

# Construction Quality Assurance/Quality Control Plan - Groundwater Source Control Measure

Prepared for:  
Legacy Site Services  
LLC

Arkema Inc. Facility  
Portland, Oregon

January 2011

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Legacy Site Services LLC

Construction Quality  
Assurance/Quality Control Plan -  
Groundwater Source Control  
Measure  
*Arkema Inc. Facility, Portland, Oregon*

January 2011

Project No. 0116759



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**1.0 CONSTRUCTION QUALITY ASSURANCE/QUALITY CONTROL PLAN**

**1.1 PURPOSE**

On behalf of Legacy Site Services LLC (LSS), agent for Arkema Inc., ERM-West, Inc. (ERM), has prepared this Construction Quality Assurance/Quality Control (CQA/QC) Plan for the former Arkema Inc. Portland Plant (the site) located at 6400 NW Front Avenue in Portland, Oregon. This CQA/QC Plan has been prepared pursuant to the Order on Consent requiring source control measures and a feasibility study issued by the Oregon Department of Environmental Quality (ODEQ), signed 31 October 2008 (DEQ No. LQVC-NWR-08-04).

The purpose of this document is to present the CQA/QC requirements for construction of the Groundwater Source Control Measure (GW SCM) Groundwater barrier wall (GWBW) and the related construction certification report. This CQA/QC Plan defines the various management and inspection staff personnel directly responsible for the construction quality control (CQC) activities, as well as construction quality assurance (CQA) activities, including position descriptions, responsibilities, and experience requirements. In addition, this CQA/QC Plan addresses specific quality assurance and quality control (QA/QC) testing requirements for each of the various components of the GBW construction. During construction, contractors, vendors, and others involved in the implementation of the GBW, will be required to provide supplemental supporting documents. These supplemental requirements will be outlined in the technical specifications provided in the Final Design package submittal.

## 2.0 *POSITION RESPONSIBILITIES*

The construction contractor will be responsible for the quality of construction in the finished product and for compliance with the construction documents, drawings, and specifications. The Project Engineer will have ultimate responsibility for the oversight of construction and for conformance with the construction drawings, specifications, and quality assurance requirements. The complete construction, design, and CQA team organization is presented on Figure 1.

The CQC team members will be employed by the construction contractor. Therefore, specific positions, and their associated descriptions and responsibilities, will be set forth by the contractor procured. However, the construction contract documents require that the contractor assign an individual to manage the CQC team and that the individual will not be directly involved in supervising construction activities.

## 2.1 *CONSTRUCTION QUALITY ASSURANCE TEAM*

The CQA team will solely participate in the quality assurance function and will not be involved in any other aspect of the construction effort. This team will, however, possess all of the credentials, capabilities, and experience of an independent design/construction oversight team. The duties and responsibilities of each position are described below. One individual or entity may perform multiple CQA responsibilities.

Project Engineer - The Project Engineer is responsible for overall implementation and management of the CQA/QC Plan and will supervise the preparation of the construction certification report. The Project Engineer will be independent of the construction contractor, but directly accountable to LSS for the successful completion of the work. The duties and responsibilities of the Project Engineer include the following:

- Review and approve shop drawings.
- Provide support to the CQA Manager in interpreting the meaning and intent of the construction plans and specifications and in the performance and supervision of the CQA testing program.
- Provide consultation and technical support to LSS.
- Identify, as appropriate and in coordination with the CQA Manager, discrepancies or deficiencies in project work. Any deficiencies deemed by the Project Engineer to require immediate attention will be reported to LSS immediately.

- Sign, certify, and seal the construction certification report as a Professional Engineer registered in the state of Oregon, who attests to the quality of the work being certified. The report will include the results of all CQA and CQC testing and deviations from the construction plans and specifications. In addition, the report will include "as-built" drawings, daily inspection reports, photographs, and other applicable documents.
- Prepare the final "as-built" drawings indicating the features constructed and the existing location of all features.
- Make recommendations to LSS regarding the approval of construction subcontractors and material vendors.
- Evaluate the contractor's project schedule.
- Review and make recommendations to LSS regarding any delays to the project schedule.
- Review and evaluate change orders proposed by the contractor, owner, designer, or CQA team. All change orders will require a signature indicating approval from all above-referenced parties as well as the ODEQ.
- Provide other technical support to LSS as required.

CQA Manager - The CQA Manager will be assigned to the site on a full-time basis, and will report directly to the Project Engineer. The duties and responsibilities of the CQA Manager include the following:

- Perform and/or oversee all CQA testing activities.
- Coordinate CQA activities with the Construction Manager and the Project Engineer.
- Review contractor invoices and recommend payment schedule to the Project Engineer.
- Maintain copies of all CQA and CQC testing results and certifications.
- Prepare and distribute weekly construction reports to the Project Engineer and LSS.
- Provide input on the construction certification report.

The general purpose of the CQA Manager is to ensure that the contractor provides a full, complete, and properly constructed product in accordance with all plans and specifications. The primary duties of the CQA Manager are to verify that all QA and QC tests required under the construction contract are performed, and assure that all installed equipment and materials have passed the required tests. The CQA Manager will complete material and equipment tests and maintain reports of testing results, any failures, and any corrective actions employed to obtain acceptable test results. All test data, reporting data, and contractor submissions will be included in the construction certification report. The CQA Manager shall be permitted to suspend construction activities under conditions such as inclement weather, where they believe the integrity of the GWBW or any of its components will be compromised.

Geotechnical CQA Manager - The Geotechnical CQA Manager will be on site during all earthwork operations requiring quality assurance testing, including excavation and site preparation, and construction of the GWBW and cap. They will oversee the activities of the Field CQA Inspectors and coordinate the testing programs of the CQA Laboratory.

CQA Laboratory - The CQA Laboratory will be an entity independent of both LSS and the construction contractor, located either on site or off site. It will be responsible for conducting tests on soil materials and soil-reagent mixes to ensure conformance with the contract plans and specifications. The CQA Laboratory will not analyze soils or soil-reagent mixes provided by any party involved with the supply of materials, the construction contractor, or subcontractors. The CQA Laboratory will report directly to the CQA Manager.

Field CQA Inspectors - Field CQA Inspectors will report directly to the CQA Manager and will be present during all major construction activities. The duties and responsibilities of this position include the following:

- Visually inspect materials imported to the site for conformance with contract specifications and for variations from tests completed prior to the materials being delivered to the site.
- Obtain samples for geotechnical CQA testing.
- Observe field sampling and testing performed by the contractor's CQC staff, and review test results.
- Observe and record observations regarding the storage and handling of equipment and materials.
- Independently verify quantity calculations.
- Prepare daily reports documenting all contractor activities.



- Assist with the generation of soil volume placement estimates.
- Assist with the preparation of "as-built" drawings.

## 2.2

### *CONSTRUCTION QUALITY CONTROL TEAM*

Key positions in the construction contractor's CQC team will be delineated in the construction contract; e.g., Contractor Superintendent, Contractor CQC Manager, etc. Other CQC positions and responsibilities will be assigned at the discretion of the procured contractor. The construction contractor's CQC team will be subject to the review and approval of the CQA Manager before site mobilization is authorized. Team members may be employed directly by the contractor, or as subcontracted firms or individuals. One individual or entity may perform multiple CQC responsibilities. The CQC team will consist of the following positions, or equivalent:

Contractor Superintendent - The construction Contractor Superintendent will have overall responsibility for implementing the CQC program, including appointment of a CQC Manager, and providing daily construction reports documenting testing and construction activities. The daily reports will be provided to the CQA Manager. The CQC Manager may not be the construction Contractor Superintendent and must be approved by the Project Engineer.

CQC Manager - The CQC Manager will be responsible for overseeing all quality control testing performed by the contractor and providing contractor certification reports to the CQA Manager. Other related duties will include coordinating shop drawing submittals, providing required samples, and coordinating work and testing with the CQA Manager. The CQC Manager will provide daily construction reports which document all testing and describe construction activities performed at the site. The CQC daily report will be provided to the construction Contractor Superintendent and a copy provided to the CQA Manager. The CQC Manager will report directly to the construction Contractor Superintendent.

CQC Laboratory - The CQC Laboratory will be an independent, qualified, soils and materials testing laboratory retained by the contractor. The laboratory will conduct tests on representative soils and soil-reagent mixes at the source facilities of materials brought on site, in the field during activities conducted at the site, and/or at the laboratory to determine compliance with construction contract documents.

Field CQC Inspectors - Field CQC Inspectors will report directly to the CQC Manager and will be present during all major construction activities. The duties and responsibilities of this position include the following:

- Conduct field testing on samples of slurry and soil-reagent backfill to control construction of the GWBW.
- Visually inspect materials imported to the site for conformance with contract specifications and for variations from tests completed prior to the materials being delivered to the site.
- Perform moisture-density relationship tests on constructed soils to ensure that compaction and moisture content are in conformance with construction specifications.
- Obtain samples for geotechnical CQC testing.
- Observe and record observations regarding the storage and handling of equipment and materials.
- Prepare daily reports documenting all contractor activities.
- Assist the Construction Manager in the generation of soil volume placement estimates.
- Assist with the preparation of "as-built" drawings.

Land Surveyor - The survey crew will consist of a qualified land surveyor and assistants. The land surveyor will identify and establish initial horizontal and vertical control for the construction contractor and will provide ground and aerial surveying of the site for the preparation of certified "as-built" drawings for inclusion in the construction certification report. The land surveyor must be licensed in the state of Oregon and certify all "as-built" drawings and thicknesses, as required in the technical specifications. The survey crew will report directly to the CQC Manager.

### 3.0 *LEVEL OF EXPERIENCE*

#### 3.1 *CONSTRUCTION QUALITY ASSURANCE TEAM*

Project Engineer - The Project Engineer will be a Professional Engineer, or work under the direct supervision of a Professional Engineer, registered in the state of Oregon. The Project Engineer will have a thorough knowledge and familiarity with the project and demonstrated experience in the design and construction of various types of groundwater barrier walls (i.e., soil-bentonite slurry wall, deep soil mixing, jet grouting). In addition, they will have experience in earthwork. The Project Engineer will have a minimum of 10 years experience in civil engineering design and construction and a minimum of five years of experience in groundwater barrier wall design and/or construction.

CQA Manager - The CQA Manager will have experience in civil construction projects including earthwork, and soils and materials testing. The CQA Manager will have a thorough familiarity with the project and testing requirements, and have directly-applicable experience in the testing of materials used to construct groundwater barrier walls. The CQA Manager will have a minimum of five years of experience in materials testing or an equivalent. The CQA Manager will be certified for operation of a nuclear density gauge.

Geotechnical CQA Manager - The Geotechnical CQA Manager will have a working knowledge of field and laboratory geotechnical testing protocols and procedures for a wide variety of soils. They must have a minimum of three years of experience performing and overseeing earthwork operations associated with groundwater barrier wall construction, and one year as a geotechnical inspector.

CQA Laboratory - The CQA Laboratory will have experience in testing soils, soil-reagent mixes, and other construction materials, and will be familiar with related American Society for Testing and Materials (ASTM), American Association of State Highway and Transportation Officials (AASHTO), and other construction materials testing standards.

Field CQA Inspectors - Field CQA Inspectors will have experience and/or training in both the testing and inspection of earthwork, granular materials, groundwater barrier walls, concrete, and other site improvements. The inspectors that perform soil, slurry, and soil-reagent backfill testing will have a minimum of one year experience performing the required tests, including familiarity with the use and application of sand cones, Marsh funnels, filter presses, slump cones, scales, ovens, Shelby-tube sampling, nuclear density gauges, levels and tripods, and will be certified for operation of a nuclear density gauge.

## 3.2

**CONSTRUCTION QUALITY CONTROL TEAM**

Construction Contractor Superintendent - The construction Contractor Superintendent will be trained in the areas of landfill/civil/earthwork construction and engineering. The Superintendent will have demonstrated experience in earthwork projects and groundwater barrier wall construction, and will have a familiarity with the project. The Superintendent will have a minimum of 10 years experience in the construction field.

CQC Manager - The CQC Manager will have a working knowledge of civil engineering, earthwork, and construction materials testing. The CQC Manager will have demonstrated experience with earthwork projects and groundwater barrier wall construction. The CQC Manager will have a minimum of five years experience in construction and materials testing.

Field CQC Inspectors - Field CQC Inspectors will have experience and/or training in both the testing and inspection of earthwork, granular materials, groundwater barrier walls, concrete, and other site improvements. The inspectors that perform soil, slurry, and soil-reagent backfill testing will have a minimum of one year experience performing the required tests, including familiarity with the use and application of sand cones, Marsh funnels, filter presses, slump cones, scales, ovens, Shelby-tube sampling, nuclear density gauges, levels and tripods, and will be certified for operation of a nuclear density gauge.

CQC Laboratory - The CQC Laboratory will be an independent laboratory subject to the approval of the CQA Manager. The CQC Laboratory will have a minimum of three years experience in testing soils, soil-reagent mixes, and other construction materials, and will be familiar with ASTM, AASHTO and other applicable test standards.

Land Surveyor - The Land Surveyor will have at least five years experience as a crew chief in performing topographic surveys, and must be a professional land surveyor registered in the state of Oregon.

#### 4.0 *QUALITY ASSURANCE AND QUALITY CONTROL TESTING*

QA/QC testing will be conducted for each of the major items under construction. The components of the GWBW construction subject to QA/QC testing include the following:

- GWBW – soil-bentonite slurry wall, jet grouting, and deep soil mixing;
- General earthwork - common fill, clay, and trench spoils test pad; and
- Granular materials.

Each component is discussed separately below.

#### 4.1 *SOIL-BENTONITE SLURRY WALL*

##### 4.1.1 *Bentonite*

##### 4.1.1.1 *Pre-Construction*

- The contractor must submit the name of the bentonite supplier, the source of bentonite, and a sample to the CQA Manager prior to construction, in accordance with the Specifications.
- The contractor must submit the results of the following tests: free swell (USP NF XVII), plastic viscosity (API 13A), viscometer (API 13A), and residue larger than 75 micrometers ( $\mu\text{m}$ ) (API 13A) for each proposed source of bentonite.
- The contractor must submit the results of the following tests: YP/PV ratio (API 13A), filtrate loss (API 13A), and moisture content (ASTM D2216) for each truck or railcar shipment of bentonite.
- The contractor must supply samples of bentonite, as required by the contract specifications, or as requested by the CQA Manager.

##### 4.1.1.2 *Construction*

- The contractor must supply, for each designated load of bentonite, the bentonite manufacturer's certifications and laboratory test results that demonstrate that the bentonite meets contract specifications.
- The contractor shall keep a log of bentonite deliveries that includes: date, source, time of delivery, weight, and laboratory quality control test results supplied by the manufacturer.

4.1.1.3 *Post-Construction*

- No testing required.

4.1.2 *Mix Water*

4.1.2.1 *Pre-Construction*

- The contractor must submit the results of the following tests: pH (API RP 13B-1), total dissolved solids (EPA 600), and hardness (API RP 13B-1) for each proposed source of water.

4.1.2.2 *Construction*

- No testing required.

4.1.2.3 *Post-Construction*

- No testing required.

4.1.3 *Slurry (Initial and In-Trench)*

4.1.3.1 *Pre-Construction*

- No testing required.

4.1.3.2 *Construction*

- The contractor must submit the results of the following tests for slurry prior to placement in the trench: viscosity (API RP 13B-1), density (ASTM D4380), filtrate loss (API RP 13B-1), and pH (API RP 13B-1) (must be performed twice per 8-hour shift).
- The contractor must submit the results of the following tests for in-trench slurry: viscosity (API RP 13B-1) and density (ASTM D4380) (must be performed twice per 8-hour shift).

4.1.3.3 *Post-Construction*

- No testing required.

4.1.4 *Soil-Bentonite Backfill*

4.1.4.1 *Pre-Construction*

- The contractor shall obtain samples of the soil to be incorporated into the soil-bentonite backfill, as required by contract specifications, and as deemed necessary by the Project Engineer to achieve the performance requirements of

the wall. The contractor must submit results of the following tests performed once for every 500 cubic yards of soil: particle size analysis (ASTM D422), moisture content (ASTM D2216), and Atterberg limits (ASTM D4318).

**4.1.4.2**      *Construction*

- The contractor shall obtain samples of the soil-bentonite backfill as required by the contract specifications and as deemed necessary by the Project Engineer to achieve the performance requirements of the wall. The contractor must submit results of the following tests performed once per day or once every 200 lineal feet of installed GWBW at 25 vertical foot intervals: particle size analysis (ASTM D422), Atterberg limits (ASTM D4318), and permeability (ASTM D5084).
- The contractor shall test the slump (ASTM C143) and density (ASTM D4380) of the soil-bentonite backfill twice per 8-hour shift.

**4.1.4.3**      *Post-Construction*

- The contractor shall obtain undisturbed samples of the soil-bentonite backfill, as required by contract specifications, and as deemed necessary by the Project Engineer to achieve the performance requirements of the wall. At a minimum, one undisturbed sample of the backfill shall be taken from between the ground surface and mid-depth, and one sample from between mid-depth and the trench bottom in both the Chlorate Area and the Acid Plant Area. The contractor shall test these samples for permeability (ASTM D5084).
- The coefficient of permeability of the soil-bentonite backfill must be verified to be less than  $1 \times 10^{-6}$  centimeters per second (cm/sec).

**4.2**            ***JET GROUTING AND DEEP SOIL MIXING***

**4.2.1**            ***Bentonite***

**4.2.1.1**        *Pre-Construction*

- The contractor must submit the name of the bentonite supplier, the source of bentonite, and a sample to the CQA Manager prior to construction, in accordance with the technical specifications.
- The contractor must submit the results of the following tests: free swell (USP NF XVII), plastic viscosity (API 13A), viscometer (API 13A), and residue larger than 75  $\mu\text{m}$  (API 13A) for each proposed source of bentonite.
- The contractor must submit the results of the following tests: YP/PV ratio

(API 13A), filtrate loss (API 13A), and moisture content (ASTM D2216) for each truck or railcar shipment of bentonite.

- The contractor must supply samples of bentonite, as required by contract specifications, or as requested by the CQA Manager.

4.2.1.2 *Construction*

- The contractor must supply, for each designated load of bentonite, the bentonite manufacturer's certifications and laboratory test results that demonstrate that the bentonite meets contract specifications.
- The contractor shall keep a log of bentonite deliveries that includes: date, source, time of delivery, weight, and laboratory quality control test results supplied by the manufacturer.

4.2.1.3 *Post-Construction*

- No testing required.

4.2.2 *Soil-Reagent Matrix*

4.2.2.1 *Pre-Construction*

- No testing required.

4.2.2.2 *Construction*

- The contractor shall obtain samples of the uncured soil-reagent matrix, as required by contract specifications, and as deemed necessary by the Project Engineer to achieve the performance requirements of the wall. At a minimum, one sample of the soil-reagent matrix shall be taken per day or one sample for each 200 lineal feet of installed groundwater barrier wall at 25 vertical-foot intervals. The contractor shall test these samples for permeability (ASTM D-5084).

4.2.2.3 *Post-Construction*

- The contractor shall obtain samples of the cured soil-reagent matrix, as required by contract specifications, and as deemed necessary by the Project Engineer to achieve the performance requirements of the wall. At a minimum, one sample of the soil-reagent matrix shall be taken from between the ground surface and mid-depth of the trench, and one sample from between mid-depth and the trench bottom in both the Chlorate Area and the Acid Plant Area. The contractor shall test these samples for permeability (ASTM D-5084).



### 4.3 GENERAL EARTH WORK - COMMON FILL

#### 4.3.1 *Pre-Construction*

- The contractor shall submit the locations of all borrow sources to the CQA Manager no less than two weeks prior to the anticipated placement of any soil materials.
- The contractor shall submit a 50-pound sample from each of the proposed borrow sources. The samples shall be submitted to the CQA Manager no less than two weeks prior to the anticipated placement of any soil material.
- The contractor shall submit with each sample the sample location, a sketch of the sample location, depth of the sample, a description of the soil, the sampling methodology, and estimated available quantity of soil.
- The contractor shall submit the results of the following tests performed once every 2,000 cubic yards or a minimum of one set of results.: particle-size analyses with hydrometer (ASTM D422), moisture content and density relationship (ASTM D1557), Atterberg limits (ASTM D4318), soil classification (ASTM D2487), and moisture content (ASTM D2216). The test results shall verify that the soils meet the contract specifications and shall be submitted to the CQA Manager no less than one week prior to the anticipated placement of any soil materials.
- The CQA Manager, or designee, shall inspect each proposed borrow source and obtain one sample for independent analysis for particle-size distribution.
- A summary report shall be prepared by the CQA Manager and shall include: a summary of laboratory test data, drawings depicting sample and test locations, a summary of sampling methods, and a brief letter certifying that the available volume of soil meets or exceeds regulatory and construction criteria.

#### 4.3.2 *Construction*

- The contractor shall test the in-place density and moisture content of all common-fill material in accordance with ASTM D2922 and ASTM D3017, respectively, and the contract technical specifications. Three tests must be conducted per lift, per area of interest. The common fill will be compacted to 90 percent of the maximum Modified Proctor Density (ASTM D1557), and every 25th nuclear density test and moisture test must be verified in accordance with ASTM D1556 and ASTM D2216, respectively.
- The CQC Manager shall obtain a sample of common-fill material if they note any change in the color, consistency, or texture of the material. The sample shall be tested in accordance with ASTM D422, ASTM D1557, ASTM D4318, ASTM D2487, and ASTM D2216, by the Geotechnical CQC Laboratory.

- The soils shall be placed using loose lifts, 9 inches in thickness or less, to achieve uniform compaction at a maximum thickness of 6 inches. The maximum clod size shall not exceed the lift thickness.
- If test results indicate that the in-place common-fill material does not meet the required specifications, the material shall be removed, replaced, and re-tested at the contractor's expense.
- The final grade of all common-fill soils shall be smooth and even, and measure to within two-tenths of a foot below to five-tenths of a foot above (-0.2 to +0.5) the grades and contours indicated on the Drawings. All thicknesses and "as-built" drawings are required to be certified by the Land Surveyor.

#### 4.3.3 *Post-Construction*

- The in-place common-fill material shall be protected from rain, drying, desiccation, and erosion.
- Any and all defective areas, as defined by the CQA Manager, shall be removed, repaired, and re-tested at the contractor's expense.
- Prior to the placement of any covering material, the common-fill material shall be inspected and approved by the CQA and CQC Managers. The common-fill material shall be inspected for cracks, holes, defects, or other features that may be detrimental to structural performance, as determined by the CQA Manager.

#### 4.4 *GENERAL EARTHWORK - CLAY*

##### 4.4.1 *Pre-Construction*

- The contractor shall submit the locations of all borrow sources to the CQA Manager no less than two weeks prior to the anticipated placement of any soil materials.
- The contractor shall submit a 50-pound sample from each of the proposed borrow pits. The samples shall be submitted to the CQA Manager no less than two weeks prior to the anticipated placement of any soil materials.
- The contractor shall submit with each sample the sample location, a sketch of the sample location, depth of the sample, a description of the soil, the sampling methodology, and estimated available quantity of soil.
- The contractor shall submit the results of the following tests: particle-size analysis with hydrometer (ASTM D422), moisture content (ASTM D2216), Atterberg limits (ASTM D4318), moisture content and density relationship

(ASTM D1557), soil classification (ASTM D2487), and permeability (ASTM D5084). The test results shall verify that the soil meets contract specifications, including a laboratory permeability less than or equal to  $1 \times 10^{-5}$  cm/sec. The test results shall be submitted to the CQA Manager no less than one week prior to the anticipated placement of any clay soil furnished from off site.

- The CQA Manager, or designee, shall inspect each proposed borrow source and obtain one sample for independent analyses of particle-size distribution.
- A summary report shall be prepared by the CQA Manager and shall include: a summary of laboratory test data, drawings depicting sample and test locations, a summary of sampling methods, and a brief letter certifying that the available volume of soil meets or exceeds regulatory and construction criteria.

#### **4.4.2**

##### ***Construction***

- The contractor shall test the in-place density and moisture content of all clay material in accordance with ASTM D2922 and ASTM D3017, respectively, and technical specifications. Tests shall be conducted every 50 lineal feet on each lift. The clay shall be compacted to 90 percent of the maximum Modified Proctor Density (ASTM D-1557), and nuclear density tests and moisture tests shall be verified in accordance with ASTM D1556 and ASTM D2216, respectively. A minimum of three verification tests shall be conducted for each soil material type.
- The CQC Manager shall obtain a sample of clay if any change in the color, consistency, or texture of the material is noted. The sample shall be tested in accordance with ASTM D422, ASTM D2216, ASTM D2487, ASTM D1557, ASTM D5084, and ASTM D4318, by the Geotechnical CQC Laboratory.
- If test results indicate that the in-place material does not meet the required specifications, the material shall be removed, replaced, and re-tested at the contractor's expense.
- The final grade of all clay material shall be smooth and even, and measure to within two-tenths of a foot below to five-tenths of a foot above (-0.2 to +0.5) the grades and contours indicated on the Drawings. All thicknesses and "as-built" drawings are required to be certified by the CQC Surveyor.

#### **4.4.3**

##### ***Post-Construction***

- The in-place material shall be protected from rain, drying, desiccation, and erosion.
- Any and all defective areas, as defined by the CQA Manager, shall be removed, repaired, and re-tested at the contractor's expense.

- Prior to the placement of any covering material, the clay material shall be inspected and approved by the CQA and CQC Managers. The clay material shall be inspected for cracks, holes, defects, or other features that may be detrimental to the structural performance, as determined by the CQA Manager.

#### 4.5 *GENERAL EARTH WORK - TRENCH SPOILS TEST PAD*

##### 4.5.1 *Pre-Construction*

- No testing required.

##### 4.5.2 *Construction*

- The contractor shall test the in-place density and moisture content of the trench spoils test pad in accordance with ASTM D2922 and ASTM D3017, respectively, and the technical specifications. A minimum of one in-place density and moisture content test shall be conducted per test pad. The trench spoils shall be compacted to 90 percent of the maximum Standard Proctor Density (ASTM D698).
- The trench spoils shall be placed using loose lifts, 12 inches in thickness or less.
- If test results indicate that the trench spoils test pad does not meet the required specifications, the test pad shall be removed and reconstructed using modified construction techniques.
- The final grade of all trench spoils shall be smooth and even, and measure to within two-tenths of a foot below to five-tenths of a foot above (-0.2 to +0.5) the grades and contours indicated on the Drawings. All thicknesses and "as-built" drawings are required to be certified by the CQC Surveyor.

##### 4.5.3 *Post-Construction*

- The in-place trench spoils shall be protected from rain, drying, desiccation, and erosion.
- Any and all defective areas, as defined by the CQA Manager, shall be removed, repaired, and re-tested at the contractor's expense.
- Prior to the placement of any covering material, the trench spoils shall be inspected and approved by the CQA and CQC Managers. The trench spoils shall be inspected for cracks, holes, defects, or other features that may be detrimental to the structural performance, as determined by the CQA Manager.

## 4.6 GRANULAR MATERIALS

### 4.6.1 *Pre-Construction*

- The contractor shall submit the location of all borrow sources to the CQA Manager no less than two weeks prior to the anticipated placement of any granular materials.
- The contractor shall submit a 50-pound sample from each of the proposed borrow sources. The samples shall be submitted to the CQA Manager no less than two weeks prior to the anticipated placement of any granular materials.
- The contractor shall submit with each sample the sample location, a sketch of the sample location, depth of the sample, a description of the granular material, the sampling methodology, and estimated available quantity of granular material.
- The contractor shall submit the results of the particle-size analyses (AASHTO T 27) conducted for every 1,000 cubic yards of granular material imported to the site. The test results shall be submitted to the CQA Manager no less than one week prior to the anticipated placement of any granular materials.
- The CQA Manager, or designee, shall inspect each potential borrow source and obtain one sample for independent analysis of particle-size distribution.

### 4.6.2 *Construction*

- If test results indicate that the in-place material does not meet the specifications, the material shall be removed, replaced, and retested at the contractor's expense.
- The final grade of the granular material shall be measured to within two-tenths of a foot below to five tenths of a foot above (-0.2 to +0.5) the grades and contours indicated on the Drawings. All thicknesses and "as-built" drawings are required to be certified by the CQC Surveyor.

### 4.6.3 *Post-Construction*

- The CQA Manager shall perform thickness measurements in the field to check compliance with contract specifications. All thicknesses are required to be certified by the CQC Surveyor.

## 5.0 CONSTRUCTION CERTIFICATION REPORT

The Construction Certification Report will be prepared by a Professional Engineer registered in the state of Oregon and submitted to the ODEQ. The report will be assembled and submitted within 45 days following completion of the GWBW, and will include the following information:

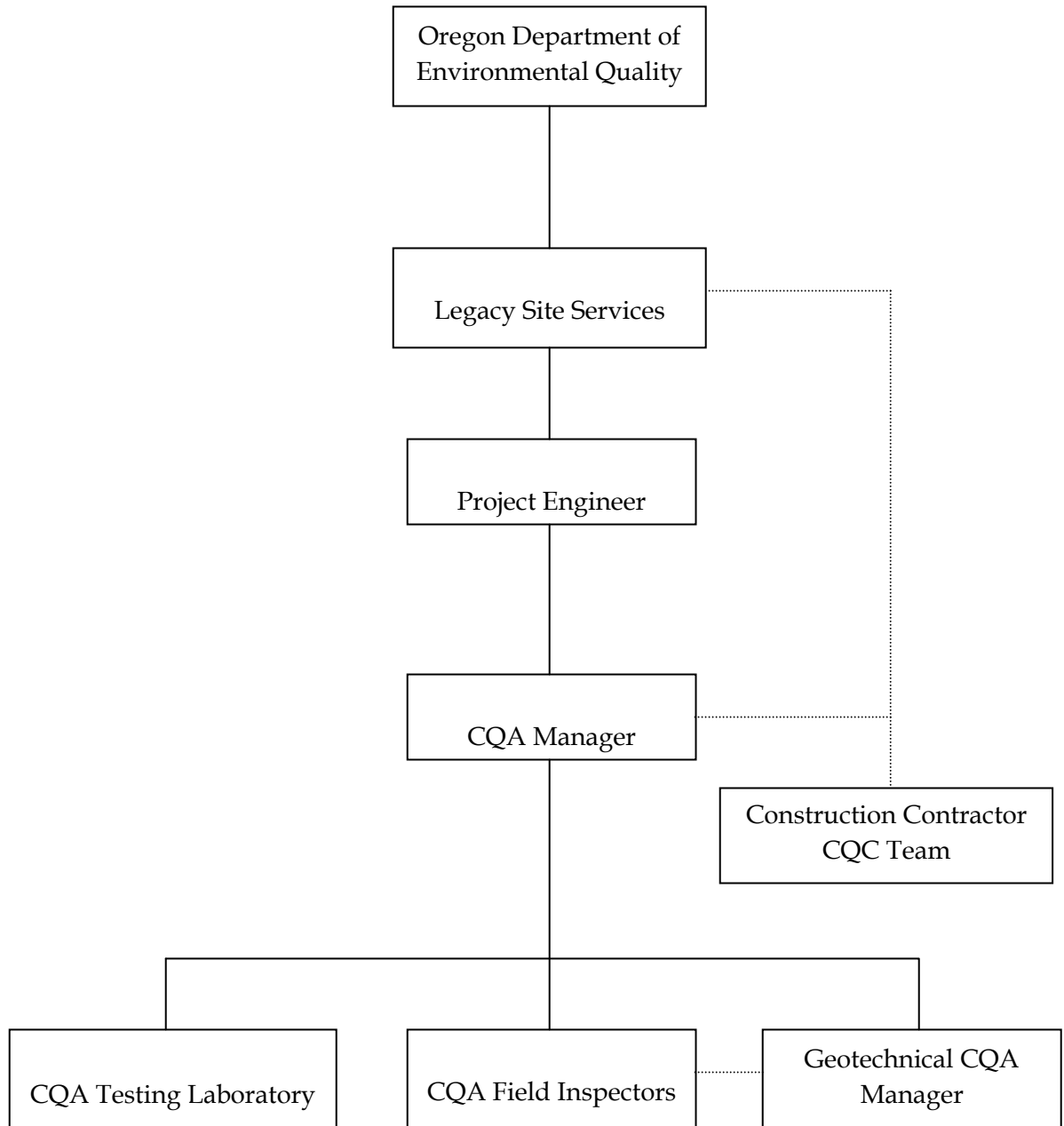
- Results of CQA and CQC testing;
- Documented deviations from the Final Design;
- Record or "as-built" drawings, including:
  - Plan views with test locations;
  - Cross sections; and
  - Necessary details;
- Daily reports;
- Site photographs;
- A statement of certification and compliance, signed and stamped by the supervising Professional Engineer registered in the state of Oregon, for GWBW components including:
  - The groundwater barrier wall; and
  - The clay cap; and
- The professional land surveyor certification for the GWBW location.

## 6.0 CONTINGENCY PLAN

During construction of the GBW components, construction difficulties may occur. The following is a list of potential construction difficulties and contingent solutions:

- Trench instability - Slurry elevation within the trench can be increased to bring the slurry closer to the ground surface and/or slurry density can be increased.
- High permeability lenses within the trench - Trench segments containing high permeability lenses can be re-excavated and filled with soil-bentonite backfill or grouted.
- Soil materials too wet - Soil can be disked or harrowed and allowed to dry until the appropriate moisture content is obtained.
- Soil materials too dry - Moisture can be added with the addition of water and thorough mixing, via disking.
- Erosion of newly placed soil - Eroded areas will be repaired immediately and will be maintained until granular materials are placed. Additional soil will be placed and compacted in affected areas. Extra silt fences will be installed as necessary to retard/redirect flows. Erosion mats, riprap or other controls will also be evaluated on a case-by-case basis.
- Inclement weather impeding the progress of the work - In the event that weather makes work difficult or affects the integrity of the work (i.e., freezing conditions during soil placement), work will be suspended until weather conditions permit.
- Stormwater ditches, ponds, and culverts clog with sediments - All excess sediment will be removed from ditches and culverts, as necessary, for proper operation.
- Cover system soils may settle - Any significant settlement will be repaired immediately through the addition of fill material.

FIGURE 1 - PROJECT ORGANIZATION CHART





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