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Backus	12/09/2011	15726	41-03

November 14, 2011

Ms. Patricia Backus, P.E.
North Carolina Department of
Environment and Natural Resources
401 Oberlin Rd
Raleigh, NC 27605

RE: Application for Continued Operation – Response to Comments
City of Greensboro, White Street Construction and Demolition Landfill (C&DLF, Phase II)
Guilford County, Permit No. 41-03
HDR Project No. 06770-67286-018

Dear Ms. Backus:

HDR Engineering Inc. of the Carolinas (HDR), on behalf of the City of Greensboro Environmental Services Department is hereby submitting the following responses to comments in your July 11, 2011 letter and October 17, 2011 e-mail clarification.

To aid in your review, we have structured this response letter to match the order of your comments with responses provided immediately after. In addition, a revised copy of each updated document is provided with tracked changes for your ease in reviewing the specific revisions that have been made.

Closure Plan
Rule .0547(4)(d) states the closure and post-closure plan are to be in accordance with Rule .1629. Rule .1629 (b)(1)(A) further states that a closure plan must include a description of the cap system and the methods and procedures to be used to install the cap that conforms to the requirements set forth in paragraph (C) of Rule .1627. Construction requirements for the cap system must incorporate specific requirements from Rule .1624.

The following documents from HDR's March 14, 2011 submittal have been updated, added, or revised in response to this comment.

- Closure Plan (revised)
- Appendix F - Technical Specifications (new)
- Appendix G - Construction Quality Assurance Plan (new)

HDR Engineering, Inc. of the Carolinas
440 S Church Street
Suite 1000
Charlotte, NC 28202-2075
Phone: (704) 338-6700
Fax: (704) 338-6760
www.hdrinc.com

Construction and Demolition Application Overview
Revise the Construction and Demolition Application Overview that was included in the original application to reflect the waste acceptance and compaction estimates provided on the revised Drawing C-06. Also, include the total gross capacity.

The following documents from the original application and HDR's March 14, 2011 submittal have been updated or revised in response to this comment.

- Construction & Demolition Application Overview
- Drawing C-06

In addition, Drawing CD-81B has been revised to clarify that Phase I was not permitted as an LCID landfill.

If you have any questions regarding this submittal, please do not hesitate to call me at (704) 338-6843.

Sincerely,

HDR Engineering, Inc. of the Carolinas

Michael D. Plummer, PE
Project Manager

MDP/ELS/apb

Enclosures

cc: Dale Wyrick, P.E., City of Greensboro (w/o enclosures)
Gail Hay, P.E., City of Greensboro (with enclosures)
Joe Readling, P.E., HDR Engineering (w/o enclosures)

RE: 20111114 MDP-P.Backus Phase II Permit Renewal Response to Comments
Application for Continued Operation – Response to Comments
City of Greensboro, White Street Construction and Demolition Landfill (C&DLF, Phase II)
Guilford County, Permit No. 41-03

SUBMITTAL DOCUMENTS

- Closure Plan
- Appendix F - Technical Specifications
- Appendix G - Construction Quality Assurance Plan

.1627 Closure Plans

The following closure and post closure plans for the White Street Landfill Phase II have been prepared in accordance with Rule .1627 for MSW landfills as required by Rule .0547(4)(d) governing existing C&D landfill units constructed on top of closed MSW landfills.

1.0 Closure

In accordance with the Solid Waste Management rules and/or statutes, and upon achievement of the final design and approved contours, the City of Greensboro proposes to construct the regulatory cap system over the construction and demolition debris landfill area. Prior to the placement of the final cap, the City of Greensboro will verify that fill area slopes constructed within the disposal area meet the approved slope requirements The City will construct the areas such that post-settlement slopes of a minimum of 5 percent to a maximum of 25 percent can be achieved. Additionally, final contours will be established to enhance drainage from the construction and demolition debris fill areas to reduce the potential for infiltration into the waste mass. It is estimated that the total landfill operating volume at completion will be 2,315,800 cubic yards. The maximum area requiring a cap at any one time is approximately 64 acres.

An active gas collection system is currently in operation in Phase II to allow movement of gas generated from the completed fill area to the gas management area. Modifications to the system will not be required based on the C&D closure.

Commencement of closure activities will begin as required in accordance with Rule .1627 as promulgated. Once begun, closure will proceed and continue in compliance with Rule .1627.

A sign indicating the anticipated date of the final waste acceptance into the construction and demolition debris disposal unit as well as anticipated closure will be conspicuously posted at the facility at least 30 days in advance. The City of Greensboro may employ other avenues and devices to notify the public of the planned closure. These may include advertising in the local print media, advertising on local television, mailing to regular account customers, and notices on the City of Greensboro cable television channel. Prior to beginning closure of the unit, or portions thereof, the Division will be notified that intent to close has been placed in the operating record.

The closure will begin after completion of a portion of the final grades but no later than 30 days after the final receipt of waste. The design of the landfill in combination with the maintenance plan should assure a fairly uncomplicated closure period. The closure of the entire unit, or portions thereof, will be completed within 180 days unless an extension has been requested and received due to changes in the anticipated schedule.

The cap system designed will be constructed in accordance with Rule .1624(b)(8),(9), and (15) to minimize infiltration and erosion. The proposed cap system will minimize infiltration with the use of a low-permeability barrier that contains a minimum 18 inches of earthen material. The proposed permeability barrier will be less than or equal to the permeability of any base liner system or in-situ subsoils underlying the landfill, or a permeability specified for the final cover in the effective permit, or a

permeability no greater than $1x10^{-5}$ cm/sec, whichever is less. Additionally, erosion of the cap system will be minimized with the placement of at least 6 inches of earthen material that is capable of sustaining native plant growth. This layer will assist in the reduction of root penetration and protect the low permeability barrier layer. The installation and testing of the cap system will be performed as required by the specifications found in Appendix F, and the Construction Quality Assurance Plan found in Appendix G.

The construction of the regulatory cap system is anticipated to utilize borrow material from on-site landfill sources that satisfy the permeability requirements. Off-site materials that satisfy the permeability requirements will supplement volume differentials. In order to assure that the material meets the established criteria, the material will be tested prior to use and after placement. Final construction methods for the compacted clay liner shall be based upon the type and quality of the borrow source and shall be verified in the field by constructing test pad(s). A professional engineer licensed in the state of North Carolina shall certify that the compacted clay liner installation conforms with the plans approved by the NC DENR Division of Waste Management.

The anticipated schedule for closure activities to be initiated by the City of Greensboro will begin when that portion of the landfill unit meets one or more of the following requirements, unless an extension has been granted by NCDENR.

1. No later than 30 days after the date on which the C&D unit receives the known final receipt of wastes.

2. No later than one year after the most recent receipt of wastes, if the C&D unit has remaining capacity.

The material of the erosion layer will be selected considering soil type, nutrient levels, pH, erodibility, and other factors. Finished sideslopes shall be stable and configured to adequately control erosion and run-off. The erosion and storm water control system designed for Phase II is adequate to handle the runoff from the C&D area. The final cover will be graded, seeded, and stabilized. All cover material will be free of putrescible material, solid waste, construction debris, vegetation, rocks, frozen soil and other deleterious materials. The vegetation should be selected based upon:

- Species of grasses which are locally adapted and resistant to drought or temperature extremes;
- Having roots which will not disrupt the low permeability layer;
- Ability to thrive in low nutrient soil and develop a good stand to resist erosion;
- Survive and function with little or no maintenance.

The cap will be mowed on a routine basis to ensure growth of large, deep-rooted vegetation does not occur.

2.0 Closure Verification

The following procedures will be implemented following closure of the construction and demolition debris disposal unit in Phase II.

1. A Construction Quality Assurance (CQA) report shall be submitted to the Division. The report shall describe the observations and tests used before, during, and upon completion of cap construction to ensure that the construction materials meet the design specifications and the construction and certification requirements. The CQA report shall contain as built drawings.

2. A signed certification from an independent registered professional engineer verifying that closure has been completed in accordance with the closure plan will be submitted to the Division.

3. At least one sign notifying all persons of the closing of the disposal unit and that wastes are no longer accepted there will be posted. Suitable barriers will be installed and maintained to ensure against further waste disposal.

4. Within 90 days, a survey plat, compliant with G.S. 47-30 will be prepared by a professional land surveyor registered in the state of North Carolina. The plat shall be placed in the operating record of the facility.

5. A notation shall be recorded on the facility deed (or deeds) notifying the public that the land has been used as a solid waste management disposal facility and that future use is restricted under paragraph (8) of Rule.1627. A copy of the deed notation as recorded shall be filed with the operating record.

6. Following closure the Division will be notified that a certification, signed by the project engineer verifying that the closure has been completed in accordance with the closure plan, and has been placed in the operating record.

3.0 Post Closure Plan

This post-closure plan has been developed to outline steps to be taken to ensure environmental soundness of the landfill during its post-closure care period. The post-closure care period will last at least 30 years after closure completion and at a minimum will consist of the following.

1. Maintaining integrity and effectiveness of the final cover system.

2. Continued implementation of the approved groundwater monitoring plan through routine groundwater and surface water monitoring events.

3. Maintaining and operating a landfill gas control system and routine landfill gas monitoring events.

4. Maintaining surface run-on and run off controls.

3.1 Post Closure Monitoring Plan

The closed unit will be monitored for a minimum of 30 years. A series of inspections shall be scheduled to ensure the integrity and effectiveness of the cap system, storm water management system, groundwater monitoring system, gas collection and control system, and to protect human health and the environment. Inspections will be conducted utilizing the Post-Closure inspection Checklist as exhibited in Appendix E. No wastes will remain exposed after the closure of the disposal unit. Access to the closed site by the public or domestic livestock will not pose a health hazard. After official closure of the disposal unit has occurred, the area will be maintained with grass vegetation.

3.2 Closed Unit Monitoring and Inspections

Routine monitoring and inspections of the closed disposal unit will occur on a quarterly and semi-annual basis. All inspections records, reports and actions taken will be filed with and made a part of the operating record of the facility.

Quarterly inspections of the closed site will include examination of the security of control devices for signs of deterioration or vandalism to ensure access to the facility is limited to authorized persons. The previous disposal area will be checked to ensure the integrity of the final cover system is maintained, erosion damage is repaired, vegetative cover persists, and that cover settlement, subsidence and displacement are minimal. Drainage ditches, channels and other control devices will be cleared and repairs made as necessary. Benchmark integrity will be noted and maintained.

Semi-annual inspections will include drainage of the final cover system, settlement, subsidence and displacement. Semi-annual inspections will also include the semi-annual groundwater and surface water monitoring event as well as the landfill gas collection and control system.

In addition to the routine inspection program, landfill staff, during the normal course of the workday, will note and report any deficiencies in the operations and effectiveness of the entire landfill facility. These deficiencies will then be repaired and corrected as necessary.

3.3 Post Closure Contact

All correspondence and questions concerning the post-closure care of the unit should be directed to:

Environmental Services Director
City of Greensboro
P.O. Box 3136
Greensboro, NC 27402-3136
(336) 373-7658

3.4 Description of Use

After filling operations cease at Phase II of the White Street Sanitary Landfill and the unit is officially closed in accordance with the Plan, the area will be allowed to return to its natural vegetative state.

3.5 Engineering Certification

Based on the City's monitoring reports and an engineer's quarterly site visits, annual certifications by the engineer will be placed in the operating record. They will certify that the closure plan has been followed, noting discrepancies along with the corrective actions undertaken. At the end of the post closure period, the individual certifications will be compiled into a final document and forwarded to the Division.

4.0 Maintenance

4.1 Repair of Security Control Devices

Should the routine inspection process note any deficiencies in any of the security and access control devised, maintenance and repair will be performed as necessary. Locks, vehicular gates, and fencing will be replaced if functioning improperly. Warning and information signs will be kept legible at all times and will be replaced if damaged by inclement weather or vandalism.

4.2 Erosion Damage Repair

Should the routine inspection process note any evidence of erosion in any areas of the final cap system, maintenance, repair and reseeding will be performed as necessary and as soon as possible after detection. Excessive slopes will be flattened if possible by adding clean file material. If necessary, erosion control fabrics will be used to expedite re-vegetation of slopes and to secure topsoil in place.

4.3 Correction of Settlement, Subsidence, and Displacement

Minimum slopes of 5% will be maintained after settlement in order to prevent ponding and allow for proper drainage while preventing infiltration. If vertical or horizontal displacement occurs due to differential settlement, cracks will be filled with appropriate material and final cover will be re-established.

4.4 Repair of Run-On/Run-Off Control Structures

All terraces, swales, and perimeter channels will be repaired, cleaned, or realigned to maintain original conditions and performance. Any culverts, pipe, or other control device that becomes damage will be repaired or replaced.

4.5 Gas Collection System

The landfill gas collection system is anticipated to be maintained by the City or a third party. Proper operation of the systems will be verified through testing at the landfill gas monitoring wells and probes.

If methane gas recovery wells do not function as a result of irregular settlement, accumulation of liquids (condensate, leachate, water), binding or corrosion, replacement wells can be installed if necessary.

SECTION 02220
EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Earthwork.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bid Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 01410 – Testing Laboratory Services.
   4. Section 02276 – Low Permeability Soil Cap.
   5. Construction Quality Assurance Plan.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society for Testing and Materials (ASTM):
      a. C33, Standard Specification for Concrete Aggregates.
      b. D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3).
      c. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/f (2,700 kN-m/m)).
      d. D1586, Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.
      e. D2487, Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
      f. D4253, Standard Test Methods for Maximum Index Density of Soils Using a Vibratory Table.
      g. D4254, Test Methods for Minimum Index Density of Soils and Calculation of Relative Density.
   2. North Carolina Erosion and Sediment Control Planning and Design Manual, current edition.
   3. North Carolina Department of Transportation Standard Specification for Roads and Structures, current edition.

B. Contractor to employ an independent soils laboratory (CQC Consultant), in accordance with North Carolina General Statute 143-64.31 through 146-64.36 (the Minibrooks Act), to conduct the specified tests to assure that all work complies with this Specification.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
   3. Certifications.
   4. Test reports:
      a. Soils inspection and testing results.

B. Samples:
   1. Submit samples and source of fill and backfill materials proposed for use.
   2. Submit samples and source of borrow materials proposed for use.
   3. Submit soil samples directly to CQA Consultant with notification to the Engineer.

1.4 SOILS/GEOTECHNICAL

A. The Owner will provide for the on-site services of a CQA Consultant (Soils Engineer) to selectively test materials and monitor compliance with the requirements of these Specifications. This will be in addition to Construction Quality Control (CQC), provided and paid for by the Contractor to be performed by the CQC Consultant in accordance with these Specifications and the CQA Plan.

B. The Contractor will afford these representatives access to the job site for the performance of their duties as described in the Contract Documents.

C. General Duties and Responsibilities of the Contractor's CQC Consultant: Under the direction of a qualified registered engineer or geologist:
   1. Perform stockpile and in-place testing of all soil and rock materials used in the work in conformance with these Specifications and the CQA Plan.
   2. Inspect subgrades and excavations and evaluate/determine suitability of materials encountered. Determine extent of any overexcavation required to remove unsuitable materials under roadways, structures, or other areas of construction.
   3. Document placement of fill materials and perform testing to confirm compliance with these Specifications.
   4. Evaluate the suitability of existing on-site materials for use in construction of embankments and fills within the proposed grading shown on the Contract Drawings.

D. General Duties and Responsibilities of Owner's CQA Consultant:
   1. Approve materials proposed for incorporation into the work as proposed by the CQC Consultant.
   2. Review subgrades and excavations and approve suitability of materials encountered as proposed by the CQC Consultant. Approve extent of any overexcavation required to remove unsuitable materials under roadways, structures, or other areas of construction, as proposed by the CQC Consultant.
   3. Observe placement of fill materials and testing by CQC Consultant for compliance with these specifications.
   4. Review/approve the suitability of existing on-site materials for use in construction of embankments and fills.
   5. Review construction operations and monitor for compliance with Contract Documents.

E. Available Subsurface Information: Where provided, data on subsurface soil conditions are not intended as representations or warranties of the continuity of such conditions between borings or indicated sampling locations. It shall be expressly understood that neither the Owner nor the Engineer will be responsible for any interpretation or conclusion drawn therefrom by the Contractor. Data is made available for the convenience of the Contractor.

F. Additional or supplementary soil borings or other exploratory operations may be made by the Contractor at no additional cost to the Owner. The Contractor shall provide the Owner with a copy of any data obtained/developed during such work. Such additional work shall be performed in a timely manner in accordance with and not impacting or changing the project schedule set forth in the Contract Documents.

1.5 TOLERANCES

A. Grading shall be to a tolerance of + 0.1 FT unless otherwise noted in the construction documents and then the stricter criteria shall be used.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fill and Backfill: Selected material approved by Soils Engineer and Owner.

B. Structural Fill: Structural fill should be approved by the CQC and CQA consultants.

C. The Contractor shall conduct his own quantity and quality investigations and testing to determine availability and suitability of (on-site) borrow materials, as allowed by the Owner. If material is not available on-site, Contractor is responsible for finding off-site material.

D. All earth materials proposed for use in the Work shall be adequately characterized prior to the Work by the CQC Consultant.

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect existing surface and subsurface features on-site and adjacent to site as follows:
   1. Provide barricades, coverings, or other types of protection necessary to prevent damage to existing items indicated to remain in place.
   2. Protect and maintain benchmarks, monitoring wells, existing structures, monuments, or other established reference points and property corners. If disturbed or destroyed, replace at own expense to full satisfaction of Owner and controlling agency.
   3. Verify location of utilities. Omission or inclusion of utility items does not constitute non-existence or definite location. Secure and examine local utility records for location data.
      a. Take necessary precautions to protect existing utilities from damage due to any construction activity.
      b. Repair damages to utility items at own expense.
      c. In case of damage, notify Engineer at once so required protective measures may be taken.
   4. Maintain free of damage, existing sidewalks, structures, and pavement not indicated to be removed. Any item known or unknown or not properly located that is inadvertently damaged shall be repaired to original condition. All repairs to be made and paid for by Contractor.
   5. Provide full access to public and private premises, fire hydrants, street crossings, sidewalks, and other points as designated by Owner to prevent serious interruption of travel.
   6. Maintain stockpiles and excavations in such a manner to prevent inconvenience or damage to structures on-site or on adjoining property.
   7. Avoid surcharge or excavation procedures which can result in heaving, caving, or slides.
   8. Conduct operation with minimum interference to daily landfill operations.

B. Construct erosion and sedimentation controls prior to beginning earthwork.

C. Salvageable Items: Carefully remove items to be salvaged, and store on Owner's premises unless otherwise directed.

D. Dispose of waste materials, legally, on site as directed by the owner. Burning, as a means of waste disposal, is not permitted.

3.2 SITE EXCAVATION AND GRADING

A. The Work includes all operations in connection with excavation, borrow, construction of fills and embankments, rough grading, and disposal of excess materials in connection with the preparation of the site(s) for construction of the proposed facilities.

B. Excavation and Grading: Perform as required by the Contract Drawings.
   1. Contract Drawings may indicate both existing grade and finished grade required for construction of Project. Stake all units, structures, piping, roads, parking areas and walks and establish their elevations. Perform other layout work required. Replace property corner markers to original location if disturbed or destroyed.
   2. Preparation of ground surface for embankments or fills: Before fill is started, scarify to a minimum depth of 6 IN in all proposed embankment and fill areas. Where ground surface is

steeper than one vertical to four horizontal, plow surface in a manner to bench and break up surface so that fill material will bind with existing surface.

3. Protection of finish grade: During construction, shape and drain embankment and excavations. Maintain ditches and drains to provide drainage at all times. Protect graded areas against action of elements prior to acceptance of work. Re-establish grade where settlement or erosion occurs.

C. Borrow: Provide necessary amount of approved fill compacted to density equal to that indicated in this Specification. Include cost of all borrow material in original Bid. Fill material to be approved by Soils Engineer prior to placement.

D. Construct embankments and fills as required by the Contract Drawings:
   1. Construct embankments and fills at locations and to lines of grade indicated. Completed fill shall correspond to shape of typical cross section or contour indicated regardless of method used to show shape, size, and extent of line and grade of completed work.
   2. Provide approved fill material which is free from roots, organic matter, trash, frozen material, and stones having maximum dimension greater than 6 IN. Ensure that stones larger than 4 IN are not placed in upper 6 IN of fill or embankment. Do not place material in layers greater than 8 IN loose thickness. Place layers horizontally and compact each layer prior to placing additional fill.
   3. Compact by sheepsfoot, pneumatic rollers, vibrators, or by other equipment as required to obtain specified density. Control moisture for each layer necessary to meet requirements of compaction.

E. Upon reaching subgrade elevations shown, proofroll subgrade soils and obtain the CQC Consultant's review/recommendation and CQA Consultant's approval. If unsuitable materials are encountered at the subgrade elevation, repair as directed by the CQC Consultant and approved by the CQA Consultant to remove unsuitable materials. Excavation of 1 cy or greater should be preapproved by the CQC Consultant and CQA Consultant.

F. Proofrolling shall be conducted with a pneumatic-tired vehicle of at least 20 tons Gross Vehicle Weight (GVW), approved by the CQC and CQA Consultants. An alternate approved by the CQA Consultant may be used in constricted areas.

G. Where subgrade materials are determined to be unsuitable, such materials shall be removed to the lengths, widths, and depths directed by the CQC Consultant and approved by the CQA Consultant, and backfilled with suitable material unless further excavation or earthwork is required. No additional payment will be made for such excavation and backfill 6 IN or less than the finished subgrade. Payment for unsuitable material excavation greater than 6 IN beneath the finished subgrade shall be negotiated.

H. The subgrade of areas to receive fill shall be smooth and free of all vegetation, sticks, roots, rocks, and debris.

I. Dewatering (as required): Provide and maintain dewatering of all surface water and/or groundwater as required for excavation. Where groundwater is or is expected to be encountered during excavation, install a dewatering system to prevent softening and disturbance of subgrade below foundations and fill material, to allow foundations, fill material, and structures/backfill to be placed in the dry, and maintain a stable excavation. Soils and hydrogeologic information may be reviewed before beginning excavation to determine where goundwater is likely to be encountered during excavation. Employ a dewatering specialist for selecting/designing, monitoring, and operating the dewatering system as needed. Keep dewatering system in operation until dead load of structure exceeds possible buoyant uplift force on structure or fill material. Dispose of groundwater to an area which will not interfere with construction operations or damage existing construction as approved by the Owner. Install groundwater monitoring points as necessary. Shut off dewatering system at such a rate so as to prevent a quick upsurge of water that might weaken the subgrade. Installation, start-up, monitoring maintenance, and shut-off of the dewatering system shall be at no additional cost to the Owner.

J. Do not place fill when the subgrade is frozen, wet, loose, or soft.

K. Moisture control:
   1. Moisture content of materials prior to, and during compaction, shall be uniform throughout each layer of material.
   2. Granular materials shall be thoroughly wetted during or immediately prior to compaction.
   3. Supplementary water shall be added as required to materials by sprinkling and mixing uniformly throughout layer.
   4. Materials too wet for placing shall be temporarily spread or aerated until moisture content is acceptable. If these materials cannot be processed in time to use, the Contractor shall find alternatives acceptable to the CQC Consultant and the CQA Consultant.

3.3 USE OF EXPLOSIVES

A. Blasting is not allowed for this project.

3.4 FIELD QUALITY CONTROL

A. Moisture density relations, to be established by the CQC Consultant are required for all materials to be compacted.

B. Extent of compaction testing will be as necessary to assure compliance with Specifications and Drawings.

C. Give minimum of 24 HR advance notice to CQC Consultant and CQA Consultant when ready for compaction or subgrade testing and inspection.

D. Should any compaction density test or subgrade inspection fail to meet Specification requirements, perform corrective work as necessary.

E. Pay for all costs associated with corrective work and retesting resulting from failing compaction density tests.

3.5 COMPACTION DENSITY REQUIREMENTS

A. Obtain approval from Soils Engineer with regard to suitability of soils and acceptable subgrade prior to subsequent operations.

B. Provide dewatering system necessary to successfully complete compaction and construction requirements.

C. Remove frozen, loose, wet, or soft, material and replace with approved material as directed by Soils Engineer.

D. Stabilize subgrade with well graded granular materials as directed by Soils Engineer.

E. Assure by results of testing that compaction densities comply with the following requirements:
   1. Sitework:

SOIL TYPE	COMPACTION DENSITY
Cohesive Soils	95 percent, ASTM D698
Cohesionless Soils	75 percent relative density per ASTM D4253 and D4254

   2. Perform testing at a minimum frequency of 1 test per lift per 10,000 square feet.

3.6 EXCAVATION, FILLING, AND BACKFILLING FOR STRUCTURES

A. General:
   1. In general, work includes, but is not necessarily limited to, excavation for structures and retaining walls, removal of underground obstructions and undesirable material, backfilling, filling, and fill, backfill, and subgrade compaction.
   2. Obtain fill and backfill material necessary to produce grades required. Materials and source to be approved by Soils Engineer. Excavated material approved by Soils Engineer may also be used for fill and backfill.

3. In this Section of the Specifications, the word "foundations" includes footings, base slabs, foundation walls, mat foundations, grade beams, piers and any other support placed directly on soil.
4. In the paragraphs of this Section of the Specifications, the word "soil" also includes any type of rock subgrade that may be present at or below existing subgrade levels.

B. Excavation Requirements for Structures:
1. General. Do not commence excavation for foundations for structures until:
   a. Soils Engineer approves:
      1) The removal of topsoil and other unsuitable and undesirable material from existing subgrade.
      2) Density and moisture content of site area compacted fill material meets requirements of specifications.
      3) Site surcharge or mass fill material can be removed from entire construction site or portion thereof.
      4) Surcharge or mass fill material has been removed from construction area or portions thereof.
   b. Engineer grants approval to begin excavations.
2. Dimensions:
   a. Excavate to elevations and dimensions indicated or specified.
   b. Allow additional space as required for construction operations and inspection of foundations.
3. Removal of obstructions and undesirable materials in excavation includes, but is not necessarily limited to, removal of old foundations, existing construction, unsuitable subgrade soils, expansive type soils, and any other materials which may be concealed beneath present grade, as required to execute work indicated on Contract Drawings. If undesirable material and obstructions are encountered during excavation, remove material and replace as directed by Soils Engineer.
4. Level off bottoms of excavations to receive foundations, floor slabs, equipment support pads, or compacted fill. Remove loose materials and bring excavations into approved condition to receive concrete or fill material. Where compacted fill material must be placed to bring subgrade elevation up to underside of construction, scarify existing subgrade upon which fill material is to be placed to a depth of 6 IN and then compact to density stated in this Section of Specifications before fill material can be placed thereon. Do not carry excavations lower than shown for foundations except as directed by Soils Engineer or Engineer. If any part of excavations is carried below required depth without authorization, maintain excavation and start foundation from excavated level with concrete of same strength as required for superimposed foundation, and no extra compensation will be made to Contractor therefore.
5. Notify Soils Engineer and Engineer as soon as excavation is completed in order that subgrades may be inspected. Do not commence further construction until subgrade under compacted fill material, under foundations, under floor slabs-on-grade, under equipment support pads, and under retaining wall footings has been inspected and approved by the Soils Engineer as being free of undesirable material, being of compaction density required by this specification, and being capable of supporting the allowable foundation design bearing pressures and superimposed foundation, fill, and building loads to be placed thereon. Soils Engineer shall be given the opportunity to inspect subgrade below fill material both prior to and after subgrade compaction.
   a. Place fill material, foundations, retaining wall footings, floor slabs-on-grade, and equipment support pads as soon as weather conditions permit after excavation is completed, inspected, and approved and after forms and reinforcing are inspected and approved. Before concrete or fill material is placed, protect approved subgrade from becoming loose, wet, frozen, or soft due to weather, construction operations, or other reasons.

6. Dewatering: Where groundwater is or is expected to be encountered during excavation, install a dewatering system to prevent softening and disturbance of subgrade below foundations and fill material, to allow foundations and fill material to be placed in the dry, and to maintain a stable excavation side slope. Groundwater shall be maintained at least 3 FT below the bottom of any excavation. Review soils investigation before beginning excavation and determine where groundwater is likely to be encountered during excavation. Employ dewatering specialist for selecting and operating dewatering system. Keep dewatering system in operation until dead load of structure exceeds possible buoyant uplift force on structure. Dispose of groundwater to an area which will not interfere with construction operations or damage existing construction. Install groundwater monitoring wells as necessary. Shut off dewatering system at such a rate to prevent a quick upsurge of water that might weaken the subgrade.
7. Subgrade stabilization: If subgrade under foundations, fill material, floor slabs-on-grade, or equipment support pads is in a frozen, loose, wet, or soft condition before construction is placed thereon, remove frozen, loose, wet, or soft material and replace with approved compacted material as directed by Soils Engineer. Provide compaction density of replacement material as stated in this specification section. Loose, wet, or soft materials, when approved by Soils Engineer, may be stabilized by a compacted working mat of well graded crushed stone. Compact stone mat thoroughly into subgrade to avoid future migration of fines into the stone voids. Remove and replace frozen materials as directed by Soils Engineer. Method of stabilization shall be performed as directed by Soils Engineer. Do not place further construction on the repaired subgrades, until the subgrades have been approved by the Soils Engineer.
8. Do not place floor slabs-on-grade including equipment support pads until subgrade below has been approved, piping has been tested and approved, reinforcement placement has been approved, and Contractor receives approval to commence slab construction. Do not place building floor slabs-on-grade including equipment support pads when temperature of air surrounding the slab and pads is or is expected to be below 40 DegF before structure is completed and heated to a temperature of at least 50 DegF.
9. Drainage: Control grading around structures so that ground is pitched to prevent water from running into excavated areas or damaging structures. Maintain excavations where foundations, floor slabs, equipment support pads or fill material are to be placed free of water. Provide pumping required to keep excavated spaces clear of water during construction. Should any water be encountered in the excavation, notify Engineer and Soils Engineer. Provide free discharge of water by trenches, pumps, wells, well points, or other means as necessary and drain to point of disposal that will not damage existing or new construction or interfere with construction operations.
10. Frost protection: Do not place foundations, slabs-on-grade, equipment support pads, or fill material on frozen ground. When freezing temperatures may be expected, do not excavate to full depth indicated, unless foundations, floor slabs, equipment support pads, or fill material can be placed immediately after excavation has been completed and approved. Protect excavation from frost if placing of concrete or fill is delayed.
    a. Where a concrete slab is a base slab-on-grade located under and within a structure that will not be heated, protect subgrade under the slab from becoming frozen until final acceptance of the Project by the Owner.
    b. Protect subgrade under foundations of a structure from becoming frozen until structure is completed and heated to a temperature of at least 50 DegF.

C. Fill and Backfill Inside of Structure and Below Foundations, Base Slabs, Floor Slabs, Equipment Support Pads and Piping:
1. Structural fill under floor slabs-on-grade: Place all floor slabs-on-grade on a minimum of 6 IN of structural fill unless otherwise indicated.

2. Fill and backfill placement: Prior to placing fill and backfill material, optimum moisture and maximum density properties for proposed material shall be obtained from Soils Engineer. Place fill and backfill material in thin lifts as necessary to obtain required compaction density. Compact material by means of equipment of sufficient size and proper type to obtain specified density. Use hand operated equipment for filling and backfilling next to walls. Do not place fill and backfill when the temperature is less than 40 DegF and when subgrade to receive fill and backfill material is frozen, wet, loose, or soft. Use vibratory equipment to compact granular material; do not use water.
3. Where fill material is required below foundations, place fill material, conforming to the required density and moisture content, outside the exterior limits of foundations located around perimeter of structure the following horizontal distance whichever is greater:
   a. As required to provide fill material to indicated finished grade.
   b. 5 FT.
   c. Distance equal to depth of compacted fill below bottom of foundations.
   d. As directed by Soils Engineer.

D. Filling and Backfilling Outside of Structures. This paragraph of these specifications apply to fill and backfill placed outside of structures above bottom level of both foundations and piping but not under paving. Provide material as approved by Soils Engineer for filling and backfilling outside of structures.
1. Fill and backfill placement: Prior to placing fill and backfill material, obtain optimum moisture and maximum density properties for proposed material from Soils Engineer. Place fill and backfill material in thin lifts as necessary to obtain required compaction density. Compact material with equipment of proper type and size to obtain density specified. Use only hand operated equipment for filling and backfilling next to walls and retaining walls. Do not place fill or backfill material when temperature is less than 40 DegF and when subgrade to receive material is frozen, wet, loose, or soft. Use vibratory equipment for compacting granular material; do not use water.
2. Backfilling against walls:
   a. Do not backfill around any part of structures until each part has reached specified 28-day compressive strength and backfill material has been approved. Do not start backfilling until concrete forms have been removed, trash removed from excavations, pointing of masonry work, concrete finishing, dampproofing and waterproofing have been completed.
   b. Do not place fills against walls until floor slabs at top, bottom, and at intermediate levels of walls are in place and have reached 28-day required compressive strength to prevent wall movement.
   c. Bring backfill and fill up uniformly around the structures and individual walls, piers, or columns.

3.7 SPECIAL REQUIREMENTS

A. Erosion Control: Conduct work to minimize erosion of site. Construct stilling areas to settle and detain eroded material. Remove eroded material washed off site. Clean streets daily of any spillage of dirt, rocks, or debris from equipment entering or leaving site.

END OF SECTION

SECTION 02276
LOW PERMEABILITY SOIL CAP

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Soil used for the low permeability layer of the final cover system.

B. Related Sections include but are not necessarily limited to:
   1. Section 02220 - Earthwork.
   2. Construction Quality Assurance Plan.

1.2 QUALITY STANDARDS

A. Reference Standards:
   1. ASTM - American Society for Testing and Materials:
      a. ASTM D422 - Particle Size Analysis.
      b. ASTM D698 - Standard Proctor.
      c. ASTM D854 - Specific Gravity.
      d. ASTM D1140 - Fines Content in Soils.
      e. ASTM D1556 - In-situ Density Measurement Using the Sand Cone.
      f. ASTM D1557 - Modified Proctor.
      g. ASTM D2166 - Unconfined Compressive Strength.
      h. ASTM D2216 - Moisture Content Using Over-Dry Method.
      i. ASTM D2487 - Soils Classification.
      j. ASTM D2573 - Field Vane Shear Test.
      k. ASTM D2922 - In-situ Density Using Nuclear Methods.
      l. ASTM D3017 - In-situ Moisture Content Using Nuclear Methods.
      m. ASTM D4318 - Atterberg Limits.
      n. ASTM D5084 - Flexible Wall permeameter.
   2. USEPA - United States Environmental Protection Agency
      a. EPA/600/R-93/182 -"Quality Assurance and Quality Control for Waste Containment Facilities," September, 1993.
   3. ASCE – American Society of Civil Engineers.
      a. ASCE Paper No. 25333 – Water Content – Density Criteria for Compacted Soil Liners (Daniel et at, 1998).
      b. ASCE Paper No. 23827 – In-Site Hydraulic Conductivity for Compacted Clay (Daniel et at, 1989).
   4. Construction Quality Assurance (CQA) Plan.

1.3 SUBMITTALS

A. See Section 01340 – Submittals and Section 02220 - Earthwork.

B. Refer to the CQA Plan.

1.4 JOB CONDITIONS

A. Verify conditions of subgrade prior to commencing work.

1.5 TOLERANCES

A. The low permeability soil cap must meet the following tolerances:
   1. The saturated hydraulic permeability of the low permeability soil cap must be equal to or less than 1.0×10^{-5} cm/sec, as determined by ASTM D5084.
   2. The thickness of the low permeability soil cap must be equal to or greater than 18 inches.
   3. The work should be constructed to lines, grades, and control points indicated on the Drawings, and shall be controlled and documented with survey methods. Laser based survey systems are preferred for grading.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Low Permeability Soil - General:
   1. Contractor shall provide natural, fine-grained soil or bentonite amended soil that is capable of being worked to produce a soil layer of thickness shown on the Drawings that meets the hydraulic conductivity requirements.
   2. In accordance with these Specifications, the Contractor is responsible for conducting a borrow soil characterization study (BSCS) of the Owner's on-site borrow area to determine if suitable soils exist for construction of the low permeability soil cap.
   3. Contractor shall provide the CQA Consultant and Owner access to information about the borrow source of the low permeability soil and certify that it is not contaminated with hazardous materials or hazardous wastes.
   4. The soil shall be relatively homogeneous in color and texture and shall be free from roots, stones, foreign objects, and other deleterious materials.
   5. Some soils not meeting the requirements of B.1. and B.4. below, may be acceptable for use in the Work at the sole discretion of the Engineer. The contractor may submit data on soils for the Engineer's review. For the Engineer to approve the materials, the submittal should contain: a statement signed by a qualified professional Engineer that the proposed soils will meet the hydraulic conductivity requirement and are otherwise suitable for use in the Work; and, supporting geotechnical test results and data.
   6. All soils must be approved for use by the Engineer prior to use in the Work.

B. Natural Fine-Grained Soil
   1. Classification: Natural fine-grained soil shall have a classification of CH, CL, MH, ML, SC or SM as determined by ASTM D2488.
   2. Grain sizes shall be within the following gradation:

Sieve Size	Percent Passing by Weight
3/4 IN	100
No. 4	> 90
No. 200	> 30

   3. Hydraulic Conductivity: The saturated hydraulic conductivity of the natural fine-grained soil shall meet the stated tolerances, when compacted in accordance with requirements established by the CQC Consultant and Contractor on the basis of the low permeability soil cap test strip as specified herein.
   4. Other Low Permeability Soil Cap Properties:
      a. The liquid limit shall be determined in the BSCS measured by ASTM D4318.
      b. The plasticity index shall be determined in the BSCS as measured by ASTM D4318.

C. Bentonite Amended Soil (where applicable):
   1. Hydraulic conductivity of constructed bentonite amended soil shall meet the tolerances when compacted in accordance with requirements established by the CQC Consultant on the basis of test results from the low permeability soil cap test strip and the borrow soil characterization study.
   2. Soil used in the bentonite amended soil shall be free from roots, organic matter, debris, particles larger than 3/4 IN, and other deleterious material. All soil used in the bentonite amended soil shall be taken from THE Owner's borrow area.
   3. Unless approved otherwise by the CQC Consultant, the soil used in the bentonite amended soil shall meet the following washed sieve gradation:

Sieve Size	Percent Passing by Weight
¾ IN	100
No. 4	55-100
No. 20	45-75
No. 200	10-40

   4. Bentonite:
      a. Bentonite shall be free-flowing, powdered, high-swelling, sodium montmorillonite clay (bentonite) free of additives.
      b. Acceptable bentonite manufacturers are:
         1) American Colloid, Co., (800) 637-6654.
         2) Bentonite Corp., (303) 291-2940.
         3) CETCO, (813) 527-0605.
         4) Federal Industrial, (800) 231-3565.
         5) WYO-BEN, (800) 548-7055.
      c. The Contractor may propose a bentonite supplier other than those listed above if it is demonstrated that its use in the amended soil satisfies the requirements of these Specifications.

D. Permeability Test
   1. Laboratory permeability tests (ASTM D-5084) shall be conducted in constant head, triaxial type permeameters. The specimens shall be consolidated under an isotropic effective consolidation stress not to exceed 10 psi. The inflow to and outflow from the specimens shall be monitored with time and the coefficient of permeability calculated for each recorded flow increment. The test shall continue until steady state flow is achieved and relatively constant values of coefficient of permeability are measured.

2.2 LOW PERMEABILITY SOIL CAP MATERIAL ACCEPTANCE

A. General: All imported, on-site, and processed materials specified in this Section are subject to the following requirements:
   1. All tests necessary for the Contractor to locate and define acceptable sources of materials shall be made by the CQC Consultant. Certification that the material conforms to the Specification requirements along with copies of the test results from a qualified commercial testing laboratory shall be submitted to the CQA Consultant for approval at least 10 days before the material is required for use. All material samples shall be furnished by the Contractor at the Contractor's sole expense.
   2. All samples required in this Section shall be representative and be clearly marked to show the source of the material and the intended use on the project. Sampling of the material source shall be done by the CQC Consultant in accordance with ASTM D75.
   3. Notify the CQA Consultant at least 24 hours prior to sampling so that they may observe the sampling procedures.
   4. Tentative acceptance of the material source shall be based on an inspection of the source by the CQA Consultant and the certified test results of the Borrow Source Characterization Study (BSCS) as submitted by the Contractor to the CQA Consultant. No imported

materials shall be delivered to the site until the proposed source and materials tests have been accepted in writing by the CQA Consultant.

5. Final acceptance of any material will be based on results of tests made on material samples taken from the completed low permeability soil cap test strip, combined with the results of the BSCS. If tests conducted by the CQC Consultant or the CQA Consultant indicate that the material does not meet Specification requirements, material placement will be terminated until corrective measures are taken. Material which does not conform to the Specification requirements and is placed in the work shall be removed and replaced at the Contractor's sole expense.
6. Contractor shall be solely responsible for obtaining all permits required to obtain acceptable sources of materials for use in the work.

B. Sampling and testing required herein shall be done at the Contractor's sole expense.

C. Borrow Source Characterization Study:

1. The Contractor will be responsible for all processing and screening of the low permeability soil cap material at his own cost to meet the requirements of the Specifications. The Contractor will be responsible for the erosion protection of the stockpile and borrow area during his operation. The Contractor shall coordinate all aspects of this operation with the CQC Consultant, CQA Consultant, and Project Manager.
2. CQC Consultant shall complete a BSCS of natural fine-grained soils or of soil that will be used in bentonite amended soils.
3. Contractor shall conduct tests, including particle size, Atterberg limits, moisture-density, and hydraulic conductivity tests, as necessary to locate an acceptable source of material within the Owner's borrow area.
4. Once a potential source of material has been located, the CQC Consultant shall develop and undertake a testing program to demonstrate the acceptability of the proposed material. Certified results of all tests shall be submitted to the CQA Consultant upon completion of tests. Tentative acceptance of the borrow source by the CQA Consultant will be based upon the results of the study. The testing program shall include the following elements, at a minimum:
   a. An excavation plan for the borrow source indicating proposed surface mining limits and depths of samples to be taken for testing.
   b. Test pits for borrow source sampling shall be appropriately spaced to reflect site geomorphology and sampled at depth intervals appropriate to the proposed excavation methods.
   c. A minimum of 12 samples shall be collected and tested for the parameters required as described in the following paragraphs.
5. Test Parameters and Reporting for Natural Fine-Grained Soils: All samples collected from the proposed borrow area for natural fine-grained soils shall be tested for the following parameters:

Parameter	Test Method
Particle Size (sieve plus hydrometer)	ASTM D422
Atterberg Limits	ASTM D4318
Standard Proctor	ASTM D698
Hydraulic Conductivity(1)	ASTM D5084

   (1) Hydraulic conductivity tests shall be performed on recompacted samples of the proposed material, compacted according to criteria developed by the CQC Consultant using data from tests conducted in accordance with ASTM D698.

6. Test Parameter for Soil to be Used in Bentonite Amended Soil:
   a. Parameters and reporting for soils to be used in bentonite amended soil shall be the same as for natural fine-grained soil.

b. Tests required under this paragraph are part of the BSCS. Additional tests on the bentonite amended soil product are required for low permeability soil cap acceptance. See 2.1E.

D. Borrow Soils Conformance Testing:

1. Following acceptance of a borrow source for natural fine-grained soils and soils for bentonite amendment, the following tests shall be performed by the CQC Consultant on samples taken from the excavated material using the methods and at the frequencies indicated below:

Test	Test Method	Minimum Frequency
Percent Fines	ASTM D1140	1 per 5,000 cu yd
Atterberg Limits	ASTM D4318	1 per 5,000 cu yd
Standard Proctor	ASTM D698	1 per 10,000 cu yd

2. The CQC Consultant shall conduct tests more often if variation in test results is occurring, or if material appears to depart from Specifications.
3. The CQA Consultant may also conduct independent tests to confirm the accuracy of the CQC testing.
4. If tests indicate material does not meet Specification requirements, Contractor shall terminate material placement until corrective measures are taken.
5. Contractor shall remove and replace material which does not meet Specification requirements at no additional cost to the Owner.

E. Bentonite Amended Soil Conformance Testing (where applicable):

1. Following acceptance of a source for soils to be used in bentonite amended soils, the CQC Consultant shall perform a Design Mix Analysis and submit certifications for the imported bentonite material as described below.
2. Design Mix Analysis:
   a. Collect two of the coarsest samples of the soil taken from the approved borrow area (based on percent retained on #200 sieve). Soil samples for testing shall be at least 100 pounds each.
   b. Trial mix samples shall be prepared by mixing each soil sample with three trial application rates of bentonite. Compact each trial mix sample to a dry density equal to 95 percent relative compaction and at a moisture content within the range of optimum to optimum plus 3 percent (ASTM D-698) for the unamended soil.
   c. Test the hydraulic conductivity of the trial mix samples using ASTM D5084 and report all data to CQA Consultant. Graph measured hydraulic conductivity vs. percent bentonite.
   d. Contractor shall select a minimum bentonite content needed to consistently achieve the required in-place hydraulic conductivity.
3. After mix design and initial testing, CQC Consultant shall conduct tests of the mixed bentonite amended soil, after it has been discharged from the pugmill and before this is placed in the work using the following methods and at the following frequencies.

Test	Method	Minimum Frequency
Standard Proctor	ASTM D698	1 per 10,000 cu yd

4. Bentonite: CQC Consultant shall submit certifications from the supplier of the bentonite material that it meets the requirements specified under PART 2, PRODUCTS.

F. Fine-Grained Material Dewatering, Mixing, and Staging

1. Dewatering of low permeability soil cap borrow excavations, if required, shall be solely at the Contractor's expense.
2. Drying, blending, or wetting required to maintain the low permeability soil cap soil at a suitable moisture content shall be solely at the Contractor's expense.

2.3 EQUIPMENT

A. Compaction Equipment:
   1. The compaction equipment shall be of a suitable type, adequate to obtain the permeability specified, that provides a kneading action, such as a wobble-wheeled roller or a sheepsfoot roller having tines as long as the maximum loose lift thickness to ensure proper lift interface compaction free of voids.
   2. The CQC Consultant shall confirm compaction equipment adequacy, and recommend changes if required, based on the low permeability soil cap test strip. Such additional equipment will be provided by Contractor at no additional cost.
   3. The compaction equipment shall be maintained and operated in a condition that will deliver manufacturer's rated compactive effort.
   4. Hand-operated equipment shall be capable of achieving specified soil densities.
   5. The finished surface of the final lift shall be rolled with a smooth steel drum roller or rubber-tired roller to eliminate tine or roller marks and provide a smooth, dense surface. The final lift surface shall be roughened using dozer tracks prior to placement of topsoil in order to allow bonding between the two materials.

B. Moisture Control Equipment:
   1. Equipment for applying water shall be of a type and quality adequate for the work, shall not leak, and shall be equipped with a distributor bar or other approved device to assure uniform application.
   2. Equipment for mixing and drying out material shall consist of blades, discs, or other equipment defined by the CQC Consultant as approved by the CQA Consultant.
   3. Mixing of natural fine-grained soils may also be required to get even distribution of moisture.
   4. Low permeability soil cap material must not be compacted within 24 hours of the adjustment of water content by the addition of water.

C. Bentonite Amended Soil Mixing Equipment (where applicable):
   1. Contractor shall mix, process, and condition the bentonite amended soil in a pugmill prior to placing and compacting the mixture.
   2. The pugmill shall have the capability to break up soil clumps and mix material to form a homogeneous blend. The pugmill shall have controls that allow a variable rate of discharge from it, to control the degree of mixing. The pugmill shall have automated controls to control the rate of feed of each material to within an accuracy of 2 percent by weight.
   3. The pugmill discharge shall be equipped with a batching bin having a drop outlet for loading hauling vehicles directly from the pugmill. Pugmill shall be positioned to allow direct discharge to hauling vehicles.
   4. Contractor shall not store amended soil in a manner or for a length of time that will cause any degradation of the project or amended soil.

PART 3 - EXECUTION

3.1 LOW PERMEABILITY SOIL CAP TEST STRIP

A. Test Strip Installation:
   1. Prior to actual low permeability soil cap installation, a low permeability soil cap test strip of a dimension no less than 100 FT long by 30 FT wide by 1.5 FT thick shall be constructed by the Contractor over a compacted subgrade within the partial closure area.
   2. The low permeability soil cap test strip shall be constructed in 6 IN lifts. The final compacted thickness of each lift shall be a maximum of 6 IN. Prior to placement of successive lifts, the surface of the lift in place shall be scarified or otherwise conditioned to eliminate lift interfaces.
   3. The low permeability soil cap test strip shall be constructed using the same equipment and construction procedures that are anticipated for use during actual cap installation.

4. During test strip installation, the Contractor in coordination with his CQC Consultant and the CQA Consultant shall determine the field procedures that are best suited for his construction equipment to achieve the requirements specified herein.
5. If the test strip fails to achieve the desired results, the soil material of the strip shall be completely removed, and additional test strip(s) shall be constructed until the requirements are met.
6. The CQC Consultant shall document that the subgrade of the test strip low permeability soil cap is properly compacted to at least 95 percent of the maximum dry density, as determined using the Standard Proctor test (ASTM D-698). Field density tests on the subgrade shall be performed by the CQC Consultant and documented at a minimum of three test locations within the test strip area.
7. At least five field density measurements shall be performed by the CQC Consultant on each lift of the low permeability soil cap test strip. The field density tests shall be conducted using a nuclear gauge (ASTM D-2922) or other method, as approved by the CQA Consultant. Corresponding tests for moisture content to determine dry density shall likewise be performed by using a nuclear gauge (ASTM D-3017), or other approved method. On the test pad, the density measurement if performed by a nuclear gauge shall be verified through performance of one sand cone test (ASTM D-1556) or drive tube test (ASTM D-2937) at a location selected by the CQA Consultant. The moisture content measurement, if performed by a nuclear gauge shall be verified by recovering at least five samples for oven-dry testing (ASTM D-2216) from the test location.
8. A composite sample will be taken from each lift for recompacted lab permeability (ASTM D-5084).
9. Upon completion of the low permeability soil cap test strip, the CQC Consultant, as observed by the CQA Consultant, shall measure the thickness of the test strip at a minimum of five random locations.
10. A minimum of five random samples of the low permeability soil cap construction materials delivered to the site during test strip installation shall be tested by the CQC Consultant for moisture content (ASTM D-2216), sieve analyses (ASTM D-421, D-422) and Atterberg limits (ASTM D-4318).
11. The CQC Consultant shall conduct at least one standard Proctor (ASTM D-698) and one modified Proctor (ASTM D-1557) compaction test on bag samples of the test strip material to determine the moisture-density relationships.
12. A minimum of one undisturbed sample shall be taken from each lift of the test strip by the CQC Consultant for laboratory hydraulic conductivity testing. The samples shall be taken within a 2 FT radius of the in-situ density and moisture tests. The CQA Consultant will also conduct at least one confirmatory in-situ hydraulic conductivity testing.
13. The data gathered from the test strip sampling (i.e., field density, moisture, undisturbed samples, and in-situ hydraulic conductivity) shall be used along with the Proctor curve for the soil to develop a range of acceptable moisture and density test values which are likely to be consistent with the required maximum permeability. This range of moisture/density values will be established by the CQC Consultant and the CQA Consultant and will be utilized as a means to establish Pass/Fail Criteria for the area to be lined by the subject material.
14. The test strip will be considered acceptable if the measured hydraulic conductivity of the test strip as determined by ASTM D-5084 meets the requirements of the Specifications.
15. If field and laboratory test data indicate that the installed test strip meets the requirements of this Specification, it may be used as part of the low permeability soil cap provided that it is adequately protected by the Installer from drying and equipment damage after installation. The Installer shall scarify the material along the edge of the test strip. A minimum 2 FT overlap per lift is required for mixing and compaction between the test strip and the low permeability soil cap.
16. If the test strip fails to meet Specifications, additional mix designs (if bentonite amended) and/or test strips will be constructed until a test strip meets the requirements. No low permeability soil cap may be placed until a test strip has been accepted by the CQA Consultant.

17. Upon receipt of the test data from the CQA Consultant, the Project Manager shall inform the Contractor if the test strip can remain in-place as part of the low permeability soil cap.

3.2 INSTALLATION

A. The subgrade of the low permeability soil cap shall be smooth and free of vegetation, sticks, roots, foreign objects, and debris. It shall be the responsibility of the Contractor to keep the receiving surfaces in the accepted condition until complete installation of the low permeability soil cap is accomplished.

B. The subgrade shall be proofrolled with a pneumatic tired vehicle of at least 20 tons GVW, making passes across the area as directed by the CQC and/or CQA Consultants. The low permeability soil cap shall not be placed over areas deemed unacceptable by either the CQC or CQA Consultants based on proofroll observations or inadequate test results.

C. The low permeability soil cap shall be installed in 6 IN compacted lifts. The material shall be placed consistent with criteria developed from construction of a satisfactory test strip.

D. When particles exceeding ¾ IN are observed at the final lift surface, they shall be removed by the Contractor prior to final rolling of the surface.

E. Equipment shall be used such that bonding of the lifts will occur. Equipment shall have cleats or other protrusions of such length necessary to completely penetrate into the loose lift. Compaction shall be performed using appropriately heavy, properly ballasted, penetrating foot compactor making a minimum number of passes as approved by the CQC Consultant and CQA Consultant based on the low permeability soil cap test strip.

F. If desiccation and crusting of the lift surface occurs prior to placement of the next lift, this area shall be scarified to a minimum depth of 2 IN or until sufficiently moist materials are encountered, whichever is greater. After scarification, the superficial material should be reworked to obtain a moisture content at least 2 percent above optimum moisture content. Alternately, the drier superficial soil may be stripped and mixed with additional moist soil to achieve a moisture content satisfying the project requirements.

G. No frozen material shall be placed.

H. Material shall not be placed on a previous lift which is frozen. Frozen in-place material shall be removed prior to placement of additional soil material.

I. Material which has been subjected to a freeze/thaw cycle(s) shall be disked and recompacted prior to placement of subsequent lifts.

J. During construction, exposed finished lifts of the low permeability soil cap material should be sprinkled with water to minimize desiccation, as necessary. The Contractor is responsible to protect the low permeability soil cap from rain, drying, desiccation, erosion and freezing. All defective areas shall be repaired by the Contractor to the satisfaction of the CQC Consultant at no extra compensation.

K. At the end of each day's construction activities, completed lifts or sections of the compacted low permeability soil cap should be sealed. Common sealing methods include rolling with a rubber tired or smooth-drum roller, backdragging with a bulldozer, or placement of temporary cover soil over the compacted low permeability soil cap. The compacted low permeability soil cap should be sprinkled with water, as needed.

L. If testing shows that a lift is significantly thicker than 6 IN, the top of the lift will be shaved off so that the lift is approximately 6 IN thick.

3.3 FIELD QUALITY CONTROL AND QUALITY ASSURANCE

A. Refer to the Specifications and Drawings.

B. The following field and laboratory quality control tests shall be performed by the CQC Consultant at no additional expense to the Owner during low permeability soil cap construction:

Test	Method	Minimum Frequency	Acceptable Criteria
1. Field Density	ASTM D2937	1 per every 2 acres	≥ 95%
	or		
	ASTM D2937	1/5 D3017 tests	≥ 95%
	ASTM D3017	1 per every 2 acres	≥ 95%
2. Thickness	Surveyor	8 locations/acre	≥ 18 IN
3. Atterberg Limits	ASTM D4318	1 per every 2 acres	Liquid Limit ≥ 25 Plasticity Index ≥ 10, < 30
4. Fines Content	ASTM D1140	1 per every 2 acres	> 30%
5. Hydraulic Conductivity	ASTM D5084	1 per every 5 acres	$\leq 1x10^{-5}$ cm/sec
6. Laboratory Moisture Density Relationship	ASTM D698	1 per every 2 acres	NA

C. Test methods shall also conform to criteria set forth in Paragraph 3.1, Low Permeability Soil Cap Test Strip.

D. Test frequencies may be modified by the CQA Consultant. If there are indications of declining or failing test results, frequencies may be increased. If hydraulic conductivity test results are well above acceptable, the frequency for Atterberg limit and fine content testing may be waived by the Engineer.

E. The acceptable criteria may be modified by the CQA Consultant if supported by the test strip results and approved by the Engineer.

F. Holes in the compacted low permeability soil cap created as a result of destructive testing (eg., thin-walled Shelby tube sampling and nuclear gauge, field density determinations) shall be backfilled and tamped by rod uniformly in 2 IN thick lifts. The backfill material shall be the same low permeability soil cap construction material or hydrated bentonite powder, if approved by the CQA Consultant. On the surface, the backfill material shall extend slightly beyond the holes to make sure that a good tie-in with the surrounding low permeability soil cap is achieved. Repaired areas shall be observed and documented by the CQC Consultant.

G. Give minimum of 24 HR advance notice to CQA Consultant when ready for soil testing and inspection in completed area of the low permeability soil cap.

H. For areas not meeting field and laboratory testing criteria, the Contractor shall scarify the full depth of the lift or replace the material as needed. The material shall be reshaped, rewetted as needed, rehomogenized and recompacted to the specified density. Areas not meeting the thickness requirements shall be augmented with additional materials. The added materials shall be reworked with the soil layer to ensure homogeneity and proper bonding. This may be done by scarification of the surface prior to addition of new material. The repaired area shall be properly documented, and field and laboratory quality control testing shall be performed to ensure the repaired low permeability soil cap section meets the requirements specified herein.

I. The Contractor shall pay for all costs associated with corrective work and retesting resulting from failing tests. The CQA Consultant shall be informed immediately of all failing tests.

END OF SECTION

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SECTION 02485
SEEDING

PART 1 - GENERAL

1.1 DESCRIPTION

A. General:
   1. Furnish all labor, materials, tools, equipment and services for seeding in accordance with provisions of Contract Documents.
   2. Completely coordinate with work of all other trades.
   3. See Division 1 for General Requirements.

B. Related work specified elsewhere:
   1. Section 02220 - Earthwork.
   2. Section 02270 – Soil Erosion and Sediment Control.

C. Location of work: All disturbed areas, exclusive of road surfaces.

1.2 QUALITY ASSURANCE

A. Fertilizer testing: Current methods of Association of Official Agricultural Chemists.
   1. Testing will be conducted at discretion of Engineer.

1.3 SUBMITTALS

A. See Section 01340.

B. Shop drawing submittals:
   1. Soil test results with recommendations of lime and nutrient needs.
   2. Grass seed mix that will be used for the project and application rate.
   3. Mulch type.
   4. A plan view drawing that depicts the areas to be seeded with areas measured.
   5. Certificates for each grass seed mixture, stating botanical and common name, percentage by weight, and percentages of purity, germination, and weed seed.

C. Miscellaneous Submittals:
   1. Copies of fertilizer and lime invoices, showing grade furnished and total quantity applied.
   2. A plan view drawing that depicts the areas that were seeded with concurrence from the CQA.
   3. Soil test results as required by Section 3.3 of this specification.
   4. Written warranty as required by Section 3.4 of this specification.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Establish a smooth, healthy, uniform, close strand of grass from specified seed.

B. Grass seed: Fresh, clean, latest available crop.
   1. Seeds shall meet state seed requirements and those of the Federal Seed Act.
   2. Species, proportions and minimum percentage of purity, germination, and maximum percentage of weed seed, as specified.
      a. Minimum percent purity 96%.
      b. Minimum percent germination 80%.
      c. Maximum percent weed seed 1%.
   3. All seed used shall comply with state noxious weed seed requirements.

C. Mulch: Clean, seed-free, threshed straw of oats, wheat, barley, rye, beans, or other locally available mulch material.
   1. Straw mulch:
      a. Do not use mulch containing a quantity of matured noxious weed seeds or other species that will be detrimental to seeding, or provide a menace to surrounding land.
      b. Do not use mulch material which is fresh or excessively brittle, or which is decomposed and will smother or retard growth of grass.
   2. Wood fiber and cellulose fiber mulch:
      a. Materials: Wood fiber, cellulose fiber, dark green marker dye.
      b. pH: 5.
      c. Moisture content: 12%.
      d. Wood fiber: 70% minimum.
      e. Cellulose fiber: 30% maximum.
      f. Organic content: 97%.
      g. Ash content: 1.6%.
      h. Water holding capacity: 1100% minimum.

D. Fertilizer: Commercial grade fertilizer meeting applicable requirements of State and Federal law.
   1. Do not use cyanamic compounds of hydrated lime.

E. Limestone: agricultural grade ground limestone containing not less than 85 percent of combined calcium and magnesium carbonates.
   1. 50 percent passing 100 mesh sieve.
   2. 90 percent passing 20 mesh sieve.

F. Asphalt binder: Rapid setting emulsified asphalt.

G. Water: Potable, free of substances harmful to growth.

H. Erosion Control Matting: Material shall be placed as shown on the Drawings.

2.2 DELIVERY, STORAGE AND HANDLING

A. Deliver seed in standard sealed containers labeled with producer's name and seed analysis, and in accord with US Department of Agriculture Rules and Regulations under Federal Seed Act.

B. Deliver fertilizer in original containers labeled with content analysis.

PART 3 - EXECUTION

3.1 JOB CONDITIONS

A. This project shall comply with the planting regime for the Piedmont Region.

B. Perform spring seeding between March 1 and May 15, and fall seeding between September 1 and November 1, or upon approval of the Engineer.

C. Permanent Seeding
   1. Spring (March 1 – April 30) and Fall (September 1 – November 15)
      a. Kentucky-31: 175 lbs/ac.
      b. Unhulled sercia lespedeza: 50 lbs/ac.
      c. Rye grain: 1 bushel/ac.
   2. Winter (November 16 – February 28)
      a. Kentucky-31: 200 lbs/ac.
      b. Unhulled sercia lespedeza: 50 lbs/ac.
      c. Rye Grain: 3 bushels/ac.
   3. Summer (May 1 – August 31)
      a. Kentucky-31: 50 lbs/ac.
      b. Unhulled sercia lespedeza: 50 lbs/ac.
      c. Korean or kobe lespedeza: 50 lbs/ac.

d. Weeping love grass: 5 lbs/ac.
e. Bermuda grass: 10 lbs/ac.
f. Millet: 1 bushel/ac.

D. Temporary Seeding

1. Provide winter rye at a rate of 224 lbs/acre.

3.2 SOIL PREPARATION

A. Project manager (as defined in Section 01040) to approve area after the surface is prepared and prior to seeding. If area is seeded without approval from project manager and the project manager requires the area to be disturbed, the Contractor shall reseed the area without additional cost to the Owner.

B. Limit preparation to areas which will be planted soon after preparation.

C. Loosen surface to minimum depth of four (4) IN.

D. Remove stones over one (1) IN in any dimension, sticks, roots, rubbish and other extraneous matter.

E. Test soil pH using test kits approved by USDA NRCS. Use test results to determine rate of lime application needed to make soil circumneutral. Provide application rate to Engineer for approval prior to its application.

F. Spread lime uniformly over designated areas at rate determined by soil testing.

G. After application of lime, prior to applying fertilizer, loosen areas to be seeded with double disc or other suitable device if soil has become hard or compacted. Correct any surface irregularities in order to prevent pocket or low areas which will allow water to stand.

H. Test soil fertility according to USDA NRCS approved methods. Use test results to determine rate of fertilizer application. Engineer will approve fertilizer application rate prior to application.

I. Distribute fertilizer uniformly over areas to be seeded at a rate determined by soil testing.
1. Use suitable distributor.
2. Incorporate fertilizer into soil to depth of at least two (2) IN.
3. Remove stones or other substances which will interfere with turf development or subsequent mowing.

J. Grade seeded areas to smooth, even surface with loose, uniformly fine texture.
1. Roll and rake, remove ridges and fill depressions, as required to meet finish grades.
2. Fine grade just prior to planting.

K. Restore seeded areas to specified condition if eroded or otherwise disturbed between fine grading and planting.

L. If fertilizer or lime application rate is determined (by invoices submitted) to be less than that specified, apply additional fertilizer and/or lime.

M. Protect seeded areas.

3.3 SEEDING

A. Do not use seed which is wet, moldy, or otherwise damaged.

B. Use approved mechanical power driven drills or seeders, or mechanical hand seeders, or other approved equipment.

C. Distribute seed evenly over entire area at not less than 7LB/1000 SF, 50 percent sown in one direction, remainder at right angles to first sowing.

D. Stop work when work extends beyond most favorable planting season for species designated, or when satisfactory results cannot be obtained because of drought, high winds, excessive moisture, or other factors.

E. Resume work only when favorable condition develops.

F. Lightly rake seed into soil followed by light rolling or Culti-packing.

G. Immediately protect seeded areas against erosion by mulching or placing erosion control matting. Use erosion control matting for all repair areas. Use mulching only in areas requiring overseeding due to sparse or damaged vegetation, such as temporary construction access routes, where placing matting over existing vegetation is impractical.
   1. Spread mulch in a continuous blanket using 1-1/2 TON/ACRE to depth of 4 or 5 straws.
   2. Immediately following spreading mulch, secure with evenly distributed emulsified asphalt at rate of 200 gal/acre or use mulch anchoring tool or netting.
   3. Protect all repair areas with approved erosion control matting. Install in accordance with manufacturer's recommendations.

H. Immediately after planting, water to a reasonable depth.

I. Clean-up: Remove any soil or similar material from paved areas within same working day. Upon completion of seeding, remove all excess soil, stones, and other debris from site or dispose as directed by Owner. Repair all damages to existing construction caused by lawn operations to the satisfaction of Engineer and Owner at no additional cost to Owner

3.4 MAINTENANCE

A. Remulch with new mulch or place new erosion control matting in areas where mulch or matting has been disturbed by wind or maintenance operations sufficiently to nullify its purpose. Anchor as required to prevent displacement.

B. Replant bare areas using same materials specified.

C. Contractor shall supply sufficient water until grass is established.

D. Contractor shall warranty work for one year from date of project final completion.

E. If stand is over 40% damaged for any reason either during construction or within one year of project final completion, re-establish stand in the area damaged and extend warranty for that area by six months from the date stand is established.

F. Restore seeded areas to specified condition if eroded or otherwise disturbed during construction.

3.5 WARRANTY

A. Contractor shall warranty the work for one year from date of final acceptance by the Owner.

END OF SECTION

Appendix G

WHITE STREET LANDFILL

Greensboro, North Carolina

CONSTRUCTION QUALITY ASSURANCE PLAN

PHASE II CLOSURE

Prepared for:

GREENSBORO®

Prepared by:

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Charlotte, NC 28202-5001

HDR Project No. 06770-109019-018

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SECTION 1.0
GENERAL

1.1 INTRODUCTION

This Construction Quality Assurance (CQA) Plan (Plan) has been prepared to provide the Owner, Engineer, and CQA Consultant the means to govern the construction quality and to satisfy landfill certification requirements under current solid waste management regulations.

More specifically, this Plan addresses the soils components of the closure cap system. The cap system, as referenced herein, generally consists of a compacted low permeability soil layer and a topsoil layer. General references to the various components in this Plan as the "cap system" is intended to be as described herein.

The Plan is divided into the following sections:

Section 1.0	General
Section 2.0	Low Permeability Soil Cap Construction Quality Assurance
Section 3.0	Topsoil Layer Construction Quality Assurance
Section 4.0	Surveying Construction Quality Control
Section 5.0	Construction Quality Assurance Documentation

1.2 DEFINITIONS RELATING TO CONSTRUCTION QUALITY

1.2.1 Construction Quality Assurance (CQA)

In the context of this Plan, CQA is defined as a planned and systematic program employed by the Owner to assure conformity of the cap system installation with Contract Drawings and the project specifications. CQA is provided by the CQA Consultant as a representative of the Owner and is independent from the Contractor and all manufacturers. The CQA program is designed to provide adequate confidence that items or services meet contractual and regulatory requirements and will perform satisfactorily in service.

1.2.2 Construction Quality Control (CQC)

Construction Quality Control (CQC) refers to actions taken the Contractor to ensure that the materials and the workmanship meet the requirements of this Plan and the project specifications. In the case of the cap system, CQC is provided by the Contractor's CQC Consultant.

1.2.3 CQC/CQA Certification Document

At the completion of construction, a certification document will be prepared by the CQA Consultant and be submitted to State Solid Waste Regulators. The certification report will include all CQC testing performed by the CQC Consultant and all CQA conformance testing performed by the CQA Consultant.

1.2.4 Discrepancies Between Documents

The Plan is intended to be a supporting document to improve the overall documentation of the Work. The Plan is less specific from the project specifications, and conflicts may exist between the documents. The Contractor is instructed to bring discrepancies to the attention of the Engineer or CQA Consultant for resolution. The Engineer has the sole authority to determine resolution of discrepancies existing within the Contract Documents. Unless otherwise determined by the Engineer, the more stringent requirement shall be the controlling resolution. Reference is made to the project specifications, Section 00700 - General Conditions.

1.3 PARTIES TO CONSTRUCTION QUALITY ASSURANCE

1.3.1 Description of the Parties

The parties to CQA and QC include the Owner, Project Manager, Engineer, Contractor, CQA Consultant, soils CQA laboratory, CQC Consultant, and soils CQC laboratory. The lines of authority and communications between each of the parties involved in the CQA and CQC are illustrated in Figure 1 (see page 4).

1.3.1.1 Owner

The Owner is the City of Greensboro (City), who owns and/or is responsible for the facility.

1.3.1.2 Project Manager

The Project Manager is the official representative of the Owner. The Project Manager serves as communications coordinator for the project, initiating the resolution, preconstruction, and construction meetings outlined in Section 1.7. The Project Manager shall also be responsible for proper resolution of all quality issues that arise during construction.

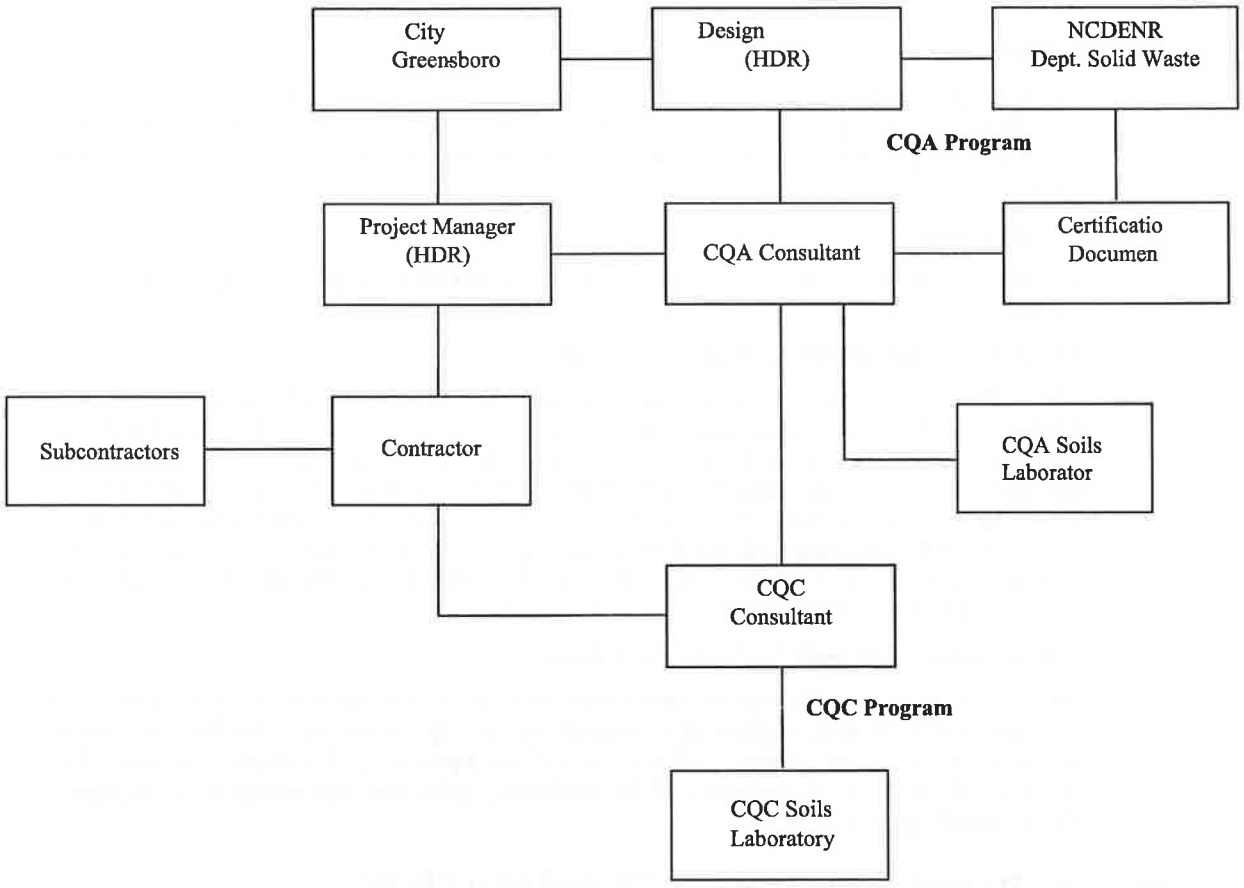
1.3.1.3 Engineer

The Engineer is responsible for the engineering design, drawings, plans, and project specifications for the cap system.

1.3.1.4 Contractor

The Contractor is responsible for the construction of the low permeability soil cap and topsoil layer. The Contractor is responsible for submittal coordination and the overall CQC on the project.

Figure 1 - CQA/CQC Lines of Authority and Communication



1.3.1.5 Construction Quality Assurance Consultant

The CQA Consultant is a representative of the Owner and is responsible for observing, testing, and documenting activities related to the CQC/CQA of the earthworks at the site. The CQA Consultant is also responsible for issuing a facility certification report, sealed by a Professional Engineer registered in North Carolina.

1.3.1.6 Soils Construction Quality Assurance Laboratory

The soils CQA laboratory is a party, independent from the Owner, that is responsible for conducting geotechnical tests on conformance samples of soils used in the cap system. The soils CQA laboratory service cannot be provided by any party involved with the Contractor.

1.3.1.7 Construction Quality Control Consultant

The CQC Consultant is a representative of the Contractor and is responsible for the earthwork and low permeability soil cap quality control sampling and testing. The term CQC Consultant shall be used to designate the Engineer in charge of the QC work. The personnel of the CQC Consultant also includes QC monitors, who are also located at the site for construction observation and monitoring. The CQC Consultant is responsible for the timely conveyance of CQC testing results to the CQA Consultant.

1.3.1.8 Soils Construction Quality Control Laboratory

The Soils CQC laboratory is a party, independent from the Contractor, which is responsible for conducting geotechnical tests on conformance samples of soils used in the cap system.

1.3.2 Qualifications of the Parties

The following qualifications are required of all parties involved with the manufacture, fabrication, installation, transportation, and CQC/CQA of all materials for the cap system. Where applicable, these qualifications must be submitted by the Contractor to the Project Manager for review and approval.

1.3.2.1 Contractor

Qualifications of the Contractor are specific to the construction contract and independent of this CQA Plan.

1.3.2.2 Construction Quality Assurance Consultant

The CQA Consultant will act as the Owner's CQA Representative and will report to the Project Manager. The CQA Consultant will perform conformance testing to satisfy the requirements of this Plan, will observe the CQC work performed by the CQC Consultant, and will prepare the certification document incorporating both CQA and CQC test data. The CQA Consultant will have experience in the CQC/CQA aspects of landfill cap system construction and soils testing, and be familiar with American Society of Testing and Materials (ASTM) and other related industry standards. The activities of the CQA Consultant will be performed under the supervision of a registered Professional Engineer.

1.3.2.3 Construction Quality Control Consultant

The CQC Consultant will be a party, independent from the Contractor. The CQC Consultant will be experienced with soils, including low permeability soil caps. The CQC Consultant will satisfy the requirements of the project specifications and be approved by the Project Manager. The activities of the CQC Consultant will be performed under the supervision of a registered Professional Engineer.

1.4 SCOPE OF CONSTRUCTION QUALITY ASSURANCE PLAN

The scope of this Plan includes the CQA of the soils components of the cap system for the subject facility. The CQA for the selection, evaluation, and placement of the soils is included in the scope. This document is intended to be used in concert with the CQC requirements presented in the project specifications.

1.5 UNITS

In this Plan, all properties and dimensions are expressed in United States units.

1.6 REFERENCES

The Plan includes references to the most recent version of the test procedures of the ASTM.

1.7 SITE AND PROJECT CONTROL

To guarantee a high degree of quality during installation, clear, open channels of communication are essential. To that end, meetings are critical.

1.7.1 CQA/CQC Resolution Meeting

Prior to field mobilization by the Contractor, a Resolution Meeting will be held. This meeting will include all parties then involved, including the Project Manager, the CQA Consultant, the Engineer, the Contractor, and the CQC Consultant.

The purpose of this meeting is to begin planning for coordination of tasks, anticipate any problems which might cause difficulties and delays in construction, and, above all, review the

CQA and CQC Plans to all of the parties involved. It is imperative that the rules regarding testing, repair, etc., be known and accepted by all.

This meeting should include all of the following activities:

- communicate to all parties any relevant documents;
- review critical design details of the project;
- review the site-specific CQA and CQC Plans;
- make any appropriate modifications to the CQA and CQC Plans to ensure that they specify all testing activities that are necessary;
- reach a consensus on the CQA/CQC quality control procedures, especially on methods for determining acceptability of the soils;
- review the proposed cap system;
- select testing equipment and review protocols for testing and placement of general earthwork materials;
- confirm methods for the low permeability soil cap material selection testing, acceptable zone determinations, and test strip installation; and
- confirm the methods for documenting and reporting, for distributing documents and reports, and confirm the lines of authority and communication.

The meeting will be documented by the Project Manager and minutes will be transmitted to all parties.

1.7.2 CQA/CQC Preconstruction Meeting

A Preconstruction Meeting will be held at the site prior to placement of the low permeability soil cap. At a minimum, the meeting will be attended by the Project Manager, Engineer, the CQA Consultant, the Contractor, and the CQC Consultant.

Specific topics considered for this meeting include:

- make any appropriate modifications to the CQA and CQC Plans;
- review the responsibilities of each party;
- review lines of authority and communication;
- review methods for documenting and reporting, and for distributing documents and reports;
- establish protocols for testing;
- establish protocols for handling deficiencies, repairs, and retesting;
- review the time schedule for all operations;
- review repair procedures; and
- establish soil stockpiling locations (if any).

The meeting will be documented by the Project Manager and minutes will be transmitted to all parties. The Resolution Meeting and the Preconstruction Meeting may be held as one meeting or separate meetings, depending on the direction of the Project Manager.

1.7.3 Daily and Weekly CQA/CQC Progress Meetings

A weekly progress meeting will be held between the Project Manager, the CQA Consultant, the Contractor, the CQC Consultant, and representatives from any other involved parties. This meeting will discuss current progress, planned activities for the next week, and any new business or revisions to the work. The CQA Consultant will log any problems, decisions or questions arising at this meeting in his daily report. Any matter requiring action which is raised in this meeting will be reported to the appropriate parties.

A daily meeting will be held between the CQA Consultant, the CQC Consultant, and representatives from any other involved parties. This meeting will discuss current progress, planned activities for the next shift, and any new business or revisions to the work. The CQA Consultant will log any problems, decisions, or questions arising at this meeting in his daily report. Any matter requiring action which is raised in this meeting will be reported to the appropriate parties.

Meeting frequency will depend on the schedule of the project and the mutual agreement of all parties involved.

1.7.4 Problem or Work Deficiency Meetings

A special meeting will be held when and if a problem or deficiency is present or likely to occur. At a minimum, the meeting will be attended by all interested parties, the Contractor, the Project Manager, and the CQA Consultant. If the problem requires a design modification, the Engineer should also be present. The purpose of the meeting is to define and resolve the problem or work deficiency as follows:

- define and discuss the problem or deficiency;
- review alternative solutions; and
- implement an action plan to resolve the problem or deficiency.

The meeting will be documented by the Project Manager and minutes will be transmitted to affected parties.

SECTION 2.0
LOW PERMEABILITY SOIL CAP CONSTRUCTION QUALITY ASSURANCE

2.1 INTRODUCTION

This section of the Plan addresses the low permeability soil cap, and outlines the soils CQA program to be implemented with regard to materials confirmation, laboratory and field confirmation test requirements, overview and interfacing with the Contractor's CQC Program, and resolution of problems.

2.2 LOW PERMEABILITY SOIL CAP

2.2.1 Subgrade

The subgrade material below the low permeability soil cap will be prepared by the Contractor prior to the placement of fill. The CQC Consultant will provide density testing of the pre-fill subgrade at the frequency specified in the project specifications. The CQA Consultant will observe the proofroll by the Contractor, review the density test data provided by the CQC Consultant, and provide verification that the pre-fill subgrade is acceptable. The CQA Consultant may conduct confirmation density testing as deemed appropriate. The CQA Consultant will visually examine the surface of the subgrade to verify that any potentially deleterious materials have been removed.

The subgrade material below the low permeability soil cap is composed of controlled fill and in situ soils. The Contractor shall place controlled fill as required to cover exposed waste and to fill depressions in the subgrade in accordance with the project specifications. The CQC Consultant shall provide testing of the controlled fill material in accordance with the project specifications. The CQA Consultant will provide confirmation testing of the controlled fill as deemed appropriate.

2.2.2 Low Permeability Soil Cap Material

The low permeability soil cap shall be placed and compacted in accordance with the project specifications. The CQC Consultant shall conduct field density and moisture tests at the frequency presented in the project specifications. The CQA Consultant shall provide conformance tests at a frequency of approximately 10 percent of the required CQC tests. Additional CQA conformance testing may be performed at the discretion of the CQA Consultant.

Hydraulic Conductivity, Atterberg Limits, and Percent Fines testing of the low permeability soil cap material shall be performed by the CQC Consultant in accordance with the project specifications. Additional CQA conformance testing may be performed at the discretion of the CQA Consultant.

Thickness measurement shall be conducted in accordance with the project specifications by the CQC Consultant and observed by the CQA Consultant.

2.3 SOILS TESTING

2.3.1 Test Methods

All testing used to evaluate the suitability or conformance of soils materials will be carried out in accordance with the project specifications.

2.3.2 Soils Testing Requirements

The soil CQC testing must comply with the minimum frequencies presented in the project specifications. The frequency of CQA testing required will be determined by the CQA Consultant in light of the potential variability of materials and the acceptance/failure rate of the CQC testing.

2.4 LOW PERMEABILITY SOIL CAP CONSTRUCTION QUALITY ASSURANCE

CQA will be performed on low permeability soil cap construction. CQA evaluation will consist of: (1) monitoring the work and observing the CQC testing; and (2) performing laboratory and field conformance tests. Laboratory CQA conformance tests will be conducted on samples taken at the borrow source, stockpile, and during the course of the work prior to construction. Field CQA conformance tests will be conducted during the course of the work.

2.4.1 Monitoring

The CQA Consultant shall monitor and document the construction of the low permeability soil cap. Monitoring the construction work for the subgrade and the soil cap includes the following:

- observing CQC testing to determine the water content and other physical properties of the subgrade and low permeability soil cap during compaction and compilation of the data;
- monitoring the loose thickness of lifts as placed;
- monitoring the action of the compaction and/or heavy hauling equipment on the construction surface (i.e., penetration, pumping, cracking. etc.); and
- monitoring the number of passes used to compact each lift.

2.4.2 Construction Quality Assurance Judgmental Testing

During construction, the frequency of conformance testing may be increased at the discretion of the CQA Consultant when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas will be considered when:

- the rollers slip during rolling operation;
- the lift thickness is greater than specified;
- the fill material is at an improper moisture content;
- fewer than the specified number of roller passes are made;
- dirt-clogged rollers are used to compact the material;
- the rollers may not have used optimum ballast;
- the fill materials differ substantially from those specified; or
- the degree of compaction is doubtful.

2.4.3 Perforations in Cap

Perforations that must be filled will include, but not be limited to, the following:

- nuclear density test probe locations;
- permeability sampling locations; and/or
- thickness checks.

Unless otherwise noted, or as directed by the Project Manager, all perforations of the subgrade and low permeability soil cap by probes or sample tubes will be backfilled in accordance with project specifications. The CQA Consultant will observe and confirm that adequate procedures are being employed.

2.4.4 Deficiencies

If a defect is discovered in the low permeability soil cap product, the CQC Consultant will immediately determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQC Consultant will determine the extent of the deficient area by additional tests, observations, a review of records, or other appropriate means. If the defect is related to adverse site conditions, such as overly wet soils or surface desiccation, the CQC Consultant will define the limits and nature of the defect.

2.4.4.1 Notification

After determining the extent and nature of a defect, the CQC Consultant will notify the Project Manager, the CQA Consultant, and Contractor and schedule appropriate retests when the work deficiency is corrected. The CQA Consultant shall observe all retests on defects.

2.4.4.2 Repairs and Retesting

The Contractor will correct the deficiency to the satisfaction of the CQA Consultant. If a project specification criterion cannot be met, or unusual weather conditions hinder work, then the CQC Consultant will develop and present to the Project Manager and CQA Consultant suggested solutions for approval.

All retests recommended by the CQC Consultant must verify that the defect has been corrected before any additional work is performed by the Contractor in the area of the deficiency. The CQA Consultant will verify that all installation requirements are met and that all submittals are provided.

SECTION 3.0
TOPSOIL LAYER CONSTRUCTION QUALITY ASSURANCE

3.1 INTRODUCTION

This section of the Plan addresses the topsoil layer of the cap system and outlines the CQA program to be implemented with regard to materials confirmation, laboratory and field test requirements, overview and interfacing with the Contractor's CQC Program, and resolution of problems.

3.2 TOPSOIL LAYER

3.2.1 Topsoil Layer Material

The topsoil layer shall be placed in accordance with the project specifications. The CQC Consultant will provide thickness testing of the material at the frequency specified in the project specifications.

3.3 MATERIALS TESTING

3.3.1 Test Methods

All testing used to evaluate the suitability or conformance of topsoil layer materials will be carried out in accordance with the project specifications.

3.3.2 Material Testing Requirements

The material CQC testing must comply with the minimum frequencies presented in the project specifications. The frequency of CQA testing will be determined by the CQA Consultant in light of the potential variability of the materials and the acceptance/failure rate of the CQC testing.

3.4 TOPSOIL LAYER CONSTRUCTION QUALITY ASSURANCE

CQA evaluation of the topsoil layer will consist of monitoring the work and observing the CQC testing.

3.4.1 Monitoring

The CQA Consultant shall monitor and document the construction of the topsoil layer. Monitoring the construction work for the topsoil layer includes the following:

- verifying material meets specification requirements for topsoil;
- monitor placement of material to ensure that it is accomplished in a manner that does not damage the low permeability soil cap;
- review CQC Consultant thickness testing results and conduct confirmation thickness testing as deemed appropriate; and,
- verify that the finished surface is free of stones, sticks, or other material 1 IN or more in any dimension and suitable for seeding.

3.4.2 Deficiencies

If a defect is discovered in the topsoil layer product, the CQC Consultant will immediately determine the extent and nature of the defect and report it to the CQA Consultant. If the defect is indicated by an unsatisfactory test result, the CQC Consultant will determine the extent of the deficient area by additional tests, observations, a review of records, or other means that the CQA Consultant deems appropriate.

3.5.2.1 Notification

After determining the extent and nature of a defect, the CQC Consultant will notify the Project Manager and Contractor and schedule appropriate retests when the work deficiency is corrected. The CQA Consultant shall observe all retests on defects.

3.5.2.2 Repairs and Retesting

The Contractor will correct the deficiency to the satisfaction of the CQA Consultant. If a project specification criterion cannot be met, or unusual weather conditions hinder work, then the CQC Consultant will develop and present to the Project Manager suggested solutions for his approval.

All retests recommended by the CQC Consultant must verify that the defect has been corrected before any additional work is performed by the Contractor in the area of the deficiency. The CQA Consultant will verify that all installation requirements are met and that all submittals are provided.

SECTION 4.0
SURVEYING CONSTRUCTION QUALITY CONTROL

4.1 INTRODUCTION

Surveying of lines and grades is conducted on an ongoing basis during construction of the cap system. Close CQC of the surveying is absolutely essential to ensure that slopes are properly constructed. The surveying conducted at the site shall be performed by the Contractor.

4.2 SURVEY CONTROL

Permanent benchmarks and baseline control points are to be established for the site at locations convenient for daily tie-in. The vertical and horizontal controls for this benchmark will be established within normal land surveying standards.

4.3 SURVEYING PERSONNEL

The Contractor's survey crew will consist of a senior surveyor, and as many surveying CQC monitors as are required to satisfactorily undertake the requirements for the work. All surveying CQC Personnel will be experienced in the provision of these services, including detailed, and accurate documentation.

All surveying will be performed under the direct supervision of a registered Professional Engineer or Licensed Land Surveyor licensed in the state in which the project is located. The Licensed Land Surveyor may be the senior surveyor.

4.4 PRECISION AND ACCURACY

A wide variety of survey equipment is available to meet the requirements of this project. The survey instruments used for this work should be sufficiently precise and accurate to meet the needs of the project. All survey instruments should be capable of reading to a precision of 0.01-foot and with a setting accuracy of 20 seconds (5.6×10^{-3} degrees).

4.5 LINES AND GRADES

The following surfaces shall be surveyed to verify the lines and grades achieved during construction. The survey should at least include (as deemed appropriate by the Engineer and CQA Consultant):

- one or more construction baselines;
- a working grid with a sufficient number of benchmarks;
- surface of the subgrade;
- all existing structures within closure area;
- surface of the low permeability soil cap component;
- surface of the topsoil layer;
- elevations and locations of temporary berms;
- top/toe of all perimeter berms, roads, and channels;
- location of edge of final cover; and
- locations and invert elevations of slope drains.

Laser planes are highly recommended for achieving the correct lines and grades during construction of each surface.

4.6 FREQUENCY AND SPACING

All surveying will be carried out immediately upon completion of a given installation to facilitate progress and avoid delaying commencement of the next installation. In addition, spot checks, as determined by the senior surveyor, CQA Consultant, or Project Manager, during construction may be necessary to assist the Contractor in complying with the required grades.

The following spacings and locations will be provided by the CQC surveyor, as a minimum, for survey points:

- surfaces with slopes less than 10 percent will be surveyed on a square grid not wider than 100 feet;
- on slopes greater than 10 percent, a square grid not wider than 100 feet will be used; however in any case, a line of survey points at the crest, midpoint, and toe of the slope will be taken; and
- a line of survey points no farther apart than 100 feet will be taken along any slope break (this will include the inside edge and outside edge of any bench on a slope).

4.7 THICKNESS MEASUREMENTS

The CQC surveyor, as a representative of the Contractor, shall obtain top and bottom elevations of the low permeability soil cap and and topsoil layer at a maximum 100-foot grid points and at all grade break lines. The procedure for obtaining top and bottom elevations shall be agreed to by the CQA Consultant and Engineer prior to construction. The CQC surveyor shall review the survey information with the Contractor to ensure that the survey demonstrates compliance with the project technical specifications. The Contractor is responsible for identifying and reporting to the CQA Consultant any areas of non-compliance evidenced by the survey, and for repairing such areas. The CQA Consultant and Contractor shall review the thickness measurements of the low permeability soil cap component prior to placement of the topsoil layer.

4.8 TOLERANCES

Except for soil cap components where no minus tolerances are acceptable, following is the maximum tolerance for survey points:

- on surfaces, the maximum tolerances shall be 0.2 foot. This tolerance must be set to the record elevation of the surface below it and not the design elevation.

4.9 DOCUMENTATION

All field survey notes will be retained by the senior surveyor. The results from the field surveys will be documented on a set of Survey Record (As-Built) Drawings by the Contractor for submittal to the CQA Consultant. The Contractor shall certify to the CQA Consultant and Engineer that the results of the survey demonstrates compliance with the Contract Documents. These drawings shall, at a minimum, show the final elevations and locations of all surfaces and appurtenances surveyed in Subsection 4.5 of this Plan.

SECTION 5.0
CONSTRUCTION QUALITY ASSURANCE DOCUMENTATION

5.1 DOCUMENTATION

An effective Plan depends largely on recognition of all construction activities that should be monitored and on assigning responsibilities for the monitoring of each activity. This is most effectively accomplished and verified by the documentation of QA activities. The CQA Consultant will document that all QA requirements have been addressed and satisfied.

This Plan integrates the testing and inspection performed by the CQC Consultant in accordance with the project specifications with the CQA overview and conformance testing performed by the CQA Consultant, in accordance with this Plan.

The CQA Consultant will provide the Project Manager with the CQC Consultant's daily and weekly reports including signed descriptive remarks, data sheets, and logs to verify that all CQC monitoring activities have been carried out. The CQA Consultant will also provide the Project Manager with a weekly report summarizing CQA activities and identifying potential QA problems. The CQA Consultant will also maintain, at the job site, a complete file of plans, reports, project specifications, a CQA Plan, checklists, test procedures, daily logs, and other pertinent documents.

5.2 RECORDKEEPING

The CQC Consultant's reporting procedures will include preparation of a daily report which, at a minimum, will consist of: a) field notes, including memoranda of meetings and/or discussions with the Contractor; b) observation logs and testing data sheets; and c) construction problem and solution data sheets. The daily report must be completed at the end of each CQC Consultant's shift, prior to leaving the site. This information will be submitted weekly to the CQA Consultant for review.

The CQC Consultant's weekly reports must summarize the major events that occurred during that week. Critical problems that occur shall be communicated verbally to the Project Manager or CQA Consultant immediately, as well as being included in the weekly reports. The CQC Consultant's weekly report must be submitted to the CQA Consultant no later than the Monday following the week reported.

The CQA Consultant's weekly report must summarize the CQC Consultant's weekly and daily reports, CQA conformance testing activities, construction problems that occurred, and the resolution of construction problems. The CQA Consultant's weekly report should identify all potential or actual compliance problems outstanding. The CQA Consultant's weekly report must be submitted to the Project Manager on the Wednesday following the week reported.

5.2.1 Memorandum of Discussion with CQC Consultant

A report will be prepared summarizing each discussion between the CQA Consultant. At a minimum, the report will include the following information:

- date, project name, location, and other identification;
- name of parties to discussion at the time;
- relevant subject matter or issues;
- activities planned and schedule; and
- signature of the CQA Consultant.

5.2.2 CQA Observation Logs and Testing Data Sheets

CQA observation logs and conformance testing data sheets will be prepared by the CQA Consultant on a weekly basis. At a minimum, these logs and data sheets will include the following information:

- an identifying sheet number for cross-referencing and document control;
- date, project name, location, and other identification;

- data on weather conditions;
- a reduced-scale Site Plan showing all proposed work areas and test locations;
- descriptions and locations of ongoing construction;
- descriptions and specific locations of areas, or units, of work being tested and/or observed and documented;
- locations where tests and samples were taken;
- a summary of test results;
- calibrations or recalibrations of test equipment, and actions taken as a result of recalibration;
- off-site materials received, including quality verification documentation;
- decisions made regarding acceptance of units of work, and/or corrective actions to be taken in instances of substandard quality; and
- the CQA Consultant's signature.

5.2.3 CQA Construction Problem and Solution Data Sheets

CQA sheets describing special construction situations will be cross-referenced with specific CQA observation logs and testing data sheets, and must include the following information, where available:

- an identifying sheet number for cross-referencing and document control;
- a detailed description of the situation or deficiency;
- the location and probable cause of the situation or deficiency;
- how and when the situation or deficiency was found or located;
- documentation of the response to the situation or deficiency;
- final results of any responses;
- any measures taken to prevent a similar situation from occurring in the future; and
- the signatures of the CQA Consultant the Project Manager, indicating concurrence, if required by this Plan.

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

5.3 CQA PHOTOGRAPHIC REPORTING DATA SHEETS

Photographic reporting data sheets, where used, will be cross-referenced with CQA observation logs and testing data sheets and/or CQA construction problem and solution data sheets. Photographs shall be taken at regular intervals during the construction process and in all areas deemed critical.

These photographs will serve as a pictorial record of work progress, problems, and mitigation activities. The basic file will contain color prints; digital copies will be stored in a separate file in chronological order. These records will be presented to the Project Manager upon completion of the project.

In lieu of photographic documentation, videotaping may be used to record work progress, problems, and mitigation activities. The Project Manager may require that a portion of the documentation be recorded by photographic means in conjunction with videotaping.

5.4 DESIGN AND/OR PROJECT TECHNICAL SPECIFICATION CHANGES

Design and/or project specification changes may be required during construction. In such cases, the CQA Consultant will notify the Project Manager and the Engineer. The Project Manager will then notify the appropriate agency, if necessary.

Design and/or project specification changes will be made only with the written agreement of the Project Manager and the Engineer, and will take the form of an addendum to the project specifications. All design changes shall include a detail (if necessary) and state which detail it replaces in the plans.

5.5 CQA PROGRESS REPORTS

The CQA Consultant will prepare a summary progress report each week, or at time intervals established at the pre-construction meeting. As a minimum, this report will include the following information;

- a unique identifying sheet number for cross-referencing and document control;
- the date, project name, location, and other information;
- a summary of work activities during progress reporting period;
- a summary of construction situations, deficiencies, and/or defects occurring during the progress reporting period; and
- summary of all test results, failures and retests, and signature of the CQA Consultant.

5.6 SIGNATURE AND FINAL REPORT

At the completion of each major construction activity at the Landfill, the CQA Consultant will certify all required forms, observation logs, field and laboratory testing data sheets including sample location plans, construction problems, and solution data sheets. The CQA Consultant will also provide a final report, which will certify that the work has been performed in compliance with the plans and project technical specifications, and that the supporting documents provide the necessary information.

The CQA Consultant will also provide summaries of all the data listed above with the report. The Record Drawings will include scale drawings depicting the location of the construction and details pertaining to the extent of construction (e.g., depths, plan dimensions, elevations, soil component thicknesses, etc.). All surveying and base maps required for development of the Record Drawings will be done by the Construction surveyor. These documents will be certified by the Contractor and CQC Consultant and delivered to the CQA Consultant and included as part of the CQA documentation (Certification) report.

It may be necessary to prepare interim certifications, as allowed by the regulatory agency to expedite completion and review.

5.7 STORAGE OF RECORDS

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

RE: 20111114 MDP-P.Backus Phase II Permit Renewal Response to Comments
Application for Continued Operation – Response to Comments
City of Greensboro, White Street Construction and Demolition Landfill (C&DLF, Phase II)
Guilford County, Permit No. 41-03

SUBMITTAL DOCUMENTS

- Construction & Demolition Application Overview
- Drawing C-06
- Drawing CD-81B

Construction and Demolition Application Overview

In November of 1995, HDR, on behalf of the City of Greensboro, submitted a Transition Plan for the Phase II sanitary landfill of the White Street Landfill. The Transition Plan was approved in July of 1996 and Olver certified closure of the sanitary landfill in March 1999. After NCDENR approval of the Transition Plan, the City of Greensboro submitted a permit application to dispose of Construction and Demolition (C&D) debris over top of the closed municipal solid waste (MSW) in Phase II. NCDENR issued the original C&D over MSW permit for Phase II in July of 1998.

In accordance with the North Carolina Solid Waste Management Rule 15A NCAC 13B Section .0547(4), the City of Greensboro is submitting a permit application to continue C&D disposal on top of the closed Phase II sanitary landfill. The City of Greensboro currently operated the C&D landfill in accordance with Facility Permit No. 41-03.

The City of Greensboro proposed to maintain the final maximum permitted elevation of 872 feet above mean seal level as approved in previous permit applications. Based on the existing contours and additional filling to reach the 4:1 regulatory side sloped, Phase II has a remaining operating airspace of approximately 1,118,000 cubic yards. Volume calculations were performed in AutoCAD.

In 2010, the White Street Landfill received 46,614 tons of C&D. Based on an estimated waste density placement of 1,700 pounds per cubic years, the five-year volume consumed is approximately 300,000 cubic yards. Based on the available air space and projected waste receipt, Phase II final contours should be reached in approximately fifteen years. Fill calculations are provided on Drawing C-06 of the application. The total area of C&D disposal requiring a cap will be approximately 64 acres.

To continue operations, Section .0547 required owners and operators of existing C&D landfills on top of closed MSW landfills to submit a permit application by July 1, 2008 including the following:

a. Local government approval in accordance with Rule .0536(c)(11),
b. An operations plan in accordance with Rule .0542 of this Section,
c. A corrective action plan for the closed MSW landfill in accordance with Rules .1635, .1636, and .1637,
d. A closure and post-closure plan in accordance with Rule .1627, and
e. Financial assurance in accordance with Rule .1628.

This permit application contains the above information.

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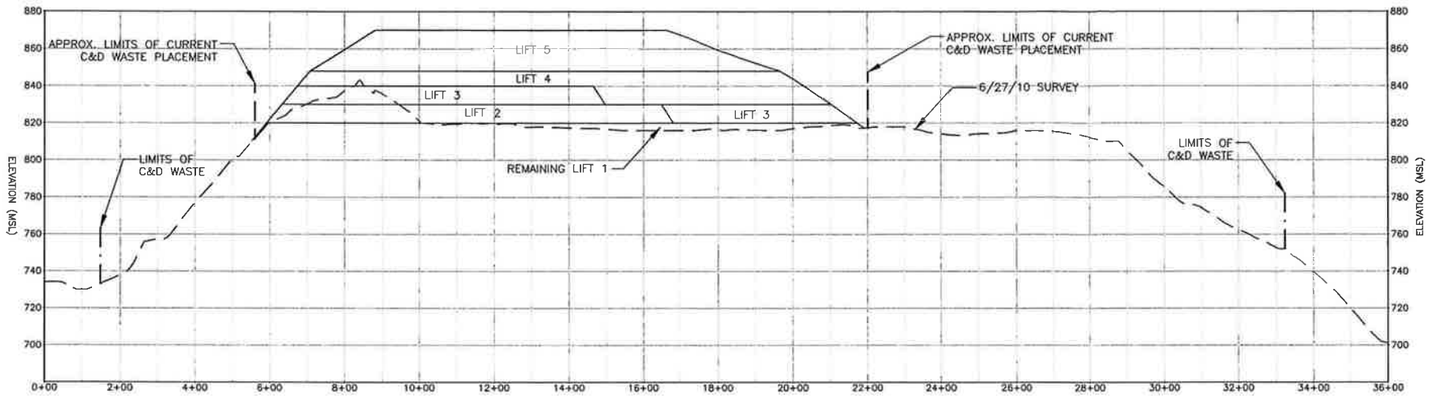
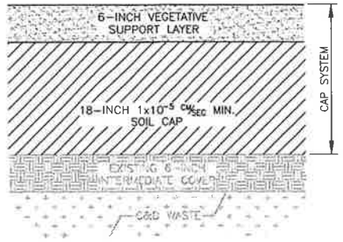


SOUTH – NORTH CROSS-SECTION

HORIZONTAL 1" = 200' VERTICAL 1" = 40'

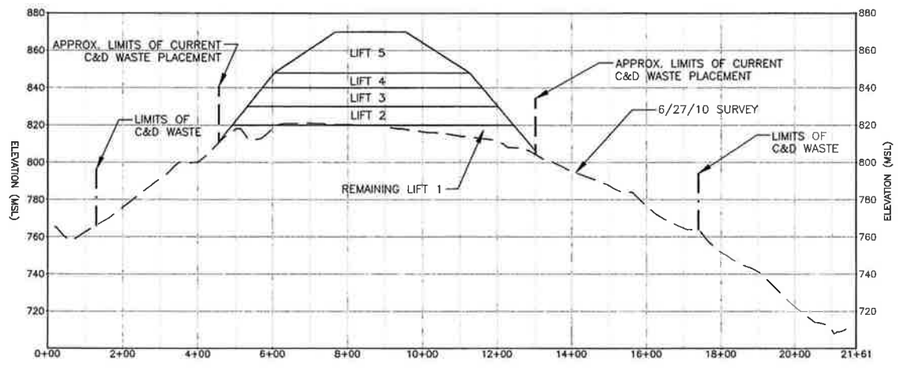
A C-06



TYPICAL CAP SYSTEM

NTS

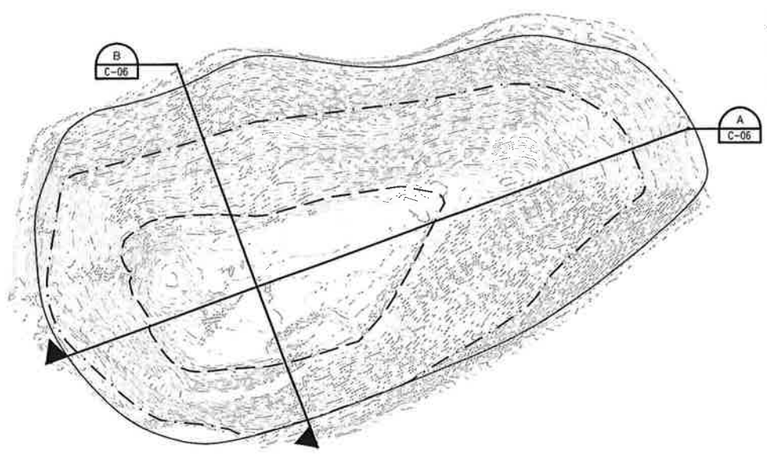
1 –



EAST – WEST CROSS-SECTION

HORIZONTAL 1" = 200' VERTICAL 1" = 40'

B C-06



PHASE II CROSS-SECTION LAYOUT

HORIZONTAL 1" = 400'

C C-06

GENERAL NOTES:

1. SURVEY FOR PHASE II AREA TAKEN FROM AERIAL SURVEY BY BRADY SURVEYING DATED JUNE 27, 2010.
2. EXTENTS OF WASTE PLACED AFTER OCTOBER 9, 1993 TAKEN FROM PHASE II TRANSITION PLAN DATED NOVEMBER 1995.

PHASE II REMAINING CAPACITY:

TOTAL OPERATING CAPACITY = 2,315,800 CY*
AIRSPACE CONSUMED TO DATE = 1,197,930 CY
OPERATING AIRSPACE REMAINING = 1,117,870 CY**

* AS REPORTED IN THE NC SOLID WASTE MANAGEMENT ANNUAL REPORT FISCAL YEAR 2008-2009.
** AIRSPACE REMAINING AS OF JUNE 27, 2010 SURVEY.

PHASE II OVERALL FILLING PLAN:

1. THE LANDFILL WILL BE CONSTRUCTED IN APPROXIMATELY 10 FOOT LIFTS.
2. EACH LIFT IS APPROXIMATELY 260,000 CY.
3. BASED ON THE TONNAGE AND VOLUME CONSUMED FROM MARCH 25, 2007 TO JUNE 27, 2010 THE WASTE DENSITY IS APPROXIMATELY 1,700 LBS/CY.

PHASE II 5-YEAR FILLING PLAN:

2010 WASTE ACCEPTANCE RATE = 46,614 TONS
APPROXIMATE WASTE DENSITY OF 1,700 LBS/CY
5-YEAR TONNAGE PROJECTION = 255,000 TONS*
5-YEAR CAPACITY = 300,000 CY
*ASSUMES A 3% ANNUAL GROWTH.

GENERAL LEGEND:

- EXISTING CONTOURS
- APPROX. MSW LANDFILL LIMITS
- LIMITS OF C&D WASTE
- APPROX. LIMITS OF CURRENT C&D WASTE PLACEMENT

HDR
HDR Engineering, Inc. of the Carolinas
N.C.B.E.L.S. License Number: F-0116
440 S Church Street, Suite 1000 | Charlotte, NC 28202

ISSUE	DATE	DESCRIPTION
B	09/11	REVISED PER NCDENR COMMENTS
A	03/11	ISSUED FOR NCDENR APPROVAL

PROJECT MANAGER	M.D. PLUMMER, P.E.
	E.L. HARTWICK, E.I.
PROJECT NUMBER	6770-109019-018

WHITE STREET LANDFILL
PERMIT 41-03
PHASE II
PERMIT RENEWAL APPLICATION
Greensboro North Carolina

FILL PLAN

0 1" 2"

FILENAME	C-06.dwg
SCALE	AS SHOWN

SHEET C-06

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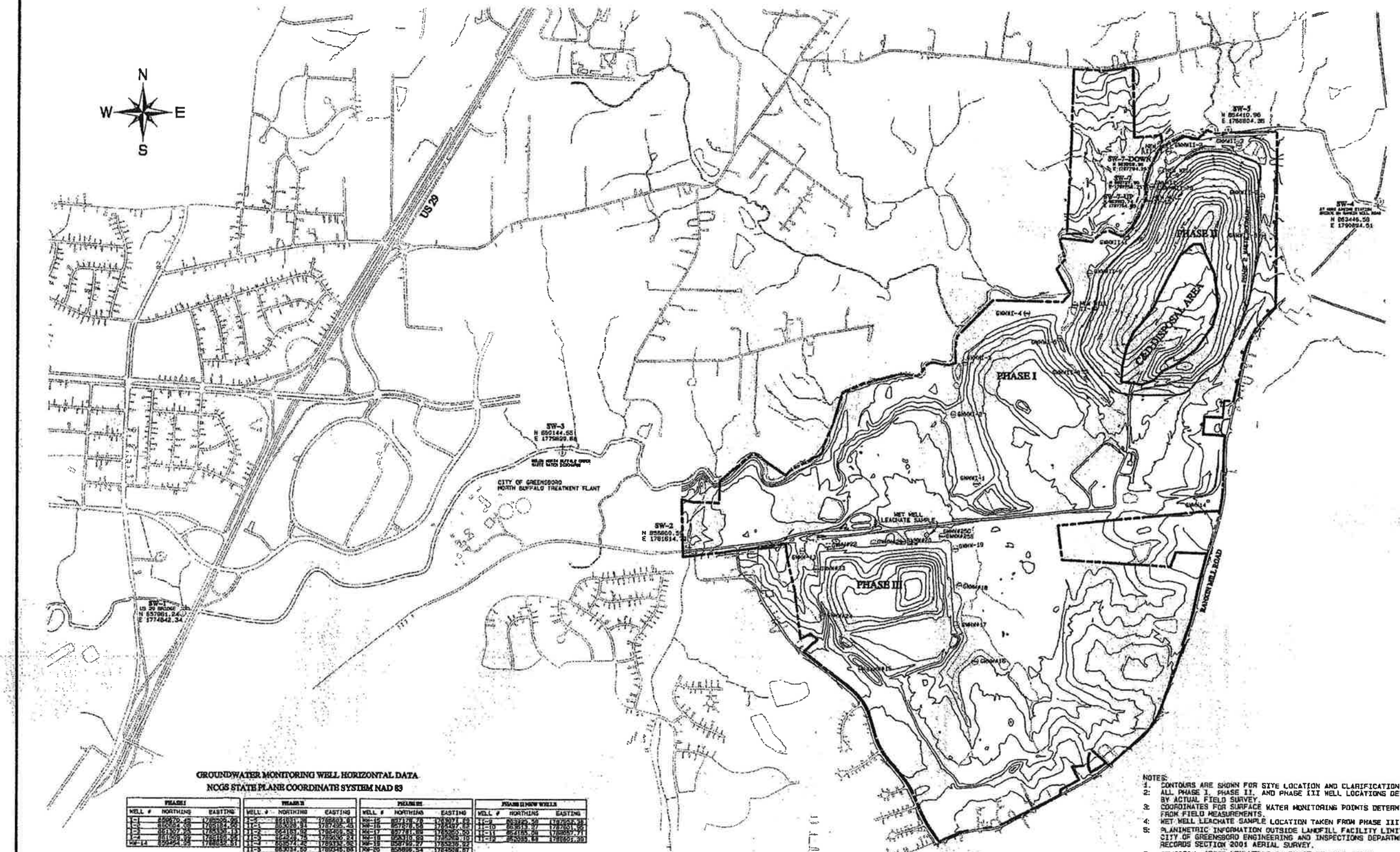

GROUNDWATER MONITORING WELL HORIZONTAL DATA

NCGS STATE PLANE COORDINATE SYSTEM NAD 83

PHASE I		
WELL #	NORTHING	EASTING
MW-1	858579.49	1780055.09
MW-2	858064.09	1780114.66
MW-3	857927.26	1780138.13
MW-4	858104.92	1780169.66
MW-14	858454.35	1780082.61

PHASE II		
WELL #	NORTHING	EASTING
MW-5	858181.98	1780682.81
MW-6	858068.81	1781196.45
MW-7	858068.81	1781196.45
MW-8	858214.78	1780900.93
MW-9	858214.78	1780900.93
MW-10	858214.78	1780900.93
MW-11	858214.78	1780900.93
MW-12	858214.78	1780900.93
MW-13	858214.78	1780900.93
MW-14	858214.78	1780900.93
MW-15	858214.78	1780900.93
MW-16	858214.78	1780900.93
MW-17	858214.78	1780900.93
MW-18	858214.78	1780900.93
MW-19	858214.78	1780900.93
MW-20	858214.78	1780900.93
MW-21	858214.78	1780900.93
MW-22	858214.78	1780900.93
MW-23	858214.78	1780900.93
MW-24	858214.78	1780900.93
MW-25	858214.78	1780900.93
MW-26	858214.78	1780900.93

PHASE III		
WELL #	NORTHING	EASTING
MW-15	857716.78	1780971.48
MW-16	857816.68	1780497.69
MW-17	857716.68	1780300.50
MW-18	858016.69	1780098.10
MW-19	858016.69	1780098.10
MW-20	858016.69	1780098.10
MW-21	858016.69	1780098.10
MW-22	858016.69	1780098.10
MW-23	858016.69	1780098.10
MW-24	858016.69	1780098.10
MW-25	858016.69	1780098.10
MW-26	858016.69	1780098.10

PHASE II NEW WELLS		
WELL #	NORTHING	EASTING
MW-9	858214.78	1780900.93
MW-10	858214.78	1780900.93
MW-11	858214.78	1780900.93
MW-12	858214.78	1780900.93

NOTES:

1. CONTOURS ARE SHOWN FOR SITE LOCATION AND CLARIFICATION ONLY.
2. ALL PHASE I, PHASE II, AND PHASE III WELL LOCATIONS DETERMINED BY ACTUAL FIELD SURVEY.
3. COORDINATES FOR SURFACE WATER MONITORING POINTS DETERMINED FROM FIELD MEASUREMENTS.
4. MET WELL LEACHATE SAMPLE LOCATION TAKEN FROM PHASE III AS-BUILT SURVEY.
5. PLANIMETRIC INFORMATION OUTSIDE LANDFILL FACILITY LIMITS TAKEN FROM CITY OF GREENSBORO ENGINEERING AND INSPECTIONS DEPARTMENT RECORDS SECTION 2001 AERIAL SURVEY.
6. REVISION: ADDED MEW WELLS ON PHASE II JUNE, 2009. LOCATIONS AND ELEVATIONS DETERMINED BY ACTUAL FIELD SURVEY
7. REVISION: DELETED THE WORDS "Closed LCID" UNDER PHASE I, NOVEMBER, 2011.

SCALE 1" = 600'

DATE	
SURVEYED BY	COG
DESIGNED BY	
DRAWN BY	DS BOST
CHECKED BY	

CITY OF GREENSBORO
ENVIRONMENTAL SERVICES DEPARTMENT
SOLID WASTE MANAGEMENT DIVISION

WHITE STREET LANDFILL
GROUNDWATER MONITORING SYSTEM

CD - 81B

SHEET NO.

____ OF ____

RE: 20111114 MDP-P.Backus Phase II Permit Renewal Response to Comments
Application for Continued Operation – Response to Comments
City of Greensboro, White Street Construction and Demolition Landfill (C&DLF, Phase II)
Guilford County, Permit No. 41-03

SUBMITTAL DOCUMENTS with tracked changes

- Closure Plan (revised pages only)

.1627 Closure Plans

The following closure and post closure plans for the White Street Landfill Phase II have been prepared in accordance with Rule .1627 for MSW landfills as required by Rule .0547(4)(d) governing existing C&D landfill units constructed on top of closed MSW landfills.

1.0 Closure

In accordance with the ~~Division's policy~~Solid Waste Management rules and/or statutes, and upon achievement of the final design and approved contours, the City of Greensboro proposes to construct the regulatory cap system over the construction and demolition debris landfill area. Prior to the placement of the final cap, the City of Greensboro will verify that fill area slopes constructed within the disposal area meet the approved slope requirements The City will construct the areas such that post-settlement slopes of a minimum of 5 percent to a maximum of 25 percent can be achieved. Additionally, final contours will be established to enhance drainage from the construction and demolition debris fill areas to reduce the potential for infiltration into the waste mass. It is estimated that the total landfill operating volume at completion will be 2,315,800 cubic yards. The maximum area requiring a cap at any one time is approximately 64 acres.

An active gas collection system ~~will be installed under the cap~~is currently in operation in Phase II to allow movement of gas generated from the completed fill area to the gas management area. Modifications to the system will not be required based on the C&D closure.

Commencement of closure activities will begin as required in accordance with Rule .1627 as promulgated. Once begun, closure will proceed and continue in compliance with Rule .1627.

A sign indicating the anticipated date of the final waste acceptance into the construction and demolition debris disposal unit as well as anticipated closure will be conspicuously posted at the facility at least 30 days in advance. The City of Greensboro may employ other avenues and devices to notify the public of the planned closure. These may include advertising in the local print media, advertising on local television, mailing to regular account customers, and notices on the City of Greensboro cable television channel. Prior to beginning closure of the unit, or portions thereof, the Division will be notified that intent to close has been placed in the operating record.

The closure will begin after completion of a portion of the final grades but no later than 30 days after the final receipt of waste. The design of the landfill in combination with the maintenance plan should assure a fairly uncomplicated closure period. The closure of the entire unit, or portions thereof, will be completed within 180 days unless an extension has been requested and received due to changes in the anticipated schedule.

The cap system designed will be constructed in accordance with Rule .1624(b)(8),(9), and (15) to minimize infiltration and erosion. The proposed cap system will minimize infiltration with the use of a low-permeability barrier that contains a minimum 18 inches of earthen material. The proposed permeability barrier will be less than or equal to the permeability of any base liner system or in-situ subsoils underlying the landfill, or a permeability specified for the final cover in the effective permit, or a permeability no greater than $1x10^{-5}$ ~~E~~ cm/sec, whichever is less. Additionally, erosion of the cap system will be minimized with the placement of at least 6 inches of earthen material that is capable of sustaining

native plant growth. This layer will assist in the reduction of root penetration and protect the low permeability barrier layer. The installation and testing of the cap system will be performed as required by the specifications found in Appendix F, and the Construction Quality Assurance Plan found in Appendix G.

The construction of the regulatory cap system is anticipated to utilize borrow material from on-site landfill sources that satisfy the permeability requirements. Off-site materials that satisfy the permeability requirements will supplement volume differentials. In order to assure that the material meets the established criteria, the material will be tested prior to use and after placement. ~~Testing requirements will be outlined in the final closure plan.~~ Final Cconstruction methods for the compacted clay liner shall be based upon the type and quality of the borrow source and shall be verified in the field by constructing test pad(s). A professional engineer licensed in the state of North Carolina shall certify that the compacted clay liner installation conforms with the plans approved by the NC DENR Division of Waste Management.

The anticipated schedule for closure activities to be initiated by the City of Greensboro will begin when that portion of the landfill unit meets one or more of the following requirements, unless an extension has been granted by NCDENR.

1. No later than 30 days after the date on which the C&D unit receives the known final receipt of wastes.
2. No later than one year after the most recent receipt of wastes, if the C&D unit has remaining capacity.

The material of the erosion layer will be selected considering soil type, nutrient levels, pH, erodibility, and other factors. Finished sideslopes shall be stable and configured to adequately control erosion and run-off. The erosion and storm water control system designed for Phase II is adequate to handle the runoff from the C&D area. The final cover will be graded, seeded, and stabilized. All cover material will be free of putrescible material, solid waste, construction debris, vegetation, rocks, frozen soil and other deleterious materials. The vegetation should be selected based upon:

- Species of grasses which are locally adapted and resistant to drought or temperature extremes;
- Having roots which will not disrupt the low permeability layer;
- Ability to thrive in low nutrient soil and develop a good stand to resist erosion;
- Survive and function with little or no maintenance.

The cap will be mowed on a routine basis to ensure growth of large, deep-rooted vegetation does not occur.

2.0 Closure Verification

The following procedures will be implemented following closure of the construction and demolition debris disposal unit in Phase II.

RE: 20111114 MDP-P.Backus Phase II Permit Renewal Response to Comments
Application for Continued Operation – Response to Comments
City of Greensboro, White Street Construction and Demolition Landfill (C&DLF, Phase II)
Guilford County, Permit No. 41-03

SUBMITTAL DOCUMENTS with tracked changes

- Construction & Demolition Application Overview

Construction and Demolition Application Overview

In November of 1995, HDR, on behalf of the City of Greensboro, submitted a Transition Plan for the Phase II sanitary landfill of the White Street Landfill. The Transition Plan was approved in July of 1996 and Olver certified closure of the sanitary landfill in March 1999. After NCDENR approval of the Transition Plan, the City of Greensboro submitted a permit application to dispose of Construction and Demolition (C&D) debris over top of the closed municipal solid waste (MSW) in Phase II. NCDENR issued the original C&D over MSW permit for Phase II in July of 1998.

In accordance with the North Carolina Solid Waste Management Rule 15A NCAC 13B Section .0547(4), the City of Greensboro is submitting a permit application to continue C&D disposal on top of the closed Phase II sanitary landfill. The City of Greensboro currently operated the C&D landfill in accordance with Facility Permit No. 41-03 ~~which will expire on July 1, 2008~~.

The City of Greensboro proposed to maintain the final maximum permitted elevation of 872 feet above mean seal level as approved in previous permit applications. Based on the existing contours and additional filling to reach the 4:1 regulatory side sloped, Phase II has a remaining ~~volume~~ operating airspace of approximately ~~1,308,000~~1,118,000 cubic yards. Volume calculations were performed in ~~the 2008 version of~~ AutoCAD ~~and verified through City of Greensboro personnel utilizing Terramodel Site Work version 10.41~~.

In ~~recent years~~2010, the White Street Landfill ~~has~~ received ~~an average of 130,000~~ 46,614 tons of C&D ~~per year~~. Based on an estimated waste density placement of ~~1,000~~1,700 pounds per cubic years, the ~~annual~~ five-year volume consumed is approximately ~~260,000~~300,000 cubic yards. Based on the available air space and projected waste receipt, Phase II final contours should be reached in approximately ~~five~~ fifteen years. Fill calculations are provided ~~in this section~~on Drawing C-06 of the application. The total area of C&D disposal requiring a cap will be approximately ~~38~~ 64 acres.

To continue operations, Section .0547 required owners and operators of existing C&D landfills on top of closed MSW landfills to submit a permit application by July 1, 2008 including the following:

a. Local government approval in accordance with Rule .0536(c)(11),
b. An operations plan in accordance with Rule .0542 of this Section,
c. A corrective action plan for the closed MSW landfill in accordance with Rules .1635, .1636, and .1637,
d. A closure and post-closure plan in accordance with Rule .1627, and
e. Financial assurance in accordance with Rule .1628.

This permit application contains the above information.

~~The permit modification fee for a C&D facility greater than 100,000 tons per year is $2,500. The billing address for the permit modification fee is:~~

~~City of Greensboro~~
~~PO Box 3136~~
~~Greensboro, NC 27402~~
~~Attn: Ms. Jeryl Covington, P.E.~~
~~Director Environmental Services Department~~