TRAIL RIDGE LANDFILL
INCREMENTAL CLOSURE
CLOSURE PHASES 5-7
UNITS 82-114

QUALITY ASSURANCE AND QUALITY CONTROL DOCUMENTATION

PREPARED FOR:

CITY OF JACKSONVILLE, FLORIDA

PREPARED BY:

England-Thims & Miller, Inc.
VISION ▪ EXPERIENCE ▪ RESULTS
Engineers – Planners – Surveyors – Landscape Architects
14775 Old St. Augustine Road Jacksonville, Florida 32258
Certificate of Authorization Number: 2584

ETM Job Number: E 11-019-P5 Date Issued: August 31, 2017

Refer to signature page for electronic signature

ENGINEER OF RECORD RESPONSIBILITY PAGE

Project Name: **TRAIL RIDGE LANDFILL - INCREMENTAL CLOSURE - CLOSURE PHASES 5-7 (UNITS 82-114)**
Project Location: Duval County, Located at 5100 Gilridge Drive West of US Highway 301
Project City / State: Jacksonville, Florida 32234-3608
Computer Programs used: Microsoft Word and Excel 2016, AutoCAD C3D 2017
Etm Job No. E 11-019-P5

TABLE OF CONTENTS:

Portion of pages or sections of this report signed and sealed by Engineer

Sections I-IV Only

This report is prepared in general compliance with: FDEP Permit Numbers 0013493-025-SO, 00013493-00260-SC-01 and 0013493-0027-SO-mm

This document has been electronically signed and sealed by Engineer listed at bottom of this page
On date specified below using a SHA-1 authentication code.
Printed copies of this document are not considered signed and sealed and the SHA-1 authentication code must be verified on electronic copies with separate Signature File

VISION • EXPERIENCE • RESULTS

England - Thims & Miller, Inc.
14775 Old St. Augustine Rd., Jacksonville, Fl. 32258
Phone (904) 642-8990 CA No: 2584

8/30/2017
Date:

Scott Jordan Lockwood, P.E.
Engineer of Record

68426
P.E. No.

Reset Form Print Form

Department of Environmental Protection

Bob Martinez Center
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

DEP Form # 62-701.900(2)
Form Title Certification of Construction Completion of a Solid Waste Management Facility
Effective Date May 19, 1994

Certification of Construction Completion of a Solid Waste Management Facility

0013493-0025-SO-01 & 0013493-0026-SC-01

DEP Construction Permit No: 0013493-0027-SO-mm County: Duval

Name of Project: Trail Ridge Landfill - Incremental Closure Phases 5-7 Units 82-114

Name of Owner: City of Jacksonville, Florida

Name of Engineer: ETM - England, Thims & Miller, Inc.

Type of Project: Class I Landfill - Incremental Closure of Phases 5-7 (Units 51-81)

Cost: Estimate $ 7,100,000.00 Actual $ 8,000,000.00

Site Design Quantity: 2,500 (avg) ton/day Site Acreage: 31.6 Acres

Deviations from Plans and Application Approved by DEP (attach additional pages as needed):

See attached memo for list of Deviations

Address and Telephone No. of Site: 5110 U.S. Highway 301, Baldwin, Florida 32234

Phone Number: (904) 289-9100

Name(s) of Site Supervisor: On Site Supervisor Greg Mathes (TRLI)

Date Site inspection is requested: Open - Pease send email to setup - Lockwoods@etminc.com

This is to certify that, with the exception of any deviation noted above, the construction of the project has been completed in substantial accordance with the plans authorized by Construction

0013493-0025-SO-01 & 0013493-0026-SC-01

Permit No.: 0013493-0027-SO-mm Dated: June 16, 2014 (issued date)

Date: August 31, 2017

Signature of Professional Engineer

(Refer to signature page for electronic seal information)

VISION ▪ EXPERIENCE ▪ RESULTS

DEVIATIONS MEMORANDUM

From: **Scott Jordan Lockwood, P.E.**

Re: **Trail Ridge Landfill Incremental Closure – Phases 5-7 Units 81-114**

Date: **August 31, 2017**

Note:

1. Due to settlement over the course of the construction period, there are numerous areas where settlement has occurred between the time the initial cover was placed and graded, to the time that the final layer of top soil and sod was placed. Due to this settlement many of the elevations of the final layer deviate from the design elevations. Please refer to As-built Survey prepared by Robert M. Angas Associates, Inc. (RMA). Meskel and Associates Engineering (MAE) (QA / QC Geotechnical firm) verified the proper depth of final cover materials, (initial cover, clay and top soil layers) to ensure that the appropriate thickness of materials was provided. Refer to test results included in MAE's digitally signed and sealed Testing Summary Report for the referenced project.

2. Due to settlement along Terrace 7, the slopes from Terrace 7 to Terrace 8 for all Units that interfaced with Terrace 7 were adjusted to match the grade at the Terrace 7 interface.

3. The QA / QC specifications require that the Initial cover and the vegetative cover soil be tested for shear strength. MAE used a different test than what was specified because in their opinion it was not appropriate to use the specified test. Refer to explanation and recommendations included in MAE's digitally signed and sealed Testing Summary Report for the referenced project.

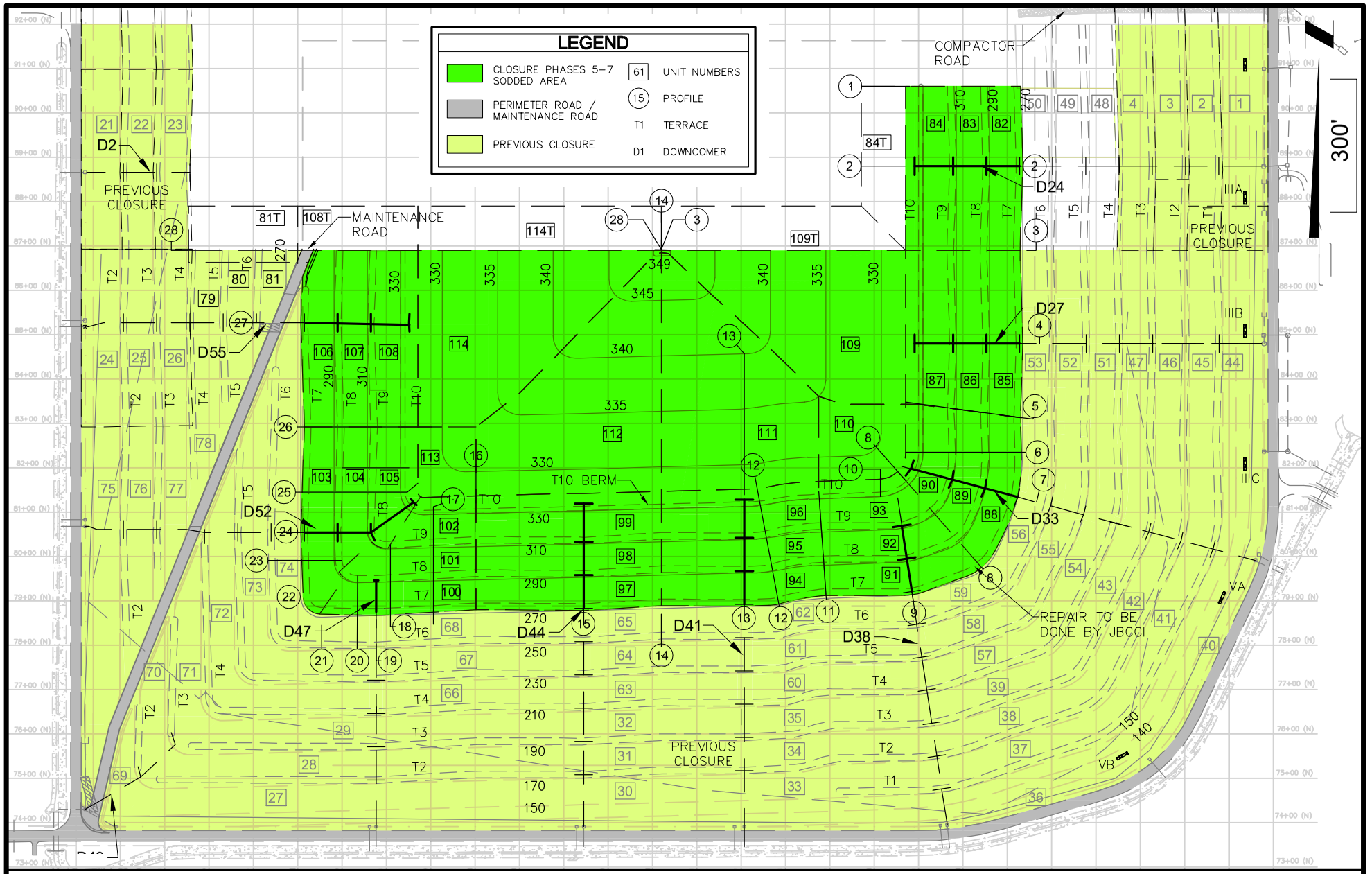
4. The QA / QC specifications require that the drainage gravel for the toe drain above the geomembrane along Terrace 10 meet a specified range. The drainage gravel fell slightly outside of the specified range. However, Golder and Associates, Inc. (GAI), evaluated the drainage gravel provided by the contractor. It is GAI's opinion that the slight variation will have no detrimental effect on the performance of the cover drainage system. Refer to explanation and recommendations included in "Record Documentation of Phases 5-7 Incremental Closure Geosynthetic Construction for Trail Ridge Landfill prepared and electronically sealed by GAI.

5. Refer to Asbuilt Survey of Trail Ridge Landfill Incremental Closure Phases 5-7 prepared by Robert M. Angas Associates, Inc. for Asbuilt information.

6. Refer to Testing Summary Report for QA / QC Materials testing data and results prepared by Meskel and Associates Engineering (MAE) (QA / QC Geotechnical firm) digitally signed and sealed Testing Summary Report for the referenced project.

7. Refer to "Record Documentation of Phases 5-7 Incremental Closure Geosynthetic Construction for Trail Ridge Landfill prepared and electronically sealed by Golder and Associates, Inc. (GAI).

England-Thims & Miller, Inc.
14775 Old St. Augustine Road, Jacksonville, Florida 32258
Phone: (904) 642-8990 • Fax: (904) 646-9485 • http://www.etminc.com



ETM
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CLOSURE MAP

TRAIL RIDGE LANDFILL
INCREMENTAL CLOSURE PHASES 5-7
FOR THE CITY OF JACKSONVILLE, FLORIDA

ETM NO.	E 11-019-P5
DRAWN BY:	S. Lockwood
DATE:	August 31, 2017
DRAWING NO.	1

PLOTTED: August 31, 2017 - 8:43 AM, BY: Scott Lockwood

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APPENDIX 1

TRAIL RIDGE LANDFILL

INCREMENTAL CLOSURE PHASES 5-7

UNITS 82-114

CONSTRUCTION PHOTOGRAPHS

April 2016 through July 2017

Start of Construction - Aerial Photograph - Trail Ridge Landfill (April 2016)

Start of Construction - Aerial Photograph - Trail Ridge Landfill (April 2016)

Balancing Initial Cover – Units 82-84 (Facing Easterly) (April 2016)

Final Grading Initial Cover – Units 82-84 (Facing Easterly) (April 2016)

Grading Initial Cover Top Area near Terrace 10 – Units 82-84 (Facing Northerly) (April 2016)

Clay excavation at the Rayonier Borrow Site (NW 257 Street) (April 2016)

Placing Clay for Clay Test Strip (Facing Northerly) (April 2016)

Compacting Clay Test Strip (Facing Southerly) (April 2016)

Pushing Shelby Tubes for the Permeability Testing – Clay Test Strip – Units 82-84 (Facing Easterly) (May 2016)

Exposing Clay Tie-In - Unit 83 (Facing Northeasterly) (May 2016)

Initial Cover grading by TRLI – Units 86 and 87 (Facing Northeasterly) (May 2016)

Compacting Clay at Terrace 9 within Unit 87 (Facing Southerly) (July 2016)

Grading and Smoothing Clay at Terrace 9 within Unit 87 (Facing Southerly) (July 2016)

Grading underdrain pipe Terrace 9 Unit 87 (Facing Northerly) (July 2016)

Grading Underdrain sand at Terrace 9 within Unit 84 (Facing Southerly) (July 2016)

Placement of top soil Unit 87 (Facing Easterly) (July 2016)

TRLI grading initial cover Unit 91 (Facing Westerly) (July 2016)

Compacting clay trench between Terraces 9 and 10 at downcomer D-27 (facing Westerly) (August 2016)

Welding Downcomer D-24 (top of the hill) (facing Southerly) (September 2016)

Placing Downcomer D-24 (facing Westerly) (September 2016)

Installation of sidedrains Downcomer D-38 (facing Northerly) (October 2016)

Rip Rap installation for sidedrains for Downcomer D-38 (facing Easterly) (October 2016)

Clay placement Units 97 through 100 (facing Westerly) (November 2016)

Clay Tie-in at Terrace 7 Unit 100 (facing Easterly) (November 2016)

Sodding Unit 92 (facing Easterly) (November 2016)

TRLI grading initial cover Unit 108 (facing Northerly) (November 2016)

Importing clay Units 106 – 108 (facing Southerly) (December 2016)

Grading clay Units 106 – 108 (facing Northerly) (December 2016)

Rip Rap construction at Terrace 8 for Downcomer D-44 (facing Southerly) (December 2016)

Rip Rap construction at Terrace 8 for Downcomer D-44 (facing Southerly) (December 2016)

Installation of Downcomer D-47 (facing Southerly) (December 2016)

Assembling Downcomer D-52 top of the hill (facing Easterly) (December 2016)

Placement of Downcomer D-52 (facing Easterly) (December 2016)

Measuring bend at Downcomer D-52 at Terrace 9 (facing Easterly) (December 2016)

Sod installation Unit 98 (facing Northerly) (December 2016)

Balancing and grading behind Terrace 10 at top of hill (facing Southerly) (January 2017)

Exposing clay and constructing anchor trench at Terrace 10 Unit 87 (facing Southerly) (January 2017)

Grading behind Terrace 10 at top of hill (facing Easterly) (February 2017)

Constructing clay anchor trench at Terrace 10 – Units 105 and 108 (facing Northerly) (February 2017)

IET installing near surface gas collectors at top of hill (east side) (facing Easterly) (February 2017)

Cleaning geomembrane for geotextile placement at top of hill (facing Southeasterly) (February 2017)

Liner repair at top of hill (easterly side) (February 2017)

Deployment of geotextile at top of hill (facing Southeasterly) (February 2017)

Deployment of geomembrane at top of hill (facing Southerly) (February 2017)

Sewing geotextile at top of hill (facing Easterly) (February 2017)

Protective cover placement (facing Northerly) (February 2017)

Filling temporary anchor trench at top of hill along Profile 3 (facing Westerly) (February 2017)

Placement of protective cover top of hill (facing Southerly) (March 2017)

Liner deployment top of hill (westerly side) (facing Westerly) (March 2017)

Top soil placed over geomembrane top of hill (facing Northerly) (March 2017)

Graded top soil top of hill (facing Westerly) (April 2017)

Edge of liner markers and haybales top of hill (facing Westerly) (May 2017)

Sod placement – watering truck top of hill (facing Easterly) (May 2017)

Top of hill (facing Westerly) (July 2017)

Top of hill (facing Southerly) (July 2017)

End of Construction - Aerial Photograph - Trail Ridge Landfill (August 2017)

APPENDIX 2

TRAIL RIDGE LANDFILL

INCREMENTAL CLOSURE PHASES 5-7

UNITS 82-114

QUALITY CONTROL /

QUALITY ASSURANCE PLAN

TRAIL RIDGE LANDFILL
INCREMENTAL CLOSURE
(CLOSURE PHASES 5 - 7)

SECTION 33

QUALITY ASSURANCE/QUALITY CONTROL PLANS

33.1 GENERAL

Attached are the Quality Assurance/Quality Control (QA/QC) Plans for Incremental Side Slope Closure as well as Incremental Top Slope Closure of Trail Ridge Landfill. The Contractor is responsible for construction of this project, including any final cover reconstruction, in accordance with the conditions set forth in the QA/QC Plans for both the side slopes as well as the top area.

The Contractor, in cooperation with the Soils Quality Assurance Engineer, shall complete both the Clay Borrow Source Pre-Qualification Form and Test Strip Qualification Form (as provided herein) and submit them to the General Quality Assurance Engineer in accordance with Section 31.101 (Final Cover).

The Contractor is responsible for coordinating all pre-qualifications, reworking, testing, and other QA/QC requirements with construction activities.

END OF SECTION

INCREMENTAL SIDE SLOPE CLOSURE
QUALITY ASSURANCE/QUALITY CONTROL PLAN

TRAIL RIDGE LANDFILL
INCREMENTAL SIDE SLOPE CLOSURE
QUALITY ASSURANCE/QUALITY CONTROL PLAN

This plan addresses the quality assurance and quality control (QA/QC) for the incremental closure (close-as-you-go) of Trail Ridge Landfill. This program delineates the quality procedures and standards for the construction. This plan includes the closure of the side slopes only (including the reconstruction of final cover on side slopes). The top area closure has a separate QA/QC Plan.

In the context of this plan, quality assurance and quality control are defined as follows:

Quality Assurance - A planned and systematic pattern of all means and actions designed to provide adequate confidence that items or services meet contractual and regulatory requirements and will perform satisfactorily in service.

Quality Control - Those actions which provide a means to measure and regulate the characteristics of an item or service to contract and regulatory requirements.

The City of Jacksonville, Florida is the owner of Trail Ridge Landfill. Trail Ridge Landfill, Inc. is the permittee and operates the landfill. England, Thims & Miller, Inc. is the design engineer. The name of the Contractor for each incremental closure shall be provided to the Department of Environmental Protection (DEP), prior to construction.

All QA/QC activities (including monitoring, sampling and testing) shall be directed and conducted by third parties, whom are independent of the Contractor.

The QA/QC Plan for this project includes General QA/QC and Soils QA/QC. The General QA/QC includes full-time services to periodically observe the contractor's work to verify substantial compliance with permits, plans, specifications and design concepts. These services will include the following:

General Quality Control Monitor - shall monitor the construction for compliance with the permits, plans, specifications and design including construction to proper lines and grades, maintain daily logs and weekly progress reports of the construction (including observation data sheets, problem identification and correction logs), make note of any construction deviations, coordinate qualifying and testing of materials, monitor any waste excavation, and monitor filling. This individual shall be experienced in civil site construction and solid waste regulations.

General Quality Assurance Engineer - shall supervise the construction monitoring and waste removal to verify compliance with permits, plans, specification and design concepts. This individual shall be experienced in civil site construction and solid waste regulations and shall be a registered Professional Engineer.

The General QA/QC Program includes monitoring the following activities:

1. General Earthwork
2. Storm Drainage Installation
3. General Construction Quality Control

The Soils QA/QC for this project includes soil material qualifying, sampling and testing to verify substantial compliance with the material standards. This work will include the following:

Soils Quality Control Monitor - shall pre-qualify soil materials, monitor the installation of soil materials, determine where in-place soil materials shall be tested, and test the in-place soil materials. This individual shall be responsible for assuring that all soil materials have been pre-qualified and have a chain-of-custody from the pre-qualified source to the project site, prior to installation. This individual shall be experienced in quality assurance of soil materials and the preparation of quality assurance documentation including quality assurance forms, reports, certification and manuals. This individual shall be experienced in civil site construction and soil testing standards and procedures and shall be certified by the Quality Assurance Engineer in the duties of the project.

Soils Quality Assurance Engineer - shall supervise the soil material pre-qualifying and testing of in-place soil materials to assure compliance with the test standards and testing frequency requirements, and verify compliance with the plans, specification and design. This individual shall be experienced in quality assurance of soil materials and the preparation of quality assurance documentation including quality assurance forms, reports, certification and manuals. This individual shall hold a B.S., M.S., or Ph.D degree in civil engineering or related fields, be experienced in civil site construction and soil testing procedures, be a registered Professional Engineer, and have worked on at least two other closure projects.

The QA/QC Plan including monitoring construction of the following:

A. Final Cover (Intermediate Cover, Compacted Clay Layer and Vegetative Cover (Top Soil))

Incremental side slope closure of Trail Ridge Landfill includes a final cover consisting of 12" of intermediate cover, 12" of clay, and 24" of vegetative cover. The clay layer of the final cover must be placed in two 6" (minimum) lifts. The Soils Quality Control Monitor shall observe the clay layer construction on a full-time (on-site) basis. The QA/QC for the final cover is as follows:

1. Intermediate Cover

a. Location - The fill material shall come from an off-site source. The Soils Quality Control Monitor shall visually inspect the fill material.

b. Standard - Soil shall be free of brush, weeds, and other litter; and free of roots, stumps, stones and any other extraneous or toxic matter.

The intermediate cover material shall be tested for shear strength in the laboratory (ASTM D-4767). The material shall only be considered

suitable if the material, as documented on laboratory test specimens, can be shown to provide a minimum safety factor of 1.5 against sliding.

The intermediate cover shall be a minimum of 12" thick.

Compacted to 90% of Modified Proctor maximum dry density (ASTM D 1557), unless the soil material contains 30.0% or greater passing the No. 200 sieve, then compacted to 90% of Standard Proctor maximum dry density (ASTM D-698).

c. Frequency - The shear strength shall be tested one time only based upon a representative sample of the material at the required density.

Depth measurements and density tests shall be conducted at the frequency of four per acre.

2. Clay Layer (referred to as Barrier Layer in Chapter 62-701, F.A.C.)

a. Borrow Source - Prior to clay layer installation, an appropriate borrow source shall be located. Suitability of the clay layer construction materials from that source shall be determined in accordance with the following:

(1) If demonstrated field experience is available from at least three prior successful projects of five or more acres each to document that a given borrow source can meet the requirements of the project specifications, then extensive laboratory testing of the borrow source will not be required. However, the source of material shall be geologically similar to and the methods of excavating and stockpiling the material shall be consistent with those used on the prior projects. Furthermore, a minimum of three representative samples from the appropriate thickness of the in-situ stratum or from stockpiles of the borrow material proposed for clay layer construction shall be submitted to the Owner=s independent soil testing laboratory to document through index testing and shear strength testing that the proposed material is consistent with the material used on prior successful projects. At a minimum, index testing shall consist of percent fines, Atterberg limits and moisture content determinations and the shear testing shall consist of triaxial testing of the clay soil and direct shear testing of the interface between the intermediate cover and the clay as well as the interface between the clay and the proposed vegetative cover material.

(2) If demonstrated field experience as defined above is not available or cannot be documented, then the following requirements shall be met.

(a) A field exploration and laboratory testing program shall be conducted by the Owner=s independent soil testing laboratory to document the horizontal and vertical extent and the homogeneity of the soil strata

proposed for use as clay layer material. A sufficient number of index tests from each potential borrow stratum shall be performed to quantify the variability of the borrow materials and to document that the proposed borrow material complies with specifications. At a minimum, the index tests shall consist of percent fines, Atterberg limits and moisture content determinations.

(b) Sufficient laboratory hydraulic conductivity tests shall be conducted on samples representative of the range invariability of the proposed borrow source (ASTM D-5084). For each such sample, test specimens shall be prepared and tested to cover the range of molding conditions (moisture content and dry density) required by project specifications. The hydraulic conductivity tests shall be conducted in triaxial type permeameters. The test specimens shall be consolidated under an isotropic consolidation stress no greater than 10 pounds per square inch and permeated with water under an adequate backpressure to achieve saturation of the test specimens. The inflow to and outflow from the specimens shall be monitored with time and the hydraulic conductivity calculated for each recorded flow increment. The test shall continue until steady state flow is achieved and relatively constant values of hydraulic conductivity are measured (ASTM D-5084). The borrow source will only be considered suitable if the hydraulic conductivity of the material, as documented on laboratory test specimens, can be shown to meet the requirements of the project specifications at the 98 percent confidence level.

(c) Sufficient shear strength testing of the clay material (ASTM D-4767) and direct shear testing of the interface between the intermediate cover and the clay as well as the interface between the clay and the proposed vegetative cover material (ASTM D-3080) shall be conducted on samples representative of the range in variability of the proposed borrow source. For each such sample, test specimens shall be prepared and tested to cover the range of molding conditions (moisture content and dry density) required by project specifications. The borrow source will only be considered suitable if the material, as documented on laboratory test specimens, can be shown to provide a minimum safety factor of 1.5 against sliding for both interfaces as well as the material itself.

(3) The Soils Quality Assurance Engineer shall review the pre-qualification data and shall approve or reject the clay layer material for use.

b. Test Strip - Prior to full-scale clay layer installation, a field test section or test strip shall be constructed at the site above a prepared subbase. The test strip shall be considered acceptable if the measured hydraulic conductivities of undisturbed samples from the test strip meet the requirements of the project specifications at the 98 percent confidence level. If the test section fails to achieve the desired results,

additional test sections shall be constructed in accordance with the following requirements:

(1) The test section shall be of sufficient size (40' wide x 60' long, at a minimum) such that full-scale clay layer installation procedures can be duplicated within the test section;

(2) The test section shall be constructed using the same equipment for spreading, kneading and compaction and the same construction procedures (e.g., number of passes, moisture addition and homogenization, if needed) that are anticipated for use during full-scale clay layer installation;

(3) At a minimum, the clay layer test section shall be subject to the following field and laboratory testing requirements by Soils Quality Control Monitor:

(a) A minimum of five random samples of the clay layer construction material delivered to the site during test section installation shall be tested for moisture content (ASTM D-2216), percent fines (ASTM D-1140) and Atterberg limits (ASTM D-4318);

(b) At least five field density and moisture determinations shall be performed on each lift of the compacted clay layer test section;

(c) Upon completion of the test section lift, the thickness of the lift shall be measured at a minimum of five random locations to check for thickness adequacy; and

(d) A minimum of five Shelby tube or drive cylinder (ASTM D-2937) samples shall be obtained from each lift of the test section for laboratory hydraulic conductivity testing. Laboratory hydraulic conductivity testing shall be conducted in triaxial type permeameters (ASTM D-5084). The test specimens shall be consolidated under an isotropic consolidation stress no greater than 10 pounds per square inch and permeated with water under an adequate backpressure to achieve saturation of the test specimens. The inflow to and outflow from the specimens shall be monitored with time and the hydraulic conductivity calculated for each recorded flow increment. The test shall continue until steady state flow is achieved and relatively constant values of hydraulic conductivity are measured (ASTM D-5084).

(e) The test strip shall meet or exceed the standards established below except the field density which shall be established by the QA Engineer, based upon the test strip results. If the test strip fails to meet these standards, the construction methods and/or material will be rejected and the test strip shall be performed again.

c. Final Cover Installation - Full scale final cover installation may begin only after completion of a successful test section. During clay layer construction, quality control testing shall be provided to document that the installed clay layer conforms to project specifications. The testing frequency for quality control testing is specified below; however, during construction of the first five acres, the frequencies shall be doubled. The clay layer shall be installed in two 6" lifts for a total minimum thickness of 12".

(1) Location - The clay layer shall be tested in place. The locations of testing shall be random locations as determined by the Soils Quality Control Monitor. If there are indications of a change in product quality or construction procedures during final cover construction, additional tests shall be performed to determine compliance.

(2) Standard

(a) Clay Layer Subgrade - Compacted to 90% of Modified Proctor maximum dry density (ASTM D-1557)D 1557), unless the soil material contains 30.0% or greater passing the No. 200 sieve, then compacted to 90% of Standard Proctor maximum dry density (ASTM D-698). (See Intermediate Cover above).

(b) Field Density - The field density shall be established by the QA Engineer based upon the test strip results and shall be determined by Standard Proctor Density (ASTM D-698). In no case shall the field density be less than 80% of Standard Proctor Density (ASTM D-698).

(c) Thickness - Each lift (two total) shall be a minimum of 6" thick.

(d) Hydraulic Conductivity - The compacted clay layer shall have an in-place hydraulic conductivity no greater than 6.67×10^{-8} cm/sec (ASTM D-5084).

(3) Field Testing Frequency

(a) Prior to the laying of the clay layer materials, the clay layer subgrade shall be compacted to the specified density. Density tests shall be conducted at a minimum rate of two tests per acre;

(b) A minimum of two moisture content and field density determinations shall be conducted per acre per lift of the compacted clay layer. The degree of compaction shall be checked using the one-point field Proctor test or other appropriate test procedures; and

(c) A minimum of four thickness measures shall be conducted per acre per lift of the compacted clay layer.

(4) Laboratory Testing Frequency

(a) Percent fines (ASTM D-1140) of the clay layer material shall be determined at a minimum frequency of two tests per acre per lift of installed clay layer;

(b) Atterberg limits determinations shall be performed on one sample per acre per lift of installed clay layer; and

(c) Hydraulic conductivity testing of Shelby tube or drive cylinder (ASTM D-2937) samples of the compacted clay layer shall be performed at a minimum frequency of one test per acre per lift. Laboratory hydraulic conductivity tests shall be conducted in triaxial type permeameters (ASTM D-5084). The test specimens shall be consolidated under an isotropic consolidation stress no greater than 10 pounds per square inch and permeated with water under an adequate backpressure to achieve saturation of the test specimens. The inflow to and outflow from the specimens shall be monitored with time and the hydraulic conductivity calculated for each recorded flow increment. The test shall continue until steady state flow is achieved and relatively constant values of hydraulic conductivity are measured.

(5) Deficiency - If the test data from a clay layer section does not meet the requirements of the project specifications, additional random samples shall be tested from that clay layer section. If such additional testing demonstrates that the thickness and hydraulic conductivity meet the requirements of the project specifications at the 95 percent confidence level, that clay layer section will be considered acceptable. If not, that clay layer section shall be reworked or reconstructed so that it does meet these requirements.

3. Clay Layer Tie-In (To Existing Clay Layer, Where Applicable)

a. Location - The edge of any existing final cover adjacent to the proposed final cover area.

b. Standard - The compacted clay layer of any existing final cover and the proposed final cover must be tied together to form one continuous seamless layer. At the interface, the existing and new clay layers shall be compacted to form a seamless connection.

c. Frequency - The Soils Quality Control Monitor shall monitor the tie-in by visual inspection on a continuous basis.

4. Vegetative Cover (Top Soil)

a. Location - The vegetative cover shall be tested in place for thickness. The location of testing shall be determined by the Soils Quality Control Monitor.

b. Standard - Top soil which is reasonably free of brush, weeds, and other litter; and relatively free of roots, stumps, stones and any other extraneous or toxic matter harmful to plant growth. Roots with a diameter greater than ⅜" shall be hand picked and removed.

The vegetative cover shall be at least 24" thick.

Prior to placement, the vegetative cover material shall be tested for shear strength in the laboratory (ASTM D-4767). The material shall only be considered suitable if the material, as documented on laboratory test specimens, can be shown to provide a minimum safety factor of 1.5 against sliding.

c. Frequency - The shear strength shall be tested one time only based upon a representative sample of the material.

Depth measurements shall be taken at the frequency of four per acre. The soil shall be monitored on a continuous basis for extraneous matter.

5. Final Cover Repairs (When Applicable)

If, during construction of the final cover system, damage is sustained on the final cover system (including the intermediate cover, clay layer and vegetative cover), the areas of damage shall be reconstructed and retested in accordance with corresponding section described above. All repair areas shall be tested at the frequencies prescribed above, unless more frequent testing is required at the discretion of the Soils Quality Assurance Engineer.

B. Downcomer Pipes

Downcomer pipes shall be installed in the final cover at the low point of the terraces, to intercept the stormwater between terraces. The downcomer pipes shall include the terrace side drains and terrace underdrain piping.

The downcomer pipes shall be constructed as shown on the Construction Drawings. The clay around the pipes shall be compacted into a uniform homogeneous material. Prior to placement of vegetative cover over the downcomer pipes, the pipe shall be inspected by the General Quality Control Monitor.

1. Location - The compacted clay layer shall be tested in place. The locations of testing shall be determined by the Soils Quality Control Monitor. If there are indications of a change in product quality or construction procedures during construction, additional tests shall be performed to determine compliance.

2. Standard –

   a. Clay Layer Subgrade - Compacted to 90% of Modified Proctor maximum dry density (ASTM D 1557)D 1557), unless the soil material contains 30.0% or greater passing the No. 200 sieve, then compacted to 90% of Standard Proctor maximum dry density (ASTM D-698) (12" thick minimum).

   b. Field Density - The field density of the clay layer shall be as established in Section A.2.c.(2)(b) above and shall be determined by Standard Proctor Density (ASTM D 698).

   c. Thickness - Twelve inches minimum below pipe.

   d. Hydraulic Conductivity - The compacted clay layer shall have an in-place hydraulic conductivity no greater than 6.67×10^{-8} cm/sec (ASTM D 5084).

3. Field Testing Frequency -

   a. Prior to the laying of the compacted clay materials, the subbase shall be compacted to the specified density. Density tests and thickness shall be conducted at a minimum rate of one per 75 linear feet of pipe. (Minimum of one test between terraces).

   b. A minimum of one moisture content and field density determination of the compacted clay layer shall be conducted per 75 linear feet of pipe.

   c. A minimum of two thickness measures of the compacted clay layer shall be conducted per 75 linear feet of pipe.

4. Laboratory Testing Frequency -

   a. Hydraulic conductivity testing of Shelby tube or drive cylinder (ASTM D 2937) samples of the compacted clay layer shall be performed at a minimum frequency of one test per 75 linear feet of pipe (at least once between terraces). Laboratory hydraulic conductivity tests shall be conducted in triaxial type permeameters (ASTM D 5084). The test specimens shall be consolidated under an isotropic consolidation stress no greater than 10 pounds per square inch and permeated with water under an adequate backpressure to achieve saturation of the test specimens. The inflow to and outflow from the specimens shall be monitored with time and the hydraulic conductivity calculated for each recorded flow increment. The test shall continue until steady state flow is achieved and relatively constant values of hydraulic conductivity are measured.

5. Deficiency - If the test data from a compacted clay layer section does not meet the requirements of the project specifications, that section shall be reworked or reconstructed so that it does meet these requirements.

C. Underdrain Filter Sand

The underdrains in the terraces shall be surrounded by filter sand as shown on the Contract Drawings. The QA/QC for the filter sand is as follows:

1. Filter Sand

a. Location - The material shall be pre-qualified prior to installation.

If the testing is done at the borrow source, a chain of custody shall be provided.

b. Standard - Clean, uniformly graded sand with a uniformity coefficient of 1.5 or greater and an effective grain size of 0.2 mm to 0.5 mm. Grain size distribution shall be conducted as part of pre-qualification.

The sand shall have a hydraulic conductivity no less than 1.0×10^{-3} cm/sec at a density of 100 percent Modified Proctor. The hydraulic conductivity testing shall be by Constant Head method (ASTM D2434).

c. Frequency - The hydraulic conductivity of the sand shall be tested once per 500 cubic yards of sand material.

D. Gas Management System (Gas Wells and Headers)

Gas wells (temporary and permanent) shall be installed in accordance with the Construction Drawings. The QA/QC for gas well materials shall be as follows:

1. Gravel for Gas Wells

a. Location - The gravel shall be pre-qualified by certification by the supplier.

b. Standard - The gravel shall be clean gravel with no fines. The gravel shall be FDOT No. 3 Course Aggregate (ASTM D 448).

The gravel shall be non-calcareous (ASTM D 4373).

c. Frequency - The gravel shall be certified by the supplier. The gravel shall be tested once per 100 C.Y.

2. Bentonite for Gas Wells

a. Location - The material shall be pre-qualified with documentation from the supplier.

b. Standard - The material shall have a hydraulic conductivity no greater than 1.0 x 10^{-8} cm/sec (ASTM D 5084).

c. Frequency - The material shall be certified by the supplier, one time only.

3. Permanent Header Pipe

The permanent header pipe shall be placed in the areas of final cover and shall be placed on the barrier soil layer, as shown on the Construction Drawings. The header pipe shall not be placed until the barrier soil has been tested and approved. The placement of the header pipe over the barrier soil layer and covering of the header pipe shall be conducted in the presence of either the Soils Quality Control Monitor or the General Quality Control Monitor.

4. Temporary Header Pipe

The temporary header pipe shall be placed in areas that have not received final cover, shall be placed on a prepared subgrade and shall be backfilled with clean fill. The header pipe shall be installed in accordance with the Construction Drawings. The pipe subgrade as well as the backfill around the pipes shall be compacted. Prior to placement of cover over the pipe, the pipe shall be inspected by the General Quality Control Monitor. The QA/QC for the installation of the temporary header pipe is as follows:

a. Location - The compacted subgrade and backfill shall be tested in place. The locations of testing shall be determined by the Soils Quality Control Monitor.

b. Standard - The subgrade and backfill shall be compacted to 85% of Standard Proctor maximum dry density (ASTM D-698) and shall be placed in 12-inch maximum lifts.

The minimum cover (clean fill) over the header pipe shall be 12 inches.

c. Frequency – The density of the subgrade and backfill shall be tested once per 500 linear feet per lift. The thickness of the cover over the pipe shall be checked once per 500 linear feet.

TRAIL RIDGE LANDFILL CLOSURE
CLAY BORROW SOURCE
PRE-QUALIFICATION FORM

CLAY SOURCE : _____

LOCATION*: _____

_____

DISTANCE FROM PROJECT SITE: _____

ESTIMATED PROJECT QUANTITY: _____

ESTIMATED SOURCE QUANTITY: _____

NUMBER OF TEST PITS: _____

* Attach a map showing the location of the clay borrow source and the horizontal and vertical extent of the clay borrow. Also include the location and approximate depth of all test pits.

TEST RESULTS:

A. TEST PIT NO. _____

Clay Stratum Description _____

Depth Below Surface From: _____ To: _____

Percent Fines _____

Atterberg Limits _____

Moisture Content _____

Hydraulic Conductivity: (cm/sec)

@ 80% Standard Proctor _____

@ 85% Standard Proctor _____

@ 90% Standard Proctor _____

Shear Testing - Int. Cover/Clay _____

Shear Testing – Clay/Veg. Cover _____

Clay Stratum Description _____

Depth Below Surface From: _____ To: _____

Percent Fines _____

Atterberg Limits _____

Moisture Content _____

Hydraulic Conductivity: (cm/sec)

@ 80% Standard Proctor _____

@ 85% Standard Proctor _____

@ 90% Standard Proctor _____

Shear Testing - Int. Cover/Clay _____

Shear Testing – Clay/Veg. Cover _____

B. TEST PIT NO. _____

Clay Stratum Description _____

Depth Below Surface From: _____ To: _____

Percent Fines _____

Atterberg Limits _____

Moisture Content _____

Hydraulic Conductivity: (cm/sec)

@ 80% Standard Proctor _____

@ 85% Standard Proctor _____

@ 90% Standard Proctor _____

Shear Testing - Int. Cover/Clay _____

Shear Testing – Clay/Veg. Cover _____

Clay Stratum Description _____

Depth Below Surface From: _____ To: _____

Percent Fines _____

Atterberg Limits _____

Moisture Content _____

Hydraulic Conductivity: (cm/sec)

@ 80% Standard Proctor _____

@ 85% Standard Proctor _____

@ 90% Standard Proctor _____

Shear Testing - Int. Cover/Clay _____

Shear Testing – Clay/Veg. Cover _____

TEST RESULTS (continued):

C. TEST PIT NO. _____

Clay Stratum Description _____

Depth Below Surface From: _____ To: _____

Percent Fines _____

Atterberg Limits _____

Moisture Content _____

Hydraulic Conductivity: (cm/sec)

@ 80% Standard Proctor _____

@ 85% Standard Proctor _____

@ 90% Standard Proctor _____

Shear Testing - Int. Cover/Clay _____

Shear Testing – Clay/Veg. Cover _____

Clay Stratum Description _____

Depth Below Surface From: _____ To: _____

Percent Fines _____

Atterberg Limits _____

Moisture Content _____

Hydraulic Conductivity: (cm/sec)

@ 80% Standard Proctor _____

@ 85% Standard Proctor _____

@ 90% Standard Proctor _____

Shear Testing - Int. Cover/Clay _____

Shear Testing – Clay/Veg. Cover _____

D. TEST PIT NO. _____

Clay Stratum Description _____

Depth Below Surface From: _____ To: _____

Percent Fines _____

Atterberg Limits _____

Moisture Content _____

Hydraulic Conductivity: (cm/sec)

@ 80% Standard Proctor _____

@ 85% Standard Proctor _____

@ 90% Standard Proctor _____

Shear Testing - Int. Cover/Clay _____

Shear Testing – Clay/Veg. Cover _____

Clay Stratum Description _____

Depth Below Surface From: _____ To: _____

Percent Fines _____

Atterberg Limits _____

Moisture Content _____

Hydraulic Conductivity: (cm/sec)

@ 80% Standard Proctor _____

@ 85% Standard Proctor _____

@ 90% Standard Proctor _____

Shear Testing - Int. Cover/Clay _____

Shear Testing – Clay/Veg. Cover _____

Attach additional sampling results as needed.

Approved by Contractor _____

Approved by QC Monitor _____

Approved by QA Engineer _____

ADDITIONAL TEST RESULTS:

E. TEST PIT NO. _____

Clay Stratum Description _____

Depth Below Surface From: _____ To: _____

Percent Fines _____

Atterberg Limits _____

Moisture Content _____

Hydraulic Conductivity: (cm/sec)

@ 80% Standard Proctor _____

@ 85% Standard Proctor _____

@ 90% Standard Proctor _____

Shear Testing - Int. Cover/Clay _____

Shear Testing – Clay/Veg. Cover _____

Clay Stratum Description _____

Depth Below Surface From: _____ To: _____

Percent Fines _____

Atterberg Limits _____

Moisture Content _____

Hydraulic Conductivity: (cm/sec)

@ 80% Standard Proctor _____

@ 85% Standard Proctor _____

@ 90% Standard Proctor _____

Shear Testing - Int. Cover/Clay _____

Shear Testing – Clay/Veg. Cover _____

F. TEST PIT NO. _____

Clay Stratum Description _____

Depth Below Surface From: _____ To: _____

Percent Fines _____

Atterberg Limits _____

Moisture Content _____

Hydraulic Conductivity: (cm/sec)

@ 80% Standard Proctor _____

@ 85% Standard Proctor _____

@ 90% Standard Proctor _____

Shear Testing - Int. Cover/Clay _____

Shear Testing – Clay/Veg. Cover _____

Clay Stratum Description _____

Depth Below Surface From: _____ To: _____

Percent Fines _____

Atterberg Limits _____

Moisture Content _____

Hydraulic Conductivity: (cm/sec)

@ 80% Standard Proctor _____

@ 85% Standard Proctor _____

@ 90% Standard Proctor _____

Shear Testing - Int. Cover/Clay _____

Shear Testing – Clay/Veg. Cover _____

Attach additional sampling results as needed.

Approved by Contractor _____

Approved by QC Monitor _____

Approved by QA Engineer _____

G. TEST PIT NO. _____

Clay Stratum Description _____

Depth Below Surface From: _____ To: _____

Percent Fines _____

Atterberg Limits _____

Moisture Content _____

Hydraulic Conductivity: (cm/sec)

@ 80% Standard Proctor _____

@ 85% Standard Proctor _____

@ 90% Standard Proctor _____

Shear Testing - Int. Cover/Clay _____

Shear Testing – Clay/Veg. Cover _____

Clay Stratum Description _____

Depth Below Surface From: _____ To: _____

Percent Fines _____

Atterberg Limits _____

Moisture Content _____

Hydraulic Conductivity: (cm/sec)

@ 80% Standard Proctor _____

@ 85% Standard Proctor _____

@ 90% Standard Proctor _____

Shear Testing - Int. Cover/Clay _____

Shear Testing – Clay/Veg. Cover _____

H. TEST PIT NO. _____

Clay Stratum Description _____

Depth Below Surface From: _____ To: _____

Percent Fines _____

Atterberg Limits _____

Moisture Content _____

Hydraulic Conductivity: (cm/sec)

@ 80% Standard Proctor _____

@ 85% Standard Proctor _____

@ 90% Standard Proctor _____

Shear Testing - Int. Cover/Clay _____

Shear Testing – Clay/Veg. Cover _____

Clay Stratum Description _____

Depth Below Surface From: _____ To: _____

Percent Fines _____

Atterberg Limits _____

Moisture Content _____

Hydraulic Conductivity: (cm/sec)

@ 80% Standard Proctor _____

@ 85% Standard Proctor _____

@ 90% Standard Proctor _____

Shear Testing - Int. Cover/Clay _____

Shear Testing – Clay/Veg. Cover _____

Attach additional sampling results as needed.

Approved by Contractor _____

Approved by QC Monitor _____

Approved by QA Engineer _____

INCREMENTAL TOP SLOPE CLOSURE
QUALITY ASSURANCE/QUALITY CONTROL PLAN

TRAIL RIDGE LANDFILL
INCREMENTAL TOP SLOPE CLOSURE
QUALITY ASSURANCE/QUALITY CONTROL PLAN

This plan specifically addresses the quality assurance and quality control (QA/QC) for Trail Ridge Landfill, Top Area Closure. This program delineates the quality procedures and standards for the construction.

In the context of this plan, quality assurance, quality control and the plan participants are defined as follows:

Quality Assurance - A planned and systematic pattern of all means and actions designed to provide adequate confidence that items or services meet contractual and regulatory requirements and will perform satisfactorily in service.

Quality Control - Those actions which provide a means to measure and regulate the characteristics of an item or service to contract and regulatory requirements.

Permittee - Trail Ridge Landfill, Inc.

Owner - The City of Jacksonville

Design Engineer - England, Thims & Miller, Inc.

The QA/QC Program for this project includes General QA/QC, Soils QA/QC, and Synthetic Liner System QA/QC. These QA/QC activities (including monitoring, sampling and testing) shall be directed and conducted by the third parties who are independent of the Contractor.

The General QA/QC includes full-time services to periodically observe the contractor's work to verify substantial compliance with permits, plans, specifications and design concepts.

General Quality Control Monitor - shall monitor the construction for compliance with the permits, plans, specifications and design including construction to proper lines and grades, maintain daily logs and weekly progress reports of the construction (including observation data sheets, problem identification and correction logs), make note of construction deviations, coordinate qualifying and testing of materials, and monitor filling. This individual shall be experienced in civil site construction and solid waste regulations.

General Quality Assurance Engineer - shall supervise the construction monitoring to verify compliance with permits, plans, specification and design concepts. This individual shall be experienced in civil site construction and solid waste regulations and shall be a registered Professional Engineer.

The General QA/QC Program includes monitoring the following activities:

1. General Earthwork
2. Drainage Installation
3. Overall Liner System Installation
4. General Construction Quality Control

The Soils QA/QC for this project includes soil material qualifying, sampling and testing to verify substantial compliance with the material standards.

Soils Quality Control Monitor - shall pre-qualify soil materials, monitor the installation of soil materials, determine where in-place soil materials shall be tested, and test the in-place soil materials. This individual shall be responsible for assuring that all soil materials have been pre-qualified and have a chain-of-custody from the pre-qualified source to the project site, prior to installation. This individual shall be experienced in quality assurance of soil materials and the preparation of quality assurance documentation including quality assurance forms, reports, certification and manuals. This individual shall be experienced in civil site construction and soil testing standards and procedures.

Soils Quality Assurance Engineer - shall supervise the soil material pre-qualifying and testing of in-place soil materials to assure compliance with the test standards and testing frequency requirements, and verify compliance with the plans, specification and design. This individual shall be experienced in quality assurance of soil materials and the preparation of quality assurance documentation including quality assurance forms, reports, certification and manuals. This individual shall hold a B.S., M.S., or PhD degree in civil engineering or related fields, be experienced in civil site construction and soil testing procedures and shall be a registered Professional Engineer.

The Top Area closure of Trail Ridge Landfill includes a final cover consisting of 12" of intermediate cover, a 50-mil Agru Super Gripnet® Drain Liner or equivalent geomembrane liner, non-woven geotextile, and 24" protective cover layer (from bottom to top). The QA/QC for the final cover is as follows:

A. INTERMEDIATE COVER

1. Location - The fill material shall come from an off-site source. The Soils Quality Control Monitor shall visually inspect the fill material.

2. Standard - Soil shall be free of brush, weeds, and other litter; and free of roots, stumps, stones and any other extraneous or toxic matter.

   The intermediate cover shall be a minimum of 12" thick.

   Compacted to 90% of Modified Proctor maximum dry density (ASTM D 1557), unless the soil material contains 30.0% or greater passing the No. 200 sieve, then compacted to 90% of Standard Proctor maximum dry density (ASTM D-698).

3. Frequency - Depth measurements and density tests shall be conducted at the frequency of four per acre.

B. GEOMEMBRANE LINER

The final cover shall include a 50-mil Agru Super Gripnet® Drain Liner or equivalent geomembrane liner. The geomembrane liner shall be installed, monitored and tested in accordance with the requirements of Section 02776 (LINEAR LOW DENSITY POLYETHYLENE (LLDPE) GEOMEMBRANE LINER) of the Technical Specifications.

C. NON-WOVEN GEOTEXTILE

The final cover shall include an 8-oz non-woven geotextile (filter fabric). The geotextile shall be installed, monitored and tested in accordance with the requirements of Section 02272 (FILTER FABRIC FOR SUBSURFACE PIPING AND LANDFILL CAP DRAINAGE LAYER) of the Technical Specifications.

D. PROTECTIVE COVER LAYER

After the geomembrane and non-woven geotextile have been installed, they shall be covered with a protective cover layer. The protective cover layer shall include an 18” soil fill layer and 6” top soil layer and shall be a minimum of 24" in thickness.

1. Location - The protective cover layer shall be tested in place. The location of testing shall be determined by the Soils Quality Control Monitor.

2. Standard - The protective cover soils shall be reasonably free of brush, weeds, and other litter; and relatively free of roots, stumps, stones and any other extraneous or toxic matter harmful to plant growth. Roots with a diameter greater than 1/2" shall be hand picked and removed.

   The top soil layer shall be at least 24" thick.

3. Frequency - Depth measurements shall be taken at the frequency of four per acre. The soil shall be monitored on a continuous basis for extraneous matter.

E. UNDERDRAIN FILTER SAND

The underdrains shall be surrounded by filter sand.

1 Location - The material shall be pre-qualified prior to installation.

   If the testing is done at the borrow source, a chain of custody shall be provided.

2. Standard - Clean, uniformly graded sand with a uniformity coefficient of 1.5 or greater and an effective grain size of 0.2 mm to 0.5 mm. Grain size distribution shall be conducted as part of pre-qualification.

   The sand shall have a hydraulic conductivity no less than 1.0×10^{-3} cm/sec at a density of 100 percent Modified Proctor. The hydraulic conductivity testing shall be by Constant Head method (ASTM D2434).

3. Frequency - The hydraulic conductivity of the sand shall be tested once per 500 cubic yard of sand material.

F. Gas Management System (Gas Wells and Headers)

Gas wells (temporary and permanent) shall be installed in accordance with the Construction Drawings. The QA/QC for gas well materials shall be as follows:

1. Gravel for Gas Wells

   a. Location - The gravel shall be pre-qualified by certification by the supplier.

   b. Standard - The gravel shall be clean gravel with no fines. The gravel shall be FDOT No. 3 Course Aggregate (ASTM D 448).

      The gravel shall be non-calcareous (ASTM D 4373).

   c. Frequency - The gravel shall be certified by the supplier. The gravel shall be tested once per 100 C.Y.

2. Bentonite for Gas Wells

   a. Location - The material shall be pre-qualified with documentation from the supplier.

   b. Standard - The material shall have a hydraulic conductivity no greater than 1.0×10^{-8} cm/sec (ASTM D 5084).

   c. Frequency - The material shall be certified by the supplier, one time only.

3. Permanent Header Pipe

   The permanent header pipe shall be placed in the areas of final cover and shall be placed on the geomembrane layer, as shown on the Construction Drawings. The header pipe shall not be placed until the geomembrane has been tested and approved. The placement of the header pipe over the geomembrane layer and covering of the header pipe shall be conducted in the presence of either the Soils Quality Control Monitor or the General Quality Control Monitor.