Prepared for:

Anniston Calhoun County
Fort McClellan Joint Powers Authority
Anniston, Alabama

and

Matrix Environmental Services, LLC
Anniston, Alabama

FINAL (100%) CONSTRUCTION QUALITY ASSURANCE PLAN

LANDFILL COVER SYSTEMS LANDFILL 3 AND FILL AREA NORTHWEST OF REILLY AIRFIELD McCLELLAN, ANNISTON, ALABAMA

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Project Number: GR3762

February 2007

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SECTION I
GENERAL

1. INTRODUCTION

This Construction Quality Assurance Plan (CQA Plan) has been prepared for Landfill 3 (LF3) and Fill Area Northwest of Reilly Airfield (FANWR) located in Anniston, Alabama which is owned by Anniston-Calhoun County Fort McClellan Development Joint Powers Authority (JPA).

The purpose of this CQA Plan is to assure that design requirements are satisfied for the different components of the facility and to present the principles and practices of Construction Quality Assurance (CQA) required during the closure of waste containment facilities. Quality management involves both quality assurance and quality control activities performed to verify that construction activities meet the permitted design plans and specifications.

For the purpose of this permit application, this CQA Plan is written in general terminology (i.e., using "Owner," or "CQA Consultant" versus actual names of entities). During the construction process, the specific parties involved will review this CQA Plan and modify it as necessary for site-specific conditions. The modifications will be executed as described subsequently and will be amended to this CQA Plan.

2. SCOPE OF THE CQA PLAN

The CQA Plan includes six primary elements:

- Technical Specifications;
- Responsibility and Authority;
- CQA Personnel Qualifications;

- Monitoring Activities;
- Sampling & Testing Strategies; and
- Documentation.

Technical specifications, monitoring activities, and sampling and testing strategies for the individual components of the cover system (i.e., final cover system) are presented in Sections II through IV as follows:

- Section II - Soil Components of the Cover System;
- Section III - Surveying; and
- Section IV - Documentation.

This CQA Plan has been developed to be used in conjunction with the design drawings titled "*Landfill Cover Systems, Landfill 3 and Fill Area Northwest of Reilly Airfield McClellan, Anniston, Alabama*" prepared by GeoSyntec Consultants, Inc. and dated October 2006 (hereafter referenced as the Drawings).

3. DEFINITIONS AND USE OF TERMS

The following provides general information regarding specific terms, references, and units as used in the CQA Plan.

3.1 Definitions Relating to CQA

In the context of this CQA Plan, Technical Requirements, Construction Quality Assurance, and Construction Quality Control are defined as shown below.

- Technical Requirements – Technical Requirements refers to the minimum requirement parameters and installation procedures for materials used to construct the final cover systems as defined within this CQA Plan.

- Technical Specifications – Technical Specifications refers to the separate specifications package developed in conjunction with the Drawings that provide details of the required constructed product including: (i) acceptable materials, (ii) submittal review and approval, (iii) performance standards, and (iv) project authority.

- Construction Documents – Construction Documents is a term that is used throughout this CQA Plan to collectively reference the Drawings, Technical Specifications, Design Report, and CQA Plan.

- Conformance Samples – Conformance Samples refer to those samples of material that are used to verify the minimum required values are met prior to use and that the material is consistent within the borrow/stockpile areas.

- Performance Samples – Performance Samples refer to those samples of material used to ensure that placed/installed materials meet the minimum design requirements.

- Construction Quality Assurance (CQA) – CQA refers to measures taken by the Owner to determine if the Contractor is in compliance with the Drawings and Specifications.

- Construction Quality Control (CQC) – CQC refers to measures taken by the Contractor to determine compliance with the requirements for material and workmanship as stated the Drawings and Specifications.

3.2 References to Standard

The CQA Plan includes references to test procedures of the American Society for Testing and Materials (ASTM), the Federal Test Method Standards (FTMS), and the United States Department of Agriculture (USDA).

3.3 Units

Properties and dimensions given in the CQA Plan are expressed in U.S. units and may be followed by approximate equivalent values in SI units in parentheses. The values given in SI units are typically accurate. In cases of conflict, the U.S. units govern.

4. RESPONSIBILITY AND AUTHORITY

The principal parties involved in the CQA of the landfill cover systems include the Owner, the Owner's Representative, the Engineer, the CQA Consultant, the Soils CQA Laboratory, and the Contractor. The general responsibilities and authorities of each of these parties or authority of a given party may be modified or expanded as dictated by specific project needs during Pre-Construction Meetings.

4.1 Owner

The Owner is the Fort McClellan Development Joint Powers Authority (JPA). The Owner has authorized execution of the Contract by the Construction Manager as Agent. The Owner shall act through its duly appointed Agent, (the Owner's Representative/Construction Manager), MES.

4.2 Owner's Representative/Construction Manager

The Construction Manager, Matrix Environmental Services, L.L.C. (MES), is the duly appointed Agent of the Owner and also referred to as the Owner's Representative. The Owner's Representative/Construction Manager is responsible for overall management of the project, administration of the project contracts, and coordination of site construction operations. The Owner's Representative/Construction Manager shall be responsible for review and approval of submittals, work plans, design/specification changes, schedules, clarifications, and shop drawings. The Owner's Representative/Construction Manager is also responsible for obtaining approval of

Design and Specification changes and making design clarification requests which may be required during construction.

4.3 Engineer

The Engineer (GeoSyntec Consultants) was retained by the MES, to prepare permits and construction documents necessary for acceptance by Alabama Department of Environment Management (ADEM) to construct the cover systems. The construction documents establish the limits, type, and details for the landfill cover systems and other components for the site.

During construction, the Engineer may be requested by the Owner's Representative to clarify discrepancies in the construction documents. The Engineer through direction of the Owner's Representative only may also approve substantive changes to the construction documents for the facility. Substantive changes include changes which modify or impact the technical basis for engineered component of the design. Substantive changes to the construction documents may require approval by ADEM.

4.4 CQA Consultant

The CQA Consultant (GeoSyntec Consultants) is responsible for observing and documenting activities related to the construction documents and the CQA Plan. The CQA Consultant is represented on-site by the CQA Coordinator and supporting on-site CQA monitoring personnel, as appropriate.

In general, the responsibilities and authorities of the CQA Consultant include:

- working understanding of the Drawings and Technical Specifications in relation to the various aspects of the CQA Plan;
- scheduling, coordinating, and performing CQA activities;

- performing independent on-site observation of the work in progress to assess compliance with the construction documents;
- recognizing and reporting deviations from the construction documents to the Engineer and Construction Manager;
- securing documents which approve changes to the construction documents;
- verifying that the CQA Consultant's test equipment meets testing and calibration requirements, and that tests are conducted according to standardized procedures defined in the CQA Plan;
- recording and maintaining test data accurately;
- identifying work that should be accepted, rejected, or further evaluated by CQA personnel and/or the Construction Manager;
- verifying that corrective measures are implemented;
- documenting and reporting construction and CQA activities;
- collecting data needed for record documentation; and
- maintaining open lines of communications with other parties involved in the construction.

Certifications shall bear the seal of the CQA Certifying Engineer for the State of Alabama.

4.4 Soils CQA Laboratory

The Soils CQA Laboratory is responsible for performing the laboratory testing required by the CQA Plan to determine specific characteristics of the soils and aggregates. The Soils CQA Laboratory is also responsible for providing adequate documentation of geotechnical results, test methods followed, and testing equipment

used. Work of the Soils CQA Laboratory will be administered by, and reported to, the CQA Consultant.

4.5 Contractor

The Contractor is responsible for the following:

- Health and Safety monitoring;
- clearing and vegetation removal (grubbing) of the project area;
- grinding of stumps in the perimeter areas;
- preparation of subgrade;
- construction of landfill access roads and trails;
- waste excavation and relocation;
- placement of structural fill;
- placement of the low-permeability soil for the final cover system;
- installation of geotextiles for separation, roadways, and trails;
- placement of the topsoil and aggregates;
- construction of stormwater control structures and piping; and
- construction of sedimentation and erosion control facilities, temporary and permanent access roads, installation of the split rail fence, and other support activities outside the cover system site.

It is the responsibility of the Contractor to use procedures and equipment necessary to produce results in conformance with contract documents.

5. QUALIFICATIONS OF KEY PERSONNEL AND ORGANIZATIONS

5.1 Audits

The Owner's Representative shall be responsible to perform audits of the Contractors records and documentation throughout the Project. The Owner's Representative shall be responsible to develop the Audit Checklists. The following audits will be performed by the Owner's Representative.

- Pre-Audit – A pre-audit will be conducted to evaluate the Contractor's record keeping practices and systems and to ensure that project documents will be kept as specified.

- Periodic Audits – Periodic audits will be performed to validate compliance with the requirements for project document record keeping and data management.

- Close-Out Audit – A close-out audit will be conducted to cross-reference project documentation within two weeks of project completion.

The CQA Consultant shall be responsible to perform an audit of the Soil CQA Laboratory prior to the start of work. The audit checklist will be developed by the CQA Consultant and will include checking compliance with the testing standard required by the CQA Plan.

5.2 CQA Consultant

The CQA Consultant shall be a qualified engineering firm with experience in construction quality assurance and quality control, particularly on projects involving similar landfill cover systems. The CQA Consultant shall designate a Certifying Engineer who is a Professional Engineer registered in the State of Alabama. The Certifying Engineer shall be solely responsible for the CQA personnel and their activities, as well as the preparation of a certification report to certify the project has

been constructed in accordance with the Technical Specifications, CQA Plan, permit documents, and Drawings. The CQA Consultant shall be capable of assigning technically qualified personnel to the project, including an on-site CQA Coordinator and CQA Monitors, as needed. The person designated as the CQA Coordinator shall possess a thorough knowledge of all aspects of landfill construction.

CQA Monitors shall be specifically trained in quality assurance of earthwork. Unless otherwise approved by the Owner, the CQA Coordinator shall have a minimum of 2 years and 100,000 cubic yards field experience in the placement and testing of low permeability soils. The CQA Coordinator shall be onsite fulltime or as directed by the Construction Manager during landfill capping construction activities and the CQA Monitor shall be onsite as needed per the discretion of the Construction Manager.

5.3 Soils CQA Laboratories

The Soils CQA Laboratory shall be pre-qualified by the CQA Consultant. The Soils CQA Laboratory shall be experienced in performing laboratory tests to determine characteristics as required by this CQA Plan. The Soils Laboratory shall demonstrate that the firm follows the standard test methods listed in the CQA Plan and maintains the appropriately calibrated equipment to perform the tests. The Soils CQA Laboratory shall also demonstrate to the CQA Consultant that the firm adheres to a formal in-house quality control program and can provide the required analytical and procedural documentation and reports.

6. PROJECT MEETINGS

To achieve a high degree of quality during installation, clear, open channels of communication are essential. Meetings shall be held as directed by the Construction Manager and as described in Section 01200 (Project Meetings) of the Technical Specifications.

6.1 Pre-Construction

A Pre-Construction Meeting will be held and will include the following parties: the Owner, the Construction Manager, the CQA Consultant, and the Contractor.

The purpose for this meeting is to begin planning for coordination of tasks, anticipate problems which might cause difficulties and delays in construction, and review the requirements presented in the CQA Plan to the parties involved.

The meeting shall include the following activities:

- Health and Safety;
- distribution of relevant documents;
- discussion of construction scheduling;
- reviewing of critical design details of the project;
- reviewing of the Technical Specifications and CQA Plan;
- identify modifications to the CQA Plan;
- reaching a consensus on the site-specific CQA Plan and construction quality control procedures, especially on methods for determining acceptability of the soils;
- selection of testing equipment and review protocols for testing and placement of soil materials;
- confirmation of the methods for documenting and reporting, and for distributing documents and reports; and
- confirmation of the lines of authority and communication.

The meeting shall be documented by the Construction Manager or his designee and minutes shall be transmitted as per Specifications Section 01200 to all the parties involved.

6.2 Weekly Meetings

A weekly meeting shall be held between the CQA Consultant, the Contractor, the Construction Manager, and other involved parties working at the site during the week. Those attending will discuss, plan, and coordinate the work and the CQA activities to be completed that week. More frequent meetings may be held as requested by the Construction Manager to address construction issues. The meeting will be documented by the Construction Manager or his designee and minutes will be transmitted to involved parties as per Specification Section 01200.

6.3 Problem or Work Deficiency Meetings

A special meeting shall be held when and if a problem or deficiency, which would impact the construction schedule, is present or likely to occur and cannot wait to be addressed during regular weekly meetings. At a minimum, the meeting shall be attended by the Contractor, the Construction Manager (or other designated Owner's representative), and the CQA Consultant. The purpose of the meeting is to define and resolve the problem or work deficiency as follows:

- definition and discussion of the problem or deficiency;
- review of alternative solutions; and
- implementation of an action plan to resolve the problem or deficiency.

The meeting shall be documented by the Construction Manager or his designee and minutes shall be transmitted as per Technical Specification Section 01200 to all the parties in attendance.

SECTION II
SOIL COMPONENTS OF THE FINAL COVER SYSTEM

1. INTRODUCTION

Section II of this CQA Plan addresses material specifications and CQA activities associated with construction of the soil components for the landfill cover system. Details of the soil components of the final cover systems are provided in the Drawings. These components include:

- subgrade;
- structural fill;
- low permeability soil; and
- topsoil.

The soil components of the final cover systems shall meet requirements related to material characteristics and construction quality. Both field and laboratory tests shall be performed prior to construction to evaluate if the characteristics of soil from proposed sources meet the material acceptance requirements.

2. TEST METHODS AND SAMPLING REQUIREMENTS

Tables II-1A and II-1B present the laboratory and field test methods which shall be used to determine material characteristics and evaluate construction quality for the soil components of the containment system. The tests shall be conducted in accordance with the current versions of the corresponding standard methods provided.

Table II-2 provides information regarding the minimum test frequencies and values. The table also includes the locations at which samples shall be collected, the sample size, and the acceptance criteria.

3. WASTE EXCAVATION AND PLACEMENT

An area within the FANWR will require the excavation and relocation of waste. Prior to initiation of work, the Contractor shall submit a Materials and Waste Handling Work Plan that addresses excavation, removal, handling, and placement of the waste material to the Construction Manager for approval. The plan should outline measures to minimize the exposure of the waste and limit surface water run-off from areas of exposed waste. Placed waste materials shall be compacted by a minimum of 4 passes with a padfoot compactor and shall be placed in a maximum loose lift thickness of 10 in.

4. SUBGRADE/STRUCTURAL FILL

4.1 Subgrade

Subgrade refers to the layer of soil covering the waste in the containment facility or existing grades after vegetation has been removed.

Vegetation and other potentially deleterious materials such as loose organics or soft materials shall be removed and the resulting voids filled with acceptable material, appropriately compacted. The surface shall be proof rolled prior to the placement of subsequent lifts or layers by a Caterpillar CS-563 compactor or equivalent.

After proof rolling and/or other suitable techniques, visual examination of the subgrade preparation by the CQA Consultant will be sufficient to evaluate its suitability as a foundation for the subsequent structural fill layers.

The subgrade should be accepted by the CQA Consultant if it does not pump or rut excessively. If excessive pumping or rutting occurs, the area should be reworked or removed by undercutting to more suitable material.

4.2 Structural Fill

Structural fill is comprised of the soils used to reach the planned grades for the bottom of the low permeability soil material. The CQA Consultant shall obtain samples from within the identified borrow area (BAS-2) and stockpile areas from BAS-4 (as outlined in the Borrow Area Management Plan) and subject the soils to the Conformance testing indicated in Tables II-1A, II-1B, and II-2. Structural fill shall be placed in lifts no more than 8 in. in thickness (compacted). For the trough areas within LF3, a 2-foot maximum bridge lift will be permitted. The surface on each lift shall be scarified prior to the placement of the subsequent layer to promote adhesion of the soils. The final surface of the structural fill layer shall be smooth, firm, and unyielding. Unsuitable areas will necessitate reworking to achieve a suitable surface.

The surface of the finished subgrade/structural fill will be surveyed in accordance with Section III for as-built documentation prior to placement of the compacted soil layer.

5. LOW PERMEABILITY SOIL

Material for the low permeability soil shall consist of relatively homogenous, silty, and clayey soils which are substantially free of debris, rock, plant materials, frozen materials, foreign objects, organics, and other deleterious substances. The CQA Consultant shall obtain samples from within the identified borrow and stockpile area and subject the soils to the Conformance testing indicated in Tables II-1A, II-1B, and II-2.

Based on the results of these laboratory tests, material which may meet the requirements of low permeability soil material shall be identified. A range of moisture/density values which results in the required permeability should be determined

based on the laboratory testing data. This data will be used to determine an acceptable permeability zone (APZ). This APZ will then be used as the pass/fail criteria of the field density tests. In addition to the APZ, thin walled tube samples may be obtained, at the discretion of the Construction Manager or Certifying Engineer, to verify compliance of the constructed low permeability soil layer.

The low permeability soil material shall be placed in 8 in. loose (6 in. compacted) lifts. The surface of each lift shall be scarified and wetted prior to placement of the subsequent lift to promote adhesion between layers. The lift depth shall be verified by a manual method (i.e., hand auguring). Soil clods shall be broken down by disking, and moisture conditioning shall be conducted to preserve the homogeneity of the soil and to obtain relatively uniform moisture content through the soil mass. The moisture content of the low permeability soil may be field tested during processing and placement when requested by the Contractor for verification purposes. The moisture content of the low permeability soil shall be field tested following compaction. The action of heavy equipment shall be observed for penetration, pumping, and cracking of the compacted soil layer surface. Performance testing shall be accomplished in accordance with Table II-2.

The finished surface shall be firm, uniform, smooth, and free of desiccation cracks. Perforations in the low permeability soil layer created by nuclear density probes, stakes, or any other methods shall be filled with bentonite, a soil-bentonite mixture, or a Certifying Engineer approved equal.

6. TOPSOIL

The topsoil shall be composed of soils meeting the requirements of Specification Section 02204.

Care should be exercised when material is being placed around groundwater wells and other appurtenances to prevent damage to these components. The finished surface of the top soil layer will be surveyed in accordance with Section III for as-built documentation. Soil thickness verification will be performed by manual methods (i.e.,

hand auguring and/or thickness markers) due to possible settlement of the waste layers during construction activities.

7. POTENTIAL PROBLEMS AND DEFICIENCIES

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

- excessive pumping or cracking of material occurs;
- under adverse weather conditions;
- work is conducted in difficult areas; and
- a high frequency of failing tests is observed.

If a defect is discovered in the product, the CQA Consultant shall immediately determine the extent and nature of the defect and inform the Construction Manager. If the defect is indicated by an unsatisfactory test result, the CQA Consultant shall determine the extent of the deficient area by additional tests, observations, a review of records, or other appropriate means. Deficiencies shall be corrected by the Contractor to the satisfaction of the CQA Consultant and the Construction Manager.

The CQA Consultant shall schedule appropriate retests after the work deficiency has been corrected. Retests recommended by the CQA Consultant must verify that the defect has been corrected before any additional work is performed by the Contractor in the area of the deficiency.

SECTION III
SURVEYING

1. INTRODUCTION

Surveying of lines and grades shall be conducted by the Owner's Representative on an ongoing basis during construction of the soil layers. Surveying shall be performed to provide documentation for record plans, verify quantities of soils, and assist the Contractor to comply with the required grades. Surveying conducted at the site shall be part of the construction quality assurance program.

2. SURVEY CONTROL

One or more permanent benchmarks will be established or directed for use for the site at a location convenient for daily tie-in. The vertical and horizontal controls for this benchmark will be established within normal land surveying standards.

3. SURVEYING PERSONNEL

Surveying will be performed under the direct supervision of a qualified, Land Surveyor licensed by the State of Alabama, who may also be the Senior Surveyor on-site. The survey crew will consist of the Senior Surveyor and as many Surveying Assistants as are required to satisfactorily undertake the work. Surveying personnel will be experienced in the provision of these services including detailed, accurate documentation.

4. PRECISION AND ACCURACY

The survey instruments used for this work shall be precise and accurate to meet the needs of the project. Survey instruments shall be capable of reading to a precision of 0.01 ft (3.1 mm) and with a setting accuracy of 10 seconds. Calibration certificates for

survey instruments shall be submitted to the CQA Consultant prior to initiation of surveying activities.

5. LINES AND GRADES

When required, the following surfaces shall be surveyed to determine the lines and grades achieved during construction:

- surface of excavation/structural fill (prior to low permeability soil layer placement);
- surface of waste excavation/fill areas;
- surface of the finished low permeability soil layer;
- alignment and inverts of piping (both inside and outside the landfill footprint); and
- profiles, cross sections, inverts for ditches, roads, and sedimentation basins.

6. FREQUENCY AND SPACING

Surveying shall be performed as soon as possible after completion of a given layer or section to facilitate progress and avoid delaying subsequent work activities. In addition, spot checks during construction will be necessary to assist the Contractor in complying with the required grades.

The following spacing and locations shall be provided, as a minimum, for survey points:

- surfaces with slopes less than 10 percent will be surveyed on a square grid not wider than 50 ft;

- on slopes greater than 10 percent, a square grid not wider than 50 ft will be used, but in any case, a line at the crest, midpoint, and toe of the slope will be taken;

- a line of survey points no farther than 100 ft apart will be taken along any slope break (this will include the inside edge and outside edge of any bench on a slope); and

- along linear features, survey sections or points should be at 50 ft centers.

7. TOLERANCES

Acceptable tolerances upon completion of each layer, within the project areas, shall be 0 to - 0.1 ft (30 mm) on final subgrade and structural fill elevations, and 0 to + 0.1 ft on low permeability soil and topsoil layers, provided minimum permit conditions and state regulations are adhered to (i.e., thickness, grades, etc.). Surveying tolerances may need to be more stringent in the certain areas (i.e., trench inverts and pipe alignments) to measure accurate construction.

8. DOCUMENTATION

Original field survey notes shall be retained by the Senior Surveyor. The Surveyor shall produce record plans for the Construction Manager as the job progresses. The results from the field surveys will be documented on a set of record plans. At a minimum these plans shall show the final elevations of the surfaces listed in Subsection 5.0 of this section at a scale of 1 in. equal 100 ft with contour intervals no greater than 2 ft.

SECTION IV
DOCUMENTATION

1. INTRODUCTION

An effective CQA Plan depends largely on recognition of 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 quality assurance activities. The CQA Consultant shall document that quality assurance requirements have been addressed and satisfied.

The CQA Consultant shall provide the Construction Manager with signed descriptive remarks, data sheets, and logs to verify that monitoring activities have been carried out. The CQA Consultant shall also maintain at the job site a complete file of Design Plans, design specifications, the CQA Plan, checklists, test procedures, daily logs, and other pertinent documents.

2. DAILY RECORDKEEPING

Standard reporting procedures shall include preparation of a daily report which, at a minimum, shall consist of a daily summary report including memoranda of meetings and/or discussions with the Construction Manager and/or site contractors, observation logs, and test data sheets. Other forms of daily recordkeeping to be used as appropriate include construction problem and solution data sheets and photographic reporting data sheets.

2.1 Daily Summary Report

The CQA Consultant shall prepare a daily summary report which may include the following information as appropriate:

- date, project name, location, and other identification;
- data on weather condition;
- information on meetings held or discussions which took place:
  - names of parties to discussion;
  - relevant subject matter or issues;
  - decisions reached; and
  - activities planned and their schedule.
- a reduced-scale site plan showing all proposed work areas and test locations;
- descriptions and locations of ongoing construction;
- descriptions and locations of work being tested and/or observed and documented; as well as test results;
- calibrations or recalibration of test equipment and actions taken as a result of recalibration, or reference to specific observation logs and/or test data sheets;
- off-site materials received, including quality verification documentation; and
- decisions made regarding acceptance of units of work, and/or corrective actions to be taken in instances of substandard quality.

2.2 Construction Problem and Solution Report

Reports describing special construction situations or clarifications to technical specifications or construction deficiencies shall be prepared by the CQA Consultant.

These reports may include the following information as appropriate:

- a detailed description of the clarification, or construction deficiency;
- the location and probable cause of the situation or construction deficiency;
- documentation of the corrective action taken to address the situation or deficiency;
- final results of any responses; and
- the signature of the CQA Coordinator, Certifying Engineer, and the Construction Manager indicating concurrence.

The Certifying Engineer shall be made aware of any significant recurring non-conformance with the design specifications. The Certification Engineer shall then determine the cause of the non-conformance and recommend appropriate changes in procedures or specifications to the Construction Manager. If these changes are significant in nature, they will be submitted to the Engineer for approval. When this type of evaluation is made the results shall be documented, and any revision to procedures, design specification, or permit specifications will be approved by the Owner, Engineer, and if necessary, Alabama Department of Environmental Management (ADEM).

2.3 Photographic Reporting Data Sheets

Photographic reporting data sheets, where used, shall be cross-referenced with observation logs and test data sheets and/or construction problem and solution reports.

These photographs will serve as a pictorial record of work progress, problems, and mitigation activities. The basic file shall contain digital photographs. A copy of photographs will be provided electronically. These records will be presented to the Construction Manager when requested and upon completion of the project.

2.4 Design and/or Specification Changes and Clarifications

Design and/or Specification changes or clarifications may be required during construction. In such cases, the CQA Consultant shall notify the Construction Manager. The Construction Manager shall then notify ADEM, if necessary.

Significant design and/or permit specifications changes shall be made only with the written agreement of the Construction Manager and the Engineer, and shall take the form of an addendum to the specifications and/or CQA Plan. Clarifications to specifications shall be documented by the CQA Consultant as they are made.

3. REPORTS

The CQA Consultant shall prepare periodic reports which summarize construction activities and the results of observations and tests. Progress reports shall be prepared at regular time intervals to document the status of the work. Certifications shall be prepared at the completion of major construction activities.

At the completion of the work, final documentation shall be prepared and shall include the seal of a Professional Engineer registered in the State of Alabama and supporting field and laboratory test results.

3.1 Final Certification Documentation

At the completion of the work, the CQA Consultant shall submit to the Construction Manager the signed Final Certification Documentation. The Final Certification Documentation shall describe activities associated with the construction of the item including construction procedures and observations and tests performed by CQA personnel. The report shall be organized into sections discussing the major components of construction, including structural fill, low permeability soil and topsoil. At a minimum, the Final Certification Documentation shall include:

- summaries of construction activities as they conform to the CQA Plan;

- observation logs and test data sheets including sample location plans and supporting field and laboratory test results;
- construction problems and solutions reports;
- changes from design and material specifications;
- record drawings; and
- a summary statement sealed and signed by a Professional Engineer registered in the State of Alabama.

The record drawings shall include scale plans depicting the location of the construction and details pertaining to the extent of construction (e.g., depths, plan dimensions, elevations, soil component thicknesses, etc.). Surveying and base maps required for development of the record drawings shall be prepared by the Surveyor retained by the Contractor.

TABLES

LABORATORY TEST METHODS FOR THE EVALUATION OF SOIL AND AGGREGATE

COMMON TEST NAME	PARAMETER DEFINED	STANDARD METHOD
Soil Classification	Unified Soil Classification System	ASTM D2487
Sieve and Hydrometer Analysis	Particle Size Distribution of Coarse and Fine Grained Soils	ASTM D422
Sieve Analysis for Aggregates	Particle Size Distribution for Aggregates	ASTM C136
Atterberg Limits	Liquid and Plastic Limits, Plasticity Index	ASTM D4318
Standard Proctor Density	Moisture/Density Relationship Using 5.5 lb (2.46 kg) Rammer and 12 in. (305 mm) Drop	ASTM D698
Modified Proctor Density	Moisture/Density Relationship Using 10 lb (4.54 kg) Rammer and 18 in. (457 mm) Drop	ASTM D1557
Moisture Content	Water to Dry Weight Ratio	ASTM D2216
Permeability: Flexible Wall Permeameter	Permeability (Hydraulic Conductivity) on Undisturbed or Remolded Samples of Soil	ASTM D5084
Permeability: Constant Head	Permeability (Hydraulic Conductivity) of Aggregates	ASTM D2434
Carbonate Content	Carbonate Content of Aggregate	ASTM D3042
Organic Content	Percent Ash and/or Organic Content in Soils	ASTM D2974

Notes: 1) Not all tests are required for this site; refer to Table II-2 in the CQA Plan.

2) Latest version of applicable ASTM International or USDA testing standards shall be used when conducting tests.

FIELD TEST METHODS
FOR THE EVALUATION OF SOIL AND AGGREGATE

COMMON TEST NAME	PARAMETER DEFINED	STANDARD METHOD
Visual Classification	Maximum Particle Size, General Material Characteristics	ASTM D2488
USDA Classification	Classification of Ability to Support Vegetation	USDA Method
Nuclear Densometer	In-Place Density and Moisture Content	ASTM D2922 and ASTM D3017
Moisture Content	In-Place Moisture as Check on Nuclear Densometer Measurements	ASTM D2216
Sand Cone Density	In-Place Density as Check on Nuclear Densometer Measurements	ASTM D1556
Drive Tube Sample	In-Place Density as Check on Nuclear Densometer Measurements	ASTM D2937
Lift Depth Check	Thickness of Placed Soils or Aggregates	Visual Confirmation

Notes: 1) Not all tests are required for this site; refer to Table II-2 in the CQA Plan.

2) Latest version of applicable ASTM International or USDA testing standards shall be used when conducting tests.

TABLE II-2

MINIMUM TEST FREQUENCIES FOR SOIL AND AGGREGATE MATERIALS IN LANDFILL CLOSURE SYSTEMS

LINER COMPONENT	REQUIRED TEST	MINIMUM FREQUENCY	SAMPLE SIZE[a]	ACCEPTANCE CRITERIA
Subgrade	Visual Observation	As required	N/A	Surface does not pump or rut excessively.
Structural Fill Conformance Testing[c]	Visual Observation	As required	N/A	Substantially free of debris, large rocks, plant materials, or other deleterious material.
	Sieve Analysis	1 per source, 1 per 5,000 yd^3 & 1 per material change	5-10 lb	Max. 5 in. in greatest dimension no more than 15% by weight larger than 3 inches.
	Standard Proctor Density	1 per source, 1 per 5,000 yd^3 & 1 per material change	5-10 lb	Determination of maximum dry density and optimum moisture content.
Structural Fill Performance Testing[d]	Visual Observation	As required	N/A	Final surface: firm, smooth, and uniform.
	Lift Depth Check	As required		8 in. compacted lift
	Nuclear Densometer In-place Density and Moisture Content	1 per 10,000 ft^2 per lift	N/A	≥ 95% Standard Proctor maximum dry density.
	Moisture Content	1 per 5 nuclear densometer tests	Varies	Check nuclear densometer measurements to determine if recalibration and/or moisture correction is necessary.
	Sand Cone Density or Drive Tube Sample	1 per 25 nuclear densometer tests	Varies	Check nuclear densometer measurements to determine if recalibration is necessary.

TABLE 1 (continued)

MINIMUM TEST FREQUENCIES FOR SOIL AND AGGREGATE MATERIALS IN CONTAINMENT SYSTEM CONSTRUCTION

LINER COMPONENT	REQUIRED TEST	MINIMUM FREQUENCY	SAMPLE SIZE[a]	ACCEPTANCE CRITERIA
Low Permeability Soil Conformance Testing[c]	Visual Observation	As required	N/A	Substantially free of debris, large rocks, plant materials, or other deleterious material.
	Sieve Analysis	1 per source, 1 per 5,000 yd^3 & 1 per material change	5-10 lb	2 inch max. particle size[b]
	Atterberg Limits	1 per source, 1 per 5,000 yd^3 & 1 per material change	5-10 lb	Plasticity Index: ≥ 10[b]
	Standard Proctor Density	1 per source & 1 per material change	5-10 lb	Determination of maximum dry density and optimum moisture content.
	Moisture Content	1 per source	Varies	Determine if adequate moisture is present prior to compaction.
	Flexible Wall Permeability (remolded)	1 per source & as required to establish Acceptable Permeability Zone (APZ)	50 lb	$\leq 1x10^{-5}$ cm/sec
	Soil Classification	1 per source, 1 per 5,000 yd^3 & 1 per material change	5-10 lb	SC, CL, CH, MH, or ML
Low Permeability Soil Performance Testing[d]	Visual Observation	As required	N/A	Final surface: firm, smooth, and uniform.
	Nuclear Densometer In-place Density and Moisture Content	1 per 10,000 ft^2 per lift	N/A	$\geq$ 95% Standard Proctor maximum dry density[b]. Moisture Content as necessary to achieve required permeability.
	Moisture Content	1 per 5 nuclear densometer tests	Varies	Check nuclear densometer measurements to determine if recalibration is necessary.
	Sand Cone Density or Drive Tube Sample	1 per 25 nuclear densometer tests	Varies	Check nuclear densometer measurements to determine if recalibration is necessary.

TABLE 1. (continued)

MINIMUM TEST FREQUENCIES FOR SOIL AND AGGREGATE MATERIALS IN CONTAINMENT SYSTEM CONSTRUCTION

LINER COMPONENT	REQUIRED TEST	MINIMUM FREQUENCY	SAMPLE SIZE[a]	ACCEPTANCE CRITERIA
Low Permeability Soil Performance Testing[d] (continued)	Lift Depth Check	As required	N/A	6 in. compacted lift
	Flex Wall Permeability	As necessary, at the discretion of CQA Consultant	Thin walled tube	$\leq 1x10^{-5}$ cm/sec

[a] In general, where the symbol "N/A" (not applicable) is used, the test is performed on in-place materials.

[b] Minor variations shall be allowed in acceptance criteria for low permeability soil in order to maintain permeability less than 1×10^{-5} cm/sec. Under no circumstances shall acceptance criteria be augmented which results in permeability grater than 1×10^{-5} cm/sec.

[c] Conformance testing is performed on borrow sources and placed material to ensure the minimum required values are met and the material remains consistent.

[d] Performance testing is performed on materials after placement is complete to ensure that the lift or layer meets design requirements