BID AND CONTRACT DOCUMENTS

VOLUME III

CONSTRUCTION QUALITY ASSURANCE (CQA) MANUAL

for

City of Walla Walla
Walla Walla, Washington

Sudbury Road Landfill
Remedial Action

January 2016

Volume I	Bidding Forms, Agreement Forms, and Technical Specifications
Volume II	Plans
Volume III	Construction Quality Assurance (CQA) Manual

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CONSTRUCTION QUALITY ASSURANCE (CQA) MANUAL

SUDBURY ROAD LANDFILL REMEDIAL ACTION

Walla Walla, Washington

City Project No. LF09010

JANUARY 2016

Prepared for:

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this construction quality assurance (CQA) manual is to describe construction quality assurance procedures that will be used during the Closure of Area 2 and Area 5 (Remedial Action) at the Sudbury Road Landfill (SRLF) in Walla Walla, Washington. CQA personnel will use this manual as their guidance document to implement the CQA program.

Detailed manufacturer's quality control (MQC) and construction quality control (CQC) requirements, which are the responsibility of organizations that manufacture materials, and contractors that install these materials, are provided in the technical specifications issued for construction.

The project was designed by J-U-B ENGINEERS, Inc., (J-U-B) and upon completion of the project a construction report will be prepared by J-U-B documenting that construction was performed in accordance with the design intent, construction drawings and technical specifications. CQA, MQC, and CQA data generated during the project will be used to support conclusions presented in the construction report.

1.2 Document Format

This CQA Manual is organized as follows:

- Section 1 provides this introduction, defines the format of the document and provides definitions specific to terms used in the document;
- Section 2 defines personnel and organizations that will be working on this project and their roles;
- Section 3 provides information regarding various project related meetings;
- Section 4 defines general CQA procedures including items such as project reporting, data collection, record keeping, project filing, etc.;
- Section 5 defines CQA procedures for earthwork construction;
- Section 6 defines CQA procedures for mechanical construction such as HDPE pipe installation;

1.3 Definitions

Whenever the terms listed below are used, the intent and meaning will be as indicated.

AASHTO. American Association of State Highway and Transportation Officials.

ASTM. ASTM International, Inc.

Construction Quality Assurance (CQA). A planned and systematic pattern of procedures and documentation designed to provide confidence that items of work or services meet the requirements of the contract documents (construction drawings and technical specifications). Construction quality assurance includes verifying that the contractor is performing quality control requirements defined in the technical specifications.

Construction Quality Control (CQC). Those actions that provide a means to measure and regulate the characteristics of an item or service to comply with the requirements of the contract documents. Quality control will be performed by the contractor.

Construction Drawings. The official plans, profiles, typical cross-sections, elevations, and details, as well as their amendments and supplemental drawings, which show the locations, character, dimensions, and details of the work to be performed. Construction drawings may also be referred to as the "plans."

Contract Documents. The official set of documents issued by the owner, which include bidding requirements, contract forms, contract conditions, technical specifications, construction drawings, addenda, and contract modifications.

Earthwork. A construction activity involving the use of soil materials as defined in the technical specifications and Section 6 of this manual.

Manufacture Quality Control (MQC). Those actions that provide a means to measure and regulate the manufactured characteristics of a material or product to comply with the requirements of the technical specifications. MQC will be performed by the material manufacturers.

Non-conformance. A deficiency in characteristic, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate. Examples of non-conformance include, but are not limited to, physical defects, test failures, and inadequate documentation.

Owner. The City of Walla Walla, Washington (City).

Procedure. A written instruction that specifies or describes how an activity is to be performed.

Project Documents. Contractor submittals, construction drawings, record drawings, technical specifications, shop drawings, construction quality control and quality assurance manuals, health and safety plans, and project schedules.

Project Communication Records. Documents created throughout the project that record phone conversations, fax communications or other ancillary contact between participants of the project. Such documents are to be maintained as part of the Project Documents.

Record Drawings. Drawings recording the constructed dimensions, details, and coordinates of the project. Also referred to as "as-builts."

Technical Specifications. The qualitative requirements for products, materials, and workmanship upon which the contract is based.

Testing. Verification that an item meets specified requirements by subjecting that item to a set of physical, chemical, environmental, or operating conditions.

2.0 PERSONNEL & ORGANIZATION RESPONSIBILITIES

This section of the CQA Manual describes personnel and organizations that will be assigned to this project and their roles.

2.1 Construction Manager (CM)

The CM is responsible for working directly with the owner to administer the construction contract, and to provide coordination between the owner, contractor and engineers. The CM is also responsible for managing the CQA program, supervising the CQA monitors, conducting progress meetings, and preparing the construction report for review by the engineer of record. The CM must report to and obtain approval of the engineer of record when issues regarding a design change or CQA procedural change are considered.

The CM will control construction documents, including technical specifications, construction drawings, and change orders. The CM must maintain one or more copies of the most current set of contract documents for use by the contractor and CQAO. Upon issuance of new copies or revisions to any of these construction documents, it is the responsibility of the CM to notify the contractor and CQAO of the revisions, to provide revised contract documents, and then order the recall of all copies of the contract documents that do not include the latest revisions.

The CM will also maintain one master copy of the CQA manual for reproduction and distribution. When and if revisions are made to the CQA manual, it is the responsibility of the CM to notify individuals and organizations that have a copy of the CQA manual, to provide revised copies, and then order the recall of all copies that do not include the latest revisions.

The CM will maintain a master of each CQA form used to administer the CQA program. These include daily progress report forms, test report forms and other project forms. Upon issuance of a new or modified form, the CM will recall and remove all superseded copies along with the master, notify the CQA monitors, and provide new copies for their use.

2.2 Owner's Project Manager

The owner's project manager is an employee of the owner, and is the owner's on-site technical representative responsible for communicating with regulatory agencies such as the Health Department or the Department of Ecology. The owner's project manager will request assistance from the CM, CQA monitors, and engineer of record to resolve technical or regulatory related issues during construction.

2.3 Construction Quality Assurance Organization (CQAO)

The CQAO is the organization responsible for implementing the construction quality assurance program described in this document and works directly for the Owner.

2.4 CQA Laboratory

The CQA laboratory is a qualified laboratory working directly for the CQAO that performs off-site tests such as soil and geosynthetics testing.

2.5 Engineer of Record

The engineer of record is responsible for the design, as it exists at the time construction begins. The engineer of record must approve all design changes, CQA procedural changes, and provide clarifications to design questions made during construction. The engineer of record and construction manager can be the same individual.

2.6 CQA Officer

The CQA officer is a registered professional engineer in the State of Washington responsible for certifying that construction was performed in accordance with the design intent, construction drawings, technical specifications, and any approved design changes or CQA procedural changes made during construction. The CQA officer and engineer of record may be the same individual.

2.7 CQA Monitors

CQA monitors represent the Construction Quality Assurance Organization (CQAO) and owner by monitoring and testing the contractor's work in accordance with the CQA Manual. The CQA monitors report to the CM. CQA monitors observe and document the activities of the contractor in sufficient detail, and with sufficient continuity to provide a high level of confidence that the work product fully complies with the intent of the construction drawings and technical specifications. CQA monitors also perform tests, when appropriate, to provide a high level of confidence that the characteristics of the work meet the requirements of the construction drawings and technical specifications.

Whenever CQA monitors perform observations or perform tests, they are responsible for timely preparation and processing of all required documentation and reports. Accurate and concise reports must be prepared for all monitoring activities and for each test performed, the day that that CQA activity occurs.

2.8 Contractors

The contractors are responsible for coordinating amongst themselves, scheduling and performing the work within the timeframe and budget agreed to in the contract, and performing the work in accordance with the construction drawings and technical specifications. The contractors are also responsible for implementing manufacturer's quality control (MQC) procedures, and construction quality control (CQC) procedures, to document materials are manufactured and installed in accordance with the construction drawings and technical specifications. The contractors are also expected to cooperate with the CQA monitors to achieve a quality product.

2.9 Project Surveyor

The project surveyor will work at the direction of the contractor to set construction control stakes, perform surveys to document as-built conditions, and perform surveys to measure installed quantities of materials.

3.0 PROJECT MEETINGS

In order to administer the construction contract, and to coordinate the contractors activities with those of the CQAO, a variety of meetings will be held. They are discussed in the following paragraphs.

3.1 Pre-Construction Meeting

A pre-construction meeting will be held at the site and be attended by the Owner, CM, engineer of record, CQA officer, CQA monitors, contractor, suppliers or subcontractors selected by the contractor, and others designated by the Owner. The meeting will be administered by the CM. The purpose of this meeting will be to:

- present a proposed construction progress schedule and submittals register as required by the Contract Documents;
- discuss liquidated damages (if any);
- discuss procedures for handling submittals;
- discuss the direction of correspondence, and coordinate responsibility between contractor, engineer, and owner;
- establish reporting and documentation procedures for each party;
- request and schedule progress meetings;
- present a summary of the laboratory materials testing and field testing that will be required to meet CQC, MQC and CQA requirements;
- discuss applications for payment, and progress payment procedures;
- discuss procedures for field orders, work change directives and change orders;
- discuss owner's site regulations;
- review the construction drawings, and technical specifications;
- review the CQA manual;
- review work area security, safety procedures, and related issues;
- provide all parties with relevant contract documents;
- review testing equipment and procedures;
- establish testing protocols and procedures for correcting and documenting non-conforming work or materials;
- conduct a site inspection to discuss work area, stockpile areas, lay down areas, material storage areas, access roads, haul roads, and related items.

The CM must record minutes of the meeting and provide copies to all parties present at the meeting.

3.2 Daily Progress Meetings

An informal progress meeting is recommended daily before the start of work. At a minimum, the CQA monitor and contractor's superintendent should conduct this meeting. A suggested typical agenda for this meeting may include:

- a discussion of the previous day's construction related problems and how they will be resolved;
- review of relevant test data;
- discussing the contractor's personnel and equipment assignments for the day;
- identifying expected material and/or equipment deliveries and determining where they will be staged, stored, and inventoried;
- resolving any outstanding problems or disputes; and
- discussing any site health and safety issues relevant to that day's scheduled work.

3.3 Progress Meetings

Scheduled progress meetings will be held regularly (assume weekly during construction). Typically, the CM, CQA monitor, contractor, and Owner will be present. The CM will prepare the agenda for each meeting, administer the meeting, and prepare meeting minutes for distribution to all parties. At a minimum, the progress meetings must address the following:

- reviewing meeting minutes from previous progress meeting;
- discussing work in progress, and key activities scheduled for the upcoming week;
- addressing any outstanding issues or conflicts that may or may not interfere with work progress;
- reviewing a submittals register to identify any outstanding submittal issues;
- reviewing MQC, CQC, and CQA testing scheduled to take place that week;
- reviewing an updated schedule provided by the contractor; and
- reviewing any health and safety issues for the site.

At the beginning of each progress meeting all parties in attendance at the previous meeting must agree to the contents of the previous meeting minutes. Any changes to the meeting minutes must be marked on the file copy. The CM must keep a copy of all meeting minutes at that project site, and in a project file that can be accessed at any point during or after the project.

3.4 Other Meetings

As required, special meetings will be held to discuss problems or non-conforming work. At a minimum, the, CM, CQA monitors, contractor and Owner must attend this meeting. If the problem requires a design modification and subsequent change order, the engineer of record or CQA officer must also be present. The CM must document the meeting.

4.0 GENERAL CQA PROCEDURES

Success of the quality assurance program requires thorough performance of the required monitoring and testing activities, thorough documentation of completed monitoring and testing activities, and frequent senior review of CQA documentation. Therefore, the CQA Monitors and CM must assure that all construction quality assurance procedures have been implemented, that results of the program are reviewed frequently, and corrections, if necessary, are implemented.

Procedures for completing, documenting, reviewing, and filing CQA and related activities are summarized in this section. They include:

- completing a daily record of construction progress;
- verifying material quality;
- preparing CQA test reports;
- summarizing CQA test data;
- reviewing CQC and MQC test reports provided by the contractor;
- documenting and correcting non-conforming work;
- preparing CQA progress reports;
- documenting design modifications;
- documenting CQA program modifications;
- documenting as-built conditions;
- preparing other project records;
- obtaining photographic documentation of the project;
- filing project documentation;
- preparing a construction report;
- calibrating testing equipment;
- complying with test standards.

The following sub-sections discuss each of these procedural items. Report forms are presented in Appendices A and B.

4.1 Preparing a Daily Record of Construction Progress

The daily record of construction progress must summarize each day's construction, CQA, CQC, and MQC activities, and any relevant discussions between the contractor, CQAO and owner. A report must be prepared by each CQA monitor on a daily basis. Each completed report must be submitted to the CM by email or fax for review no later than the following day. The review must include a check for clarity, legibility, traceability, and completeness. At a minimum, the report must include the following:

- date, project name, project number, and project location;
- a unique number for cross-referencing and document filing;
- a description of that day's weather conditions;

- a description of ongoing construction activities in the area of the CQA monitor's responsibility;
- a summary of CQA, CQC and MQC activities for that day;
- an inventory of equipment used by the contractor and an inventory of labor personnel used by the contractor;
- a summary of pertinent project related discussions, and names of parties involved in those discussions;
- a brief description of tests performed, and identification as to whether or not the tests were passing or failing, and in the event of failure, a re-test with pass/fail results. A reference to attached test data can be used to meet this requirement;
- a description of any nonconforming work, and related corrective actions, if any, (if used a nonconformance and corrective action form must be attached);
- a summary of materials received, and documentation of their quality, such as MQC data;
- follow-up information on previously reported problems or deficiencies;
- a record of any site visitors;
- the signature of the CQA Monitor; and
- the signature of the reviewer.

A copy of the daily report sent to the CM must be filed on site.

4.2 Verifying Material Quality

4.2.1 Samples

The contractors will identify sources and provide samples and test results of various materials, such as soil. Samples may be tested by the CQAO to determine if each material meets quality requirements defined in the technical specifications. A representative example of each sample, with corresponding test results, must be maintained on site to visually compare the sample with actual materials delivered to the project.

A record of soil samples obtained throughout the project must be maintained on a master log of soil sampling and testing.

A record of soil, geosynthetic and other materials provided by the submittal process must be maintained in a submittal register or submittal log.

4.2.2 Materials Submittals

Material submittals may be used by the CQAO to establish the acceptability of materials. When submittals are required, they must be submitted to the CM. Acceptance and proper review of submittals is the responsibility of the CM, CQA officer, or engineer of record.

4.2.3 Certificates of Compliance

Where allowed in the technical specifications, certificates of compliance may be used by the CQAO to establish the acceptability of materials in lieu of testing. These certificates generally state that the material is in compliance with a particular code, standard, or specification. The

certificates of compliance must directly reference the project, include the name of the product or source of the material and reference the specification section or regulation for which the certificate of compliance is being provided. Submission of a certificate of compliance does not relieve the contractor of the responsibility of supplying and installing materials that meet the intent of the design.

4.3 Preparing CQA Test Reports

The CQA monitor and CQA laboratory must complete a test report whenever testing is performed. Laboratory test reports must be peer reviewed by the laboratory performing the tests, and all field test reports must be reviewed by the CM. Laboratory and field test reports must be reviewed within 24 hours of completing the test. The review must include a determination regarding pass or fail relative to specified quality or installation requirements, a check for mathematical accuracy, conformance to test standards, conformance to the CQA Manual, and a check for clarity, legibility, traceability, and completeness.

Laboratory and field test reports must include the following information as is appropriate for the form being used:

- the date, project name, and project location;
- a unique number for cross-referencing and document control;
- weather data;
- a reduced scale site plan showing sample and test locations;
- test equipment calibrations, if applicable;
- a summary of test results identified as passing, failing, or, in the event of a failed test, a re-test;
- completed calculations, as applicable;
- signature of the CQA monitor or laboratory technician; and
- documentation of peer review.

4.4 Summarizing CQA Test Data

CQA test data must be summarized in the form it will be presented in the construction report. Test data must be entered on the summary form no later than 5 working days following peer review or CM review of the individual test reports.

Section 5 includes tables summarizing required CQA testing. These tables also include information regarding what type of report form must be used to summarize collected data.

4.5 Reviewing MQC and CQC Test Reports

The contractor has contractual responsibilities for performing MQC and CQC testing to determine the quality of materials manufactured for this project, and the quality of their installation. These requirements are presented in the technical specifications. The CQAO must review MQC and CQC data to assure manufactured materials and their installation meet specified requirements.

The CQAO must review MQC data for conformance with specified material quality requirements within 3 working days of receiving the data. When this review is complete and material quality is

verified, the CM must initial each page of MQC data signifying that the information documents that the materials meets specified quality requirements. The CM must then file this information in the form it was received in the project files. If the MQC data does not verify material quality, the CM must immediately notify the contractor. Summarizing this data is not required

The CQA Monitor must review CQC installation data for conformance with specified requirements on the day that the installation is completed. When this review is complete, the CQA Monitor must initial each page of CQC data signifying that the CQC information documents material installation in accordance with specified requirements. If the CQC data does not verify material installation in accordance with specified requirements, the CQA Monitor must immediately notify the contractor. The CQA Monitor must then file this information in the form it was received in the project files. Summarizing this data is not required.

4.6 Documenting and Correcting Non-Conforming Work

4.6.1 Observation and Documentation of Non-Conforming Work

Whenever non-conforming work is discovered the CQA monitor must notify the foreman or superintendent supervising the work in question. The CQA monitor must then document that the contractor was notified in the daily progress report. When the non-conforming work is corrected, the CQA monitor must document that the corrective work has taken place in that day's daily progress report, or a subsequent daily progress report.

4.6.2 Determining Extent of Non-conformance

Whenever a non-conformance is discovered that requires technical input from the engineer of record, the CQA monitor or CM must first determine the extent of the non-conforming work. This can be accomplished by performing additional sampling, testing, and observations, or taking photographic records.

4.6.3 Documenting Non-Conformance

All non-conformances must be documented in writing on daily progress reports, test reports and elsewhere, as appropriate. The documentation must occur immediately upon determining the extent of the non-conformance. For a non-conformance that is considered serious or complex in nature, or which requires an engineering evaluation, a non-conformance report must be initiated and issued to the engineer of record, CM, Owner, and contractor.

4.6.4 Corrective Measures

When a simple or routine non-conformance is discovered as a result of testing , such as a failed field moisture/density test, corrective measures must be determined by specification direction (i.e. re-compact until a passing test is achieved). If the simple or routine non-conformance is determined by observation, such as a non-conforming grade tolerance, the CQA monitor, CM, and contractor will discuss standard construction methods to correct the deficiency.

For a more serious non-conformance, such as accidental damage to an installed material, which requires a non-conformance report, the engineer of record must determine corrective measures. A copy of the non-conformance report, with the engineer of record's corrective measure determination, must be forwarded to the CQA monitor and contractor for implementation of the corrective measure.

4.6.5 Verification of Corrective Measures

Upon notification to the CQA monitor by the contractor that corrective measures are complete, the CQA monitor must verify its completion. The verification must be documented by observations or re-testing and with photographs. The CQA monitor must prepare written documentation of the corrective measures on daily reports, logs and forms, and the non-conformance report. The report must then become part of the project documentation.

4.7 Preparing CQA Progress Reports

CQA progress reports may be prepared by the CM on a periodic basis. The purpose of these reports is to document completion of MQC, CQC and CQA procedures relative to specific work completed by the contractor. This must be done in a manner that documents MQC tests, CQC tests, CQA tests are keeping pace with material manufacturing and installation.

The CQA progress report should be brief, and where possible, supported by tables or other graphics, such as the CQA checklist described above. The report may contain the following information:

- The date, project name, and project location;
- The quantity of materials delivered to the site for the report period that require MQC test reports, the number of MQC test reports delivered, and a statement regarding whether or not the test frequency meets the specified quantity, and whether or not the material meets specified requirements;
- The quantity of contract bid items completed or installed by the contractor for the report period that require CQC testing, the number of CQC test reports delivered, and a statement regarding whether or not the test frequency meets the specified quantity, and whether or not the material was installed as specified;
- The quantity of contract bid items completed or installed by the contractor for the report period that require CQA testing, the number of CQA tests completed, and a statement regarding whether or not the CQA test frequency meets requirements of the CQA manual, and whether or not the CQA tests assure material quality and installation in accordance with specified requirements;
- A summary of deficiencies, or defects, discovered as a result of the CQA program, and a description of how these deficiencies were resolved;
- A summary of delinquent MQC, CQC or CQA work that is impacting the progress or quality of the project.
- A summary of design or CQA modifications made during the report period, if any;
- A copy of the submittal log updated to reflect the end of the report period;

If prepared, this report is for the benefit of the owner, and could also be submitted to the engineer of record, and the CQA monitors. Copies must be kept on file.

4.8 Documenting Design Modifications

Design changes may be required during construction. Design changes can only be made by written agreement of the engineer of record, owner, and contractor. These changes must be made by field order, work change directive, or change order to the contract. When field orders, work change directives, or change orders are issued, the engineer of record or CM will prepare

them for distribution. These documents must be signed by the engineer of record, owner, and contractor. A copy of the design changes must also be distributed to the CQAO for distribution among the CQA monitors. Design change documentation must be filed.

4.9 Documenting CQA Modifications

Changes to CQA procedures may be required during construction. CQA procedural changes can only be made by written agreement of the engineer of record, and owner. These changes must be made in writing by the engineer of record and must identify the CQA procedural change and its justification. When CQA procedural changes are made, the engineer of record will distribute them to the owner, and CQAO. A copy of the CQA change must also be distributed to the CQAO for distribution among the CQA monitors. CQA procedural changes must be filed.

4.10 Collecting As-Built Records

The CQA monitors, the contractor, and project surveyor must collect as-built information throughout the project as required by their contractual obligations. During each weekly progress meeting the CM must compile as-built information provided by the CQA monitors, contractor, and project surveyor into one set of "as-built" construction drawings and technical specifications, which must be maintained at the project site. These "as-built" construction drawings and technical specifications must be clearly marked as "project as-built drawings" and "project as-built technical specifications." At the completion of the project, all as-built information must be provided to the CQA officer for use in preparing as-built drawings that must be included in the construction report.

4.11 Processing Other Project Records

Other project records must be completed as needed. Use of other project records is limited to the scope for which they are intended. For example, a pertinent telephone conversation may be recorded on a telephone record form. The record must be completed by filling in all of the blanks provided on the form, and it must be signed by the individual completing the form. All project records must be maintained in project files.

4.12 Photographic Documentation

Construction activities must be photographed by the CQA monitors to document progression of the work. Photographs must also be taken to document any significant problems encountered during the work, and corrective actions taken to correct the problem.

Photographs must be identified by number, location, time, date, and photographer. Photos must be taken with a digital camera and photos downloaded on a daily basis for review and filing. The digital photo must have a date and time stamp. The photographer must document the subject of the photograph in a photograph log. Selected photographs may be used in the construction report.

4.13 Filing Project Information and Documentation

The CM must implement a project filing system that results in a complete and retrievable record of the project. Three complete sets of filed materials will be kept. One for the CQAO, which will

be kept on site, one for the owner, which will be kept in the landfill office, and one for the CM, which will be kept at the CM's office.

The files must contain information listed in Table 4-1.

Table 4-1 Documentation Filing

Item to be Filed	On Site CQA File	CM's Off Site File	Owner's File	Copy to Contractor
MQC Data	Yes	Yes	Yes	No
CQC Data	Yes	Yes	Yes	No
CQA Data	Yes	Yes	Yes	Upon request only
Submittals				
From Contractor	Yes	Yes	No	No
Returned with comments etc.	Yes	Yes	No	Yes
Final approved submittals	Yes	Yes	Yes	Yes
Photographs	Yes	Yes	Yes	Upon request only
Progress reports	Yes	Yes	Yes	Upon request only
Communications, faxes, emails, etc.	Yes	Yes	Yes	Upon request only

4.14 Preparing a Construction Report

At the completion of the project, the CQAO will prepare and submit a final construction report. This report will document the extent to which the work was performed in compliance with the construction drawings and technical specifications.

At a minimum, the report will contain the following:

- an introduction;
- a summary of all parties responsible for completing the project;
- a summary of all major landfill construction activities;
- a summary of all MQC, CQC, and CQA tests;
- a description of significant construction problems, and their resolution;

- a discussion of design changes, and CQA procedural changes, and the justification for these changes including references to any correspondence, if any, with state or local regulatory agencies involved with the changes;
- as-built record drawings; and
- a statement that the work was completed in accordance with the construction drawings, technical specifications and design intent, which is signed and stamped by a professional engineer(s) registered in the state of Washington.

The as-built record drawings must accurately locate the as-constructed location of landfill components, including liner systems, buried utilities, piping, etc. All surveying required to develop record drawings must be performed by the project surveyor. The professional engineer that stamps and signs the construction report must review and verify that as-builts are correct, before they are included in the final construction report.

4.15 Calibrating Test Equipment

Before the CQA laboratories or on site CQA monitors place testing equipment into service, the accuracy of each piece of equipment must be verified by calibration. Types of on-site equipment requiring calibration include nuclear gauges, tensiometers, and scales. The calibration procedures and frequencies must be completed per the manufacturer's instructions or ASTM standards. Copies of current calibration certificates for equipment must be maintained on site, or in the various laboratories for review upon request. Whenever the equipment is suspect or is producing questionable results, it must be removed from service immediately and re-calibrated.

4.16 Test Standards

The CQA laboratories and CQA monitors must perform various field and laboratory tests in accordance with applicable standards as specified in the contract documents or this manual. In most instances the applicable test procedure is an ASTM standard.

The following test standards apply to soil testing for this project.

- ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates;
- ASTM D422 - Standard Test Method for Particle-Size Analysis of Soils;
- ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3)(600 kN-m/m$^{3)}$:
- ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3));
- ASTM D2216 - Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
- ASTM D2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth);
- ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils;

- ASTM D5084 - Hydraulic Conductivity of Soils ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

5.0 EARTHWORK CONSTRUCTION QUALITY ASSURANCE

This section defines the earthwork construction quality assurance program for Area 2 and Area 5 closure (Remedial Action) and associated infrastructure.

5.1 Scope of Earthwork Construction

The scope of earthwork construction for this project includes the following components:

- Clear;
- grub;
- excavation;
- trenching and backfilling for gas collection system;
- engineered fill placement;
- crushed aggregate placement for access roads;
- Area 2 and Area 5 subgrade preparation;
- cover soil placement;
- finish grading (biosolids, compost, mulch, tackifier, dryland seed);
- north ditch construction;
- compost access road construction.

5.2 Soil Sampling

5.2.1 Sample Processing

The CQA monitors are responsible for the timely processing and testing of soil samples. The CM must determine which samples will be tested on-site and which will be tested off-site. This determination will be made based on available manpower, available equipment, complexity of test, and time available to determine results. For expediency, samples tested off-site must be shipped the same day as they are obtained.

As test data is obtained from the on-site and off-site laboratories it must be summarized on the Soil Classification and Permeability Summary form (Form S-2).

5.2.2 Sample Numbering

The CQA monitors must maintain a sample numbering system for all soil samples obtained for the project. These samples include those obtained prior to construction for conformance or slope

stability testing, and samples obtained during construction such as samples obtained for moisture-density relationship testing.

Documentation of soil sampling must be recorded on the Master Soil Sample Log (Form S-1) and be maintained throughout the project. The log must include soil sample numbers beginning with (0001) and proceeding sequentially. No sample number can be repeated, and re-tests of a sample that does not meet specified requirements must be given the original number with a letter suffix (i.e., re-tests for a sample not meeting specified requirements 0021 would be 0021A, 0021B, etc.). Information contained in the master soil sample log must include:

- sample number;
- test(s) being performed;
- date the sample was obtained;
- name of CQA monitor that obtained the sample;
- location that the sample was obtained, such as a stockpile, a fill, a borrow area, etc.
- location testing will take place (on-site vs. off-site);
- date sample sent off-site;
- date test results were completed on site or received from off-site;
- name of CQA monitor that performed the on-site testing;
- comments about the test results, such as pass / fail information.

5.2.3 Sample Tagging

The CQA monitors must maintain the identification of all samples obtained throughout the project from the time the sample is obtained to the time testing is completed. The monitor must place an identifying tag on the sample or mark the sample container with the sample number immediately upon sampling. The tag or identifying container must remain with the sample throughout processing, testing and storage. The tag or container must have the following information:

- sample number;
- soil material type;
- project name and project number;
- name of CQA monitor that obtained the sample; and
- the date the sample was obtained.

5.3 Conformance and Construction Phase Testing

Table 5-1 establishes test frequencies for earthwork CQA testing. It includes classification and conformance tests that must be performed prior to soil installation to assure soil materials meet

quality standards established in the technical specifications, and construction testing to assure installed materials meet specified installation requirements.

The listed test frequencies establish a minimum number of required tests. Additional testing must be conducted whenever work or materials are suspect, marginal, or of poor quality. Extra testing may also be performed to provide additional data for engineering evaluation. Any re-tests performed as a result of a failing test cannot contribute to the total number of tests performed in satisfying the minimum test frequency.

Table 5-1 Testing Frequency for Soil Cover

Required Tests	ASTM Designation	Test Frequency	Estimated Total Number of Tests	Form for Summarizing Test Data
Borrow Area Soil				
Gradation (Sieve & Hydrometer)	D422	1/ material type	1	S-2
Moisture / Density Relationship	D698	1/ material type	1	S-2
Hydraulic Conductivity	D5084	1/ material type	1	S-2
Rough Grading Area 2 Construction Testing				
Density, Nuclear Method	D2922	3/acre/lift	29	S-3
Moisture Content, Nuclear Method	D6938	3/acre/lift	29	S-3
Final Grading Area 2 Construction Testing				
Density, Nuclear Method	D2922	3/acre/lift	10	S-3
Moisture Content, Nuclear Method	D6938	3/acre/lift	10	S-3
Rough Grading Area 5 Construction Testing				
Density, Nuclear Method	D2922	3/acre/lift	96	S-3
Moisture Content, Nuclear Method	D6938	3/acre/lift	96	S-3
Final Grading Area 5 Construction Testing				
Density, Nuclear Method	D2922	3/acre/lift	29	S-3
Moisture Content, Nuclear Method	D6938	3/acre/lift	29	S-3

Table 5-2 Testing Frequency for Aggregate and Trench Backfill

Required Tests	ASTM Designation	Test Frequency	Estimated Total Number of Tests	Form for Summarizing Test Data
Compost Road Aggregate Conformance Testing				
Gradation	C137	1 / material type	1	S-2
Moisture / Density Relationship	D698	1 / material type	1	S-2
Compost Road Aggregate Construction Testing				
Density, Nuclear Method	D2922	1/100 lf	3	S-3
Moisture Content, Nuclear Method	D6938	1/100 lf	3	S-3
Haul Road Aggregate Conformance Testing				
Gradation	C137	1 / material type	1	S-2
Moisture / Density Relationship	D698	1 / material type	1	S-2
Haul Road Aggregate Construction Testing				
Density, Nuclear Method	D2922	1/100 lf	42	S-3
Moisture Content, Nuclear Method	D6938	1/100 lf	42	S-3
Utility Trench Backfill Conformance Testing				
Gradation	D422	1 / material type	1	S-2
Moisture / Density Relationship	D698	1 / material type	1	S-2
Utility Trench Backfill Construction Testing				
Density, Nuclear Method	D2922	At foundation plus 2-feet above pipe and increments of 2-feet vertical depth to subgrade every 200 lineal feet	47	S-3
Moisture Content, Nuclear Method	D6938	At foundation plus 2-feet above pipe and increments of 2-feet vertical depth to subgrade every 200 lineal feet	47	S-3

5.4 Field Moisture/Density Test Numbering

Each soil component that requires field moisture and density testing has a pre-assigned set of test numbers as listed below. No test number can be repeated for a given soil component, and re-tests of failing tests must be given a letter suffix along with the original test number. (i.e., re-tests for a failing Test #112 would be 112A, 112B, etc.). Test data must be recorded/submitted on the laboratory's field density test form and summarized on summary form (Form S-3).

Table 5-2 Field Moisture/Density Test Numbering

COMPONENT	TEST NUMBER SERIES
Access Road Aggregate	100-199
Utility Trench Backfill	200-399
Area 2 Soil Cover	400-599
Area 5 Soil Cover	600-1099

5.5 Earthwork Observation and Testing Requirements

Earthwork components for the project are listed in paragraph 5.1 of this section. Each component has specific material quality and installation requirements that must be monitored and tested. The following paragraphs list monitoring and testing requirements for each type of earthwork.

5.5.1 Excavation to Design Grades

- verify construction staking is performed prior to work;
- periodically verify slope requirements and grading tolerances are met;
- verify ditch excavations meet slope and cross-sectional requirements;
- verify lumped subsoil, boulders, and rock of the dimensions identified in the technical specifications is removed from the excavation and completed surface of the landfill cell subgrade;
- verify excavated materials not used as engineered fill or other earthwork components are stockpiled in designated areas; and
- verify dust control is continuous throughout the excavation operations.

5.5.2 Utility Trench Backfilling

- verify source of material is suitable for backfill by sampling backfill materials, log samples on Form S-1, and perform classification testing at required frequencies;

- summarize classification test results on Form S-2;
- verify lift thickness;
- test compaction and moisture content at required frequencies and record data on Form S-3;
- summarize nuclear moisture density test data on Form S-3;
- verify completed grades meet finished grade requirements;
- verify final grading meets tolerance requirements; and
- verify dust control is continuous through engineering fill placement operations.

5.5.3 Engineered Fill Placement

- verify source of material is suitable for engineered fill by sampling material excavated from Phase 2, log samples on Form S-1, and perform classification testing at required frequencies;
- summarize classification test results on Form S-2;
- verify lift thickness;
- test compaction and moisture content at required frequencies and record data on Form S-3;
- summarize nuclear moisture density test data on Form S-3;
- verify CQA data is reviewed, summarized, and filed as indicated in this manual.
- verify completed grades meet slope requirements;
- verify final grading meets tolerance requirements; and
- verify dust control is continuous throughout engineering fill placement operations.

5.5.4 Access Road Aggregate Placement

- verify source of material is suitable for aggregate base course by obtaining material submittal from contractor, logging the sample on Form S-1, and performing classification testing at required frequencies;
- summarize classification test results on Form S-2;
- verify lift thickness;
- test compaction and moisture content at required frequencies and record data on Form S-3;
- summarize nuclear moisture density test data on Form S-3;

- verify CQA data is reviewed, summarized, and filed as indicated in this manual.
- verify completed grades and tolerances meet specified requirements; and
- verify dust control is continuous throughout aggregate placement operations.

5.5.5 Area 2 and Area 5 Cover Subgrade Preparation

- The CQA monitor must verify that the subgrade elevation shown on the Plans are met in the field.
- Visual inspection of grading stakes can be used to field verify the proper depth has been reached.
- Subgrade elevations are set at 5' below the finished grade of the soil cover and ensure that a minimum of 4.8' of soil cover will be met.

5.5.6 Area 2 and Area 5 Soil Cover Layer

- obtain sample of proposed soil from the on-site borrow area that will be used for the Area 2 and Area 5 Soil Cover layer, and record sample on Form S-1;
- perform gradation (with hydrometer), standard proctor and hydraulic conductivity testing of the proposed material prior to installation at the frequencies established in this manual to verify material quality, and record test data on Form S-1;
- verify CQA data is reviewed, summarized on Form S-1, and filed as indicated in this manual.
- keep sample of proposed material for visual reference;
- verify that 2,500 square yard test section is completed in accordance with technical specifications;
- during placement of material over subgrade or preceeding lift verify 24-inch maximum lift thickness is maintained below spreading equipment;
- verify equipment spreading material has ground pressure less than 5 psi;
- verify grade control is established to control thickness of installed soil layer;
- verify thickness of soil cover;
- verify that an as-built survey of final grade is performed; and
- verify that Finish Grading is constructed between September 15 and November 15.

5.5.7 Area 2 and Area 5 Soil Cover Layer Acceptance

Prior to Finish Grade placement, the CQA monitor and contractor must inspect the surface. The CQA monitor must verify the following:

- the Area 2 and Area 5 Soil Cover has been prepared in accordance with the technical specifications;
- the thickness of the Area 2 and Area 5 Soil Cover is 4.8 feet (minimum);
- all finish grades drain towards erosion control ditches;
- the flowlines of all erosion control ditches are uniform in grade;
- there are no excessively soft areas;
- all construction stakes have been removed;
- an as-built survey of the final grade has been performed; and
- Finish Grading is scheduled to be constructed between September 15 and November 15.

6.0 GAS COLLECTION AND CONTROL SYSTEM CONSTRUCTION QUALITY ASSURANCE

6.1 Introduction

This section describes CQA procedures for the installation of the LFG collection and control systems.

This plan stresses careful documentation during the quality assurance process, including review of contractor's submittals, verification of supplied materials, equipment installation, and testing. Conformance testing refers to material testing that takes place before material installation. Construction testing includes activities that occur during installation. The scope of work for construction of the LFG collection and control system includes:

- Drilling and installation of LFG extraction wells
- Fabrication and installation of the condensate sump/pumps
- Installation of HDPE piping for LFG, condensate, and compressed air
- Blower/flare equipment skid startup

6.2 LFG Extraction Wells

There are vertical wells that will be constructed for the LFG control system. The location of each well will be staked and surveyed by the surveyor as shown on the construction drawings.

6.2.1 Extraction Well Drilling

The CQA monitor must verify:

- The location and number of extraction wells, based on contractor's survey and construction drawings.
- The correct drill auger size to provide the well dimensions shown on the construction drawings.
- The temporary grading required to situate the drill rig.
- The log representative decomposition and moisture conditions of waste at periodic depth intervals.
- Log depths to encountered leachate (if any) during well drilling.

Log attainment of plan depth of well boring, as shown on the construction drawings.

- Log depth of accumulated leachate (if any), in completed borings.

6.2.2 Extraction Well Casing Installation

The CQA monitor must verify the:

- Pipe, granular backfill, and bentonite meet the material properties defined in the technical specifications,
- Well borehole is clear of excessive loose material.
- Casing pipe size, length, and perforations.
- Casing is installed at center of the borehole and plumb.
- Annual space around casing is properly sealed.
- Casing, wellhead fittings and valves are properly installed.

6.3 Polyethylene Pipe Conformance and Construction Testing

This section describes CQA procedures for polyethylene pipe installations. Solid-wall HDPE pipe will be utilized to construct the gas collection system. Installation requirements are specified in the technical specifications.

6.3.1 Pre-construction Submittal Review

At least 10 days prior to shipment of the product, the Manufacturer must provide the CQAO the following items for review:

- list of individuals certified for polyethylene pipe fusion welding including a copy of their current certificates;
- manufacturer's product data for pipe and fittings that demonstrate the materials comply with the technical specifications;
- copy of manufacturer's quality control data for materials;
- installer's proposed welding system that will be used for the project; and
- written instructions from the manufacturer for storage, and handling.

All submittals received by the CQAO must be recorded on the Submittal Log (Form A-2), and then placed in the project files for review by the CQA Monitors.

6.3.2 Delivery

During delivery of HDPE pipe the CQA monitor must:

- verify equipment used to unload the pipe does not damage the material;
- verify care is used to unload the pipe;

- verify all documentation required by the technical specifications has been received;
- verify the pipe size, length, and dimension;
- Verify pipe perforations in locations and dimensions specified in the contract documents;
- verify materials are stored in a location that will protect the pipe puncture, cutting, or any other damaging or deleterious conditions;
- verify materials are not stacked higher than specified in the technical specifications or as recommended by the Manufacturer; and
- verify that materials have the required markings described in the technical specifications including pipe manufacturer, SDR size, ASTM designation, and date of manufacturer.

Damaged pipe must be rejected. If rejected, verify rejected material is removed from the site or stored at a location separate from accepted materials. Pipe that does not have proper manufacturer's documentation must also be stored at a separate location, until all documentation has been received and approved.

6.3.3 HDPE Pipe Construction Monitoring

Before pipe fusion welding and installation operations begin, the CQA monitor must verify that qualified fusion welding technicians are performing the work.

During pipe fusion welding operations the CQA monitor must verify the following:

- Qualifications and certifications of HDPE pipe fusion weld operators;
- Pipe is installed to the lines and grades shown on the drawings by reviewing the as-built surveys, and periodic grade checks at 10-foot intervals in mild-slope segments, as required;
- Hot plate temperatures are maintained with a minimum temperature of 400°F but no more than 450°F, and the temperature difference between any two points on the hot plate should not exceed 20°F;
- Pipe ends are squarely faced and cuttings are removed before fusion welding occurs;
- Loose materials (shavings, soil, stones, etc.) are removed from the pipe.
- Pipe installation is performed with minimum amount of lifting and moving;
- Fittings are not used as the point of attachment for lifting;
- Correct location and installation of valves, flanges, monitoring ports, and other appurtenances;
- Correct operation of all valves;

- Joining, holding and cooling time for fusion welding varies with pipe size and wall thickness noting that a complete process is approximately 30-90 seconds per inch of pipe diameter and a bead should be cool to the touch;
- Pressure testing, pulling or installation of pipe should not take place for a minimum of 30 minutes after fusing;
- Cooling time of the fusion-welded pipe is approximately five minutes before release from the weld machine;
- Fusion weld roll-back (melted HDPE) is approximately $^{3}/_{8}$ inches after the pipe ends are jointed;
- Pipes are properly aligned in the trench and are at the design grade; and
- Backfilling operations are conducted in accordance with the technical specifications.

Documentation of the above work must be provided in the Daily Report.

6.4 Blower/Flare Skid and Startup

The blower/flare skid consists of a flare unit, two blowers, condensate knockout tank, condensate pumps, air compressor, valves, piping, and electrical/motor control panels. All equipment and control panels are skid mounted. The Contractor will be responsible to coordinate with the City on startup/shutdown of the blower/flare skid. The City and the gas system operator (CB&I) will perform all blower/flare shutdowns and startups. The Contactor will be required to be present during the shutdown/startup.

6.4.1 Blower/Flare Startup

Upon completion of the installation, make all required arrangements, conduct all required tests, make all required changes, and secure all required inspections and approvals. The Contractor shall coordinate with the flare/blower operation and maintenance technical representative and be present for on-site operation testing and training. The owner/engineer and operator should be notified 15 days prior to the intended start-up of the equipment.

The Contractor shall demonstrate to the CQA Engineer that the sump pump, flow meters, valves, etc. operate as intended. Demonstration of the sump pump operation shall be completed by adding clean water to the sump to verify operation of the pump and discharge to the condensate discharge point.

The contractor is required to be on site for up to three days to start the equipment, provide a system shakedown, verify that the system is properly installed, and provide a brief training session for the Owner and in accordance with the Owner's long-term operations and maintenance program. The Owner/ Engineer and Operations and Maintenance Contractor should be notified 15 days prior to the intended start-up of the equipment.

6.4.2 Maintenance

The Contractor will be required to be available for two weeks after the initial system startup of the landfill gas control system to make any necessary adjustments, repairs, or maintenance for proper system operation at no cost to the Owner/Engineer.

6.5 Condensate Sump/Pumps

6.5.1 Equipment Fabrication and Delivery

During delivery, the CQA monitor must verify the following:

- Correct pump model(s) and sizes
- No damage occurred during shipping and handling
- All documentation listed in the technical specifications has been received, including installation and operating instructions
- Correct hoses, connections, and appurtenances are provided per the technical specifications

6.5.2 Sump/Pump Installation

The CQA monitor must verify the:

- Pipe, backfill, and bentonite meet the material properties listed in the technical specifications.
- Sump excavation is clear of excessive loose material.
- Correct sump pipe size and length.
- Sump is installed at center of the excavation and is plumb.

Appendix A

Earthwork Testing and Installation Report Forms

Appendix B

General and Administrative Report Forms

Appendix A

Earthwork Testing and Installation Report Forms

MASTER SOIL SAMPLE LOG (S-1)

Client:	City of Walla Walla
Project Site:	Sudbury Road Landfill
Project Name:	LF009010 - Remedial Action
Project Number:	30-11-012

Date Project Initiated	
Date Project Completed	

Sample Number	Date Sampled	Sampled By	Specification Section Number	CQA Manual Reference Section Number	Sample Location	Sample Tested in On-site Laboratory	Sample Tested in Off-site Laboratory	Date Sample Sent to Off-site Laboratory	Date On-site Lab Results Received	Date Off-site Lab Results Received	General Test Results or Other Comments

Page 1 of

J·U·B

SUMMARY OF SOIL CLASSIFICATION AND PERMEABILITY TESTING (S-2)

Client:	City of Walla Walla
Project Site:	Sudbury Road Landfill
Project:	LF09010 - Remedial Action
Project No.:	30-11-012

Data Entered By:	
Date Entered:	
Checked By:	
Date Checked:	

			MOISTURE DENSITY RELATIONS (ASTM D698 or ASTM D1557)				PERCENT PASSING BY SIEVE SIZE (ASTM C 136)														SOIL HYDRAULIC CONDUCTIVITY (ASTM ASTM D2434 or D5084)					ATTERBERG LIMITS (ASTM D4318)			MOISTURE CONTENT DRY DENSITY VERIFICATION		
SAMPLE NO.	SOIL COMPONENT	LABORATORY THAT PERFORMED TESTS	MAXIMUM DRY DENSITY (ASTM D 698)	OPTIMUM MOISTURE CONTENT (ASTM D 698)	MAXIMUM DRY DENSITY (ASTM D 1557)	OPTIMUM MOISTURE CONTENT (ASTM D 1557)	2"	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#10	#20	#30	#40	#100	#200	.001MM	REMOLDED DRY DENSITY (PCF)	REMOLDED MOISTURE CONTENT (%)	UNDISTURBED DRY DENSITY (PCF)	UNDISTURBED MOISTURE CONTENT (%)	PERMEABILITY (cm/sec.)	LL	PL	PI	NUCLEAR GAUGE DRY DENSITY	NUCLEAR GAUGE MOISTURE CONTENT	COMMENTS

SUMMARY OF IN-PLACE NUCLEAR MOISTURE DENSITY TEST RESULTS WITH OVEN MOISTURE CORRECTION ASTM D2922 AND D6938 (S-3)

Client:	City of Walla Walla		
Project Site:	Sudbury Road Landfill		
Project:	LF09010 - Remedial Action		
Project Number:	30-11-012		
Sheet		OF	
Soil Component:			

Entered by:	
Date Entered:	
Reviewed by:	
Report Number:	
Comments:	

TEST NO.	NORTHING	EASTING	ELEVATION (feet)	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)	NUCLEAR DRY DENSITY (pcf)	NUCLEAR MOISTURE CONTENT (%)	OVEN MOISTURE CONTENT (%)	CORRECTED DRY DENSITY (pcf)	RELATIVE COMPACTION (%)	PASS / FAIL

Appendix B

General and Administrative Report Forms

MEETING MINUTES

Client:	City of Walla Walla
Site:	Sudbury Road Landfill
Project:	LF09010 - Remedial Action
Project #:	30-11-012

Prepared by:	
Time:	
Date:	
Location:	
Report No.	

Purpose of Meeting:	

Attendees	Company	Contact Information

Action Item No.	Discussions, Resolutions, Action Items

Distributed to:

SUBMITTAL LOG (A-2)

Client:	City of Walla Walla
Project Site:	Sudbury Road Landfill
Project Name:	LF09010 - Area 5 Closure
Project Number:	30-11-012

Date Project Initiated	
Date Project Completed	

Status Codes:

1. Approved
2. Approved as noted
3. Approved as noted / Resubmit
4. Revise/ Resubmit as noted
5. Rejected/ Resubmit as noted

Submittal Number	Specification Section	Page	Article	Submittal Description	Date Submitted	Date of Response	Status Code	Date Re-submitted	Date of Response on Re-Submit	Comments

Page 1 of