	☐ DISSOLVED OXYGEN (mg/L)
1.25	1.25	NO	16.05	38	6.34	33.8	N/A	N/A
1.25	2.50	NO	16.11	38	6.35	38.3		
1.25	3.75	NO	16.09	38	6.32	33.4		

COLLECT SAMPLE		SAMPLE COLLECTED BY	DATE / TIME		Chlorine
Sampling Criteria Satisfied		QC by USC rlw	3-22-11 0955		NA (mg/L)

DETECTED ODORS	NA	NA

PID READING (ppm)	NA

FREE PRODUCT MEASUREMENT	DEPTH TO PRODUCT		DEPTH TO WATER		PRODUCT THICKNESS	
	N/A	(ft)	N/A	(ft)	**N/A**	(ft)

If Product Thickness Is ≥ 0.1 ft, -- DO NOT SAMPLE --

WELL CONDITION			NOTES	
PROTECTIVE CASING	Good Condition		Pressure (psi): 20	15 & 5
WELL PAD	Good Condition			
WELL CASING	Good Condition			
WELL TAG	Good Tag			

FIGURE 4

FIELD SAMPLING CALIBRATION FORM

STUDY:	**MARSHALL STEAM STATION - FGD LANDFILL GROUNDWATER MONITORING**		
DATE (s):	**March 22, 2011**	**SURFACE UNIT READER:**	**LDC**
COLLECTORS:	**LDC, RLW**	**SURFACE UNIT SERIAL #:**	**S0205**
ANALYZER MODEL#:	**MS5**	**ANALYZER SERIAL #:**	**47630**
OTHER EQUIPMENT:	**TURBIDIMETER NO.1 - 3260.1**	**WEATHER CONDITIONS:**	**Clear, 55 to 75 deg F, calm**

PROCEDURE #: HYDROLAB 3210.3 **VALIDATED BY:** LDC 3/23/11

Calibration Date / Time		**DATE:** 22-Mar-11		**TIME:** 645		**DATE:** 22-Mar-11		**TIME:** 1140	
		BP (mmHg)		717.2		**BP (mmHg)**		719.4	
Parameter	**Calibation Standard**	**Instrument Value**		**Standard Value**	**Calibration Results**	**Instrument Value**		**Standard Value**	**Calibration Results**
SPEC. COND. (uS/cm)	SS	0.0	—/—►	0.0	Instrument Zeroed	0.0	—/—►	0.0	Zero Pass
	SS	231.8	—►	227	Calibration Accepted	220.5	—/—►	227	Calibration Pass
	SS	75.2	—/—►	75	Calibration Accepted	74.2	—/—►	75	Calibration Pass
pH (units)	B (7.00)	6.95	—►	7.02	Calibration Accepted	7.07	—/—►	7.01	Calibration Pass
	B (4.00)	4.05	—►	4.00	Calibration Accepted	4.07	—/—►	4.00	Calibration Pass
	B (10.00)	10.14	—/—►	10.06	Calibration Accepted	10.14	—/—►	10.02	Calibration Pass
			Buffer Temp.	20.29			Buffer Temp.	22.94	
☐ ORP (mV)	SS (7.00)	N/A	—/—►	N/A		N/A	—/—►	N/A	
	SS (4.00)	N/A	—/—►	N/A		N/A	—/—►	N/A	
☐ DO (mg/L)	W								
	W								
	AW	N/A	—/—►	N/A		N/A	—/—►	N/A	
☑ TURB (ntu)	SS	52.7	—/—►	52.8	Calibration Accepted	53.0	—/—►	52.8	Calibration Accepted
Temp Cert Device #									
TEMP (deg C)	NIST	N/A	—/—►	N/A	Adjustment Not Available	N/A	—/—►	N/A	Adjustment Not Available
AMMONIUM (mg/L)	SS	N/A	—/—►	N/A		N/A	—/—►	N/A	
	SS	N/A	—/—►	N/A		N/A	—/—►	N/A	

INSTRUMENT MAINTENANCE	**DATE / TIME**
Conductance Subsystem	*pH Subsystem*
☐ Cleaned Electrodes	☐ Cleaned Electrodes
☐ Tested - OK	☐ Replaced ref Electrode KCL
☐ See Notes	☐ Replaced Ref. Electrode Tip
	☐ Tested - OK ☐ See Notes
Dissolved Oxygen Subsystem	*Ammonium Subsystem*
☐ Replaced Teflon Membrane	☐ Cleaned Electrode Tip
☐ Replaced DO electrolyte	☐ Installed New Electrode
☐ Cleaned Electrode	☐ Removed Electrode / Installed Plug
☐ See Notes	☐ Tested - OK ☐ See Notes
Oxidation Reduction Subsystem	*Turbidity Subsystem*
☐ Cleaned Electrode	☐ Cleaned Electrode & Wiper
☐ Tested - OK ☐ See Notes	☐ Tested - OK ☐ See Notes
Temperature Subsystem	*Depth Subsystem*
☐ Cleaned Electrode	☐ Reset / Calibrated
☐ Tested - OK ☐ See Notes	☐ Tested - OK ☐ See Notes

KEY: B = Buffer; SS = Standard solution; W = Winkler; AW = Average Winkler; —► = Adjusted To; —/—► = Not Adjusted To; N/A = Not Applicable

NOTES:

FIGURE 5

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST FORM

Duke Energy

For Detailed Instructions, see:
http://dewww/essenv/coc/

Duke Energy Analytical Lab Services

Mail Code MGO3A2 (Building 7405)
13339 Hagers Ferry Rd
Huntersville, N. C. 28078
(704) 875-5245
Fax: (704) 875-5038

Analytical Laboratory Use Only

LIMS #: | MATRIX: GW-RCRA | Samples Originating From: NC √ SC

Logged By | Date & Time | SAMPLE PROGRAM: Ground Water √ NPDES Drinking Water UST RCRA Waste

VENDOR | Cooler Temp (C)

PO # | [15]Preserv.:1=HCL 2=H_2SO_4 3=HNO_3 4=Ice 5=None

MR #

[19]Page 1 of 1

DISTRIBUTION
ORIGINAL to LAB,
COPY to CLIENT

rev Aug 2011

Customer must Complete

1)Project Name: *MARSHALL FGD LANDFILL Permit # 18-09*		2)Phone No: 875-5257
3)Client: LDC / TSH / Ed Sullivan		4)Fax No:875-4349
5)Business Unit: 20035	6)Process: BENVWS	7)Resp. To: MS00
8)Project ID:	9)Activity ID:	10)Mail Code: MGO3A3

Customer to complete all appropriate NON-SHADED areas.

Customer to complete appropriate columns to right

LAB USE ONLY [11]Lab ID	[12]Chem Desktop No.	[13]Sample Description or ID	[14]Collection Information Date	Time	Signature	[17]Comp.	[18]Grab	Alk (4.5)	NO3-N, Cl, F, SO4 (IC)	Hg (EPA 245.1)	Metals Prep - 3030C (ICP - EPA 200.7) Ag, B, Ba, Ca, Cu, Fe, K, Mg, Mn, Na, Ni, Zn				TDS		[20]Total # of Containers
								4	3		3				4		
		MS-8					X	1	1		1				1		4
		MS-9					X	1	1		1				1		4
		MS-10					X	1	1		1				1		4
		MS-11					X	1	1		1				1		4
		MS-12					X	1	1		1				1		4
		MS-13					X	1	1		1				1		4
		MS-14					X	1	1		1				1		4
		MS-15					X	1	1		1				1		4
		MS-16					X	1	1		1				1		4
		SW-1					X	1	1		1				1		4
		FIELD BLANK					X	1	1		1						3

Customer to sign & date below

21)Relinquished By	Date/Time	Accepted By:	Date/Time
Relinquished By	Date/Time	Accepted By:	Date/Time
Relinquished By	Date/Time	Accepted By:	Date/Time
23)Seal/Locked By	Date/Time	Sealed/Lock Opened By	Date/Time

24)Comments: Regulatory Agency : NCDENR/DWM -SW Section - State EDD Format Required / Permit # 18-09
Use indicated or comparible analytical methods

Customer, important please indicate desired turnaround

[22]Requested Turnaround

14 Days √
*7 Days
* 48 Hr
*Other
* Add. Cost Will Apply

FIGURE 6

NORTH CAROLINA GROUNDWATER SAMPLING SITE CHECKLIST

LOCATION / SITE Marshall Steam Station - FGD Landfill Groundwater Monitoring
SITE CONTACT Donna Burrell
WEATHER Clear, 55 to 75 deg F, calm
PAGE 1 OF 1

PERMIT # 18-09

SAMPLE DATE March 22, 2011
FIELD CREW LDC, RLW

		MS-8	MS-9	MS-10	MS-11	MS-12	MS-13	MS-14	MS-15	MS-16	SW-1						
ACCESS TO WELLS																	
Access cleared into well		YES	YES	YES	YES	YES	YES	YES	YES	YES	YES						
Access cleared around well		YES	YES	YES	YES	YES	YES	YES	YES	YES	YES						
Tall grass or weeds - needs mowing																	
Road washing out / muddy / needs grading																	
Fallen tree blocking access																	
WELL SECURITY																	
Well found locked		YES	YES	YES	YES	YES	YES	YES	YES	YES	N/A						
Well found unlocked																	
WELL LOCK CONDITION																	
Lock in good condition		YES	YES	YES	YES	YES	YES	YES	YES	YES	N/A						
Lock rusted, difficult to open / needs replacing																	
Replaced damaged lock																	
WELL CASINGS																	
Casing in good condition		YES	YES	YES	YES	YES	YES	YES	YES	YES	N/A						
Damaged casing / still functional																	
Damaged casing / repair required																	
CONCRETE PADS																	
Pad in good condition		YES	YES	YES	YES	YES	YES	YES	YES	YES	N/A						
Minor cracks																	
Major cracks / broken / repair required																	
Undermined / washing out																	
Fire ants around concrete pad																	
WELL PROTECTIVE CASINGS																	
Casing in good condition		YES	YES	YES	YES	YES	YES	YES	YES	YES	N/A						
Damaged casing / still functional																	
Damaged casing / repair required																	
Broken hinge on protective lid																	
Wasp nest inside protective casing																	
Ants inside protective casing																	
WELL CAPS																	
Well cap in good conditon		YES	YES	YES	YES	YES	YES	YES	YES	YES	N/A						
Damaged / needs replacement																	
Replaced damaged well cap																	
FLUSH MOUNT WELLS																	
Vault in good condition		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A						
Water inside vault																	
Vault bolt holes broken or stripped																	
Bolts stripped																	
Vault lid cracked or broken																	
WELL ID TAGS																	
Well tag in good condition		YES	YES	YES	YES	YES	YES	YES	YES	YES	N/A						
Well tag missing																	
Well tag damaged / illegible																	
Lacks required information - Driller Reg #																	
Lacks required information - Completion date																	
Lacks required information - Total well depth																	
Lacks required information - Depth to screen																	
Lacks required information - Non potable tag																	

NOTE:

FIGURE 7

TABLES

Table 1
Monitoring Well Information

	MS-8	MS-9	MS-10	MS-11	MS-12	MS-13	MS-14	MS-15	MS-16
Previous Well Name	N/A	N/A	N/A	N/A	OW-3	MS-6	B-5	B-4	N/A
North (ft)	680,717.89	681,384.45	681,027.65	680,297.49	679,540.04	679,732.80	679,968.41	680,428.02	681,143.02
East (ft)	1,412,027.98	1,412,181.74	1,411,622.46	1,411,564.82	1,412,086.50	1,412,500.68	1,413,123.89	1,412,993.27	1,412,486.19
Top of PVC Casing Elevation (ft)	872.34	868.04	851.29	859.78	835.66	841.90	844.07	861.47	836.98
Well Diameter	2"	2"	2"	2"	2"	2"	2"	2"	2"
Well Stick-up (ft)	3.0	2.68	3.0	2.91	2.96	2.71	2.80	3.05	3.0
Type of Casing	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC
Total Depth (ft)	48.5	50.0	20.0	39.0	27.0	38.0	41.0	59.0	35
Screen Length (ft)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Screen Interval (ft below ground surface)	38 to 48	40.0 to 50.0	10.0 to 20.0	29.0 to 39.0	17.0 to 27.0	28.0 to 38.0	31.0 to 41.0	49.0 to 59.0	24 to 34

Notes:
As-built well coordinates and top of PVC casing elevations provided by Duke Energy
Well depth and screen information was obtained from the Well Installation Records
Coordinates: NC State Plane Grid, NAD83
Elevations: NAVD 88
N/A – Not Applicable

Table 1.1
Surface Water Sample Location

	North	East	Elevation (ft)
SW-1	679,611.0	1,412,341.3	822.3

Notes:
As-built coordinates and elevation provided by Duke Energy.
Coordinates: NC State Plane Grid, NAD83
Elevations: NAVD 88

Table 2
Sample Parameters, Analytical Methods, and Detection Limits

PARAMETER	UNITS	ANALYTICAL METHOD	DETECTION LIMITS
In Situ Parameters			
Field pH	pH Units	Hydrolab	N/A
Specific Conductance	µmhos/cm	Hydrolab	N/A
Temperature	^{o}C	Hydrolab	N/A
Turbidity	NTU	HACH	N/A
Water Level	ft	Water Level Meter	0.01
Laboratory Analyses			
Nitrate	µg/L	EPA 300.0	5.4
Chloride	µg/L	EPA 300.0	22
Arsenic	µg/L	EPA 200.8/EPA 6020	0.08
Barium	µg/L	EPA 200.7/EPA 6010	0.1
Boron	µg/L	EPA 200.7/EPA 6010	3.3
Cadmium	µg/L	EPA 200.8/EPA 6020	0.1
Chromium	µg/L	EPA 200.7/EPA 6010	0.5
Copper	µg/L	EPA 200.7/EPA 6010	1.0
Iron	µg/L	EPA 200.7/EPA 6010	1.3
Lead	µg/L	EPA 200.8/EPA 6020	0.7
Manganese	µg/L	EPA 200.7/EPA 6010	0.2
Mercury	µg/L	EPA 7470	0.03
Nickel	µg/L	EPA 200.7/EPA 6010	0.5
Selenium	µg/L	EPA 200.8/EPA 6020	0.09
Silver	µg/L	EPA 200.7/EPA 6010	0.7
Zinc	µg/L	EPA 200.7/EPA 6010	2.6
Sulfate	µg/L	EPA 300.0	18
Fluoride	µg/L	EPA 300.0	17
TDS	µg/L	SM 2540C	6,670

Notes:
N/A – Not Applicable
µmhos/cm – micro-ohms per centimeter
NTU – nephelometric turbidity units
ft – feet
mg/L – milligrams per liter
µg/L – micrograms per liter
TDS – total dissolved solids

Table 3
Sample Containers, Preservatives, and Holding Times

PARAMETER	CONTAINERS	PRESERVATIVES	HOLDING TIMES
In Situ Parameters			
Field pH	In Situ	None	Analyze Immediately
Specific Conductance	In Situ	None	Analyze Immediately
Temperature	In Situ	None	Analyze Immediately
Turbidity	In Situ	None	Analyze Immediately
ORP	In Situ	None	Analyze Immediately
Laboratory Analyses			
Nitrate	500 mL HDPE	Cool to 4°C	48 hours
Chloride	500 mL HDPE	Cool to 4°C	28 days
Arsenic	500 mL HDPE	pH<2 HNO_3	6 months
Barium	500 mL HDPE	pH<2 HNO_3	6 months
Boron	500 ml HDPE	pH<2 HNO_3	6 months
Cadmium	500 mL HDPE	pH<2 HNO_3	6 months
Chromium	500 mL HDPE	pH<2 HNO_3	6 months
Copper	500 mL HDPE	pH<2 HNO_3	6 months
Iron	500 mL HDPE	pH<2 HNO_3	6 months
Lead	500 mL HDPE	pH<2 HNO_3	6 months
Manganese	500 mL HDPE	pH<2 HNO_3	6 months
Nickel	500 mL HDPE	pH<2 HNO_3	6 months
Mercury	500 mL HDPE	pH<2 HNO_3	6 months
Selenium	500 mL HDPE	pH<2 HNO_3	6 months
Silver	500 mL HDPE	pH<2 HNO_3	6 months
Zinc	500 mL HDPE	pH<2 HNO_3	6 months
Sulfate	500 mL HDPE	Cool 4°C	28 days
Fluoride	500 mL HDPE	pH<2 HNO_3	6 months
Total Dissolved Solids	500 mL HDPE	Cool 4°C	7 days

Notes:
ORP – oxidation-reduction potential
mL HDPE – milliliter high density polyethylene
HNO_3 – nitric acid

APPENDIX A

Monitoring Well Construction Records

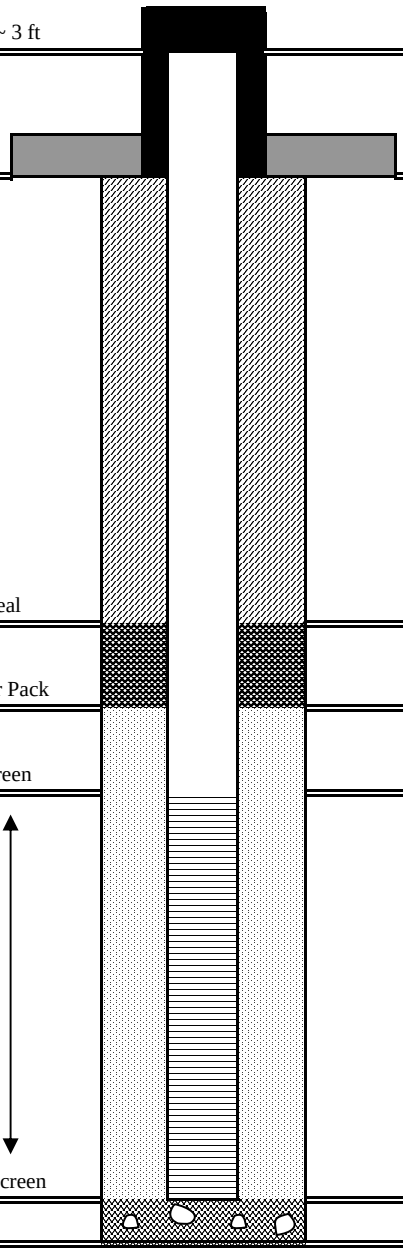
MONITORING WELL CONSTRUCTION

WELL ID: MS-8 **TOTAL DEPTH: 48.5 ft bls**

S&ME PROJECT AND NO:	WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station, 1356-06-728	Monitoring	9/12/2006

DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:	DRILLING METHOD:
S&ME, Inc.	Larry Shrader, 3349	4.25 H.S.A.

WATER LEVEL AT TOB:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
42.45 ft bls	681496.7	1412015.4	872.34	869.35



Stickup (ft): ~ 3 ft	872.34
Depth BLS 0 ft - Top of Grout	869.35
34 ft - Top of Seal	835.35
36 ft - Top of Filter Pack	833.35
38 ft - Top of Screen	831.35
Screened Interval 10 feet	
48 ft - Bottom of Screen	821.35
Cave In	820.85
48.5 ft bls - Total Depth	

PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 38 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
38 to 48 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 34 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
36 to 38 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
36 to 48 ft bls

DEVELOPMENT:
Purged ~15 Gallons

NOTES:

TBD - To Be Determined

For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(MS-8)

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Larry Shrader **CERTIFICATION #** 3349

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☒ Recovery ☐ Heat Pump Water Injection ☐ Other ☐ If Other, List Use _____

2. WELL LOCATION:
   Nearest Town: Terrell County Iredell
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☐ Ridge ☐ Slope ☐ Valley ☒ Flat
   (check appropriate box)

   Latitude/longitude of well location
   35°-36'-23.134 N / 80°-58'-41.729W
   (degrees/minutes/seconds)

   Latitude/longitude scource: ☐GPS ☐Topographic Map
   ↳ Physical Survey
   (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED 9/12/2006
5. TOTAL DEPTH 48 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☐
7. STATIC WATER LEVEL Below Top of Casing: 42.77 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~ 3.0 FT. Above Land Surface*
   ***Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.**
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a

DEPTH From	DEPTH To	DRILLING LOG Formation Descrpition
0	3	M/F Sandy Clay
3	8.5	Silty M/F Sand
8.5	39	Silty C/V.Fine Sand
39	43.5	Silty F/V. Fine Sand
		w/ Co. Sand Lenses
43.5	48	Silty F/V. Fine Sand
48	48.5	PWR

11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth From	Depth To	Diameter	Wall Thickness or Weight/Ft.	Material
	0	38	2-inch	Sch. 40	PVC

13. GROUT:

	Depth From	Depth To	Material	Method
	0	34	Neat Cement	Pour
	34	36	Bentonite	Pour

14. SCREEN:

	Depth From	Depth To	Diameter	Slot Size	Material
	38	48	2-inch in.	0.01 in.	PVC
			in.	in.	

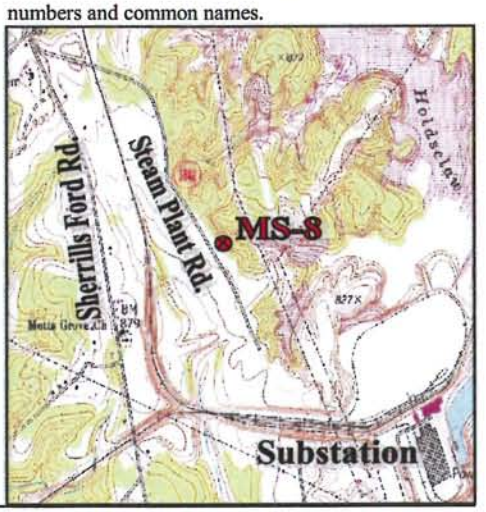
15. SAND/GRAVEL PACK:

	Depth From	Depth To	Size	Material
	36	48	#1	Silica Sand

16. REMARKS:

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



I DO HERE BY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

Larry W. Shrader 9-25-06

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

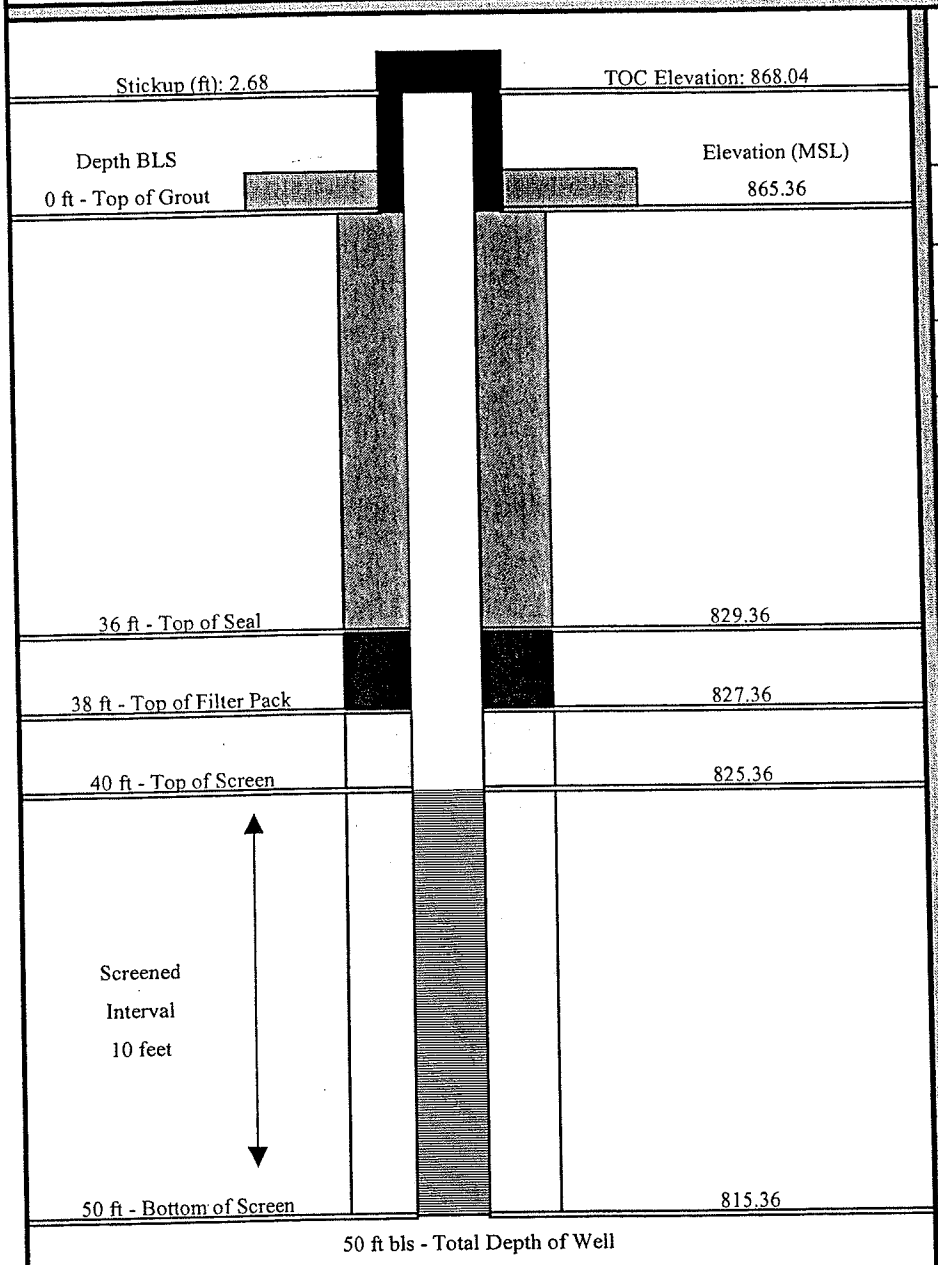
GW-1 REV. 07/2001

MONITORING WELL CONSTRUCTION

S&ME
ENVIRONMENTAL SERVICES · ENGINEERING · TESTING

WELL ID: MS-9 **TOTAL DEPTH: 50 ft bls**

S&ME PROJECT AND NO: Marshall Steam Station - Beneficial Fill, 1264-03-072		WELL USE / TYPE: Observation	INSTALLATION DATE: 01/16/2003
DRILLING CONTRACTOR: S&ME, Inc.	DRILLER AND LICENCE NO.: Brian Wilson, 2718		DRILLING METHOD: 4.25 HSA
STATIC WATER LEVEL: 44.5 ft bls at 24-hrs	NORTHING: 681384.5	EASTING: 1412181.7	TOP OF CASING ELEV.: 868.04	GROUND SURFACE ELEV.: 865.36



PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 40 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
40 to 50 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 36 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
36 to 38 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
38 to 50 ft bls

DEVELOPMENT:
Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(MS-9)

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Brian Wilson **CERTIFICATION #** 2718

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
   Nearest Town: Terrell County Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☑ Ridge ☐ Slope ☐ Valley ☐ Flat
   (check appropriate box)
   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED 01/16/2003
5. TOTAL DEPTH 50 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 48.5 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a

DEPTH From	DEPTH To	DRILLING LOG Formation Descrpition
0	4	Silty Clay
4	9	Fine Sandy Silt
9	50	Silty Very Fine Sand

11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth From	To	Ft.	Diameter	Wall Thickness or Weight/Ft.	Material
	0	40		2-inch	Sch. 40	PVC

13. GROUT:

Depth From	To	Ft.	Material	Method
0	36		Neat Cement	Pour
36	38		Bentonite	Pour

14. SCREEN:

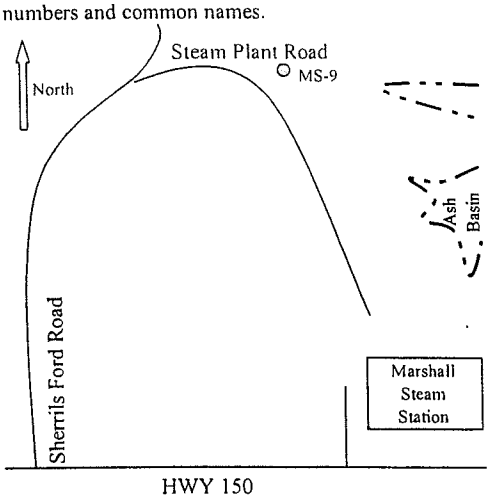
Depth From	To	Ft.	Diameter	Slot Size	Material
40	50		2-inch in.	0.01 in.	PVC
			in.	in.	

15. SAND/GRAVEL PACK:

Depth From	To	Ft.	Size	Material
38	50		#1	Silica Sand

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



16. REMARKS: _____

I DO HERE BY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

Brian E. Wilson 2-7-03

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

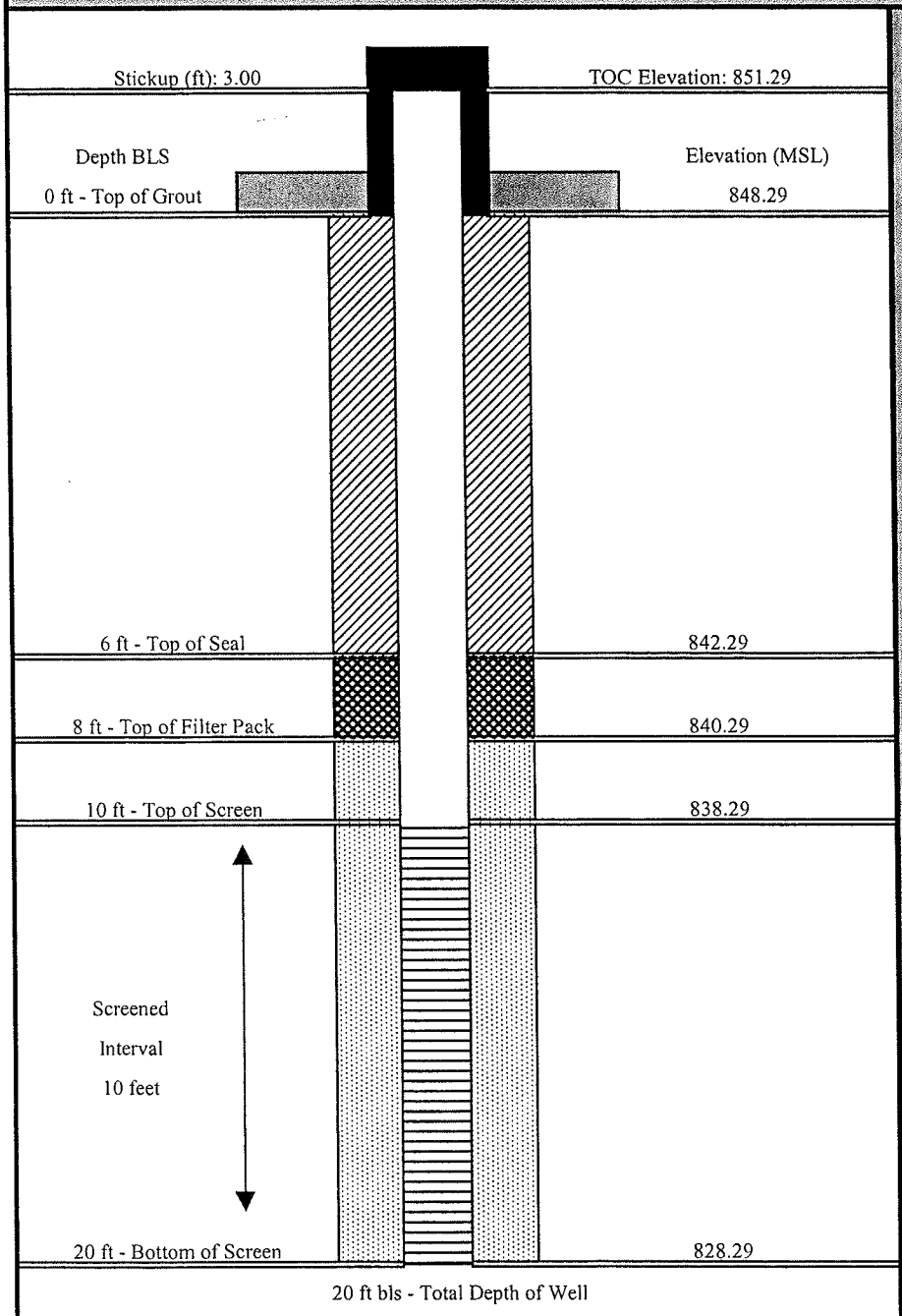
GW-1 REV. 07/2001

MONITORING WELL CONSTRUCTION

WELL ID: MS-10 **TOTAL DEPTH: 20 ft bls**

S&ME
ENVIRONMENTAL SERVICES • ENGINEERING • TESTING

S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
MSS-FGD Scrubber Landfill, 1264-02-578			Observation	07/08/2003
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:			DRILLING METHOD:
S&ME, Inc.	Jay Little, 2717			4.25 HSA
STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
12 ft bls at 24-hrs	681027.6	1411622.5	851.29	848.29



PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 10 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
10 to 20 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 6 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
6 to 8 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
8 to 20 ft bls

DEVELOPMENT:
Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD
(MS-10)

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Jay Little **CERTIFICATION #** 2717

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well
2. WELL LOCATION:
   Nearest Town: Terrell County Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☐ Ridge ☐ Slope ☑ Valley ☐ Flat
   (check appropriate box)
   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)
3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number
4. DATE DRILLED 07/08/2003
5. TOTAL DEPTH 20 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 12 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a

DEPTH From To	DRILLING LOG Formation Descrpition
0 to 7	Fine Sandy Clay
7 to 12	Silty Clay
12 to 20	Fine Sandy Silt

11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From 0	To 10	Ft.	2-inch	Sch. 40	PVC
From	To	Ft.			
From	To	Ft.			

13. GROUT:

	Depth		Material	Method
From 0	To 6	Ft.	Neat Cement	Pour
From 6	To 8	Ft.	Bentonite	Pour

14. SCREEN:

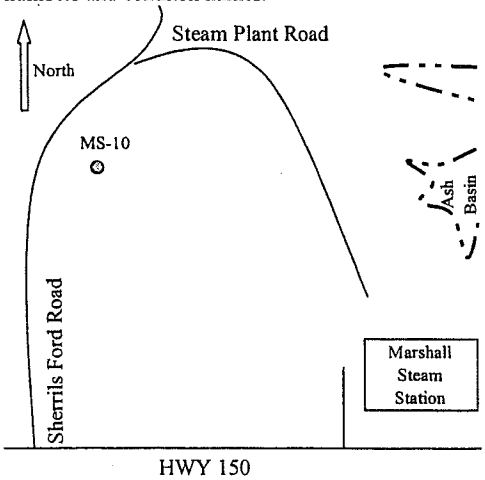
	Depth		Diameter	Slot Size	Material
From 10	To 20	Ft.	2-inch in.	0.01 in.	PVC
From	To	Ft.	in.	in.	

15. SAND/GRAVEL PACK:

	Depth		Size	Material
From 8	To 20	Ft.	#1	Silica Sand
From	To	Ft.		

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



16. REMARKS:

I DO HERE BY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

Jay A. Little 7-17-03

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

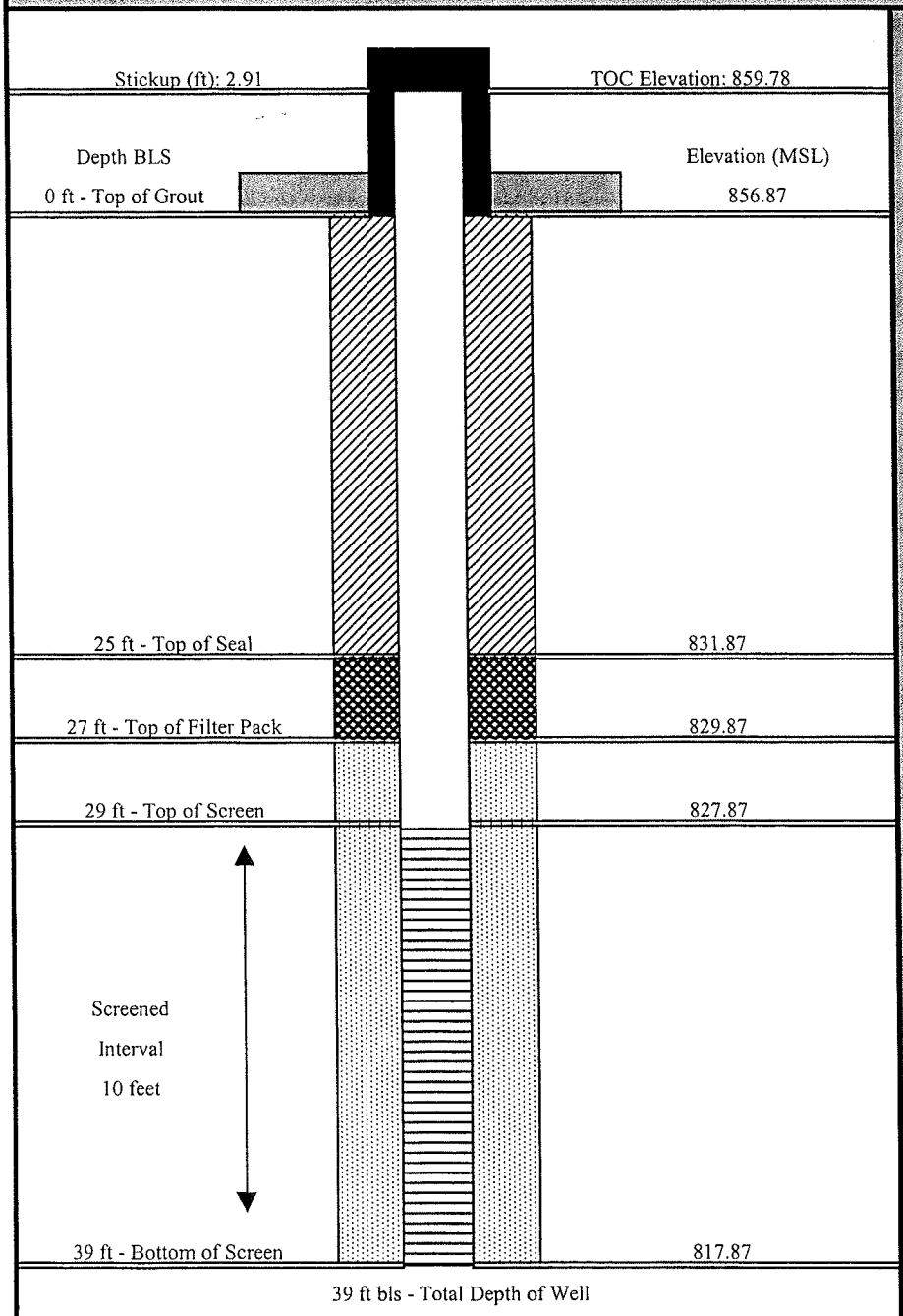
GW-1 REV. 07/2001

MONITORING WELL CONSTRUCTION

WELL ID: MS-11 **TOTAL DEPTH: 39 ft bls**

S&ME
ENVIRONMENTAL SERVICES · ENGINEERING · TESTING

S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
MSS-FGD Scrubber Landfill, 1264-02-578			Observation	07/09/2003
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:			DRILLING METHOD:
S&ME, Inc.	Jay Little, 2717			4.25 HSA
STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
33 ft bls at 24-hrs	680297.5	1411564.8	859.78	856.87



PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 29 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
29 to 39 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 25 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
25 to 27 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
37 to 39 ft bls

DEVELOPMENT:
Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(MS-11)

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Jay Little **CERTIFICATION #** 2717

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐ Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
   Nearest Town: Terrell County Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☐ Ridge ☑ Slope ☐ Valley ☐ Flat
   (check appropriate box)
   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED 07/09/2003
5. TOTAL DEPTH 39 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 33 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   ***Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.**
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a

DEPTH From To	DRILLING LOG Formation Descrpition
0 to 7	Silty Clay
7 to 12	Fine Sandy Silt
12 to 22	Silty Fine Sand
22 to 27	Silty Coarse/Fine Sand
27 to 32	Fine Sandy Silt
32 to 37	Silty Med/Fine Sand
37 to 39	Silty Coarse/Fine Sand

11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From 0	To 29	Ft.	2-inch	Sch. 40	PVC
From	To	Ft.			
From	To	Ft.			

13. GROUT:

	Depth		Material	Method
From 0	To 25	Ft.	Neat Cement	Pour
From 25	To 27	Ft.	Bentonite	Pour

14. SCREEN:

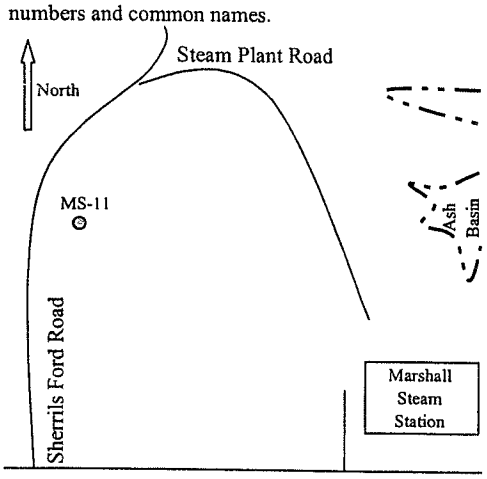
	Depth		Diameter	Slot Size	Material
From 29	To 39	Ft.	2-inch in.	0.01 in.	PVC
From	To	Ft.	in.	in.	

15. SAND/GRAVEL PACK:

	Depth		Size	Material
From 27	To 39	Ft.	#1	Silica Sand
From	To	Ft.		

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



16. REMARKS:

I DO HERE BY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

Jay A. Little 7-17-03

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

MONITORING WELL CONSTRUCTION

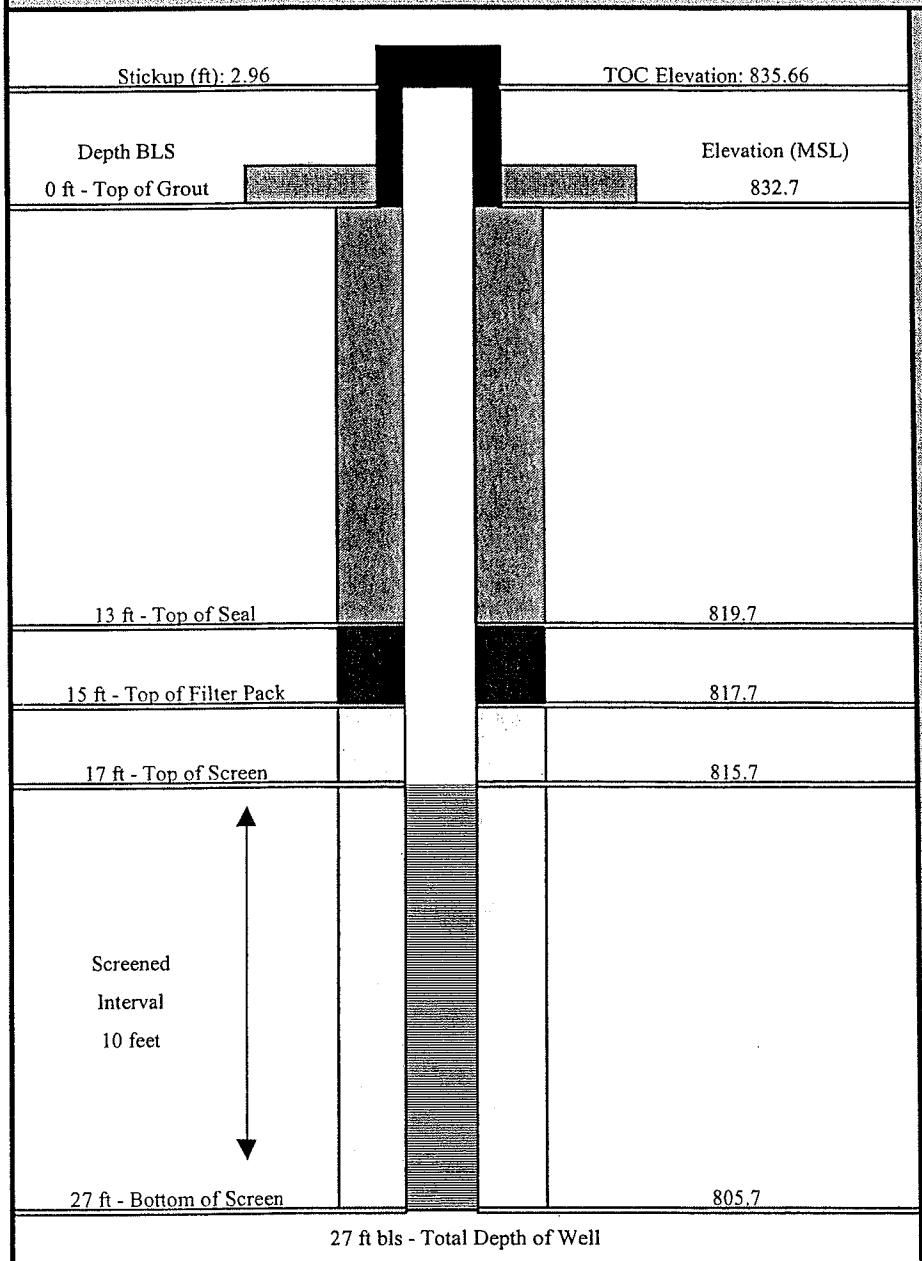
WELL ID: OW-3 (MS-12) TOTAL DEPTH: 27 ft bls

S&ME
ENVIRONMENTAL SERVICES · ENGINEERING · TESTING

S&ME PROJECT AND NO:	WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072	Observation	02/11/2003

DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:	DRILLING METHOD:
S&ME, Inc.	Brian Wilson, 2718	4.25 HSA

STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
17.89 ft bls at 24-hrs	679540.0	1412086.5	835.66	832.7



PAD TYPE:	2'x2' Concrete
PROTECTIVE CASING:	4"x4" Lockable Steel
CASING TYPE:	2-inch Sch. 40 PVC
CASING INTERVAL:	0 to 17 ft bls
SCREEN TYPE:	2-inch 0.010 Slot Sch. 40 PVC
SCREEN INTERVAL	17 to 27 ft bls
GROUT TYPE:	Neat Cement
GROUT INTERVAL	0 to 13 ft bls
SEAL TYPE:	Bentonite
SEAL INTERVAL:	13 to 15 ft bls
FILTER PACK:	#1 Filter Sand
FILTER PACK INTERVAL:	15 to 27 ft bls
DEVELOPMENT:	Purged minimum 5 well volumes

NOTES:

For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

OW-3 - MS-12

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Brian Wilson CERTIFICATION # 2718

WELL CONTRACTOR COMPANY NAME S&ME, Inc. PHONE # 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ ASSOCIATED WQ PERMIT# _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐ Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
Nearest Town: Terrell County Catawba
Marshall Steam Station
(Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

Topographic/Land setting
☐ Ridge ☐ Slope ☑ Valley ☐ Flat
(check appropriate box)

Latitude/longitude of well location
(degrees/minutes/seconds)
Latitude/longitude scource: ☐GPS ☐Topographic Map
(check box)

3. OWNER: Duke Power
Address 526 South Church Street
(Street or Route No.)
Charlotte NC 28202
City or Town State Zip Code
(704) 373-7900
Area code - Phone Number

4. DATE DRILLED 02/11/2003
5. TOTAL DEPTH 27 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 25 ft.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a

DEPTH From	To	DRILLING LOG Formation Descrpition
0	9	Sandy Clay
9	14	Fine Sandy Silt
14	19	Silty Med/Fine Sand
19	22	Fine Sandy Silt
22	27	Silty Med/Fine Sand

11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth From	To	Ft.	Diameter	Wall Thickness or Weight/Ft.	Material
	0	17		2-inch	Sch. 40	PVC

13. GROUT:

	Depth From	To	Ft.	Material	Method
	0	13		Neat Cement	Pour
	13	15		Bentonite	Pour

14. SCREEN:

	Depth From	To	Ft.	Diameter	Slot Size	Material
	17	27		2-inch in.	0.01 in.	PVC
				in.	in.	

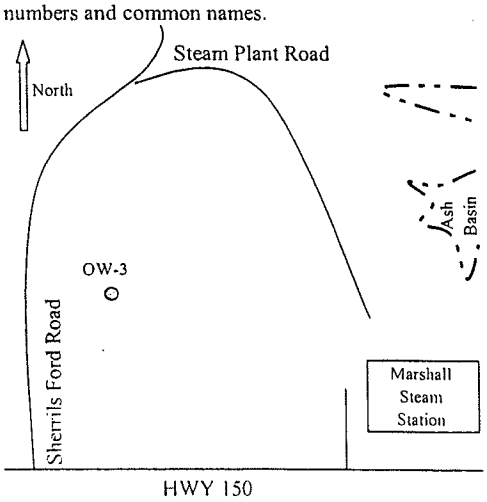
15. SAND/GRAVEL PACK:

	Depth From	To	Ft.	Size	Material
	15	27		#1	Silica Sand

16. REMARKS:

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



I DO HERE BY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

Brian Wilson 2/17/03

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

MONITORING WELL CONSTRUCTION

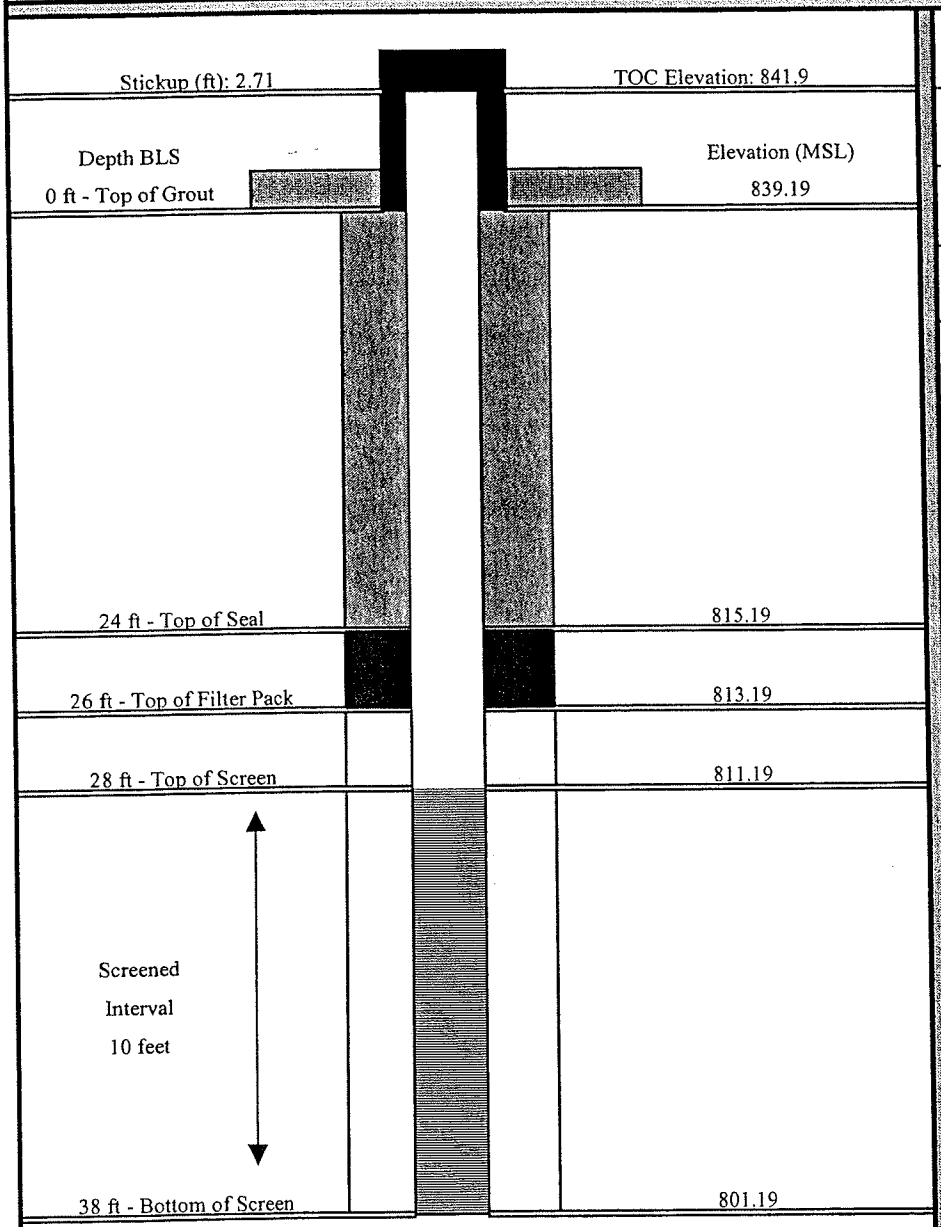
WELL ID: MS-6 (MS-13) TOTAL DEPTH: 38 ft bls

S&ME
ENVIRONMENTAL SERVICES • ENGINEERING • TESTING

S&ME PROJECT AND NO:	WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072	Observation	12/17/2002

DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:	DRILLING METHOD:
S&ME, Inc.	Jay Little, 2717	4.25 HSA

STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
26.89 ft bls at 24-hrs	679732.8	1412500.7	841.9	839.19



PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 28 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
28 to 38 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 24 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
24 to 26 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
26 to 38 ft bls

DEVELOPMENT:
Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(MS-6) - MS-13

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Jay Little CERTIFICATION # 2717

WELL CONTRACTOR COMPANY NAME S&ME, Inc. PHONE # 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ ASSOCIATED WQ PERMIT# _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐ Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
Nearest Town: Terrell County Catawba
Marshall Steam Station
(Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

Topographic/Land setting
☐ Ridge ☐ Slope ☑ Valley ☐ Flat
(check appropriate box)

Latitude/longitude of well location
(degrees/minutes/seconds)
Latitude/longitude scource: ☐GPS ☐Topographic Map
(check box)

3. OWNER: Duke Power
Address 526 South Church Street
(Street or Route No.)
Charlotte NC 28202
City or Town State Zip Code
(704) 373-7900
Area code - Phone Number

4. DATE DRILLED 12/17/2002
5. TOTAL DEPTH 38 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 31.36 ft.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a

DEPTH From To	DRILLING LOG Formation Descrpition
0 to 0.5	Fine Sandy Silt
0.5 to 9	Silty Clay
9 to 17	Fine Sandy Silt
17 to 27	Silty Fine Sand
27 to 38	Silty Med/Fine Sand

11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From 0	To 28	Ft.	2-inch	Sch. 40	PVC
From	To	Ft.			
From	To	Ft.			

13. GROUT:

	Depth		Material	Method
From 0	To 24	Ft.	Neat Cement	Pour
From 24	To 26	Ft.	Bentonite	Pour

14. SCREEN:

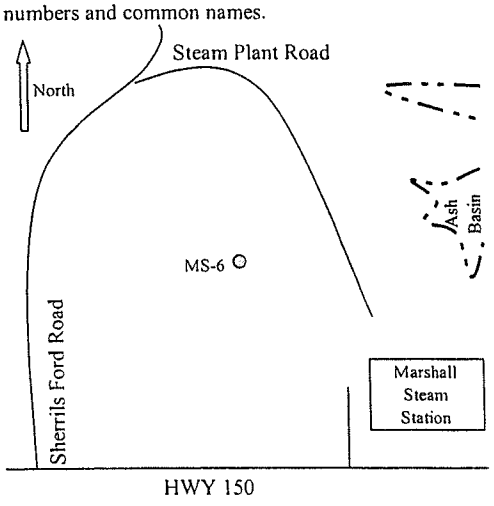
	Depth		Diameter		Slot Size		Material
From 28	To 38	Ft.	2-inch	in.	0.01	in.	PVC
From	To	Ft.		in.		in.	

15. SAND/GRAVEL PACK:

	Depth		Size	Material
From 26	To 38	Ft.	#1	Silica Sand
From	To	Ft.		

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



16. REMARKS:

I DO HERE BY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

Jay A. Little 2-7-03

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

MONITORING WELL CONSTRUCTION

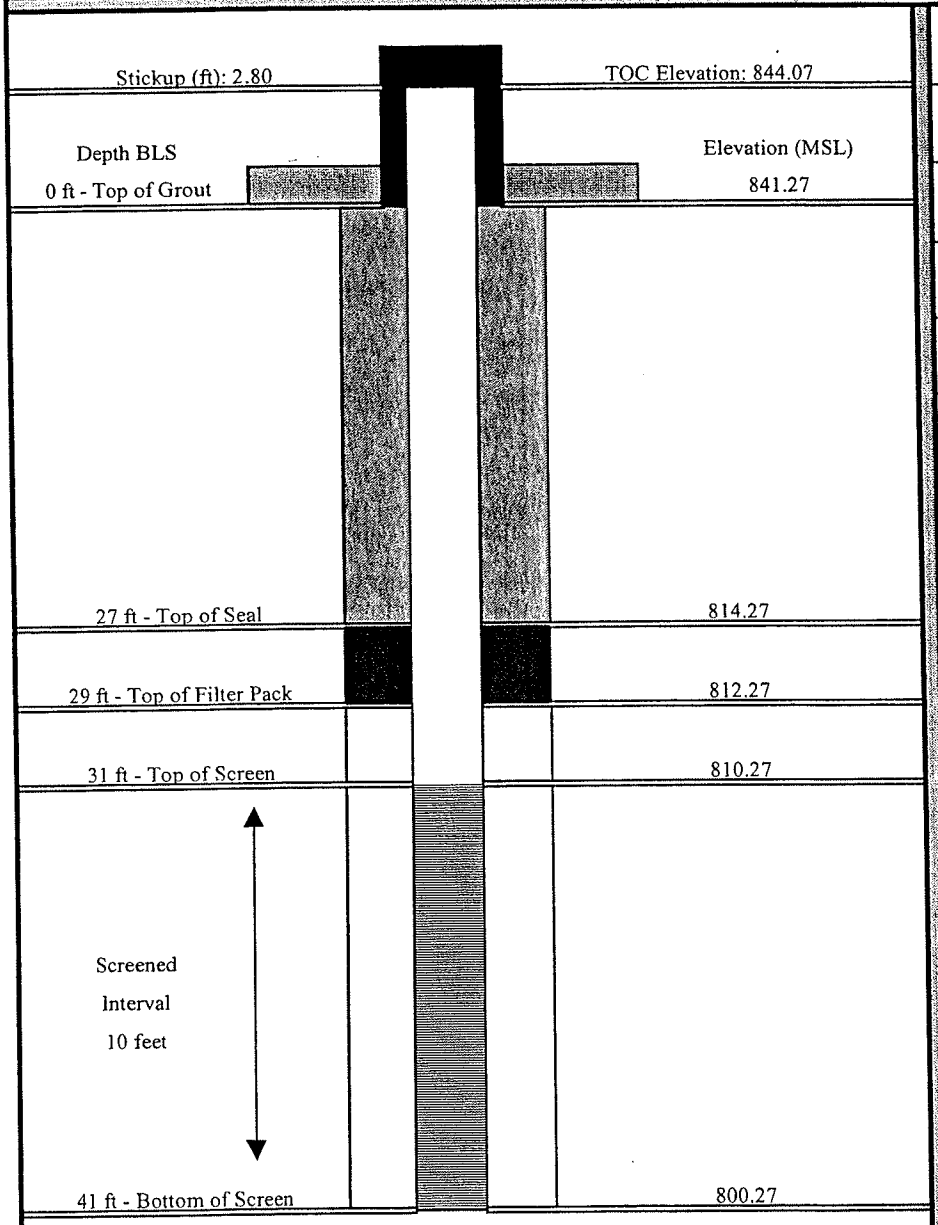
WELL ID: B-5 (MS-14) **TOTAL DEPTH: 41 ft bls**

S&ME
ENVIRONMENTAL SERVICES • ENGINEERING • TESTING

S&ME PROJECT AND NO:	WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072	Observation	01/07/2003

DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:	DRILLING METHOD:
S&ME, Inc.	Brian Wilson, 2718	4.25 HSA

STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
36.3 ft bls at 24-hrs	679968.4	1413123.9	844.07	841.27



PAD TYPE:	2'x2' Concrete
PROTECTIVE CASING:	4"x4" Lockable Steel
CASING TYPE:	2-inch Sch. 40 PVC
CASING INTERVAL:	0 to 31 ft bls
SCREEN TYPE:	2-inch 0.010 Slot Sch. 40 PVC
SCREEN INTERVAL	31 to 41 ft bls
GROUT TYPE:	Neat Cement
GROUT INTERVAL	0 to 27 ft bls
SEAL TYPE:	Bentonite
SEAL INTERVAL:	27 to 29 ft bls
FILTER PACK:	#1 Filter Sand
FILTER PACK INTERVAL:	29 to 41 ft bls
DEVELOPMENT:	Purged minimum 5 well volumes

NOTES:

For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(B-5) - MS-14

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Brian Wilson CERTIFICATION # 2718

WELL CONTRACTOR COMPANY NAME S&ME, Inc. PHONE # 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ ASSOCIATED WQ PERMIT# _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
   Nearest Town: Terrell County Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☐ Ridge ☑ Slope ☐ Valley ☐ Flat
   (check appropriate box)
   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED 01/07/2003
5. TOTAL DEPTH 41 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 39.3 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a

DEPTH From To	DRILLING LOG Formation Descrpition
0 to 3.5	Silty Clay
3.5 to 9.5	Clayey Silt
9.5 to 12	Silty Fine Sand
12 to 37	Fine Sandy Silt
37 to 41	Silty Fine Sand

11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From 0	To 31	Ft.	2-inch	Sch. 40	PVC
From	To	Ft.			
From	To	Ft.			

13. GROUT:

	Depth		Material	Method
From 0	To 27	Ft.	Neat Cement	Pour
From 27	To 29	Ft.	Bentonite	Pour

14. SCREEN:

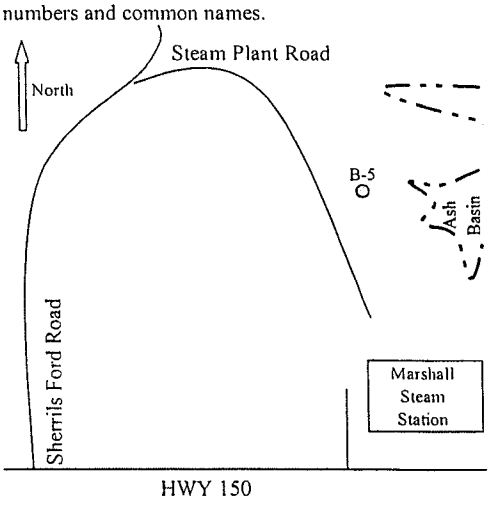
	Depth		Diameter	Slot Size	Material
From 31	To 41	Ft.	2-inch in.	0.01 in.	PVC
From	To	Ft.	in.	in.	

15. SAND/GRAVEL PACK:

	Depth		Size	Material
From 29	To 41	Ft.	#1	Silica Sand
From	To	Ft.		

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



16. REMARKS:

I DO HERE BY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

Brian E. Wilson 2/6/03

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

MONITORING WELL CONSTRUCTION

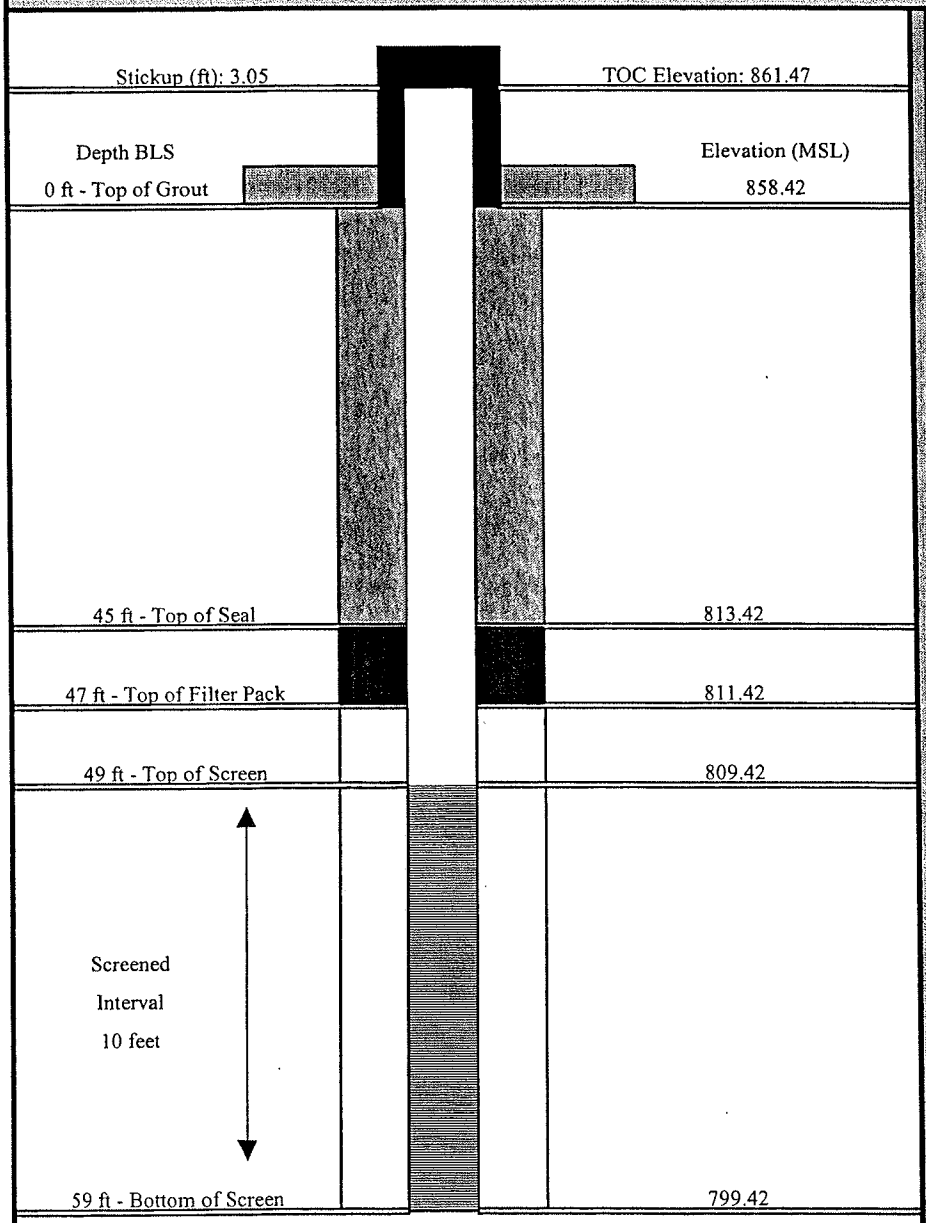
WELL ID: B-4 (MS-15) **TOTAL DEPTH: 59 ft bls**

S&ME
ENVIRONMENTAL SERVICES · ENGINEERING · TESTING

S&ME PROJECT AND NO:	WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072	Observation	12/03/2002

DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:	DRILLING METHOD:
S&ME, Inc.	Jay Little, 2717	4.25 HSA

STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
52 ft bls at 24-hrs	680428.0	1412993.3	861.47	858.42



PAD TYPE:	2'x2' Concrete
PROTECTIVE CASING:	4"x4" Lockable Steel
CASING TYPE:	2-inch Sch. 40 PVC
CASING INTERVAL:	0 to 49 ft bls
SCREEN TYPE:	2-inch 0.010 Slot Sch. 40 PVC
SCREEN INTERVAL	49 to 59 ft bls
GROUT TYPE:	Neat Cement
GROUT INTERVAL	0 to 45 ft bls
SEAL TYPE:	Bentonite
SEAL INTERVAL:	45 to 47 ft bls
FILTER PACK:	#1 Filter Sand
FILTER PACK INTERVAL:	47 to 59 ft bls
DEVELOPMENT:	Purged minimum 5 well volumes

NOTES:

For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(B-4) - MS-15

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Jay Little **CERTIFICATION #** 2717

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
   Nearest Town: Terrell County Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☑ Ridge ☐ Slope ☐ Valley ☐ Flat
   (check appropriate box)
   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED 12/03/2002
5. TOTAL DEPTH 59 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 55 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a

DEPTH From	DEPTH To	DRILLING LOG Formation Descrpition
0	7	Clayey Silt
7	42	Fine Sandy Silt
42	47	Silty Fine Sand
47	52	Fine Sandy Silt
52	59	Silty Fine Sand

11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth From	Depth To	Diameter	Wall Thickness or Weight/Ft.	Material
	0	49	2-inch	Sch. 40	PVC

13. GROUT:

	Depth From	Depth To	Material	Method
	0	45	Neat Cement	Pour
	45	47	Bentonite	Pour

14. SCREEN:

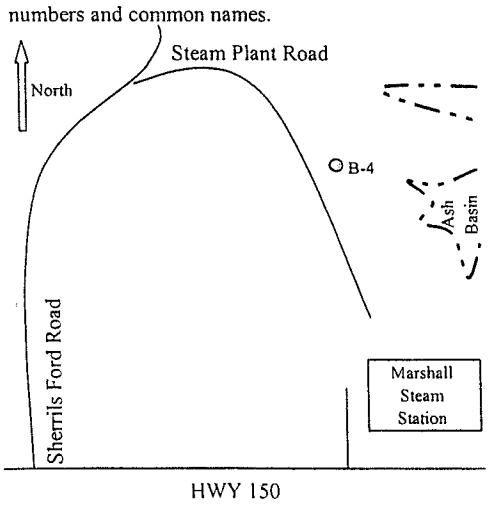
	Depth From	Depth To	Diameter	Slot Size	Material
	49	59	2-inch in.	0.01 in.	PVC
			in.	in.	

15. SAND/GRAVEL PACK:

	Depth From	Depth To	Size	Material
	47	59	#1	Silica Sand

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



16. REMARKS:

I DO HERE BY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

Jay A. Little 2-7-03

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

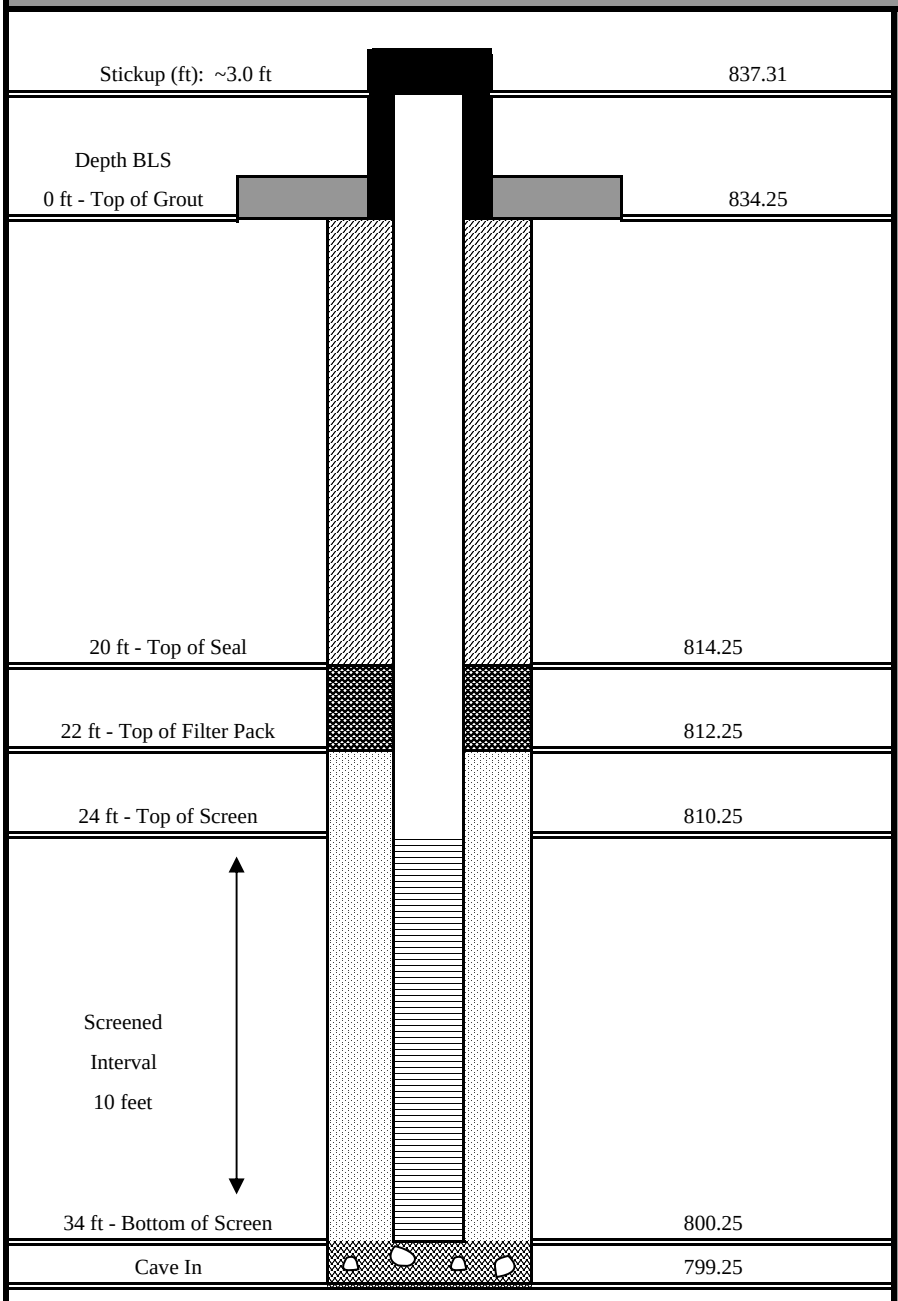
Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

MONITORING WELL CONSTRUCTION

WELL ID: MS-16 **TOTAL DEPTH: 35 ft bls**

S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station, 1356-06-728			Monitoring	9/11/2006
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:			DRILLING METHOD:
S&ME, Inc.	Larry Shrader, 3349			4.25 H.S.A.
WATER LEVEL AT TOB:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
26 ft bls	681142.3	1412485.1	837.31	834.25



PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 24 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
24 to 34 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 20 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
20 to 22 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
22 to 34 ft bls

DEVELOPMENT:
Purged ~15 Gallons

NOTES:

TBD - To Be Determined

For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(MS-16)

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Larry Shrader **CERTIFICATION #** 3349

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐ Monitoring ☒ Recovery ☐ Heat Pump Water Injection ☐ Other ☐ If Other, List Use _____

2. WELL LOCATION:
   Nearest Town: Terrell County Iredell
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☐ Ridge ☒ Slope ☐ Valley ☐ Flat
   (check appropriate box)

   Latitude/longitude of well location
   35°-36'-19.714"N / 80°-58'-35.966"W
   (degrees/minutes/seconds)

   Latitude/longitude scource: ☐GPS ☐Topographic Map
   → Physical Survey (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED 9/11/2006
5. TOTAL DEPTH 34 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☐
7. STATIC WATER LEVEL Below Top of Casing: 24.7 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~ 3.0 FT. Above Land Surface*
   ***Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.**
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a

DEPTH From	DEPTH To	DRILLING LOG Formation Descrpition
0	3	Slightly Clayey, M/F Sand
3	9.5	Fine Sandy Silt
9.5	13.5	Silty, Fine/V. Fine Sand
13.5	18.5	Medium to Fine Sand
18.5	23.5	Very Fine Sandy Silt
23.5	29	PWR
29	35	PWR

11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth From	Depth To	Diameter	Wall Thickness or Weight/Ft.	Material
	0	24 Ft.	2-inch	Sch. 40	PVC
		Ft.			
		Ft.			

13. GROUT:

Depth From	Depth To	Material	Method
0	20 Ft.	Neat Cement	Pour
20	22 Ft.	Bentonite	Pour

14. SCREEN:

Depth From	Depth To	Diameter	Slot Size	Material
24	34 Ft.	2-inch in.	0.01 in.	PVC
	Ft.	in.	in.	

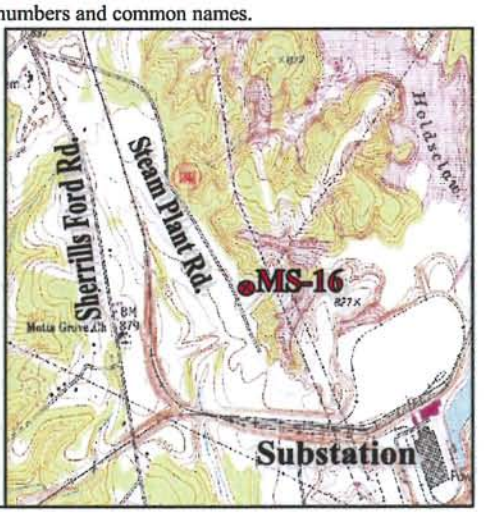
15. SAND/GRAVEL PACK:

Depth From	Depth To	Size	Material
22	34 Ft.	#1	Silica Sand
	Ft.		

16. REMARKS:

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



I DO HERE BY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

Larry W. Shrader 9-25-06

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

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128 Overhill Drive
Suite 105
Mooresville, NC 28117
Tel: 704.662.0100
Fax: 704.662.0101
www.wspsells.com

August 19, 2011

Duke Energy Corporation
Marshall Steam Station
8320 East NC Hwy 150
Terrell, NC 28682

Attention: Ms. Donna Burrell

SUBJECT: **MARSHALL FGD LANDFILL PERMIT MODIFICATION**
Catawba County, NC

Ladies and Gentlemen:

WSP SELLS has completed the permit modification drawings for the Marshall FGD Landfill. Please find attached two copies of the following drawings:

- Phasing Diagrams (PD-1 through PD-8)
- Cell 1 Leachate Collection & Removal System, Drawing No. MM6451.00-0003.001
- Cell 1 and Cell 2 Details, Drawing No. MM6451.00-0007.001
- Cell 1 Final Configuration, Drawing No. MM6451.00-0005.001
- Gas Venting System Plan, Drawing No. MM6451.00-0002.001
- Final Closure Details, Drawing No. MM6451.00-0001.001
- Erosion Control Details, Drawing No. MM6451.01-0004.001

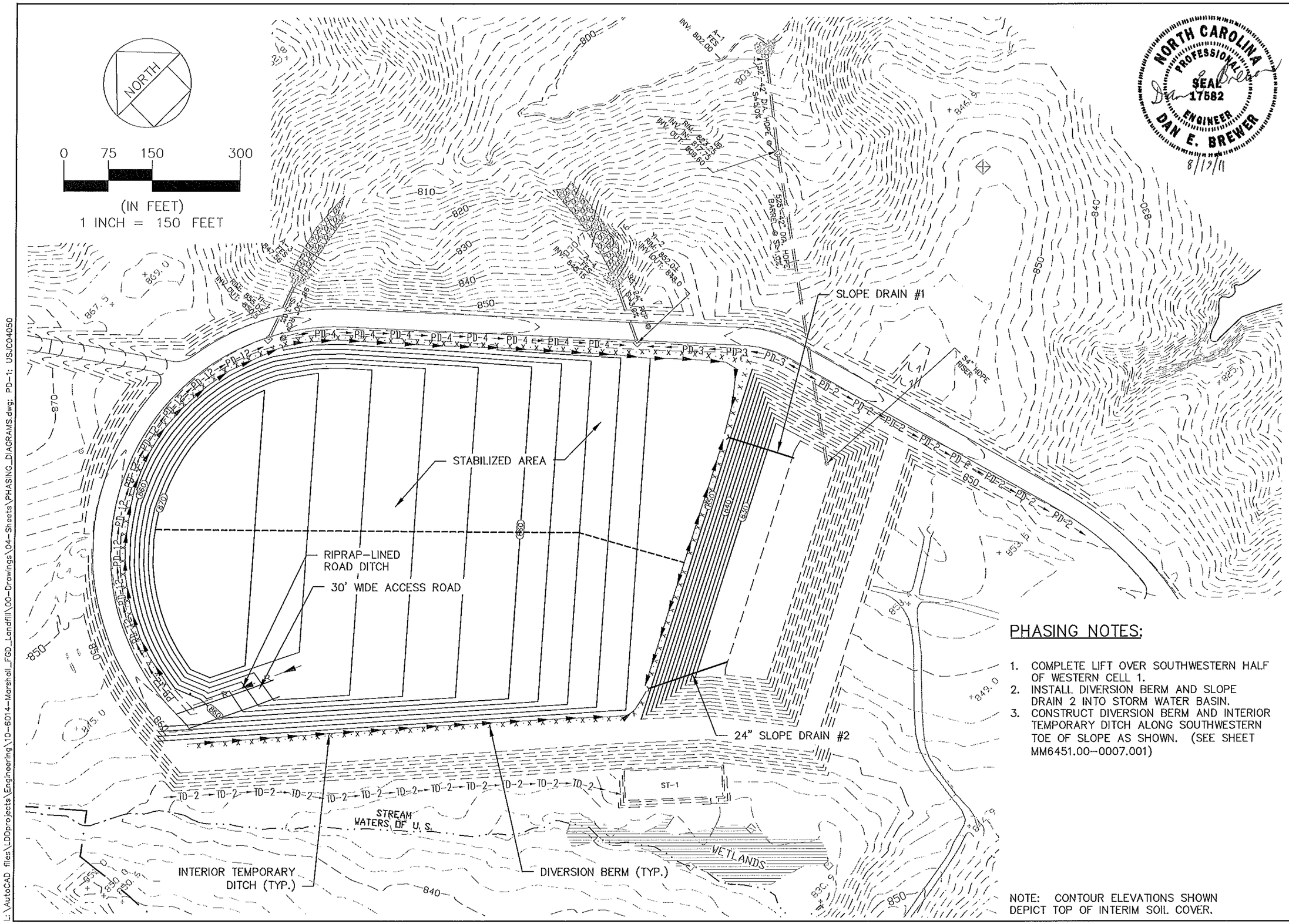
We appreciate the opportunity to be of service. Please contact us if you have any questions or need any additional information.

Sincerely,

WSP ▪ SELLS

Dan E. Brewer, P.E.
Vice President

Cc: Mr. William Miller, Altamont Environmental
Mr. Ed Sullivan, Duke Energy



PHASING NOTES:

1. COMPLETE LIFT OVER SOUTHWESTERN HALF OF WESTERN CELL 1.
2. INSTALL DIVERSION BERM AND SLOPE DRAIN 2 INTO STORM WATER BASIN.
3. CONSTRUCT DIVERSION BERM AND INTERIOR TEMPORARY DITCH ALONG SOUTHWESTERN TOE OF SLOPE AS SHOWN. (SEE SHEET MM6451.00-0007.001)

NOTE: CONTOUR ELEVATIONS SHOWN DEPICT TOP OF INTERIM SOIL COVER.

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MARSHALL STEAM STATION FGD RESIDUE LANDFILL

CATAWBA COUNTY, NC PERMIT NO. 18-09

DUKE ENERGY CAROLINAS, LLC
526 SOUTH CHURCH STREET
CHARLOTTE, NC, 28202

REVISIONS

8/12/11	UPDATED FOR CELL 1

PROJECT #: 10-6014 DATE: 8-12-11
DRAWN BY: JAC CHECKED BY: DEB

TITLE
PHASING PLAN

SHEET
PD-1

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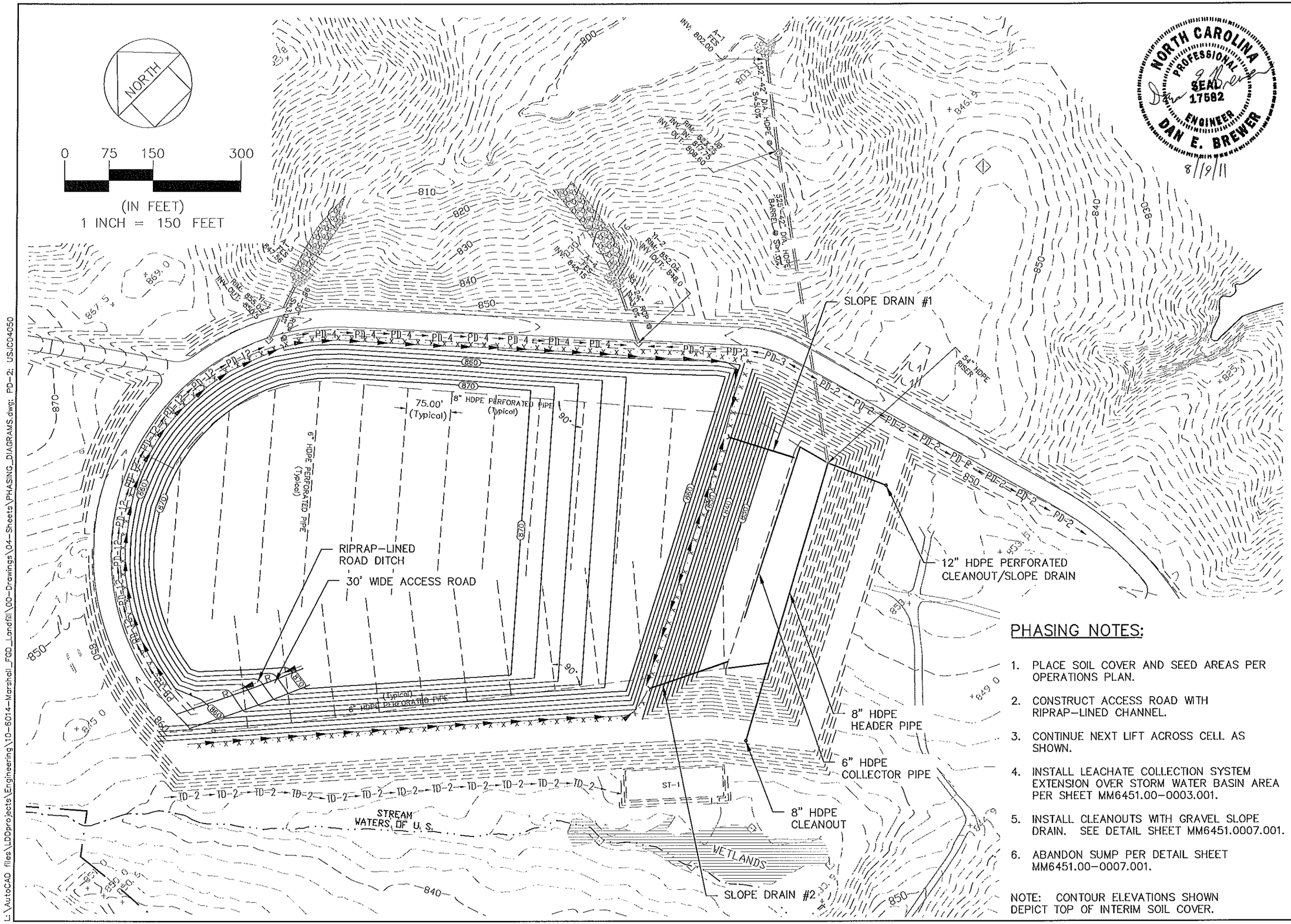

PHASING NOTES:

1. PLACE SOIL COVER AND SEED AREAS PER OPERATIONS PLAN.
2. CONSTRUCT ACCESS ROAD WITH RIPRAP-LINED CHANNEL.
3. CONTINUE NEXT LIFT ACROSS CELL AS SHOWN.
4. INSTALL LEACHATE COLLECTION SYSTEM EXTENSION OVER STORM WATER BASIN AREA PER SHEET MM6451.00-0003.001.
5. INSTALL CLEANOUTS WITH GRAVEL SLOPE DRAIN. SEE DETAIL SHEET MM6451.0007.001.
6. ABANDON SUMP PER DETAIL SHEET MM6451.00-0007.001.

NOTE: CONTOUR ELEVATIONS SHOWN DEPICT TOP OF INTERIM SOIL COVER.

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REVISIONS	
8/19/11	UPDATED FOR CELL 1

PROJECT #: 10-6014 DATE: 8-12-11
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TITLE
PHASING PLAN

SHEET
PD-2

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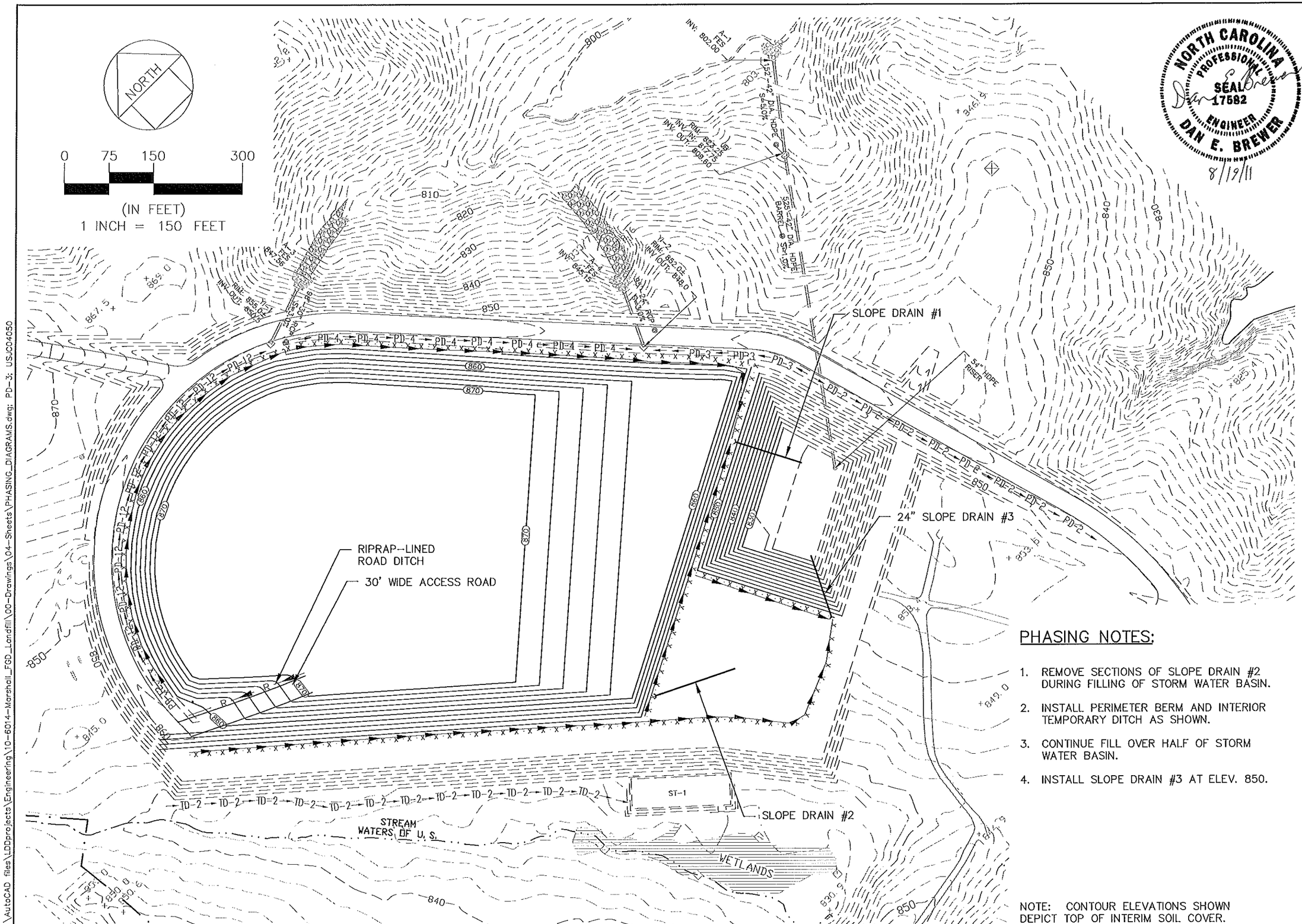

PHASING NOTES:

1. REMOVE SECTIONS OF SLOPE DRAIN #2 DURING FILLING OF STORM WATER BASIN.
2. INSTALL PERIMETER BERM AND INTERIOR TEMPORARY DITCH AS SHOWN.
3. CONTINUE FILL OVER HALF OF STORM WATER BASIN.
4. INSTALL SLOPE DRAIN #3 AT ELEV. 850.

NOTE: CONTOUR ELEVATIONS SHOWN DEPICT TOP OF INTERIM SOIL COVER.

NORTH CAROLINA PROFESSIONAL SEAL 17582 ENGINEER DAN E. BREWER
8/19/11

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8/19/11	UPDATED FOR CELL 1

PROJECT #: 10-6014 DATE: 8-12-11
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TITLE
PHASING PLAN

SHEET
PD-3

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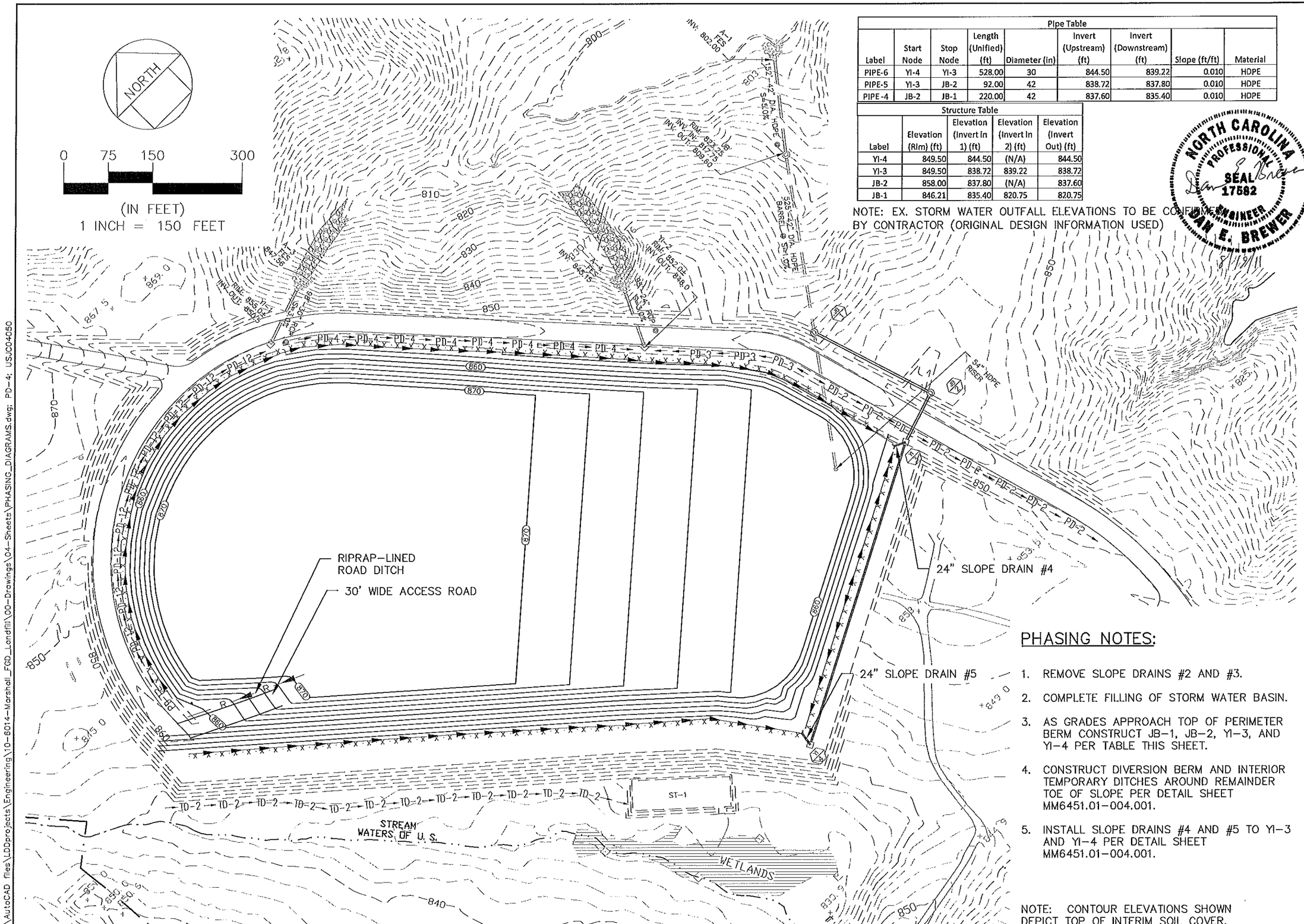

Pipe Table								
Label	Start Node	Stop Node	Length (Unified) (ft)	Diameter (in)	Invert (Upstream) (ft)	Invert (Downstream) (ft)	Slope (ft/ft)	Material
PIPE-6	YI-4	YI-3	528.00	30	844.50	839.22	0.010	HDPE
PIPE-5	YI-3	JB-2	92.00	42	838.72	837.80	0.010	HDPE
PIPE-4	JB-2	JB-1	220.00	42	837.60	835.40	0.010	HDPE

Structure Table				
Label	Elevation (Rim) (ft)	Elevation (Invert In 1) (ft)	Elevation (Invert In 2) (ft)	Elevation (Invert Out) (ft)
YI-4	849.50	844.50	(N/A)	844.50
YI-3	849.50	838.72	839.22	838.72
JB-2	858.00	837.80	(N/A)	837.60
JB-1	846.21	835.40	820.75	820.75

NOTE: EX. STORM WATER OUTFALL ELEVATIONS TO BE CONFIRMED BY CONTRACTOR (ORIGINAL DESIGN INFORMATION USED)

NORTH CAROLINA PROFESSIONAL SEAL 17582 ENGINEER JOAN E. BREWER

PHASING NOTES:

1. REMOVE SLOPE DRAINS #2 AND #3.
2. COMPLETE FILLING OF STORM WATER BASIN.
3. AS GRADES APPROACH TOP OF PERIMETER BERM CONSTRUCT JB-1, JB-2, YI-3, AND YI-4 PER TABLE THIS SHEET.
4. CONSTRUCT DIVERSION BERM AND INTERIOR TEMPORARY DITCHES AROUND REMAINDER TOE OF SLOPE PER DETAIL SHEET MM6451.01-004.001.
5. INSTALL SLOPE DRAINS #4 AND #5 TO YI-3 AND YI-4 PER DETAIL SHEET MM6451.01-004.001.

NOTE: CONTOUR ELEVATIONS SHOWN DEPICT TOP OF INTERIM SOIL COVER.

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MARSHALL STEAM STATION FGD RESIDUE LANDFILL

CATAWBA COUNTY, NC PERMIT NO. 18-09

DUKE ENERGY CAROLINAS, LLC
526 SOUTH CHURCH STREET
CHARLOTTE, NC 28202

REVISIONS	
8/19/21	UPDATED FOR CELL 1

PROJECT #: 10-6014 DATE: 8-12-11
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TITLE
PHASING PLAN

SHEET
PD-4

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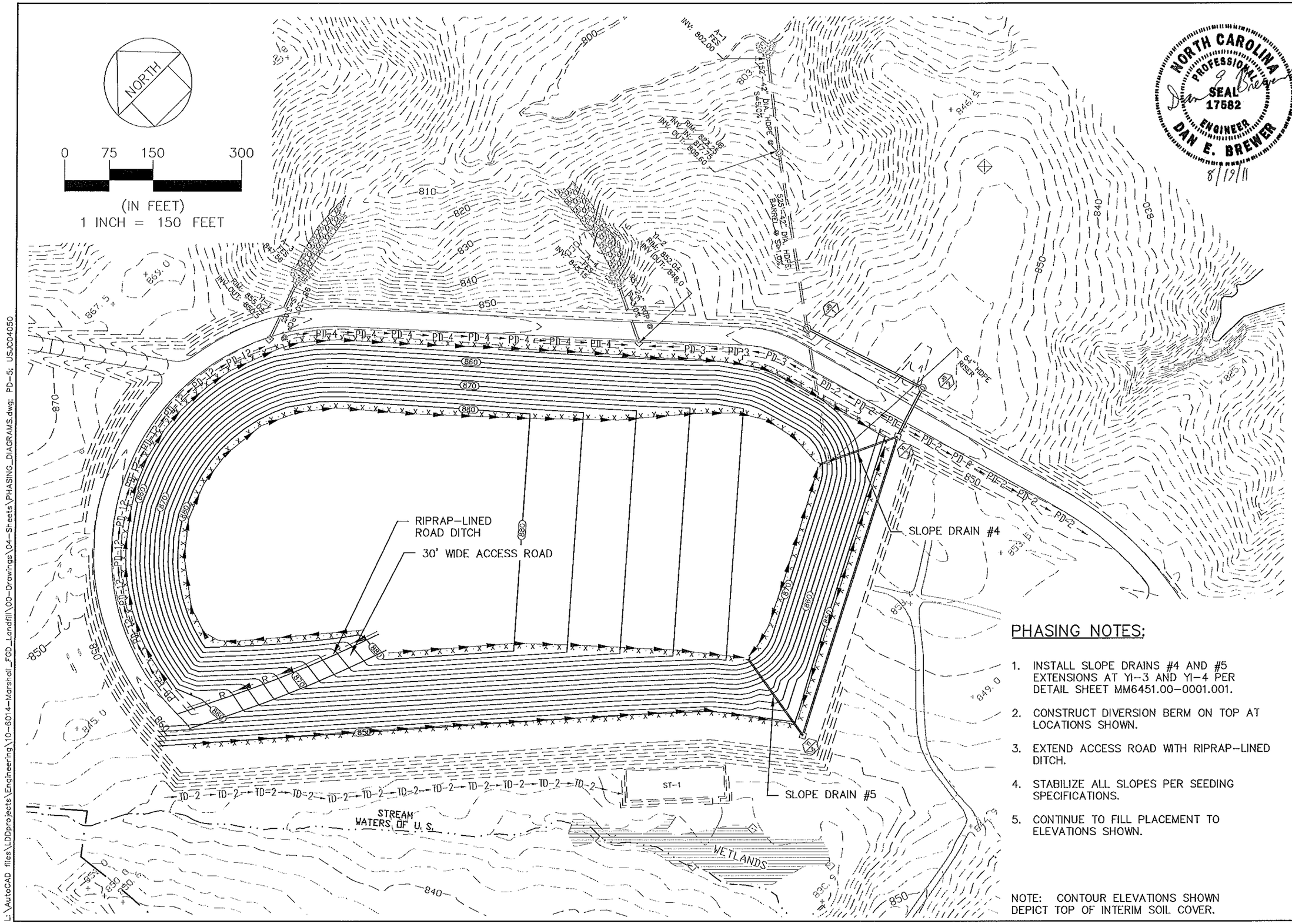

PHASING NOTES:

1. INSTALL SLOPE DRAINS #4 AND #5 EXTENSIONS AT Y1-3 AND Y1-4 PER DETAIL SHEET MM6451.00-0001.001.
2. CONSTRUCT DIVERSION BERM ON TOP AT LOCATIONS SHOWN.
3. EXTEND ACCESS ROAD WITH RIPRAP-LINED DITCH.
4. STABILIZE ALL SLOPES PER SEEDING SPECIFICATIONS.
5. CONTINUE TO FILL PLACEMENT TO ELEVATIONS SHOWN.

NOTE: CONTOUR ELEVATIONS SHOWN DEPICT TOP OF INTERIM SOIL COVER.

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TITLE
PHASING PLAN

SHEET
PD-5

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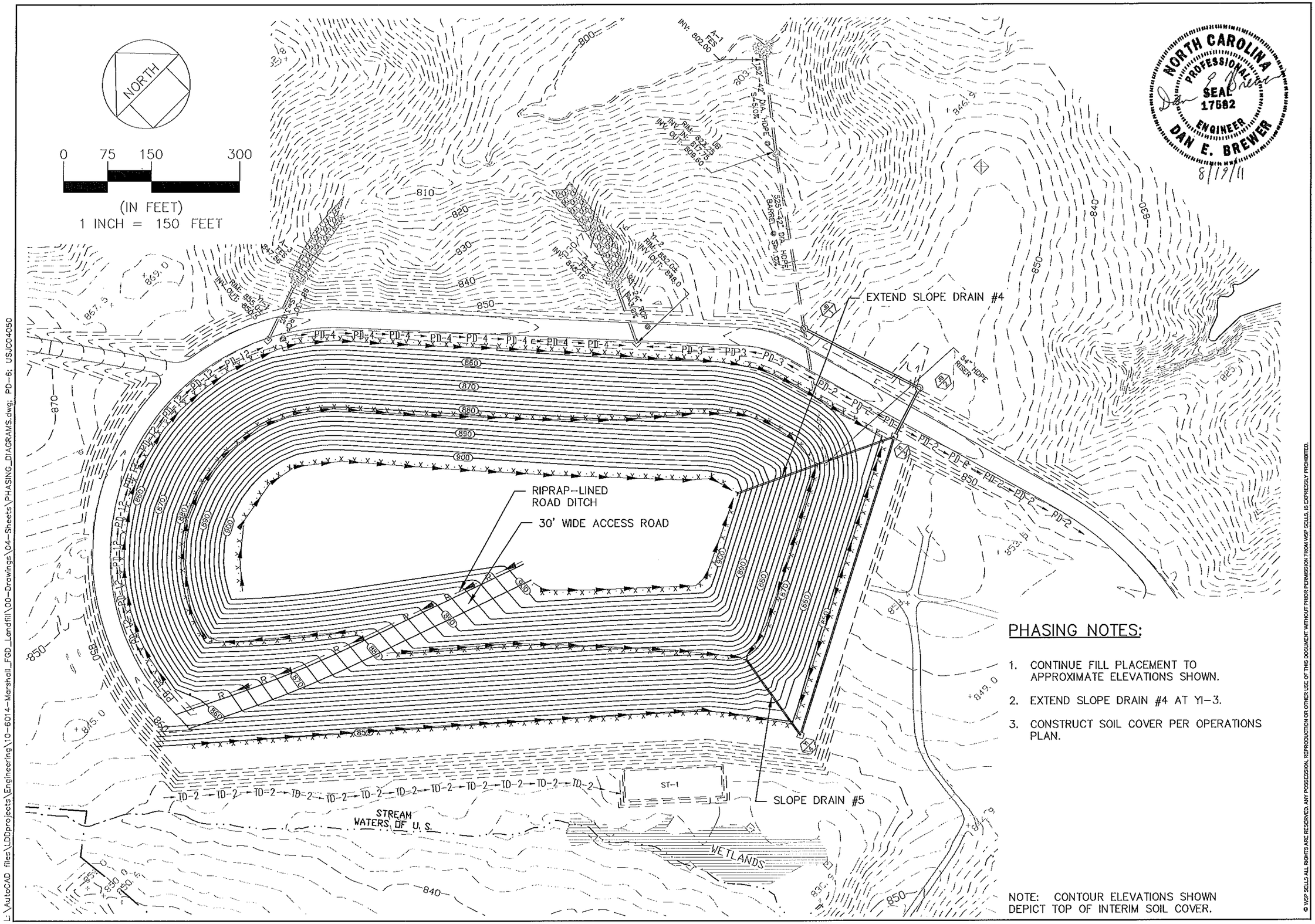

PHASING NOTES:

1. CONTINUE FILL PLACEMENT TO APPROXIMATE ELEVATIONS SHOWN.
2. EXTEND SLOPE DRAIN #4 AT YI-3.
3. CONSTRUCT SOIL COVER PER OPERATIONS PLAN.

NOTE: CONTOUR ELEVATIONS SHOWN DEPICT TOP OF INTERIM SOIL COVER.

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TITLE
PHASING PLAN

SHEET
PD-6

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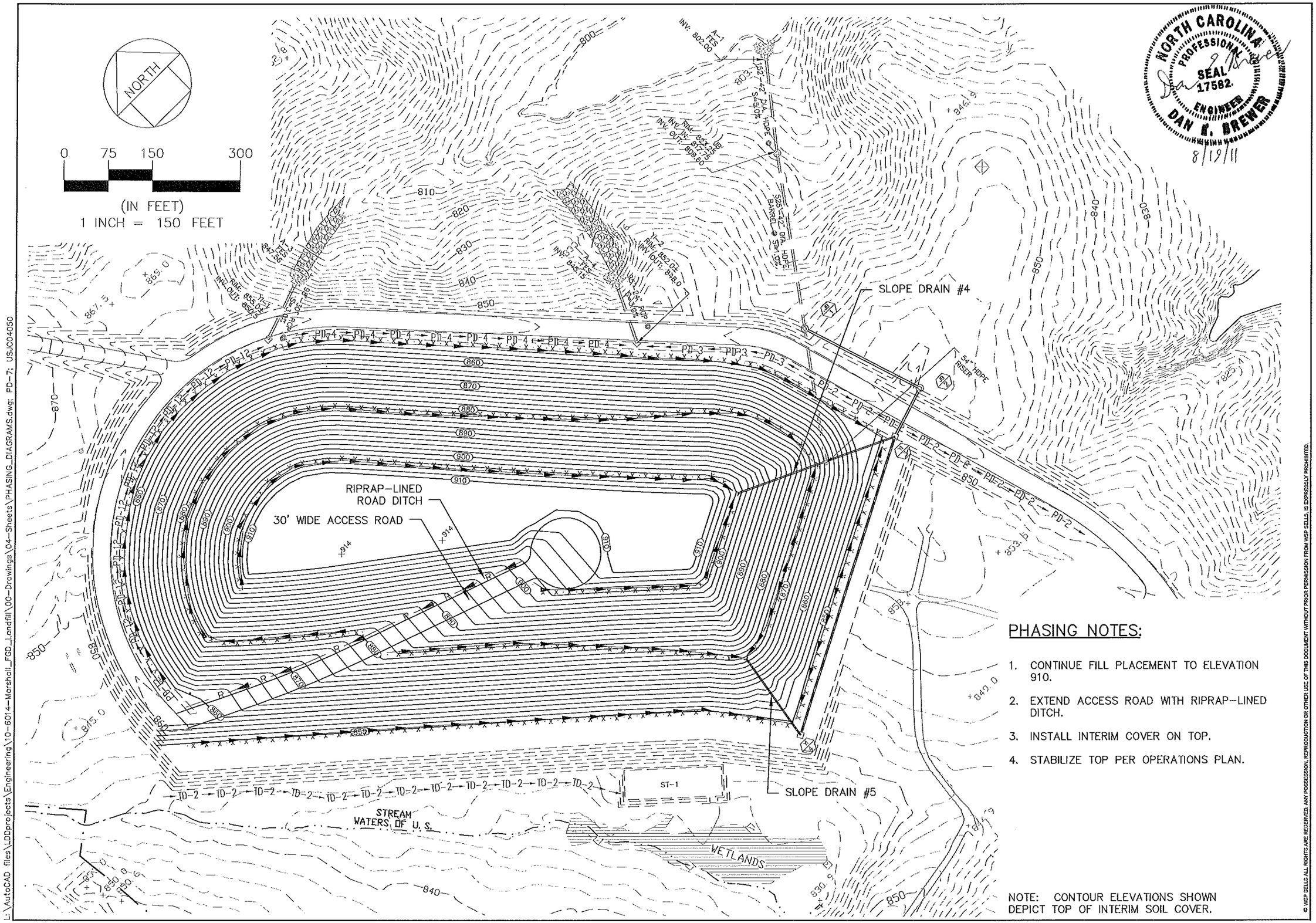

PHASING NOTES:

1. CONTINUE FILL PLACEMENT TO ELEVATION 910.
2. EXTEND ACCESS ROAD WITH RIPRAP-LINED DITCH.
3. INSTALL INTERIM COVER ON TOP.
4. STABILIZE TOP PER OPERATIONS PLAN.

NOTE: CONTOUR ELEVATIONS SHOWN DEPICT TOP OF INTERIM SOIL COVER.

NORTH CAROLINA PROFESSIONAL SEAL 17582 ENGINEER DAN F. BREWER 8/19/11

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MARSHALL STEAM STATION FGD RESIDUE LANDFILL

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DRAWN BY: JAC CHECKED BY: DEB

TITLE
PHASING PLAN

SHEET
PD-7

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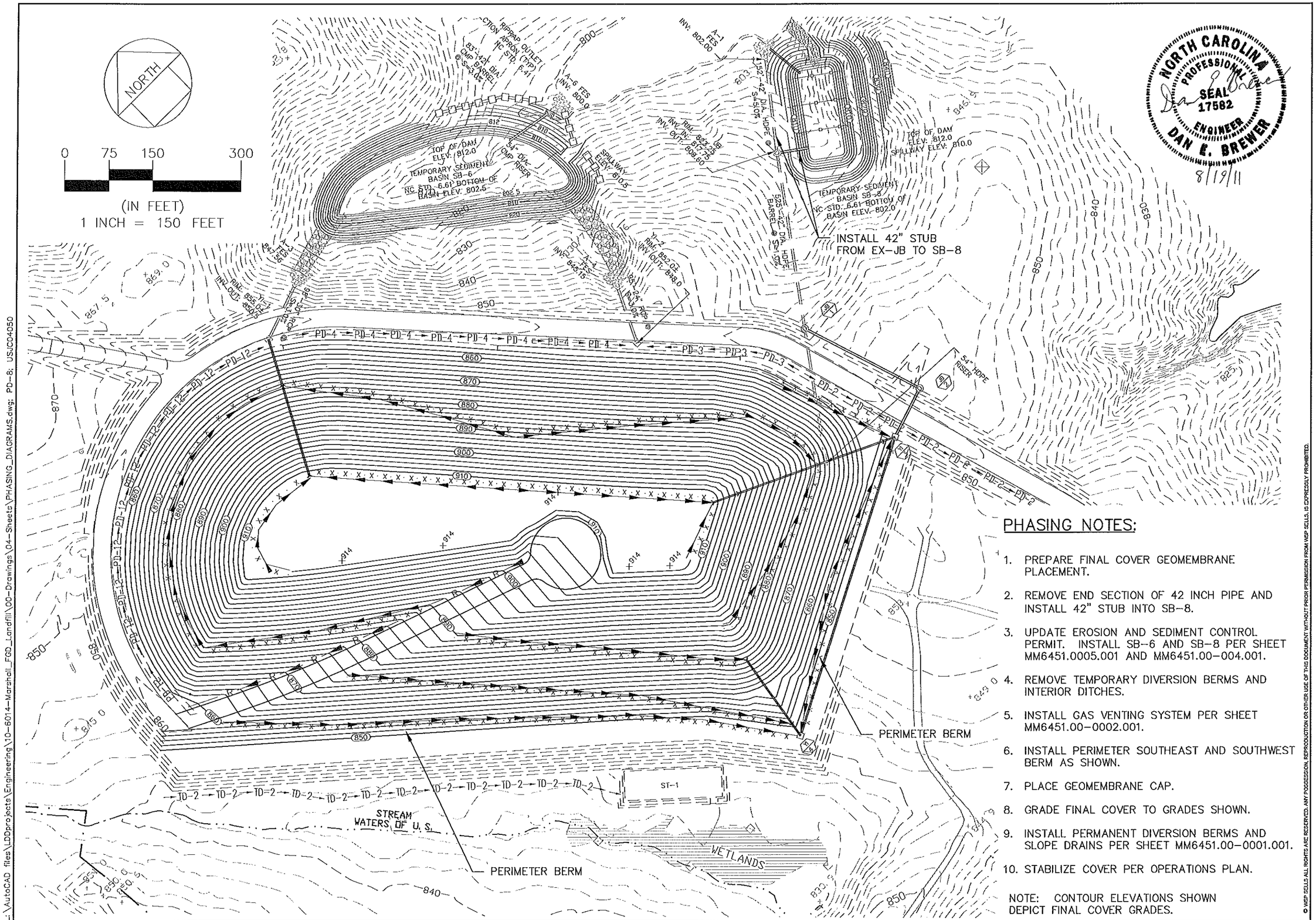

PHASING NOTES:

1. PREPARE FINAL COVER GEOMEMBRANE PLACEMENT.
2. REMOVE END SECTION OF 42 INCH PIPE AND INSTALL 42" STUB INTO SB-8.
3. UPDATE EROSION AND SEDIMENT CONTROL PERMIT. INSTALL SB-6 AND SB-8 PER SHEET MM6451.0005.001 AND MM6451.00-004.001.
4. REMOVE TEMPORARY DIVERSION BERMS AND INTERIOR DITCHES.
5. INSTALL GAS VENTING SYSTEM PER SHEET MM6451.00-0002.001.
6. INSTALL PERIMETER SOUTHEAST AND SOUTHWEST BERM AS SHOWN.
7. PLACE GEOMEMBRANE CAP.
8. GRADE FINAL COVER TO GRADES SHOWN.
9. INSTALL PERMANENT DIVERSION BERMS AND SLOPE DRAINS PER SHEET MM6451.00-0001.001.
10. STABILIZE COVER PER OPERATIONS PLAN.

NOTE: CONTOUR ELEVATIONS SHOWN DEPICT FINAL COVER GRADES.

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CATAWBA COUNTY, NC PERMIT NO. 18-09

DUKE ENERGY CAROLINAS, LLC
526 SOUTH CHURCH STREET
CHARLOTTE, NC, 28202

REVISIONS	
8/19/11	UPDATED FOR CELL 1

PROJECT # 10-6014 DATE: 8-12-11
DRAWN BY: JAC CHECKED BY: DEB

TITLE
CELL 1
FINAL CLOSURE

SHEET
PD-8

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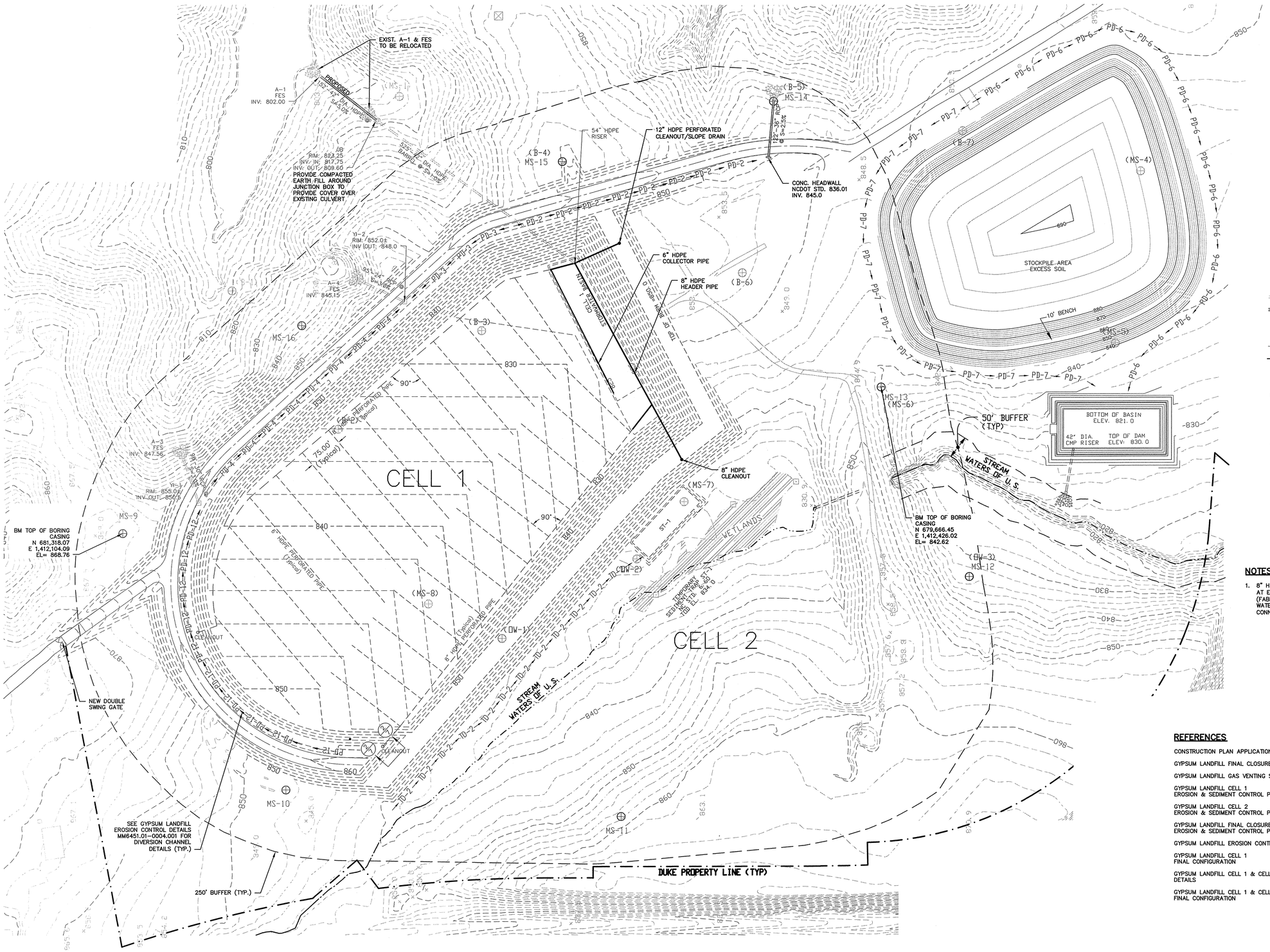

NORTH

0 50 100 200

(IN FEET)
1 INCH = 100 FEET

LEGEND

- = EXISTING STORM PIPE
- = PROPOSED STORM PIPE
- YI = PROPOSED YARD INLET
- A-1 = RIPRAP OUTLET PROTECTION APRON
- 640 = EXISTING GRADE CONTOUR
- 640 = PROPOSED FINISHED CONTOUR
- FES = FLARED END SECTION
- TD = TEMPORARY DIVERSION CHANNEL
- PD = PERMANENT DIVERSION CHANNEL
- ST-1 = TEMPORARY SEDIMENT TRAP
- SB-1 = TEMPORARY SEDIMENT BASIN
- = TEMPORARY SEDIMENT FENCE
- = LIMITS OF CONSTRUCTION
- = INLET PROTECTION

NOTES:

1. 8" HDPE PERFORATED PIPE. DAYLIGHT PIPE AT ELEVATION 826' TO DRAIN TO BASIN. (FABRICATE TEE TO DRAIN TO STORM WATER BASIN. CAP END OF PIPE TO BE CONNECTED TO CELL 2 LCRS.)

REFERENCES

CONSTRUCTION PLAN APPLICATION	MM6451.00-0000.001
GYPSUM LANDFILL FINAL CLOSURE DETAILS	MM6451.00-0001.001
GYPSUM LANDFILL GAS VENTING SYSTEM PLAN	MM6451.00-0002.001
GYPSUM LANDFILL CELL 1 EROSION & SEDIMENT CONTROL PLAN	MM6451.01-0001.001
GYPSUM LANDFILL CELL 2 EROSION & SEDIMENT CONTROL PLAN	MM6451.01-0002.001
GYPSUM LANDFILL FINAL CLOSURE EROSION & SEDIMENT CONTROL PLAN	MM6451.01-0003.001
GYPSUM LANDFILL EROSION CONTROL DETAILS	MM6451.01-0004.001
GYPSUM LANDFILL CELL 1 FINAL CONFIGURATION	MM6451.00-0005.001
GYPSUM LANDFILL CELL 1 & CELL 2 DETAILS	MM6451.00-0007.001
GYPSUM LANDFILL CELL 1 & CELL 2 FINAL CONFIGURATION	MM6451.00-0013.001

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CATAWBA COUNTY, NC

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NO	BY	DATE	REVISION
1	JAC	8/19/11	UPDATED FOR CELL 1 FINAL CLOSURE, ADDED FINAL ES&C
A	DEB	12/15/05	ISSUED FOR CPA

PROJECT #: 10-6014 DATE: 12/15/05

DRAWN BY: JAC CHECKED BY: DEB

TITLE
CELL 1
LEACHATE COLLECTION AND REMOVAL SYSTEM

SHEET

DOCUMENT NO: MM6451.00-0003.001

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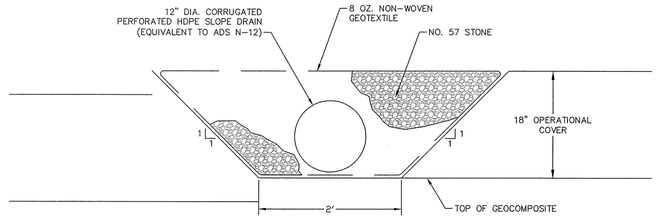
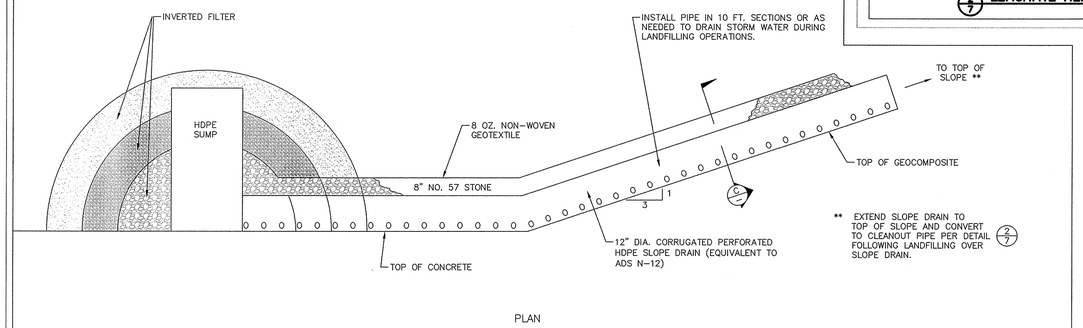
ERN: FHS00770

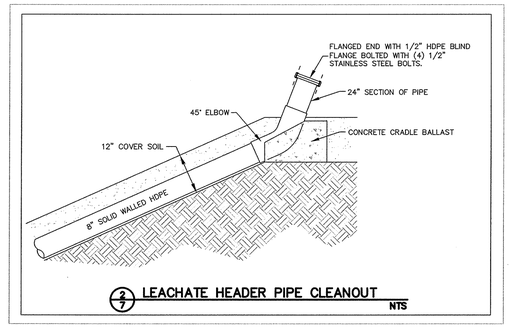


SECTION C-C



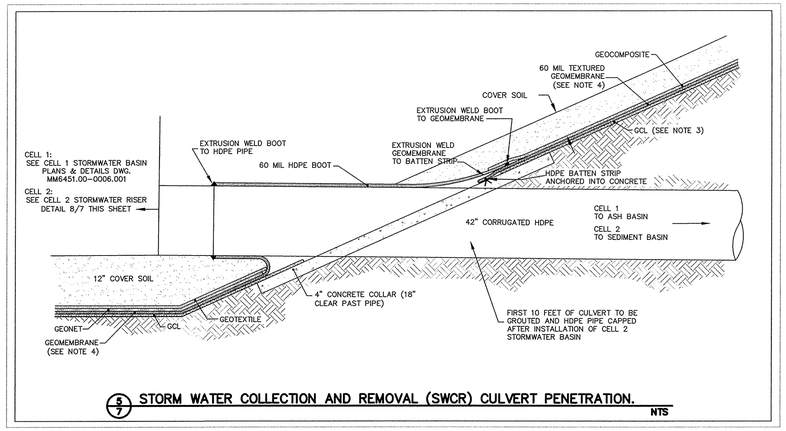
PLAN

CELL 1 INTERIOR SLOPE DRAIN TO SUMP



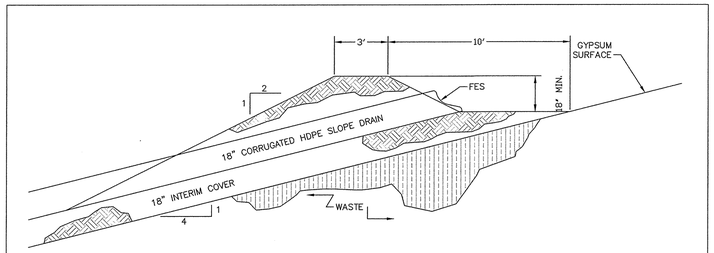
2/7 LEACHATE HEADER PIPE CLEANOUT

NTS



5/7 STORM WATER COLLECTION AND REMOVAL (SWCR) CULVERT PENETRATION.

NTS



TEMPORARY DIVERSION BERM

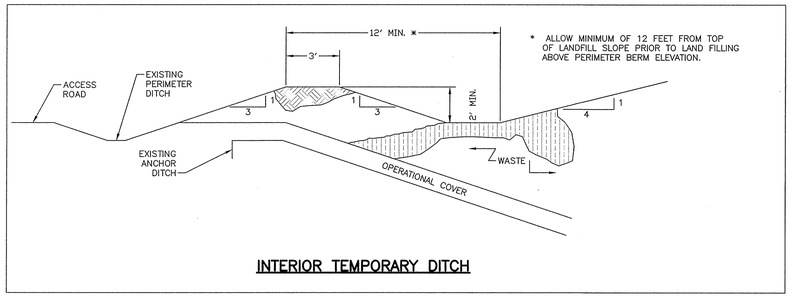
NOTES:

1) REFER TO CONSTRUCTION PLAN APPLICATION MM6451.01-0000.001 FOR MATERIALS AND CONSTRUCTION REQUIREMENTS.

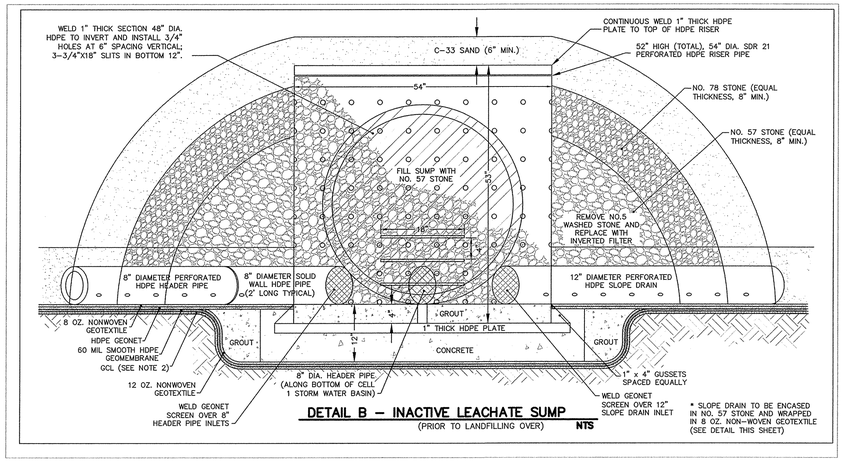
2) GCL ON BOTTOM SURFACE OF LANDFILL SHALL BE CLAYMAX 600 CL OR EQUIVALENT.

3) GCL ON SLOPES SHALL REINFORCED GCL EQUIVALENT TO BE BENTOMAT DN. REINFORCED GCL SHALL EXTEND 10 FEET PAST THE TOE OF SLOPE, ONTO THE LANDFILL FLOOR.

4) TEXTURED 60MIL HDPE GEOMEMBRANE SHALL BE USED ON THE SIDE SLOPES. THE TEXTURED GEOMEMBRANE SHALL EXTEND 10 FEET PAST THE TOE OF THE SLOPE, ONTO THE LANDFILL FLOOR.



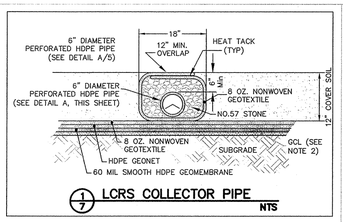
INTERIOR TEMPORARY DITCH



DETAIL B – INACTIVE LEACHATE SUMP

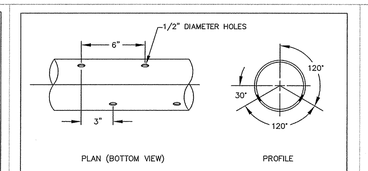
(PRIOR TO LANDFILLING OVER)

NTS



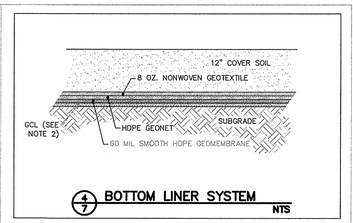
1/7 LCRS COLLECTOR PIPE

NTS



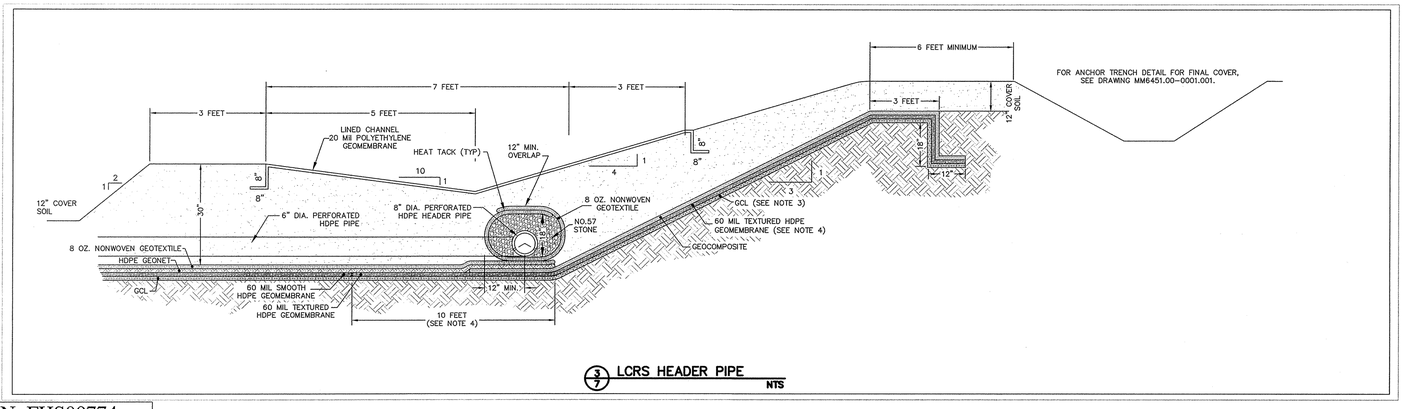
DETAIL A (LEACHATE PIPE PERFORATIONS)

NTS



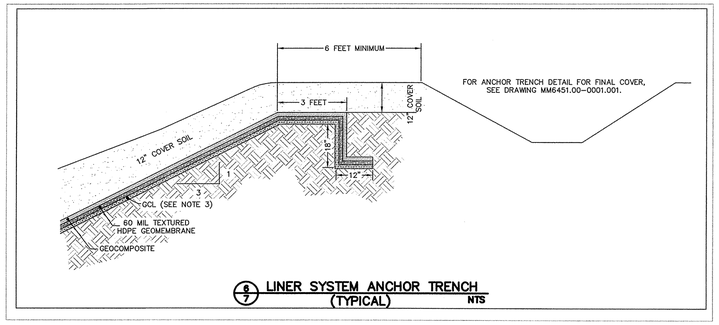
4/7 BOTTOM LINER SYSTEM

NTS



3/7 LCRS HEADER PIPE

NTS



6/7 LINER SYSTEM ANCHOR TRENCH (TYPICAL)

NTS

ERN: FHS00774

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CHARLOTTE, NC 28202

NO.	BY	DATE	REVISION
1	JAC	8/19/11	UPDATED FOR CELL 1 FINAL CLOSURE, ADDED FINAL ES&C
D	DEB	9/11/06	REVISED DETAIL 3/7
C	DEB	7/17/06	ISSUED FOR CONSTRUCTION, REVISED DETAILS AS NOTED
B	DEB	1/24/04	REVISED FOR DENR COMMENTS
A	DEB	12/15/05	ISSUED FOR CPA

PROJECT #: 10-6014 DATE: 12/15/05

DRAWN BY: JAC CHECKED BY: DEB

TITLE
CELL 1 AND CELL 2 DETAILS

SHEET

DOCUMENT NO: MM6451.00-0007.001

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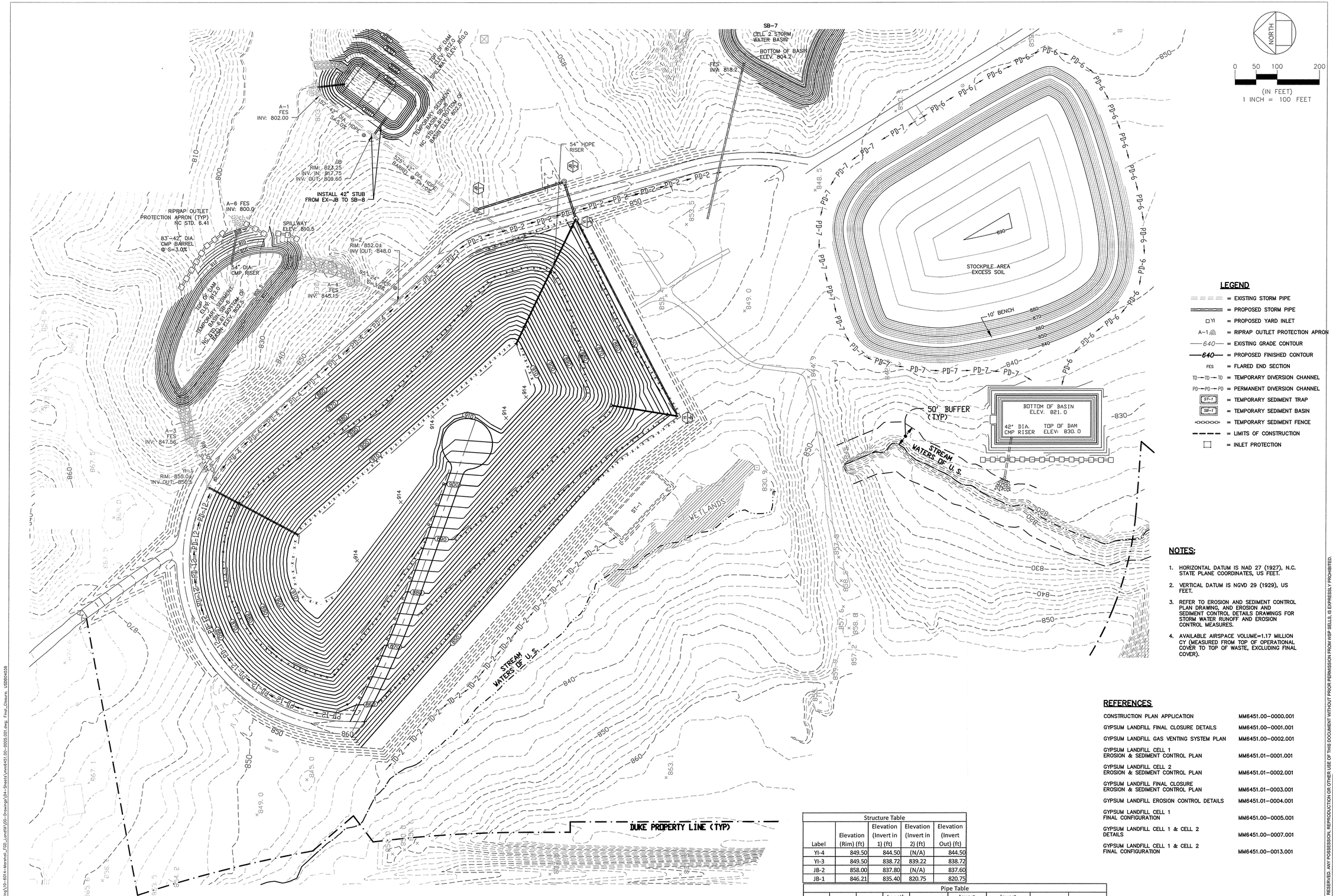

LEGEND

- = EXISTING STORM PIPE
- = PROPOSED STORM PIPE
- YI = PROPOSED YARD INLET
- A-1 = RIPRAP OUTLET PROTECTION APRON
- 640 = EXISTING GRADE CONTOUR
- 640 = PROPOSED FINISHED CONTOUR
- FES = FLARED END SECTION
- TD = TEMPORARY DIVERSION CHANNEL
- PD = PERMANENT DIVERSION CHANNEL
- ST-1 = TEMPORARY SEDIMENT TRAP
- SB-1 = TEMPORARY SEDIMENT BASIN
- = TEMPORARY SEDIMENT FENCE
- = LIMITS OF CONSTRUCTION
- = INLET PROTECTION

NOTES:

1. HORIZONTAL DATUM IS NAD 27 (1927), N.C. STATE PLANE COORDINATES, US FEET.
2. VERTICAL DATUM IS NGVD 29 (1929), US FEET.
3. REFER TO EROSION AND SEDIMENT CONTROL PLAN DRAWING, AND EROSION AND SEDIMENT CONTROL DETAILS DRAWINGS FOR STORM WATER RUNOFF AND EROSION CONTROL MEASURES.
4. AVAILABLE AIRSPACE VOLUME=1.17 MILLION CY (MEASURED FROM TOP OF OPERATIONAL COVER TO TOP OF WASTE, EXCLUDING FINAL COVER).

REFERENCES

CONSTRUCTION PLAN APPLICATION	MM6451.00-0000.001
GYPSUM LANDFILL FINAL CLOSURE DETAILS	MM6451.00-0001.001
GYPSUM LANDFILL GAS VENTING SYSTEM PLAN	MM6451.00-0002.001
GYPSUM LANDFILL CELL 1 EROSION & SEDIMENT CONTROL PLAN	MM6451.01-0001.001
GYPSUM LANDFILL CELL 2 EROSION & SEDIMENT CONTROL PLAN	MM6451.01-0002.001
GYPSUM LANDFILL FINAL CLOSURE EROSION & SEDIMENT CONTROL PLAN	MM6451.01-0003.001
GYPSUM LANDFILL EROSION CONTROL DETAILS	MM6451.01-0004.001
GYPSUM LANDFILL CELL 1 FINAL CONFIGURATION	MM6451.00-0005.001
GYPSUM LANDFILL CELL 1 & CELL 2 DETAILS	MM6451.00-0007.001
GYPSUM LANDFILL CELL 1 & CELL 2 FINAL CONFIGURATION	MM6451.00-0013.001

Structure Table

Label	Elevation (Rim) (ft)	Elevation (Invert in 1) (ft)	Elevation (Invert in 2) (ft)	Elevation (Invert Out) (ft)
YI-4	849.50	844.50	(N/A)	844.50
YI-3	849.50	838.72	839.22	838.72
JB-2	858.00	837.80	(N/A)	837.60
JB-1	846.21	835.40	820.75	820.75

Pipe Table

Label	Start Node	Stop Node	Length (Unified) (ft)	Diameter (in)	Invert (Upstream) (ft)	Invert (Downstream) (ft)	Slope (ft/ft)	Material
PIPE-6	YI-4	YI-3	528.00	30	844.50	839.22	0.010	HDPE
PIPE-5	YI-3	JB-2	92.00	42	838.72	837.80	0.010	HDPE
PIPE -4	JB-2	JB-1	220.00	42	837.60	835.40	0.010	HDPE

NOTE: EX. STORM WATER OUTFALL ELEVATIONS TO BE CONFIRMED BY CONTRACTOR (ORIGINAL DESIGN INFORMATION USED)

ERN: FHS00772

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CATAWBA COUNTY, NC

DUKE ENERGY CAROLINAS, LLC
526 SOUTH CHURCH STREET
CHARLOTTE, NC 28202

NO.	BY	DATE	REVISION
1	JAC	8/19/11	UPDATED FOR CELL 1 FINAL CLOSURE, ADD FINAL ES&C, NOTE 4
A	DEB	12/15/05	ISSUED FOR CPA

PROJECT #: 10-6014 DATE: 12/15/05

DRAWN BY: JAC CHECKED BY: DEB

TITLE
CELL 1
FINAL CONFIGURATION

SHEET

DOCUMENT NO: MM6451.00-0005.001

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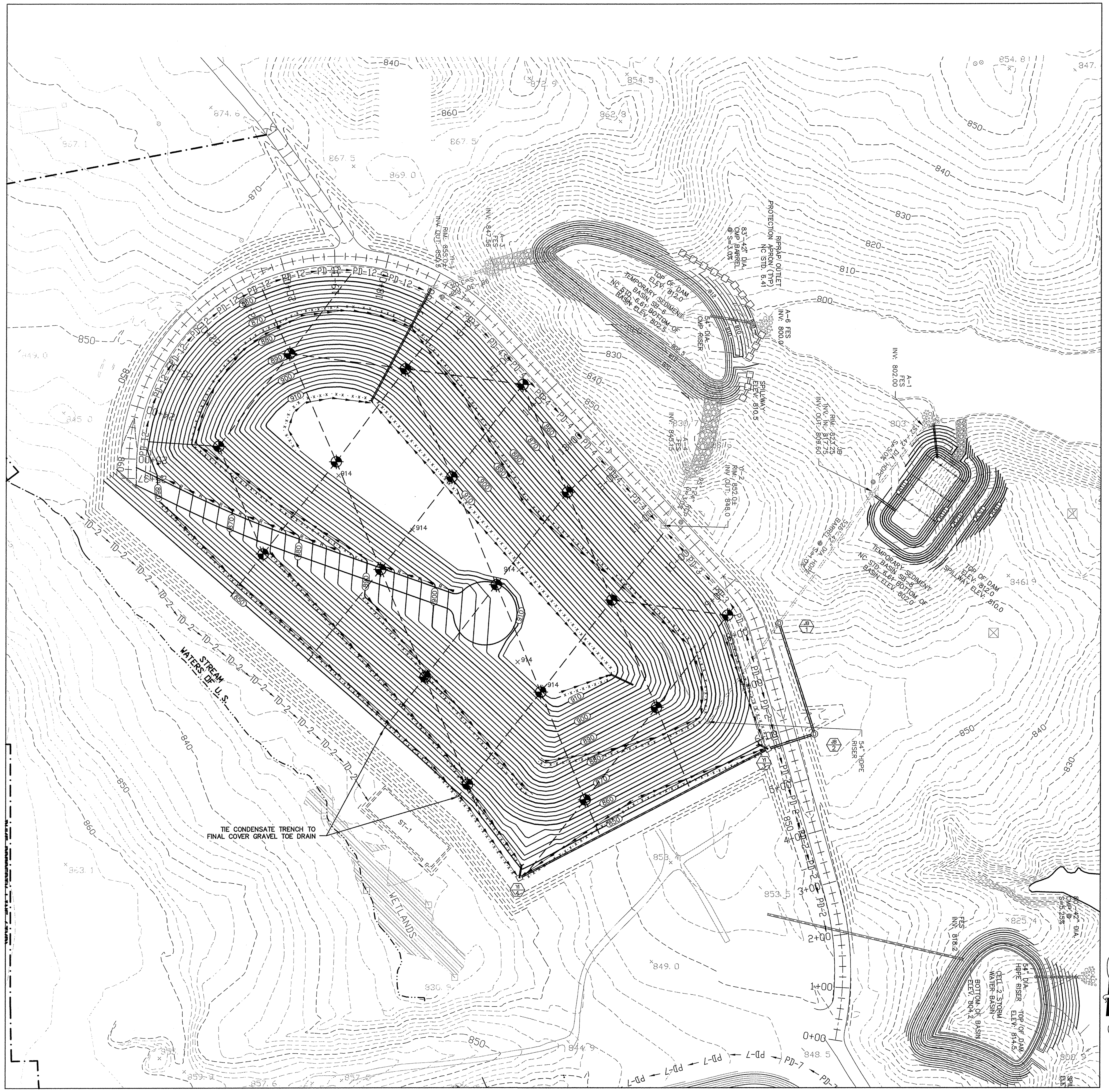
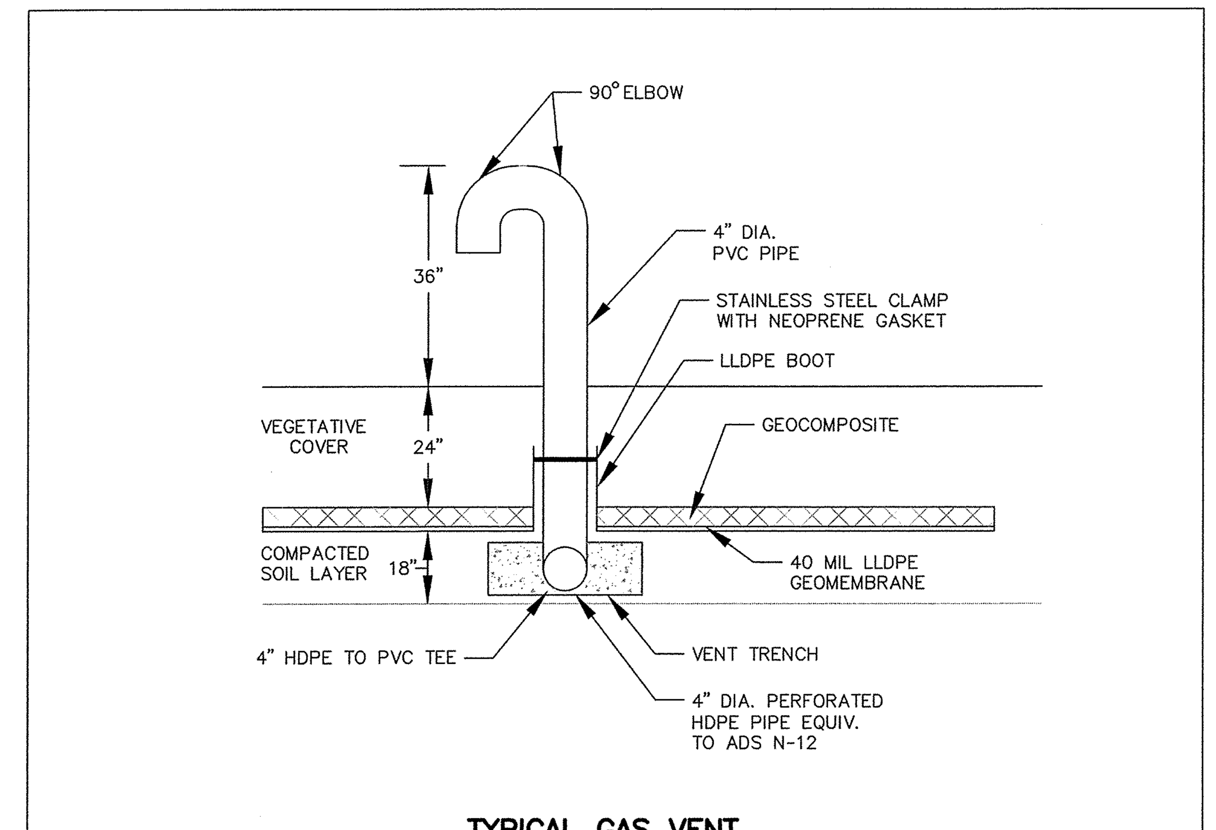
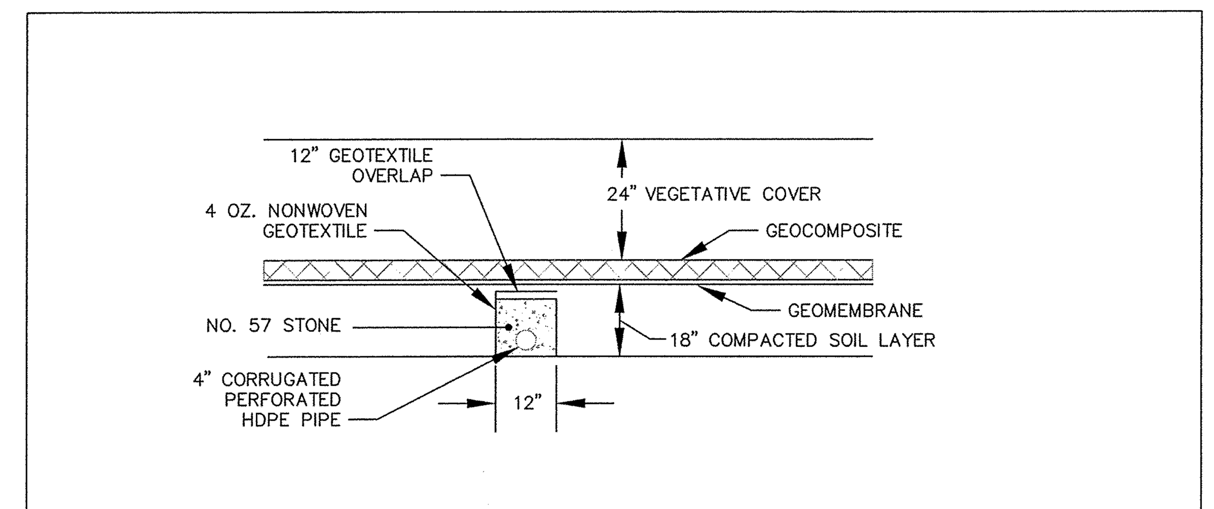


GRAPHIC SCALE

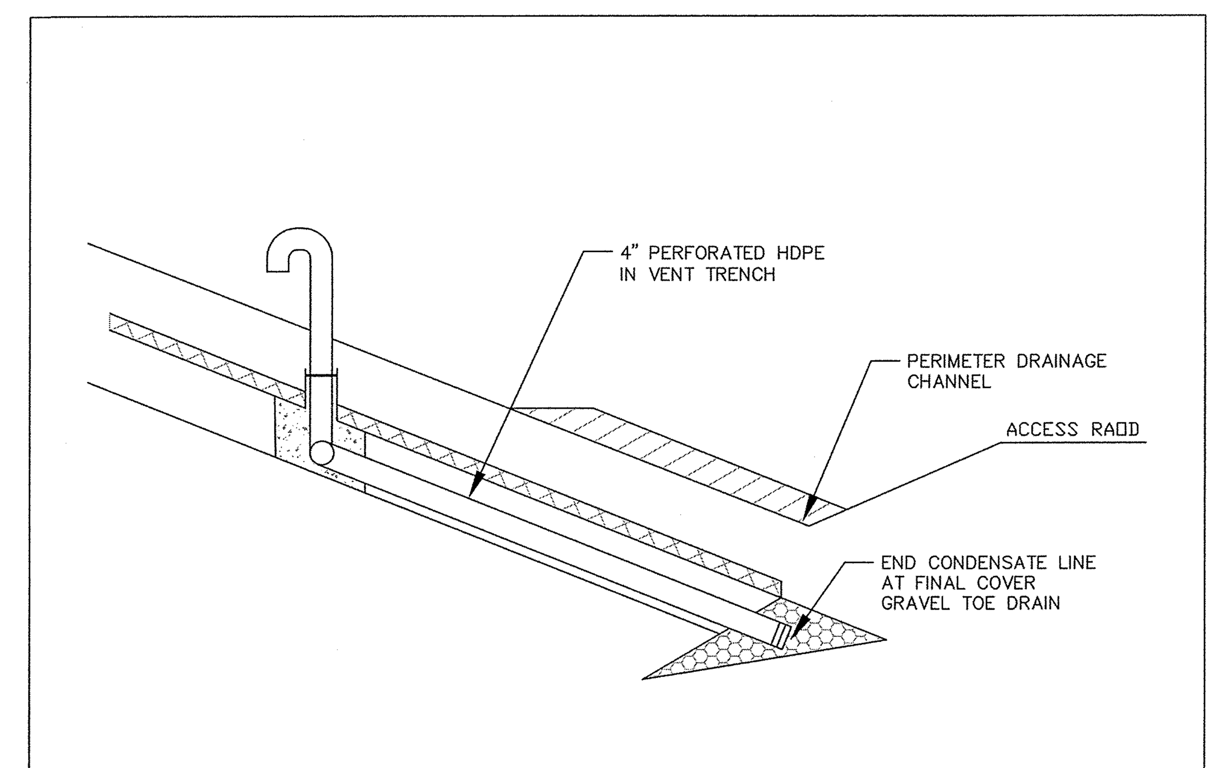
(IN FEET)
1 inch = 100 ft.



TYPICAL GAS VENT
NTS



GAS VENTING TRENCH
NTS



GAS CONDENSATE LINE
NTS

LEGEND:

- GAS VENT
- GAS VENTING TRENCH
- CONDENSATE LINE

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CHARLOTTE, NC 28202

NO.	BY	DATE	REVISION
1	JAC	8/19/11	UPDATED FOR CELL 1 FINAL CLOSURE, ADDED FINAL ES&C
B	DEB	3/26/04	ISSUED FOR PERMIT REVIEW
A	DEB	3/24/04	ISSUED FOR DUKE REVIEW

PROJECT #: 10-6014 DATE: 3/24/04
DRAWN BY: JAC CHECKED BY: DEB

TITLE
GAS VENTING SYSTEM PLAN

SHEET

DOCUMENT NO:
MM6451.00-0002.001

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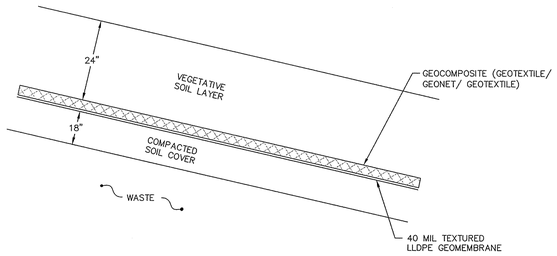
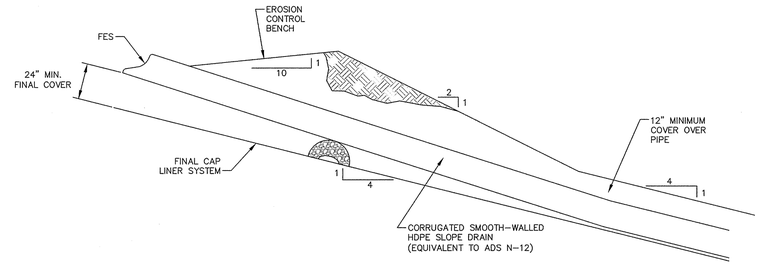
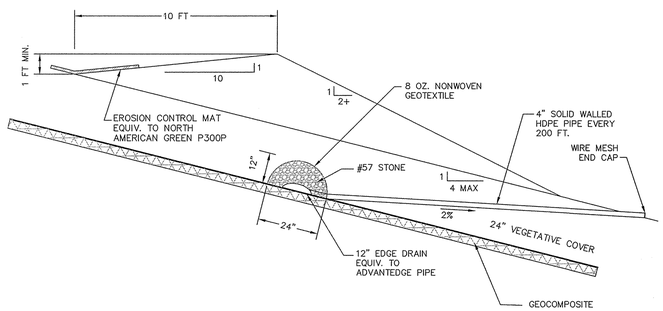


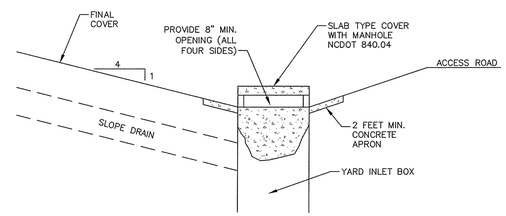
FINAL COVER SECTION
NTS



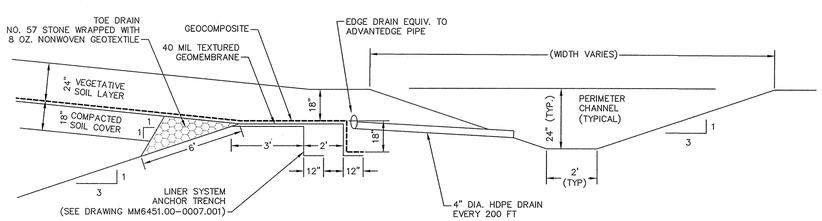
SLOPE DRAIN



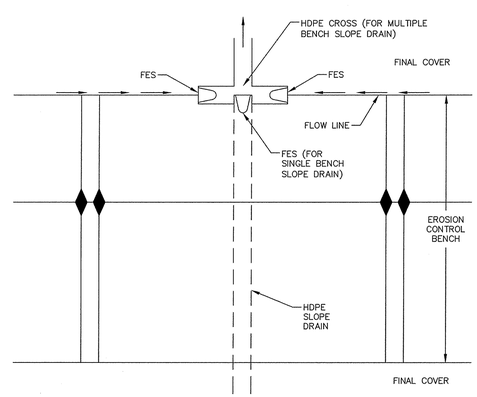
EROSION CONTROL BENCH
NTS



SLOPE DRAIN TO YARD INLET



ANCHOR TRENCH DETAIL
NTS



SLOPE DRAIN PLAN VIEW

REFERENCES

CONSTRUCTION PLAN APPLICATION	MM6451.00-0000.001
GYPSUM LANDFILL FINAL CLOSURE DETAILS	MM6451.00-0001.001
GYPSUM LANDFILL GAS VENTING SYSTEM PLAN	MM6451.00-0002.001
GYPSUM LANDFILL CELL 1 EROSION & SEDIMENT CONTROL PLAN	MM6451.01-0001.001
GYPSUM LANDFILL CELL 2 EROSION & SEDIMENT CONTROL PLAN	MM6451.01-0002.001
GYPSUM LANDFILL FINAL CLOSURE EROSION & SEDIMENT CONTROL PLAN	MM6451.01-0003.001
GYPSUM LANDFILL EROSION CONTROL DETAILS	MM6451.01-0004.001
GYPSUM LANDFILL CELL 1 FINAL CONFIGURATION	MM6451.00-0005.001
GYPSUM LANDFILL CELL 1 & CELL 2 DETAILS	MM6451.00-0007.001
GYPSUM LANDFILL CELL 1 & CELL 2 FINAL CONFIGURATION	MM6451.00-0013.001

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C	DEB	12/15/05	ISSUED FOR CPA
B	DEB	3/26/04	ISSUED FOR PERMIT REVIEW
A	DEB	3/24/04	ISSUED FOR DUKE REVIEW

PROJECT #: 10-6014 DATE: 3/24/04

DRAWN BY: JAC CHECKED BY: DEB

TITLE
FINAL CLOSURE DETAILS

SHEET

DOCUMENT NO: MM6451.00-0001.001

ERN: FHS00050

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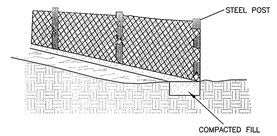
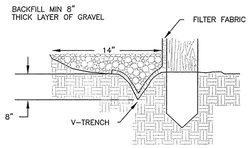
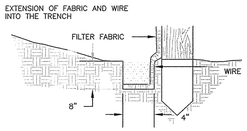






GENERAL NOTES:

1. FILTER FABRIC FENCE SHALL BE A MINIMUM OF 32" IN WIDTH AND SHALL HAVE A MINIMUM OF 6 LINE WIRES WITH 12" STAY SPACING.
2. WOVEN FILTER FABRIC BE USED WHERE SILT FENCE IS TO REMAIN FOR A PERIOD OF MORE THAN 30 DAYS.
3. STEEL POSTS SHALL BE 5'-0" IN HEIGHT AND BE OF THE SELF-FASTENER ANGLE STEEL TYPE.
4. WASHED STONE SHALL BE USED TO BURY SKIRT WHEN SILT FENCE IS USED ADJACENT TO A CHANNEL, CREEK OR POND.
5. TURN SILT FENCE UP SLOPE AT ENDS.
6. WHEN FABRIC IS USED WITH WIRE MESH 8' CENTERED POSTS MAY BE USED.

MAINTENANCE NOTES:

1. FILTER BARRIERS SHALL BE INSPECTED BY THE FINANCIALLY RESPONSIBLE PARTY OR HIS AGENT IMMEDIATELY AFTER EACH RAINFALL AND AT LEAST DAILY DURING PROLONGED RAINFALL. ANY REPAIRS NEEDED SHALL BE MADE IMMEDIATELY.
2. SHOULD THE FABRIC DECOMPOSE OR BECOME INEFFECTIVE PRIOR TO THE END OF THE EXPECTED USABLE LIFE AND THE BARRIER STILL IS NECESSARY, THE FABRIC SHALL BE REPLACED PROMPTLY.
3. SEDIMENT DEPOSITS SHOULD BE REMOVED AFTER EACH STORM EVENT OR SILT FENCE SHOULD BE REPLACED. THEY MUST BE REMOVED WHEN DEPOSITS REACH APPROX. HALF THE HEIGHT OF THE BARRIER. ANY SEDIMENT DEPOSITS REMAINING IN PLACE AFTER THE SILT FENCE IS REMOVED SHALL BE DRESSED TO CONFORM TO THE EXISTING GRADE, PREPARED AND SEEDED.

INSTALLATION DETAIL OF SEDIMENT FENCE

DETAIL #1

Temporary Seeding
Late Winter to Early Spring

Seeds	lbs/acre	Date of planting
Rye (grain)	120	Jan 1 to May 1
Annual lespedeza (kobe)	50	Jan 1 to May 1

**omit lespedeza when duration of temporary cover is not to extend beyond June

Summer

Seeds	lbs/acre	Date of planting
German millet	40	May 1 to Aug 15

Fall

Seeds	lbs/acre	Date of planting
Rye (grain)	50	Aug 15 to Dec 31

Soil amendments	lb/acre
Agriculture limestone	2,000
Fertilizer	1,000
Mulch	4,000

Permanent Seeding

Seeds	lbs/acre	Date of planting
Tall Fescue	100	Sept 1 to April 15
Sericea lespedeza	15	Sept 1 to May 1
Kobe lespedeza	10	May 1 to Sept 1
Rye	40	Aug 15 to April 15

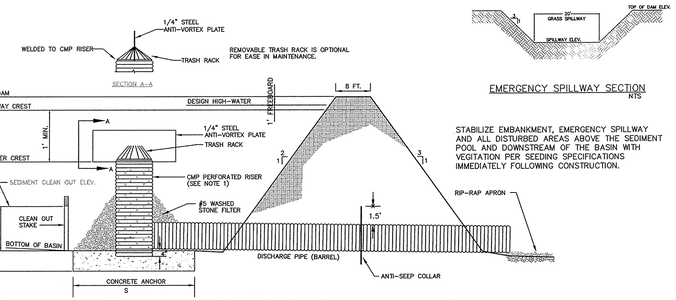
Soil amendment - have soil test performed but if not available use the following:

Soil amendments	lb/acre
Agriculture limestone	4,000
Fertilizer	1,000
Mulch	4,000

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

SEEDING SPECIFICATIONS

DETAIL #3



EMERGENCY SPILLWAY SECTION
NTS

STABILIZE EMBANKMENT, EMERGENCY SPILLWAY AND ALL DISTURBED AREAS ABOVE THE SEDIMENT POOL AND DOWNSTREAM OF THE BASIN WITH VEGITATION PER SEEDING SPECIFICATIONS IMMEDIATELY FOLLOWING CONSTRUCTION.

NOTES:
1. PERFORATIONS TO BE SPACED 4" O/C EACH WAY. SEE SEDIMENT BASIN DATA BLOCK FOR NUMBER OF ROWS AND DIAMETER OF PERFORATIONS.
2. EMERGENCY SPILLWAY TO HAVE 0.5' DESIGN DEPTH WITH 1' FREEBOARD PROVIDED. SEE SEDIMENT BASIN DATA BLOCK FOR MSL ELEVATIONS.

SEDIMENT BASIN DATA BLOCK

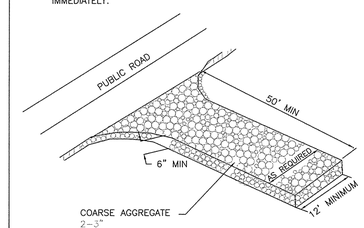
CELL EXCAVATION	BASIN DESIGNATION	TOP OF DAM WIDTH	SPILLWAY LENGTH	SPILLWAY ELEV.	SURFACE AREA	BASIN DIMENSIONS	TOP OF DAM ELEV.	CLEANOUT ELEV.	BOTTOM BASIN ELEV.	RISER DIA.	RISER CREST ELEV.	RISER HEIGHT	BARREL DIA.	BARREL LENGTH	BARREL OUTLET ELEV.	ANTI-FLOTATION ANCHOR DIMS.	PERFORATIONS
CELL 1	SB-4	8'	N/A	N/A	43,059 SF	* 101'±x426'±x6'	850.0± MSL	826.0± MSL	823.0± MSL	54"	829.0± MSL	6.0'	42"	467'+/-	818.33 ±MSL	6'x6'x1.5'	8 ROWS 1" DIA.
CELL 1	SB-5	8'	20'	810.0± MSL	29,400 SF	120'x245'x7.5'	830.0± MSL	824.0± MSL	821.0± MSL	42"	827.0 ±MSL	6.0'	36"	95'+/-	820.5 ± MSL	6'x6'x1.25'	6 ROWS 1" DIA.
CELL 1	SB-8	8'	20'	828.5± MSL	16,930 SF	92'x184'x8.0'	812.0± MSL	804.0 ± MSL	802.0± MSL	36"	808.0 ±MSL	6.0'	30"	64'+/-	801.0 ±MSL	6'x6'x1'	6 ROWS 1" DIA.
CELL 2	SB-6	8'	20'	810.5± MSL	43,355 SF	IRREGULAR S.A.	812.0± MSL	805.5 ± MSL	802.5 ± MSL	54"	808.5 ±MSL	6.0'	42"	83'+/-	800.0 ± MSL	6'x6'x1.5'	7 ROWS 1" DIA.
CELL 2	SB-7	8'	20'	813.0 ±MSL	33,818 SF	IRREGULAR S.A.	814.5 ± MSL	807.7 ± MSL	804.2 ± MSL	54"	811.2 ±MSL	7.0'	42"	80'+/-	800.0 ±MSL	6'x6'x1.75'	6 ROWS 1" DIA.

* SB-4 SHALL HAVE IRREGULAR SURFACE AREA AS SHOWN ON PLAN. SURFACE AREA SHOWN IS TAKEN AT ELEVATION 830, ONE FOOT ABOVE CREST OF RISER ELEVATION.

RISER TYPE SEDIMENT BASIN

DETAIL #6

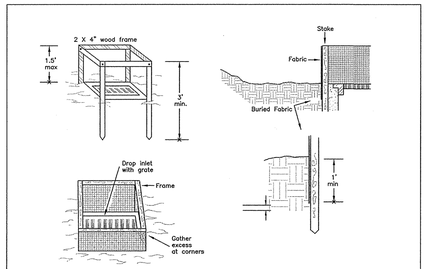
NOTES:
a. GRAVEL PAD TO BE 12'x 50' AND 6" THICK MINIMUM
b. TURNING RADIUS SUFFICIENT TO ACCOMMODATE LARGE TRUCKS IS TO BE PROVIDED (SEE COORDINATE DATA DRAWING).
c. ENTRANCE(S) SHOULD BE LOCATED TO PROVIDE FOR MAXIMUM UTILITY BY ALL CONSTRUCTION VEHICLES.
d. MUST BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR DIRECT FLOW OF MUD ONTO STREETS. PERIODIC TOPDRESSING WITH STONE SILL BE NECESSARY; KEEP SOME HANDY.
e. ANY MATERIAL WHICH STILL MAKES IT ONTO THE ROAD MUST BE CLEANED UP IMMEDIATELY.



NOTES: APPLICABLE AT ALL POINTS OF INGRESS & EGRESS UNTIL SITE IS STABILIZED, FREQUENT CHECKS OF THE DEVICE AND TIMELY MAINTENANCE MUST BE PROVIDED.

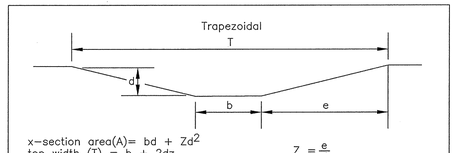
TEMPORARY CONSTRUCTION ENTRANCE

DETAIL #9



FABRIC INLET PROTECTION

DETAIL #4



x-section area(A)= bd + Zd²
top width (T) = b + 2dz
Z = e/d

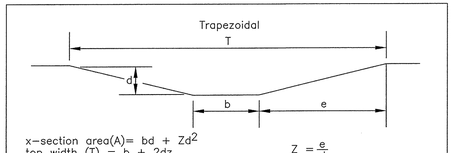
GRASS LINED CHANNEL DATA BLOCK

CHANNEL DESIGNATION	b	d	T	Z
PD-6, PD-7	2'	2'	14'	3
TD-2	3'	2'	15'	3
TD-1	6'	2.5'	21'	3

NOTE: ALL CELL 1 CHANNELS TO RECEIVE STRAW WITH NET TEMPORARY CHANNEL LINER EQUIVALENT TO NORTH AMERICAN GREEN S75. ALL CHANNELS TO RECEIVE TALL FESCUE GRASS LINER INSTALLED PER SEEDING SPECIFICATIONS (SEE DETAIL #2).

CROSS SECTION GEOMETRY OF CELL 1 GRASS-LINED DIVERSION CHANNELS

DETAIL #7



x-section area(A)= bd + Zd²
top width (T) = b + 2dz
Z = e/d

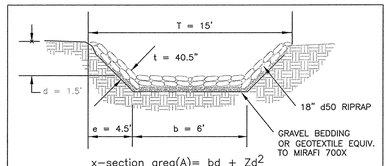
GRASS LINED CHANNEL DATA BLOCK

CHANNEL DESIGNATION	b	d	T	Z
PD-8, PD-9, PD-10, PD-11	2'	1.0'	8'	3
TD-3, PD-2, PD-3, PD-4, PD-5, PD-12	2'	2'	14'	3
PD-1	3'	2'	15'	3

NOTE:
CHANNELS PD-8, PD-9 & PD-11 TO RECEIVE SYNTHETIC MAT TEMPORARY CHANNEL LINER EQUIVALENT TO NORTH AMERICAN GREEN P300N. ALL REMAINING CHANNELS TO RECEIVE STRAW WITH NET TEMPORARY CHANNEL LINER EQUIVALENT TO NORTH AMERICAN GREEN S75. ALL CHANNELS TO RECEIVE TALL FESCUE GRASS LINER INSTALLED PER SEEDING SPECIFICATIONS (SEE DETAIL #2).

CROSS SECTION GEOMETRY OF CELL 2 & FINAL CLOSURE GRASS-LINED DIVERSION CHANNELS

DETAIL #8



x-section area(A)= bd + Zd²
top width (T) = b + 2dz
Z = e/d = 3

NOTES:
CHANNELS SHALL BE 18" d50 RIPRAP, dmax = 27", t=40.5".

TRAPEZOIDAL RIPRAP CHANNELS

DETAIL #10

SEEDING MIXTURE — RATE (lb/acre)
Species
Tall Fescue — *200 (4-5/1,000ft²)*

NURSE PLANTS
Between May 1 and Aug. 15, add 10 lb/acre Sudangrass or 10 lb/acre German millet. Prior to May 1 or after Aug. 15 add 40 lb/acre rye (grain).

SEEDING DATES
Best: August 25 – October
Possible: February – April 15

Avoid seeding from Nov. to Jan. If seeding must be done at this time, add 40lb/acre rye grain and use a channel lining that offers maximum protection.

SOIL AMENDMENTS
Apply lime and fertilizer according to soil tests, or apply 4,000 lb/acre ground agricultural limestone and 1,000 lb/acre 10-10-10 fertilizer. Operate tillage equipment across the waterway.

MULCH
Use jute, excelsior matting, or other effective channel lining material to cover the bottom of channels and ditches, and staple securely. The linch should extend above the highest calculated depth of flow. On channel side slopes above this height, and in drainages not requiring temporary linings, apply 4,000 lb/acre grain straw and anchor straw by stapling netting over the top.

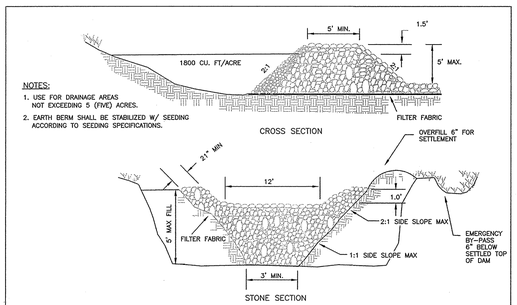
Mulch and anchoring materials must not be allowed to wash down slopes where they can clog drainage devices.

MAINTENANCE
Inspect and repair mulch frequently. Refertilize in late winter of the following year; use soil tests or apply 150 lb/acre 10-10-10. Mow regularly to a height of 2-4 inches.

Refer to Appendix 8.02 for botanical names.

GRASS-LINED DITCH SEEDING SPECIFICATIONS

DETAIL #2



NOTES:
1. USE FOR DRAINAGE AREAS NOT EXCEEDING 5 (IVE) ACRES.
2. EARTH BERM SHALL BE STABILIZED W/ SEEDING ACCORDING TO SEEDING SPECIFICATIONS.

SEDIMENT TRAP DATA BLOCK

CELL EXCAVATION	TRAP DESIGNATION	WEIR LENGTH	WEIR ELEV.	TRAP DIMENSIONS	TOP OF DAM ELEV.	CLEANOUT ELEV.	BOTTOM BASIN ELEV.
CELL 1	ST-2	12'	832.5± MSL	50'x175'	834.0± MSL	831.0±MSL	829.5± MSL
CELL 2	ST-3	6'	818.5± MSL	56'x112'	820.0± MSL	817.0±MSL	815.5± MSL
CELL 2	ST-4	6'	828.5± MSL	64'x128'	830.0± MSL	827.0±MSL	825.5± MSL

MAINTENANCE

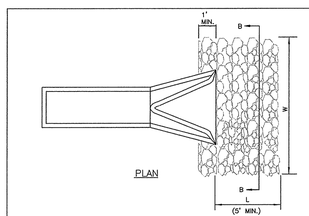
INSPECT TEMPORARY SEDIMENT TRAPS AFTER EACH PERIOD OF SIGNIFICANT RAINFALL. REMOVE SEDIMENT AND RESTORE TRAP TO ITS ORIGINAL DIMENSIONS WHEN THE SEDIMENT HAS ACCUMULATED TO ONE-HALF THE DESIGN DEPTH OF THE TRAP. PLACE THE SEDIMENT THAT IS REMOVED IN A DESIGNATED DISPOSAL AREA AND REPLACE THE CONTAMINATED PART OF THE GRAVEL FACING.

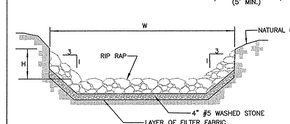
CHECK THE STRUCTURE FOR DAMAGE FROM EROSION OR PIPING. PERIODICALLY CHECK THE DEPTH OF THE SPILLWAY TO ENSURE IT IS A MINIMUM OF 1.5 FT. BELOW THE LOW POINT OF THE EMBANKMENT. IMMEDIATELY FILL ANY SETTLEMENT OF THE EMBANKMENT TO SLIGHTLY ABOVE DESIGN GRADE. ANY RIP RAP DISPLACED FROM THE SPILLWAY MUST BE REPLACED IMMEDIATELY.

STABILIZE THE EMBANKMENT AND ALL DISTURBED AREAS ABOVE THE SEDIMENT POOL AND DOWNSTREAM FROM THE TRAP IMMEDIATELY AFTER CONSTRUCTION WITH SEEDING.

GRAVEL AND RIP RAP FILTER BASIN

DETAIL #5





SECTION B-B

NOTES:
1. CLASS OR MEDIAN SIZE OF RIPRAP, LENGTH, WIDTH AND DEPTH OF APRONS PER THE OUTLET PROTECTION APRON DATA BLOCK BELOW.
2. RIPRAP SHOULD EXTEND UP BOTH SIDES OF THE APRON AND AROUND THE END OF THE PIPE OR CULVERT AT THE DISCHARGE OUTLET AT A MAXIMUM SLOPE OF 2:1 AND A HEIGHT NOT LESS THAN TWO THIRDS THE PIPE DIAMETER OR CULVERT HEIGHT.
3. THERE SHALL BE NO OVERFLOW FROM THE END OF THE APRON TO THE SURFACE OF THE RECEIVING CHANNEL. THE AREA TO BE PAVED OR RIPRAPPED SHALL BE UNDERCUT SO THAT THE INVERT OF THE APRON SHALL BE AT THE SAME GRADE (FLUSH) WITH THE SURFACE OF THE RECEIVING CHANNEL. THE APRON SHALL HAVE A CUTOFF OR TOE WALL AT THE DOWNSTREAM END.
4. THE WIDTH OF THE END OF THE APRON SHALL BE EQUAL TO THE BOTTOM WIDTH OF THE RECEIVING CHANNEL. MAXIMUM TAPER TO RECEIVING CHANNEL 5:1
5. ALL SUBGRADE FOR STRUCTURE TO BE COMPACTED TO 90% MODIFIED PROCTOR.
6. THE PLACING OF FILL, EITHER LOOSE OR COMPACTED IN THE RECEIVING CHANNEL SHALL NOT BE ALLOWED.
7. NO BENDS OR CURVES IN THE HORIZONTAL ALIGNMENT OF THE APRON WILL BE PERMITTED.

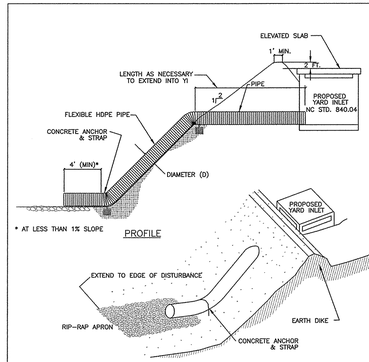
OUTLET PROTECTION APRON DATA BLOCK

APRON A-1 DATA CELL 1	APRON A-2 DATA FINAL CLOSURE	APRON A-3 DATA CELL 2	APRON A-4 DATA CELL 2	APRON A-5 DATA CELL 2	APRON A-6 DATA CELL 2
RIPRAP d50 = 12" dmax = 18" t = 27" L = 26 FT. W = 29.5 FT. H = 28"	RIPRAP d50 = 12" dmax = 18" t = 27" L = 29 FT. W = 32 FT. H = 24"	RIPRAP d50 = 12" dmax = 18" t = 27" L = 24 FT. W = 26.5 FT. H = 20"	RIPRAP d50 = 6" dmax = 9" t = 13.5" L = 12 FT. W = 13.5 FT. H = 12"	RIPRAP d50 = 12" dmax = 18" t = 27" L = 30 FT. W = 33.5 FT. H = 28"	RIPRAP d50 = 12" dmax = 18" t = 27" L = 26 FT. W = 29.5 FT. H = 28"
APRON A-7 DATA CELL 1	***APRON A-8 DATA FINAL CLOSURE**	***APRON A-9 DATA FINAL CLOSURE**	**APRON A-10 DATA CELL 2**	**APRON A-11 DATA CELL 2**	**APRON A-12 DATA CELL 2**
RIPRAP d50 = 12" dmax = 18" t = 27" L = 22 FT. W = 25.5 FT. H = 28"	RIPRAP d50 = 6" dmax = 9" t = 13.5" L = 17 FT. W = 19.5 FT. H = 20"	RIPRAP d50 = 12" dmax = 18" t = 27" L = 20 FT. W = 23 FT. H = 24"	RIPRAP d50 = 12" dmax = 18" t = 27" L = 30 FT. W = 33.5 FT. H = 28"	RIPRAP d50 = 12" dmax = 18" t = 27" L = 36 FT. W = 41 FT. H = 40"	RIPRAP d50 = 6" dmax = 9" t = 13.5" L = 14 FT. W = 15.5 FT. H = 12"

*APRONS A-8 & A-9 TO BE GROUTED WITH CONCRETE

RIPRAP APRON AT PIPE OUTLETS

DETAIL #9



CONSTRUCTION SPECIFICATIONS:
1. THE TOP OF THE EARTH DIKE OVER THE INLET PIPE AND THOSE DIKES CARRYING WATER TO THE PIPE SHALL BE AT LEAST 1 FOOT HIGHER AT ALL POINTS THAN THE TOP OF THE INLET PIPE.
2. THE PIPE SHALL BE FLEXIBLE WITH WATER TIGHT CONNECTING BANDS. FLEXIBLE PIPE SHOULD BE STAKED ON EITHER SIDE.
3. A RIP RAP APRON SHALL BE PROVIDED AT THE OUTLET, IF EMPTYING INTO A DISTURBED AREA.
4. THE SOIL AROUND AND UNDER THE INLET PIPE AND ENTRANCE SECTION SHALL BE HAND TAMPED IN 4" LIFTS TO THE TOP OF THE EARTH DIKE.
5. FOLLOW-UP INSPECTION AND ANY NEEDED MAINTENANCE SHALL BE PERFORMED AFTER EACH STORM BY THE CONTRACTOR.
6. CONCRETE ANCHOR TO BE 8" CMU FILLED WITH CONCRETE. STRAP TO BE 1-INCH GALVANIZED STEEL ANCHORED IN CONCRETE.

DRAIN DESIGNATION	PIPE DIAMETER
SD-1	18"

FLEXIBLE PIPE SLOPE DRAIN

DETAIL #11

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MARSHAL STEAM STATION FGD RESIDUE LANDFILL

CATAWBA COUNTY, NC

DUKE ENERGY CAROLINAS, LLC
526 SOUTH CHURCH STREET
CHARLOTTE, NC 28202

NO.	BY	DATE	REVISION
1	JAC	8/19/11	UPDATED FOR CELL 1 FINAL CLOSURE, ADDED FINAL ES&C
B	DEB	4/14/04	REV. PER NCDENR COMMENTS
A	DEB	3/26/04	ISSUED FOR PERMIT REVIEW

PROJECT #: 10-6014 DATE: 3/24/04

DRAWN BY: JAC CHECKED BY: DEB

TITLE
GYPSUM LANDFILL EROSION CONTROL DETAILS

SHEET

DOCUMENT NO: MM6451.01-0004.001

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ERN: FHS00055