CONSTRUCTION QUALITY ASSURANCE PLAN

PREPARED FOR:

WATAUGA RIVER

SLOPE STABILIZATION PLAN

SYCAMORE SHOALS STATE PARK

(FORMER GREENE PROPERTY)

ELIZABETHTON, TENNESSEE

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION

and

DIVISION OF REMEDIATION

NASHVILLE, TENNESSEE

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1.0 INTRODUCTION

This Construction Quality Assurance/Quality Control Plan (CQA Plan) is prepared for the Watauga River and Tributary Slope Stabilization Plan at the Sycamore Shoals State Park (former Greene Property) located in Elizabethton, Tennessee. The components of construction of the slope stabilization (including stockpile area) that require field monitoring and documentation under this plan include but may not be limited to erosion control features, clearing, site grading, geotextile placement, riprap placement, cover soil placement, topsoil with seeding and erosion control mat placement or hydroseeding, live siltation/stakes, and surveying.

This plan details the activities required of the Constructor/Contractor and CQA personnel involved with the construction, installation, surveying, and testing activities for the construction of the slope stabilization of the former Greene Property along the Watauga River and Tributary.

2.0 PURPOSE AND CONTENTS OF PLAN

The purpose of this construction quality assurance (CQA) plan is to ensure that the work is constructed to meet or exceed the design criteria. The plan addresses the following elements:

A. Qualifications, duties, and responsibilities of the CQA officer.

B. Material selection standards.

C. Construction observation and testing.

D. Documentation and record keeping.

3.0 DEFINITIONS AND USE OF TERMS

This section provides definitions for terms used in the QA/QC Plan.

Owner – Tennessee Department of Environment and Conservation, Division of Remediation.

Certification Engineer – the individual appointed by the Owner who is responsible for performing tasks outlined in this CQA Plan. The Certification Engineer will be selected prior to construction beginning and shall be a registered Professional Engineer in the state of Tennessee. Synonyms used are: CQA Engineer, CQA Officer.

Constructor/Contractor – the individual or firm responsible for facility-related construction and/or operational activities. This definition applies to any party performing work defined in the construction documents. (Note: either title/term may be referenced and used interchangeably in this document.)

Construction Manager – the individual responsible for overseeing construction of the project and representing the owner's interests.

Conformance Testing – includes testing that is performed by the Certification Engineer to confirm the quality of the construction materials prior to their use.

Design Engineer – the individual(s) or firm(s) responsible for the preparation of design documents and significant design changes during construction as determined by the Certification Engineer. The design engineer shall be a registered Professional Engineer in the state of Tennessee.

Earthwork – an activity involving the use of soil or rock materials.

Performance Testing – includes those activities that occur during and following material installation activities during facility operation.

Project Design Drawings and Documents – all project related drawings and documents, including design modifications and record drawings.

Project Documents – includes Constructor submittals, construction drawings, record drawings, specifications, shop drawings, field inspection reports, and project schedule.

Quality Assurance (QA) – provides verification that QC functions have been performed in substantial compliance with the project design drawings and documents. This function will normally be provided by a Certification Engineer.

Quality Control (QC) – functions performed by the Constructor and material supplier to verify that work performed conforms to project design drawings and documents.

Record Drawings – drawings recording the locations, elevations, and details of the facility after construction is completed.

Surveyor – the individual responsible for preparation of as-constructed surveys of the completed grading, cover soil, vegetation layer, and riprap. The surveyor shall be a registered Surveyor in the state of Tennessee.

Testing Laboratory – one or more laboratories capable of conducting the required conformance and performance laboratory testing of soils and geosynthetics required by this QA/QC Plan.

4.0 CERTIFICATION ENGINEER / CQA OFFICER QUALIFICATIONS

The Certification Engineer / CQA officer (or personnel under his direct supervision) will closely monitor construction of the various components of the facility which includes erosion control features, clearing, site grading, geotextile placement, riprap placement, cover soil placement, topsoil with seeding and erosion control mat placement or hydro seeding, live siltation/stakes, and surveying. The Certification Engineer will be a Professional Engineer licensed to practice in the state of Tennessee, who is knowledgeable in the field of soil mechanics and geosynthetics and will have a good working knowledge of the equipment and procedures generally used in the construction of landfills.

The Certification Engineer has the following duties:

- provide written, certified documentation attesting to conformance with the design requirements and the CQA Plan with respect to conditions of grading and fill, construction of the soils and geosynthetic components of the cover system and erosion control features;

- be present at appropriate intervals during construction of the soil components, perform appropriate tests, and obtain samples for laboratory analyses;
- observe material delivery and unloading;
- use the results of tests and laboratory analyses to document conformance with project requirements;
- provide to Owner and the Constructor the results of observations and test as the work progresses. Coordinate with Constructor when modifications to the plans are necessary to ensure compliance with the design drawings, specifications, and CQA Plan;
- schedule and coordinate inspection and testing activities; and
- reject defective work and verify that corrective measures have been implemented.

The Certification Engineer may utilize qualified field technicians to perform testing described and to provide additional oversight during construction as necessary.

5.0 PROJECT MEETINGS

5.1 Pre-Construction Meeting

A pre-construction meeting will be held at the site prior to the start of construction. The Owner, Construction Manager, Certification Engineer, Constructor, and others designated by the Owner will attend this meeting. The purpose of the meeting is to accomplish the following activities:

- review the construction drawings and documents, CQA Plan, work area procedures, construction procedures, construction sequencing, health and safety plan, and other related issues;
- define lines of communication and authority;
- review the project schedule;
- review best management practices for erosion and sediment control and construction storm water management during each phase of construction;
- review testing procedures and procedures for correcting and documenting construction deficiencies, repairs, and retesting;
- review testing and record drawing documentation procedures; and
- conduct a site inspection to discuss work areas, work plans, stockpiling, equipment and material laydown areas, access roads, and related items.

This meeting will be documented by the Construction Manager or authorized representative, and copies of the documentation will be distributed to all parties.

5.2 Progress Meetings

Progress meetings shall be coordinated and conducted by the Certification Engineer and/or the Construction Manager. The primary purpose of these meetings shall confirm that all parties involved with construction activities are familiar with the design, required procedures and associated CQA objectives along with any safety issues related to the construction. Specific project safety issues shall be the responsibility of designated safety professionals. Minutes of each meeting shall be documented for inclusion with the project records.

Pre-construction meetings shall be held prior to initiating individual phases of construction. The Certification Engineer and other parties that will actively participate in the construction activities shall attend this meeting.

5.3 Modifications

General construction and QC modifications may be executed following approval of the Certification Engineer, the Design Engineer, and the Owner. Proposed modifications shall be developed by the Certification Engineer, and submitted to the Owner for review and comment, and approval prior to incorporation into the facility design. Documentation of any modifications shall be submitted with copies retained for inclusion with the project records.

5.4 Contractor Submittals

Contractor submittals shall be reviewed and approved by the Certification Engineer prior to delivery and/or use of the respective construction materials. Copies of all submittals shall be included with the project records.

5.5 Conformance Testing

Conformance testing shall consist of periodic evaluation of materials and/or constructed products. Conformance testing shall be conducted and documented by the CQA Team. Results of testing shall be reviewed by the Certification Engineer to assess conformance with project requirements. Copies of all conformance testing results shall be included with the project records.

5.6 Deficiency Meetings

As required, meetings will be held to discuss problems or deficiencies. At a minimum, these meetings will be attended by the Construction Manager, Certification Engineer, and the Constructor's on-site superintendent. If a problem requires a design modification, the Design Engineer and Constructor's project manager should also be present. The meeting will be documented by the Certification Engineer.

6.0 CONSTRUCTION SEQUENCE AND SCHEDULE

6.1 General

As described previously, construction of the various components of the facility include erosion control features, clearing, site grading, geotextile placement, riprap placement, cover soil

placement, topsoil with seeding and erosion control mat placement or hydroseeding, live siltation/stakes, and surveying. At the onset of construction, the Constructor shall provide a proposed construction sequencing plan and schedule for review and approval by the Certification Engineer and Owner.

The general construction sequence envisioned to accomplish this project consists of the following major activities/items for the slope areas and the stockpile areas:

- Establishing erosion control features along river (and carried out for the facility);
- Clearing trees, chipping and/or removing;
- Establishing haul roads to stockpile area;
- Stripping and stockpiling removed soil and topsoil;
- Initiating slope excavation, site grading, and subgrade preparation;
- Placing geotextile;
- Placing riprap;
- Placing cover soil;
- Placing topsoil;
- Seeding and erosion control mat placement or hydroseeding;
- Live staking and tree planting; and
- Surveying as required as the project progresses.

In addition to providing the Schedule and Construction Sequence (as previously noted), the Constructor shall provide an Erosion Control Plan for review and approval prior to initiating work. A Health and Safety Plan shall also be provided for review only prior to initiating work.

7.0 SITE GRADING/SUBGRADE

7.1 General

Site grading, in this case, refers to soil/ash needed to attain a base of cover soil grades or structural berms and/or trenches as applicable. If soil is used for grading it may consists of a broad range of on-site soils relatively free of organics, debris, or other deleterious matter. The suitability of the soil will be determined by the Design Engineer.

Prior to the installation of the cover soil, the Contractor will grade, excavate overburden soil, or compact soil subgrade, if required, to the subgrade elevations indicated in the engineering plans.

The Contractor shall be responsible for preparing the soil subgrade surface for placement of overlying materials. Upon completion of the subgrade preparation, the CQA Monitor and the Contractor shall jointly examine the subgrade surface and prepare a certificate of acceptance. The Subgrade Acceptance Certification shall verify that the subgrade is suitable for the installation of the overlying components.

During construction, the CQA Monitor shall indicate to the Earthwork Contractor any subgrade locations which are not acceptable for placement of subsequent components. Any defects in the subgrade soil shall be repaired by the Contractor such that the properties of the repaired areas meet the project specifications.

Work also includes designated stockpile area(s), such as placement of stripped soils and placement of removed river bank spoils, as indicated in the engineering plans and as directed.

7.2 Subgrade Surveying

The surveyor will establish a 50-foot by 50-foot survey grid system on the landfill slope and stockpile area(s) and survey locations along the perimeter to verify proper line and grade in accordance with the engineering plans. Grade tolerance is +0.0 to +0.2 feet from the engineering plans.

The CQA Monitor will document the construction activities associated with the subgrade. Refer to **Sections 13.0 and 14.0** for requirements associated with surveying.

7.3 Inspections

For areas that require grading/fill, CQA Personnel shall:

- Monitor that the construction practices delineated in the project specifications are being employed by the Contractor. If the construction quality practices are not observed, the CQA Personnel shall first notify the contractor's foreman to correct the deficiency. Select Contractor practices to be monitored are as follows:
    - Materials are obtained from designated borrow areas;
    - Surface on which a lift is to be placed is scarified prior to placement, in a manner to minimize creation of preferential pathways for runoff along tracks, and that no placement of frozen soil or on frozen ground occurs;
    - Upper lift of subgrade is maintained moist and desiccation is not occurring; and
    - Compaction procedures provide sufficient energy/kneading action to destroy soil clods.

7.4 Submittals

CQA Personnel shall review and approve as complete the following documentation:

- Survey Data;
- Daily Summary Reports; and
- Borrow Source Reports.

8.0 GEOTEXTILE

The proposed design will include geotextile materials as indicated in the engineering plans and specifications. This section of the CQA Plan addresses geotextile materials for use underneath the rock riprap.

8.1 Submittals

The manufacturer of the geotextile shall submit the following:

1. Manufacturer's specifications and certification stating that the materials meet or exceed the applicable requirements of **Table 8.1**.

2. Manufacturer's instructions for handling and storage of the geotextile.

3. Manufacturer's quality control test results for geotextile. The testing shall be performed by the manufacturer as follows:

    a. The geotextile shall be sampled at a frequency of one sample for each 100,000 square feet delivered to the jobsite and shall be tested by the manufacturer to verify that the requirements in **Table 8.1** are met. Testing for UV Resistance is not required; certification by the manufacturer that this requirement is achieved shall be provided.

The CQA Monitor shall verify and document that all the information submitted by the manufacturer meets the requirements of the CQA Plan.

8.2 Material

8.2.1 Geotextile

The geotextile used as filter material for the riprap toe of slope system shall consist of continuous filament, needle punched, non-woven material and shall meet the minimum average roll values as detailed in **Table 8.1** below.

Table 8.1 Geotextile Minimum Requirements (Non-woven 12 oz/sy)

PROPERTIES	QUALIFIER	UNITS	SPECIFIED VALUES[1]	TEST METHOD
Type	---	---	Nonwoven	---
Weight	minimum	oz/yd^2	12	ASTM D 5261
Grab Tensile	minimum	lb	300	ASTM D 4632[2]
Tear Strength	minimum	lb	115	ASTM D 4533[2]

Notes

[1] All values represent minimum average roll values (i.e., any roll in a lot should meet or exceed the values in this table).

[2] Minimum value measured in machine and cross machine direction.

8.3 Material Delivery, Handling, and Storage

The Geosynthetics Contractor shall perform the following:

1. Assure that the geotextile is packed, shipped, off-loaded, and stored by appropriate methods to prevent damage. The Contractor shall be responsible for replacing any damaged or unacceptable material at no cost to the Owner.

2. Protect the materials from mud, dust, dirt, and other damaging conditions. The manufacturer's procedures for shipping, handling, and storage shall be followed.

3. Assure that the geotextile rolls are clearly labeled with the manufacturer's name, roll number, lot number, and batch number. Information shall be provided by the manufacturer which clearly identifies the corresponding roll information for the geotextiles.

The CQA Monitor shall visually inspect the surface of all rolls for defects and/or damage and document any observed damage to any of the rolls.

8.4 Material Deployment

The Contractor shall perform the following:

1. Assure that all geotextile materials are handled in a manner to prevent damage.

2. Assure that no materials are placed over the geotextile until all required documentation regarding the geotextile installation is complete and that all required certifications and testing for the materials complies with this CQA Plan.

3. Assure that the surfaces on which the materials are to be placed do not contain stones or excessive dust that could cause damage to any geosynthetic component.

4. In periods of high winds, weigh all geotextiles. The Contractor shall be responsible for damage to the geotextiles resulting from wind damage.

5. Use equipment to deploy geosynthetic components that will not cause damage to any material.

6. Assure that no personnel working on geosynthetic materials shall smoke, wear damaging shoes, or engage in other activities that could damage the materials.

The CQA Monitor shall observe and document the deployment of geotextile to verify that all provisions of the CQA Plan are met.

8.5 Field Seams

The Contractor shall perform the following:

1. Field seams for geotextile:

    a. shall overlap a minimum of six inches when sown or 12 to 36 inches without sown seams.

    b. shall be continuously sewn between panels unless other seaming methods are approved by the CQA Monitor.

    c. shall use thread that meets the manufacturer's requirements.

    d. Shall be oriented on slopes steeper than 5% parallel to the fall of the slope unless approved by the Design Engineer. If horizontal seams are used on slopes steeper than 7H:1V, the horizontal seams shall be located in the lower half of the slope and horizontal seams shall be staggered by a minimum distance of 25 feet.

The CQA Monitor shall observe and document the seaming of geotextile to verify that the requirements of the CQA Plan are met.

8.6 Defects and Repairs

The Contractor shall repair any holes or tears in the geotextile as follows, using patches made from the same material:

1. Damaged areas of geotextile shall be repaired by sewing (or heat-bonding if approved by Design Engineer) a patch in place with a 12-inch overlap in all directions.

The CQA Monitor shall observe and document the repairs made to the geotextile to verify that repairs are made according to the requirements of the CQA Plan.

8.7 Material Acceptance

The Contractor retains ownership and responsibility for the geotextile materials until accepted by the Owner.

The Owner will accept the geotextile installation when:

1. All required documentation from the manufacturer and the Contractor has been received and accepted.

2. The installation is complete.

3. The completion of field seams and repairs, including associated testing, is verified.

4. Written certification documents, including drawings, sealed by the CQA Monitor have been received by the Owner.

9.0 ROCK RIPRAP

9.1 Introduction

The slope stabilization system includes placement of an 18-inch-thick riprap layer above a geotextile as indicated in the engineering plans and specifications. This section of the CQA Plan addresses riprap material for use in the slope stabilization plan.

9.2 Material

The riprap shall be Class A-1, machined riprap, as specified in the engineering plans and specifications for erosional stability purposes in the cover.

9.3 Construction/Placement

The CQA Monitor shall perform the following:

1. Observe and document the riprap material is Class A-1, machined riprap, meeting the engineering specifications.

2. Observe and document the placement of the riprap; visually inspect for material uniformity and the presence or absence of foreign materials.

3. Monitor the placement of the riprap for potential or actual damage to the underlying geotextile of the slope stabilization system. Where damage is suspected, the geosynthetic material surface will be exposed to verify its conditions. Actual damage shall be documented, and corrective actions and repairs shall be made according to the CQA Plan.

4. At the direction of the CQA Monitor, the Contractor may place the riprap in one lift. If the CQA Monitor determines that the materials utilized must be placed in more lifts, the Earthwork Contractor will place the materials in the number of lifts determined to be acceptable by the CQA Monitor.

5. Certify that the riprap has been placed in accordance with the engineering plans and specifications at the locations tested.

The Contractor will perform the following:

1. Install the riprap above the geotextile components of the system with at least 18 inches of material maintained between the underlying geotextile and the construction equipment tires or tracks.

2. Riprap placement shall be accomplished to minimize stress on the underlying geosynthetic components of the system.

The Surveyor shall estimate the thickness of the riprap layer on a 50-foot by 50-foot grid system. Alternately, direct depth checks may be used to determine thickness. Locations where material

thickness is less than specified in the engineering plans shall be corrected. The CQA Monitor will document these situations as described in the CQA Plan.

10.0 COVER SOIL

10.1 Introduction

This section of the CQA Manual addresses the 2-foot-thick cover soil of the landfill and outlines the CQA soil program to be implemented regarding material approval, subgrade approval, test fill construction, field and laboratory control and record tests, and resolution of problems.

This also includes the designated stockpile areas, such as placement of stripped soil and placement of removed riverbank spoils, as indicated in the engineering plans and as directed.

The 2-foot-thick cover soil to be placed and compacted over the side slope area and the stockpiles, as indicated in the engineering plans, is to be a "clay-like" soil as defined in the project specifications. It is to meet the following definitions, per defined soil index tests:

- Be of a quality to be "clay-like," be easily managed, and have sufficient clay content to provide an adequate seal,
- Have a Plasticity Index (PI) > 15,
- Have a grain-size distribution with > 40% clay material, and
- From on-site sources and/or off-site imported material.

Testing as indicated in **Table 10.1** shall be conducted to approve material for use.

10.2 Material Approval

All material to be used as cover soil shall be approved in advance by the CQA Engineer. Approval is based upon successful completion of CQA control testing outlined below. Such testing can be performed either during excavation and stockpiling or from existing stockpiles prior to use.

10.2.1 Control Tests

The procedure for CQA testing during excavation and stockpiling (including existing stockpiles) is outlined below.

Each load of soil will be examined either at the borrow source or the stockpile area. Any unsuitable material will be rejected or routed to separate stockpiles consistent with its end use. Appropriate entries will be made in the daily log.

Control tests, as shown on **Table 10.1**, will be performed by the CQA Engineer prior to placement of any soil material.

10.3 Subgrade Approval

The CQA Engineer will verify that the subgrade is constructed in accordance with the project specifications. Surveying and approval/acceptance of the subgrade shall be obtained prior to proceeding with cover soil placement. Timing is addressed in **Section 13.0**.

10.4 Construction

10.4.1 Construction Monitoring

A. Cover soil shall be placed as described in the applicable section(s) of the project specifications using the construction methods, equipment, and material demonstrated in the test fill construction for each component (as applicable).

B. Only soil previously approved by the CQA Engineer (see **Section 10.2**) shall be used in construction of the cover. Unsuitable material will be removed prior to acceptance by the CQA Engineer.

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

D. The CQA Engineer will monitor protection of the cover soil during and after construction.

E. The cover soil surface shall be sprinkled with water as needed to prevent desiccation. Should desiccation occur, the last lift shall be reconstructed in accordance with the project specifications. Standing water should not be present on the cover soil.

F. Frost heave or other damage due to freezing shall require lift reconstruction in accordance with the project specifications.

G. The CQA Engineer will inspect the cover soil and certify that it is in accordance with the project specifications and approved plans prior to the Contractor beginning installation of overlying layers.

H. All cracks and voids shall be filled and the surface made uniform.

10.4.2 Control Tests

The control tests, as shown on **Table 10.2**, will be performed by the CQA Engineer prior to placement of materials.

10.4.3 Record Tests

The record tests, as shown on **Table 10.2** and as described below, will be performed by the CQA Engineer during placement of cover soil material.

A. Each lift will be checked visually for soil clods, rocks, debris, plant materials and other foreign materials. Any such material which does not meet specified requirements shall be identified and removed prior to and during the compaction process.

B. The thickness of the loose lift will be measured at random locations after spreading and leveling is completed. Loose lift thickness should not exceed the depth of penetration of the compactor's feet.

C. Moisture content will be monitored by the CQA Engineer prior to compaction. If the soil is drier than the specified minimum moisture content, water will be added, and the lift will be disked to distribute the moisture evenly.

Results of testing will be certified within seven days of soil cover placement.

10.4.4 Record Test Failure

The following procedures shall be used in the event of density or "clay-like" test failure:

A. Failed Density Test: Re-compaction of the failed area shall be performed and retested until the area meets or exceeds requirements outlined in the specifications. A failing test is assumed to indicate failure for the entire area represented by the test. The CQA Engineer may perform judgmental testing beyond the requirements of this CQA Plan to limit the area defined by the failed test. The spacing and/or intervals of the judgmental testing will be determined by the Engineer, based on the nature of the failing test and the site-specific conditions.

B. Failed "Clay-Like" Test: The area of failure shall be localized and reconstructed in accordance with the project specifications. This area will be retested as outlined within the plan by the CQA Engineer. Optionally, at least one replicate sample shall be obtained and tested by the Contractor in the immediate vicinity of the failed test. If the replicate sample passes, then the initial failing test will be discounted. However, should the replicate sample confirm the failure of the soil to meet specifications, the area of failure shall be localized, reconstructed, and retested as described above.

10.4.5 Judgmental Testing

During construction, the frequency of control and/or record testing may be increased at the discretion of the CQA Engineer when visual observations of construction performance indicate a potential problem. Additional testing of 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.
- the degree of compaction is doubtful; or
- to define the limits of a failing test.

10.4.6 Perforations

All holes resulting from compaction testing shall be patched with compacted soil approved for the appropriate construction (if allowed by the project specifications) or sodium bentonite compacted in the holes.

10.5 Deficiencies

The CQA Engineer will immediately determine the extent and nature of all defects and deficiencies and report them to the Owner and Engineer. All defects and deficiencies will be documented by the CQA Engineer. The Contractor shall correct defects and deficiencies to the satisfaction of the CQA Engineer. The CQA Engineer will observe all retests on repaired defects.

Table 10.1 CQA Testing Program for Cover Soil Material Approval

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
CONTROL TESTS:		
Visual Classification	ASTM D 2488	Each Soil Type
Moisture Content	ASTM D 2216[1]	1,000 CY per Each Soil
Grain Size Analysis (see note below)	ASTM D 422	1,000 CY per Each Soil
Atterberg Limits (see note below)	ASTM D 4318	1,000 CY per Each Soil
Moisture-Density Relationship	ASTM D 698	5,000 CY per Each Soil
Note: “Clay-Like” definition of soil is defined as PI>15 and grain-size >40% clay		

Notes

[1] Optionally, use ASTM D 4643, ASTM D 4959, or ASTM D 6938.

Table 10.2 CQA Testing Program for Cover Soil Construction

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
CONTROL TESTS: (See **Table 10.1**)		
RECORD TESTS:		
Lift Thickness	-----	Each Lift
In-Place Density	ASTM D 6938[1]	5 per acre per lift
Moisture Content	ASTM D 6938[2]	5 per acre per lift
Note: soil used is to already be approved by testing and definitions above		

Notes

[1] Optionally, use ASTM D 1556, ASTM D 2167, or ASTM D 2937. For every five nuclear density tests perform at least one density test by ASTM D 1556, ASTM D 2167, or ASTM D 2937 as a verification of the accuracy of the nuclear testing device.

[2] Optionally, use ASTM D 2216, ASTM D 4643, or ASTM D 4959. For every five nuclear moisture tests, perform at least one moisture test by ASTM D 2216, ASTM D 4643, or ASTM D 4959 as a verification of the accuracy of the nuclear testing device.

10.6 Surveying

The surveyor will establish a 50-foot by 50-foot survey grid system on the landfill slope and stockpile area and survey locations along the perimeter to verify proper line and grade in accordance with the engineering plans. Grade tolerance is +0.0 to +0.2 feet from the engineering plans.

The CQA Monitor will document the construction activities associated with the cover soil. Refer to **Sections 13.0 and 14.0** for requirements associated with surveying.

11.0 TOPSOIL & SEEDING WITH LIVE SILTATION/STAKES AND BARE ROOT TREES

11.1 Introduction

The slope stabilization system includes placement of a 12-inch-thick topsoil/vegetative layer over the cover soil as indicated in the engineering plans and specifications. This section of the CQA Plan addresses the topsoil/vegetative layer for use in the slope stabilization plan. It also addresses seeding and placement of live siltation/live stakes and planted trees as part of the stabilization plan.

11.2 Material

The topsoil shall meet the following requirements:

1. The topsoil will be free of debris, trash, stumps, or other deleterious materials.

2. The topsoil shall be loam or sandy loam capable of supporting shallow rooted vegetation.

3. Seeding as indicated in the engineering plans and specifications.

4. Live siltation and live stakes and bare root trees as indicated in the engineering plans and specifications.

11.3 Cover Soil Approval

The CQA Engineer will verify that the underlying cover soil is constructed in accordance with the project specifications. Surveying and approval/acceptance of the underlying cover soil shall be obtained prior to proceeding with topsoil placement. Timing is addressed in **Section 13.0**.

11.4 Construction/Placement

The CQA Monitor shall perform the following:

1. Observe and document the placement of the topsoil layer; visually inspect for material uniformity and the presence or absence of foreign materials.

2. Monitor the placement of the topsoil layer for potential or actual damage to the underlying components of the slope stabilization system. Where damage is suspected, the material surface will be exposed to verify its condition. Actual damage shall be documented, and corrective actions and repairs shall be made according to the CQA Plan.

3. At the direction of the CQA Monitor, the Contractor may place the topsoil layer in one lift.

4. Certify that the topsoil layer has been placed in accordance with the engineering plans and specifications at the locations tested.

5. Certify that live siltation, live stakes and bare root trees have been placed in accordance with the engineering plans and specifications at the locations tested.

6. Observe and document soil preparation, material quality, and material installation.

7. Certify that seed mix(s) and seeding has been performed in accordance with the engineering plans and specifications at the locations tested.

The Contractor will perform the following:

1. Soil placement shall be accomplished to minimize stress on the underlying components of the slope stabilization system.

2. Place live stakes, live siltation and bare root trees in accordance with the engineering plans and specifications.

3. Place live stakes, live siltation and bare root trees in accordance with the engineering plans and specifications.

4. The Surveyor shall survey the thickness of the topsoil components on a 50-foot by 50-foot grid system. Alternately, direct depth checks may be used to determine topsoil thickness.

Locations where soil thickness is less than specified in the engineering plans shall be corrected. The CQA Monitor will document these situations as described in the CQA Plan.

11.5 Surveying

The surveyor will establish a 50-foot by 50-foot survey grid system on the landfill slope and survey locations along the perimeter to verify proper line and grade in accordance with the engineering plans. Grade tolerance is +0.0 to +0.2 feet from the engineering plans.

The CQA Monitor will document the construction activities associated with the topsoil. Refer to **Sections 13.0 and 14.0** for requirements associated with surveying.

12.0 EROSION CONTROL MAT

12.1 Introduction

The proposed design will include erosion control mat materials as indicated in the engineering plans and specifications. This section of the CQA Plan addresses erosion control mat materials for use on the topsoil. Alternatively, hydroseeding may be used instead of seeding and erosion control matting.

12.2 Material

The erosion control mat shall be as specified in the engineering plans and specifications for erosional stability purposes in the cover or equivalent.

12.3 Topsoil Preparation

Prior to erosion control mat installation, the subgrade will be inspected. Observe the following:

- The topsoil is substantially free of surface irregularities and protrusions.
- The topsoil surface does not contain stones or other objects that could damage any of the components.
- The surface will be substantially smooth and free of foreign and organic material, sharp objects, particles or other deleterious material.
- Maximum particle size (e.g., rocks) larger than 1-inch to 1.5-inches be removed by Contractor from the topsoil.
- The anchor trench dimensions have been checked, and the trenches are free of sharp objects and other deleterious material.
- Construction stakes and hubs have been removed, and the resultant holes have been backfilled.

- The Contractor, Certification Engineer, and Owner or his representative have certified in writing that the surface on which the erosion control mat will be installed is acceptable.
- Final grades on the slopes as well as bench dimensions and grades conform to the design grades.
- Survey shots and as-built drawings will be carefully reviewed and evaluated to ensure the surface grades will drain as intended in the design drawings.

12.4 Delivery

Box trucks will deliver rolls via truck. Rolls may be strapped in groups allowing equipment (i.e., pick-up truck, skid steer) to pull the grouped rolls to the front of the truck. Rolls can be pulled directly to the ground or carpet stingers can move the rolls to a designated area.

Observe the following:

- The erosion control mat is wrapped in rolls with protective covering.
- The rolls are not stacked more than three high.
- The rolls are not damaged during unloading.
- Protect the material from mud, soil, dirt, dust, debris, cutting, or impact forces.
- Each roll must be marked or tagged with proper identification.
- Rolls that have been rejected due to damage are removed from the site or stored at a location separate from accepted rolls, designated by the Owner/Operator.
- Rolls that do not have proper manufacturer's documentation will be stored at a separate location until documentation has been received and approved.

12.5 Installation

Prior to installation of erosion control mat, observe the following:

- The soil layers have been installed in accordance with the contract specifications.
- The installation documentation has been completed and approved by the CQA Officer for areas where the mat is to be installed.
- The supporting surface does not contain objects left over from the installation process that could damage the material.

The contractor shall install the erosion control mat in accordance with the engineering plans and specifications.

The CQA Monitor shall observe and document placement of erosion control mat to verify that the requirements of the CQA Plan are met.

12.5.1 Installation – Deployment & Field Seaming

During deployment, observe the following:

- Observe the material as it is deployed.
- Verify that equipment used does not damage the material or underlying soils by handling, trafficking, leakage of hydrocarbons, or by other means.
- Verify that the material is deployed and installed according to the manufacturer's recommendations.
- Verify that the material is anchored to prevent movement by the wind per manufacturer's recommendations (the contractor is responsible for any damage resulting to or from windblown material).
- Verify that the material remains free of contaminants such as soil, grease, fuel, etc.
- Observe that the material is laid substantially smoothly and substantially free of tension, stress, folds, wrinkles, or creases.
- Observe the deployment of the panels to ensure proper flipping to expose the material surface up after seaming operations. After the first panel of the project is deployed, deployment will be done on the adjacent material panel to avoid damage.

12.5.2 Installation – Repairs and Tie-In Procedures

When Repairs and Tie-Ins occur, observe the following:

- Tie-In's will be completed per manufacturer's recommendations.

12.5.3 Installation – Equipment on Erosion Control Mat Material

Equipment access on placed material shall be per manufacturer's recommendations.

13.0 SURVEYING AND CONSTRUCTION TOLERANCES

The minimum thickness of the soil layers shall be surveyed to verify that the minimum soil thicknesses specified in the Design Drawings are met. Other construction tolerances are as noted on the drawings.

Surveying will be performed under this section to document as built conditions and will be the responsibility of the Constructor. The as-built survey will be performed by a surveyor registered in the state of Tennessee. Intermediate surveying for construction layout, slope staking, etc., may be performed by the Constructor's personnel.

In applicable cases, surveys will be performed before placement of the overlying layer(s), to verify that grades and elevations are in accordance with the approved plans. Surveying and approval/acceptance of the underlying soils shall be obtained prior to proceeding with overlying soils placement. Timing for approval and acceptance by Certification Engineer and/or Design Engineer prior to proceeding with subsequent overlying soils placement is expected to be within three (3) workdays following submittal of data for review. If a response or approval is not provided within that timeframe, Contractor shall contact Certification Engineer for clarification and further direction.

At a minimum, survey points shall be established on a 50 ft. x 50 ft. grid. Survey grid points shall be located such that the same grid can be reused for subsequent as-built surveys as the completion of each layer progresses. Soil layer thickness shall be obtained to the nearest 0.1 ft. and reported to the nearest 0.1 ft.

The Certification Engineer may request additional survey information as required for certification.

14.0 REPORTING AND DOCUMENTATION

14.1 Deficiencies

When deficiencies are discovered, the Certification Engineer shall immediately determine the nature and extent of the problem, notify the Constructor, and complete the required documentation. In all cases, the Certification Engineer will notify the Constructor within 2 hours of discovering the deficiency. If the deficiency will cause construction delays of more than four hours or will necessitate substantial rework, the Certification Engineer shall also notify the Construction Manager.

The Constructor shall correct the deficiency to the satisfaction of the Certification Engineer. If the Constructor is unable to correct the problem, the Certification Engineer will prepare a nonconformance report and will develop and present suggested solutions to the Construction Manager for approval.

The corrected deficiency shall be re-tested before additional work is performed. All retests, and the steps taken to correct the problem, will be documented by the Certification Engineer.

14.2 Documentation

The QA/QC Plan depends on thorough monitoring and documentation of construction activities. Therefore, the Certification Engineer shall document that Quality Assurance requirements have been addressed and satisfied. Documentation shall consist of daily record keeping, construction problem resolutions, photographic records, design revisions, weekly progress reports, and a certification and summary report.

14.3 Daily Record Keeping

At a minimum, daily records shall consist of field notes, summaries of the daily meetings with the Constructor, observations and data sheets, and construction problems and resolution reports. This information shall be submitted to the Construction Manager for review and approval.

A Daily Meeting Report will be prepared each day, summarizing discussions held with a Constructor.

This report will include the following items:

a. date, project name, and location;
b. names of parties involved in discussions;
c. data on weather conditions;
d. listing and location of construction activities underway during the time frame of the Daily Summary Report;
e. equipment present on-site;
f. descriptions of areas and/or activities being inspected and/or tested, and related documentation;
g. description of off-site materials received;
h. scheduled activities;
i. items discussed;
j. signature of the reporting personnel.

14.4 Observation and Test Sheets

Observation and test data sheets shall include the following information:

a. date, project name, and location;
b. weather data;
c. reduced-scale site plan showing work areas, including sample and test locations;
d. description of ongoing construction;
e. summary of test results identified as passing, failing, or in the event of a failed test, retest;
f. calibration of test equipment;
g. summary of decisions regarding acceptance of the work and/or corrective actions taken;
h. signature of the reporting personnel.

14.5 Construction Problem Reports

This report identifies and documents construction problems and resolutions. It is intended to document problems involving significant rework and is not intended to document items easily corrected unless the problems are recurring. At a minimum, this report shall include the following items:

a. detailed description of the problem;
b. location and cause of the problem;

c. how the problem was identified;

d. resolution of the problem;

e. personnel involved;

f. signature of the Certification Engineer and Construction Manager and reporting personnel.

14.6 Survey Control

The following procedures will be followed with respect to the as-built survey of the components of the facility.

- The subgrade, top of cover soil, and top of topsoil layer will be surveyed to verify that grades and elevations are in accordance with the approved Design Drawings. A comparison of the pre- and post-component construction surveys will be conducted, as applicable, to verify construction thickness.

- The Surveyor shall promptly submit the results of each survey to the Construction Manager. Survey results shall include copy of any field notes, electronic and hard copy of the survey point file, and electronic and hard copy of survey drawing.

- The Certification Engineer will certify that the components meet the requirements in the Design Drawings and will submit approval to the Construction Manager.

14.7 Design Changes

Design changes may be required during construction. In such cases, the Certification Engineer shall notify the Construction Manager, who will then notify the State Agencies responsible. Design changes shall only be made with written agreement of the Construction Manager.

14.8 Weekly Progress Reports

The Construction Manager will prepare weekly progress reports summarizing construction and quality control activities. At a minimum this report, submitted to the Certification Engineer shall contain the following information:

a. date, project name, and location;

b. summary of work activities;

c. summary of deficiencies and/or defects and resolutions;

d. signature of Construction Manager.

14.9 Certification Report

The Certification Engineer will be required to submit a certification report that addresses site grading and installation of subgrade/structural fill, cover soil, topsoil layer, riprap, and the soil stabilization/vegetation including seeding, live siltation/stakes, and erosion control mat.

At completion of construction, the Certification Engineer shall submit a certification report to the Construction Manager. This report shall certify that the work has been performed in substantial compliance with the approved Design Plans. At a minimum, this report shall contain the following information:

a. summary of all construction activities;
b. testing laboratory test results;
c. observation and test data sheets;
d. sampling and testing location plan;
e. description of significant construction problems and their resolution;
f. list of changes from the approved plans and the justification for these changes;
g. record drawings; and
h. a certification statement signed and sealed by the Certification Engineer.