CONSTRUCTION QUALITY ASSURANCE (CQA) MANUAL
TERMINAL 91 TANK FARM CLEANUP

PORT OF SEATTLE
SEATTLE, WASHINGTON

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CERTIFICATION PAGE

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DISTRIBUTION

LIST OF ACRONYMS AND ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
AOC	Area of Contamination
ASTM	ASTM International
BMP	Best Management Practice
CAP	Cleanup Action Plan
CFR	Code of Federal Regulations
City	City of Seattle
Contractor	Prime Construction Contractor
CQA	Construction Quality Assurance
CQC	Construction Quality Control
CQCR	Contractor's Quality Control Representative
CS	Contractor's Superintendent
CY	cubic yard
DGI	Data Gaps Investigation
DOT	Department of Transportation
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
HASP	Health and Safety Plan
MLLW	Mean Low Low Water
MQA	Manufacturing Quality Assurance
MQC	Manufacturer Quality Control
MTCA	Model Toxics Control Act
NPDES	National Pollutant Discharge Elimination System
NTP	Notice to Proceed
Port	The Port of Seattle
PCS	Port Construction Services
Port's PM	Port's Project Manager
Project	Terminal 91 Tank Farm Cleanup
RCW	Revised Code of Washington
RPM	Remedial Project Manager
SOW	Statement of Work
SWMU	Solid Waste Management Unit
SWPPP	Stormwater Pollution Prevention Plan
T-91	Terminal 91
TBM	Temporary Benchmarks
TFA	Tank Farm Area
TFAA	Tank Farm Affected Area
TFLP	Tank Farm Lease Parcel
WAC	Washington Administrative Code
WISHA	Washington Industrial Safety and Health Act
WQMP	Water Quality Monitoring Plan
WQS	Water Quality Specialist
WSDOT	Washington State Department of Transport

1.0 INTRODUCTION

1.1 Purpose of CQA Manual

This Construction Quality Assurance (CQA) Manual has been prepared to guide CQA procedures during the performance of the Terminal 91 Tank Farm Cleanup. The CQA Manual compliments Construction Drawings and Technical Specifications that define remedial actions that will be taken at Terminal 91 at the Port of Seattle Facility. The remedial action requirements are contained in Agreed Order No. DE8938 (Order), which contains a site-specific Cleanup Action Plan (CAP). The Construction Drawings and Technical Specifications define work that will be performed by Contractors, and the Port of Seattle Construction Services. This CQA Manual describes actions that will be taken by a third party independent of the Contractors and Port to assure that the work is completed in compliance with the Construction Drawings and Technical Specifications. CQA personnel will use this manual as their guidance document to implement the CQA program.

The Order (and CAP) were prepared in accordance with the Model Toxics Control Act (MTCA), Revised Code of Washington (RCW) 70.105D.050(I), and Washington Administrative Code (WAC) 173-303-646 (Corrective Action) through 64630.

Detailed construction quality control (CQC) requirements, which are the responsibility of organizations that manufacture products, and Contractors that install these products, are provided in the Technical Specifications issued for construction.

1.2 Summary of Contractor-Performed Construction Activities

The Terminal 91 Tank Farm Cleanup will consist of the following work elements, which will be performed by various Contractors and potentially Port Construction Services (PCS).

- Obtaining and/or complying with various permits including:
    - Construction Stormwater General Permit (CSWGP), including preparation of an Erosion and Sediment Control Plan (ESCP); and
    - King County discharge permit for discharge of treated non-storm water to sanitary sewer.
- Pipeline Decommissioning including decommissioning pipelines within the TFA;
- SWMU 30 Cleanup;
- Tank Farm Area Preparation;
- Asphalt and Concrete Removal Outside the TFA;
- Cutoff Wall;
- LNAPL Recovery Trenches; and

- Asphalt Final Cover and Stormwater Systems.

Details for each of these work elements are provided in Sections 4 through 11.

1.3 Construction Quality Assurance and Quality Control Objectives

CQA is a planned and systematic pattern of procedures and documentation designed to provide confidence that items of work or services meet requirements of Construction Drawings and Technical Specifications issued for construction. A third-party CQA Consultant (CQAC) that is independent of the Port and Contractor must perform CQA. CQA includes verifying that the Contractor is performing quality control requirements defined in the Technical Specifications.

This CQA Manual presents guidance for monitoring, testing, and documentation procedures that will be implemented by the CQAC to ensure that objectives of the Terminal 91 Tank Farm Cleanup are met.

The CQA activities are separate from the CQC activities. CQC activities are defined in the Construction Drawings and Technical Specifications, and are the responsibility of organizations that are performing the construction (typically material suppliers and Contractor(s)).

CQC activities provide a means to measure and regulate the characteristics of an item or service to comply with the requirements of the Construction Drawings and Technical Specifications.

1.4 Document Contents

This CQA Manual is presented in the following 11 sections:

- **Section 1** is the introduction. It summarizes work performed under the Terminal 91 Tank Farm Cleanup, defines CQA and CQC, defines terms used throughout the document, and lists contact personnel.
- **Section 2** presents the general organization structure and responsibilities of the project participants and defines terms relevant to the CQA program, Technical Specifications and Construction Drawings.
- **Section 3** presents the general requirements of the CQA program such as procedures for meetings, verifying material quality and preparing test reports.
- **Sections 4 to 11** present CQA requirements for specific work elements that will be performed by the CQAC.

1.5 Reference Documents

The following reference documents provide background information and detailed information regarding the Terminal 91 Tank Farm Cleanup project.

- Agreed Order No. DE8938
- Cleanup Action Plan (Exhibit A to the Agreed Order).
- Releases Requiring Corrective Action (Exhibit C to the Agreed Order).

- Contaminated Contingency Work Plan (Exhibit E to the Agreed Order).
- DGI Tech Memo (PES, 2012).
- Remedial Investigation Summary Report for the Terminal 91 Tank Farm Site in Seattle, Washington (RI Summary Report; Roth Consulting, 2007).
- Applicable federal, state, and local regulations regarding material characterization prior to disposal/recycling including but not limited to:
    1. 40 CFR 261, "Identification and Listing of Hazardous Wastes."
    2. NIOSH/OSHA/USCG/U.S. EPA Publication, "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities." October, 1985.
    3. WAC 173-303, "Dangerous Waste Regulations."
    4. WAC 296-843-150, "Worker and Equipment Decontamination."

1.6 Contacts and Addresses

The following addresses, phone numbers, facsimile numbers, and contacts of organizations involved with the project are provided for informational purposes only.

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2.0 ORGANIZATIONAL RESPONSIBILITIES AND DEFINITIONS

The project Technical Specifications, Construction Drawings, and this CQA Manual use a variety of titles such as "Port's Project Manager", "CQA Monitors", and "CQA Consultant" to refer to persons and organizations with various project responsibilities. These personnel and organizations are authorized to make judgments and decisions on behalf of the Port of Seattle (Port), and are responsible for ensuring that the CQA plan is implemented.

Part 2.1 of this section provides titles and describes the duties and responsibilities of these key project personnel and organizations.

The project Technical Specifications, Construction Drawings and this CQA Manual also use a variety of terms such as "construction quality control", "record drawings", and "contract documents". Part 2.2 of this Section defines these terms.

2.1 Organizational Responsibilities

2.1.1 Washington Department of Ecology (Ecology)

Ecology is the regulatory authority and responsible agency for overseeing and authorizing the Cleanup Action. In this capacity, Ecology will review and approve the design documents. Other Contractor submittals (described in the Technical Specifications and Sections 4 to 11 of this CQA Manual) may be reviewed by Ecology to ensure the Contractor's quality assurance/quality control (QA/QC) program is consistent with the cleanup design objectives. Ecology and the Port will jointly resolve unforeseen problems, potentially changing construction activities.

2.1.2 The Port of Seattle (Port)

The Port is the owner and operator of Terminal 91, which includes the TFAA.

The following Port personnel will have key roles in this project.

- Port's Project Manager (Port's PM) - The authorized representative of the Port responsible for internal Port coordination of contracting and construction management. The Port's PM will manage scheduling and coordination of Port resources as needed to ensure Contractor procurement and execution of the contract. The Port's PM will not be on-site full time, but will vary his time depending on the activities being performed and any associated administrative, inspection, and observational requirements. However, it is anticipated that the Port's PM will routinely visit the site.
- Port's Resident Engineer (Port's RE or "Engineer") will be the primary contact with the Contractor and will be the only individual to direct the Contractor or modify Contractor activities on the Port's behalf. All communications regarding design and CQA elements that may modify Contractor activities or CQA activities will go through the Port's RE. As such the Port's RE's responsibilities will include:
    - Management and maintenance of documents issued for construction (Construction Contract including Construction Drawings and Technical Specifications) and execution of the Project;

  - Management of CQA activities and associated deliverables; and
  - Interaction with the Contractor, including construction contract administration.

- Port's Environmental Management Specialist (Port's EMS) will be responsible for:
  - Overseeing Port employees and consultants who are responsible for environmental management activities as part of the Port's construction projects;
  - Reviewing Construction Drawings and Technical Specifications, background environmental information, and Contractor and consultant work plans; and
  - Assisting the Port's PM and Port's RE in selection of remedial options.

2.1.3 Contractor

The Contractor is responsible for coordinating the activities of its own forces and subcontractors, scheduling and performing the work within the timeframe and budget agreed to in the construction contract documents, performing the work in accordance with the Construction Drawings and Technical Specifications, including implementing CQC procedures to document construction complies with the intended design. The Contractor is expected to cooperate with the Port's PM, Port's RE and CQAC in their performance of CQA activities to achieve a quality product.

Contractor roles are defined in the Construction Documents issued by the Port. The Contractor's Project Manager (CPM) will report directly to the Port's RE and will be responsible for all Contractor and subcontractor activities. Contractor's Superintendent (CS) provides onsite management of and direction to the Contractor's and subcontractor's personnel. The CS will be responsible for executing the work in full compliance with the Construction Drawings and Technical Specifications, including CQC. In addition, the CS will verify proper operation and maintenance of equipment, manage subcontractors, and provide daily reports to the Port's RE.

2.1.4 Construction Quality Assurance Consultant (CQAC):

The CQAC is a third party organization, independent from the Port and Contractor, that is responsible for observing and documenting activities related to the quality of product manufacturing, product installation, and other construction activities related to the project. The CQAC is also responsible for preparing a CQA Report at the completion of the project, which is sealed by a Professional Engineer registered in the state of Washington.

The following CQAC personnel will have roles in the project:

- CQA Manager – the authorized representative of the CQAC responsible for managing the CQA program.
- CQA Monitors – the authorized representatives of the CQAC responsible for on-site implementation of this CQA Manual, including monitoring and testing of the Contractor's work and documenting CQA activities.

- CQA Officer – the authorized representative of the CQAC, and a Professional Engineer registered in the state of Washington, who is responsible for certifying that construction was performed in accordance with the intent of the Construction Drawings and Technical Specifications. The CQA Officer may also be the Design Engineer of Record, the CQA Engineer of Record, or the CQA Manager.

2.1.5 Design Engineer of Record

The individual or firm responsible for the design and preparation of the project Construction Drawings and Technical Specifications. Also referred to as "Designer."

2.1.6 Construction Quality Assurance Laboratory

The CQA Laboratory is a laboratory capable of conducting product testing required by this CQA Manual.

2.1.7 Project Surveyor

An independent surveying firm the Port appoints or the Contractor retains, to provide layout work, to perform surveys to measure installed quantities, and to perform surveys to document as-built conditions. The Surveyor will work to assist in constructing the project in substantial accordance with the Construction Drawings and Technical Specifications. The Project Surveyor must be licensed in the State of Washington.

2.2 Defined Terms

Whenever the terms listed below are used in the Technical Specifications, Construction Drawings, and this CQA Manual they have the following meanings:

Area of Contamination (AOC): The designated, contiguous area from which contaminated soil and debris can be excavated, handled, processed for re-use as fill, stockpiled, or consolidated as fill within the designated AOC area. Materials excavated from the AOC must not leave the AOC, even temporarily, or they could become subject to dangerous waste classification and as such be prohibited from re-use as fill within the AOC. The AOC for this project is defined on the Construction Drawings.

AASHTO: American Association of State Highway and Transportation Officials.

ASTM: ASTM International, Inc.

Agreed Order: Agreed Order No. DE8938, issued by the State Department of Ecology and includes all exhibits to the order.

Base Course: Crushed rock placed under crushed aggregate base that is manufactured from ledge rock, talus, gravel or crushed clean concrete.

Bentonite: Hydrogel®, a premium grade, natural, untreated, sodium-cation bentonite, conforming to the requirements of API Specification 13A, with a minimum yield of 90 barrels per ton when tested in accordance with API RP 13B, or approved equivalent.

Conformance Testing: Laboratory testing performed by the CQAC on a proposed product prior to its installation to assure it meets quality standards established in the Technical Specifications.

Construction Drawings: The 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," or "Drawings."

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 Construction Drawings and Technical Specifications issued for construction. CQA includes verifying that the Contractor is performing quality control requirements defined in the Technical Specifications.

Construction Quality Assurance Consultant: The third party organization, independent from the Port and Contractor, that is responsible for observing and documenting activities related to the quality of material manufacturing, material installation, and other construction activities related to the project. The CQAC is also responsible for preparing a CQA Report at the completion of the project, which is sealed by a Professional Engineer registered in the State of Washington.

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 Testing: Testing to assure delivered products meet quality standards defined in the Technical Specifications and meet specified installation requirements.

Contract Documents: The set of documents issued for construction by the Port, which include Bidding Requirements, Contract Forms, Contract Conditions, Technical Specifications, Construction Drawings, Addenda, and Contract Modifications.

Crushed Aggregate Base: Crushed rock placed under asphalt paving that is manufactured from ledge rock, talus, gravel or crushed clean concrete.

Cutoff Wall: A vertical cutoff wall constructed by a continuous trenching method – One Pass Trencher - that mixes on-site soil, imported fine grained soil, bentonite, and water to construct a vertical barrier wall that is at least 24 inches wide and has an hydraulic conductivity no greater than 1×10^{-7} cm/sec.

Earthwork: A construction activity involving the movement or use of soil and aggregate materials as defined in the Technical Specifications.

Ecology: The Washington State Department of Ecology.

Engineered Fill: Soil, aggregate, or crushed concrete or asphalt obtained from on-site excavations within the TFAA that is not designated as highly contaminated soil and has a moisture content that will allow compaction to the required dry density, or soil and/or aggregate obtained from off-site sources that is not contaminated and has a moisture content that will allow compaction to the required dry density.

Free Standing Water: Free standing water that develops in an excavation that may or may not be contaminated.

Exclusion Zone: A secured area with controlled access due to a potential threat to human health.

Hazardous Substances: Has the meaning provided in RCW 70.105D.020(10).

Highly Contaminated Soil: Soil that is visibly and highly contaminated with petroleum products – product saturated soil - as determined by the Port's EMS or the CQA Monitors in consultation with Ecology.

LNAPL: Light non-aqueous phase liquid.

Manufacturing Quality Assurance (MQA):- A planned system of activities that provides assurance that products are manufactured to comply with quality standards defined in the Technical Specifications. MQA includes manufacturing facility inspections, verifications, tests, audits and evaluation of raw materials and products to assess the quality of the manufactured materials.

Manufacturer 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.

Pipeline: Pipelines are defined as privately owned pipes that carry a product such as sludge, gasoline fuel, oil, or diesel.

Port: The Port of Seattle.

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

Products: Items such as geosynthetics, aggregates, pipes and other items manufactured to meet quality requirements defined in the Technical Specifications. Also referred to as materials.

Project Documents: Contractor submittals, Construction Drawings, record drawings, Technical Specifications, project communication records, shop drawings, CQC and CQA Manuals, health and safety plans, and project schedules.

Project Communication Records: Documents created throughout the project used to document 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.

Purge: The process of introducing an inert gas or a flue gas into a pipeline to reduce by displacement the oxygen content and/or the concentration of hydrocarbon vapors.

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

Regulated Materials Abatement: The process of removing and managing regulated materials such as asbestos from on site buildings prior to their demolition.

Soil: Soil that is not highly contaminated.

SWMU: Solid Waste Management Unit.

T-91: Terminal 91.

Tank Farm Area (TFA): Consists of approximately 3.4 acres and represents that portion of the TFAA, including the former storage tanks, that will be disturbed to construct the cutoff wall.

Tank Farm Affected Area (TFAA): T-91 is located at 2001 West Garfield Street, Seattle, Washington and encompasses approximately 216 acres. The TFAA is located in the central portion of T-91, comprises approximately 17 acres including the Tank Farm Lease Parcel and any areas where Hazardous Substances originating from the Tank Farm Lease Parcel operations have come to be located. The term Tank Farm Affected Area has the same meaning that the term "Site" was given in the 1998 Order.

Tank Farm Lease Parcel (TFLP): Consists of approximately four acres in the northern portion of the TFAA, which includes the site of a former tank farm, the above ground component of which was demolished in 2005 as part of an interim remedial action.

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

Testing: Procedures used to verify that a manufactured product and its installation meet specified requirements by subjecting that product and/or its installation to a set of physical, chemical, environmental, or operating conditions.

Third Party: The party or organization independent of the Port and Contractor, where the Port is the first party and the Contractor is the second party.

3.0 GENERAL CQA REQUIREMENTS

Success of the CQA program requires coordinated communications, 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, CQA Manager, and CQA Officer must assure that CQA procedures have been implemented, that results of the program are reviewed frequently, and corrections, if necessary, are implemented.

General CQA procedures described in this section include:

- Notifications;
- Coordination;
- Meetings;
- Completing a daily record of construction progress;
- Verifying material quality;
- Preparing CQA test reports;
- Summarizing CQA test data;
- Reviewing MQC and CQC test reports provided by the Contractor;
- Documenting and correcting non-conforming work;
- Utilizing CQA checklists to assure all procedures and documentation have been completed;
- 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 records;
- Control of construction documents;
- Control of CQA forms;
- Calibrating testing equipment;
- Complying with test standards; and
- Preparing a CQA report.

3.1 Notifications

As stated in the Technical Specifications, the Contractor is required to notify the CQAC in advance of performing any work requiring sampling, testing and/or monitoring described in this CQA Manual. It is the CQAC's responsibility to work with the Contractor to assure this coordination takes place. If such work requires notification of Ecology, the Port will make this notification.

3.2 Coordination of CQA Activities

Coordination between the Contractor and CQAC is required to implement this CQA Plan. It is the responsibility of the Contractor to understand construction activities that require observation and testing as stated in the "Quality Assurance" paragraphs in the Technical Specifications. It is the responsibility of the CQAC to perform the CQA work in a coordinated effort with the Contractor that minimizes disruption of the work, while confirming that it complies with the Construction Drawings and Technical Specifications.

3.3 Meetings

In order to facilitate construction, and to clearly define construction goals and activities, close coordination between the engineers, CQAC, Port's PM, Port's RE, and Contractor is essential. To meet this objective, pre-construction and progress meetings will be held.

3.3.1 Pre-construction Meeting

A pre-construction meeting will be held at the site (for each independent phase of work) and will be attended, at a minimum, by the Designer, CQAC, Port's PM, Port's RE and Contractor. The Technical Specifications provide a recommended agenda which is repeated here.

- Discuss and review general, site-specific and activity-specific health and safety issues;
- Present a proposed construction progress schedule and submittals as required by the Contract Documents;
- Discuss liquidated damages (if applicable);
- Discuss procedures for handling submittals;
- Discuss the direction of correspondence, and coordinate responsibility between Contractor and Port;
- Schedule periodic progress meetings;
- Summarize required CQA Laboratory product testing;
- Discuss payment requests, and progress payment procedures;
- Discuss change order procedures;
- Discuss Port's site regulations, terminal operations, site access, and traffic control;
- Review the Construction Drawings, Technical Specifications, CQA plan, work area security, safety procedures, and related issues;

- Provide all parties with relevant documents;
- Review responsibilities for each party;
- Define lines of communication and authority;
- Establish reporting and documenting procedures;
- Review testing equipment and procedures;
- Establish testing protocols and procedures for correcting and documenting construction or nonconformance;
- Identify subcontractors that may be working on the project site; and
- Conduct a site inspection to discuss work area, stockpile areas, lay-down areas, access roads, haul roads, and related items.

The Port's RE or his designee must take minutes of the meeting and distribute copies to all parties within 24 hours of the meeting.

3.3.2 Progress Meetings

Progress meetings will be held at a frequency agreed to during the pre-construction meeting. At a minimum they will be attended by the Port's RE, CQA Manager, and Contractor. However, depending on the meeting agenda, and stage of construction; other people such as subcontractors, CQA Monitors, product suppliers, the Port's EMS or others may attend. The purpose of these meetings is to:

- Review meeting minutes from the previous progress meeting;
- Review the status of the project;
- Discuss work in progress, and key activities scheduled for the upcoming week;
- Address any outstanding issues or conflicts that may or may not interfere with work progress;
- Review a submittal register to identify any outstanding submittal issues;
- Review MQC, CQC, and CQA testing completed during the previous week;
- Review MQC, CQC, and CQA testing scheduled to take place that week;
- Review an updated schedule provided by the Contractor;
- Schedule required surveying tasks; and
- Review any health and safety issues for the site.

The Port's PM, or his designee, will prepare the agenda for each meeting and prepare meeting minutes for distribution to all parties.

3.3.3 Daily Progress Meetings

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

- Discussing the previous day's construction related problems and how they will be resolved;
- Reviewing 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.

The CQA Monitor will include results of this meeting at his discretion in the daily progress report.

3.3.4 Special Meetings

Special meetings will be held to discuss problems or non-conformances as required. At a minimum, the Port's PM, Port's RE, Contractor, and CQA Manager will attend this meeting. If the problem requires a design modification and subsequent change order, the Designer should also be present. The Port's RE or his designee will document the meeting.

3.3.5 Completing a Daily Record of Construction Progress

Each CQA Monitor must prepare a daily record of construction progress that summarizes each day's construction activities and progress, CQA, CQC, and MQC activities, and any relevant discussions with the Contractor. Each report must be submitted to the CQA Manager by e-mail 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;
- A description of ongoing construction activities in the area of the CQA Monitor's responsibility;
- A summary of CQA, CQC, and MQA activities for that day;
- An inventory of labor and equipment 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 retest 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 products received, and documentation of their quality, such as MQA data;
- Follow-up information on previously reported problems or deficiencies;
- A record of any site visitors; and
- The signature of the CQA Monitor.

A copy of the daily report must be filed on site and be made available for review.

3.4 Material Quality

3.4.1 Samples

The Contractor is required to identify sources and provide samples of various products that will be installed in the project. Where indicated in this CQA Manual, samples must be collected by the CQAC and tested using the approved CQA Laboratory to determine if they meet 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 it with products delivered to the project.

A record of soil samples must be maintained in a Master Log of Soil Sampling and Testing.

3.4.2 Product Submittals

Product submittals may be used by the CQAC to establish the acceptability of products. The review and acceptance of the Contractor's submittals is the responsibility of the Designer, or his designee.

3.4.3 Certificates of Compliance

Where allowed in the Technical Specifications, certificates of compliance may be used by the CQAC to establish the acceptability of products in lieu of testing. These certificates generally state that the product 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, its source 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 to supply and install products that meet the intent of the design.

3.4.4 Submittal Register

A record of all samples, product submittals and certificates of compliance must be kept by the CQAC in the form of a submittal register.

3.5 CQA Test Reports

The CQA Monitor and/or CQA Laboratory must complete a test report whenever testing is performed. CQA Laboratory test reports must be peer reviewed by the CQA Laboratory performing the tests, and all field test reports must be reviewed by the CQA Manager. CQA 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.

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

- 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;
- A summary of test results identified as passing, failing, or, in the event of a failed test, a re-test;
- Completed calculations;
- Signature of the CQA Monitor or CQA Laboratory technician; and
- Signature of the CQA Laboratory peer reviewer or CQA Manager.

3.6 CQA Test Data

CQA test data must be summarized in the form it will be presented in the CQA Report. Test data must be entered on the summary form no later than 5 working days following peer review or the CQA Manager's review of the individual test reports. Sections 4 through 11 include tables summarizing guidance for CQA oversight and testing.

3.7 MQC and CQC Test Reports

The Contractor is contractually responsible for performing MQC and CQC tests to determine the quality of products manufactured for this project, and the quality of their installation. These requirements are presented in the Technical Specifications. The CQAC must review MQC and CQC data to assure manufactured products and their installation meet specified requirements.

The CQA Manager 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 product quality is verified, the CQA Manager must initial each page of MQC data signifying that the information documents that the products meet specified quality requirements. The CQA Manager must then file this information in the form it was received in the project files.

Summarizing this data is not required. If the MQC data does not verify product quality, the CQA Manager must immediately notify the Contractor, manufacturer, and / or supplier as appropriate for the product.

The CQA Monitor must review CQC data for conformance with specified installation requirements within 24 hours following completion of the installation. When this review is complete, the CQA Monitor must initial each page of CQC data signifying that the CQC information documents product installation in accordance with specified requirements. The CQA Monitor must then file this information in the form it was received in the project files. Summarizing CQC data provided by the Contractor is not required. If the CQC data does not verify product installation in accordance with specified requirements, the CQA Monitor must immediately notify the Contractor.

3.8 Non-Conforming Work

3.8.1 Documenting Non-conforming Work

Whenever non-conforming work is discovered, the CQA Monitor must document the non-conformance in writing in daily progress reports, test reports and elsewhere, as appropriate, must notify the CS supervising the work in question and the Engineer, and must document in the daily report that the Contractor was notified. 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, Designer, CQA Manager, and Contractor.

3.8.2 Determining Extent of Non-Conformance

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

3.8.3 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, and Contractor will discuss standard construction methods to correct the deficiency.

For a more serious non-conformance, such as accidental damage to an installed product, which requires a non-conformance report, the Designer must determine corrective measures. A copy of the non-conformance report, with the Designer's corrective measure determination, must be forwarded to the CQAC and Contractor for implementation of the corrective measure.

3.8.4 Verification of Corrective Measures

Upon notification to the CQAC 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 and be filed with the project record documents.

3.9 CQA Checklists

CQA checklists in the form of tables are provided in Sections 4 through 11. The purpose of these checklists is to:

- List the required CQA observation and testing for each element of work; and
- Assure that monitoring and testing is completed in a timely manner.

3.10 CQA Progress Reports

CQA progress reports may be prepared by the CQA Manager when requested by the Port's PM. The purpose of these reports, which are typically required on projects with long durations, is to periodically document completion of CQC and CQA procedures relative to specific work completed by the Contractor. This must be done in a manner that documents CQC testing and CQA testing is keeping pace with product manufacturing and installation.

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

- The date, project name, and project location;
- The quantity of products delivered to the site for the report period that require MQA test reports, the number of MQA test reports delivered, and a statement regarding whether or not the test frequency meets the specified quantity, and whether or not the product 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 product 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 product 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 MQA, 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; and

- A copy of the submittal register updated to reflect the end of the report period.

This report must be submitted to the Port's PM, the Engineer, and the CQA Monitor. Copies must be kept on file.

3.11 Design Modifications

Design changes may be required during construction, and are a normal part of the construction process. Design changes can only be made by written agreement of the Designer, Port, 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 Port's RE, Designer or CQA Manager will prepare them for distribution and signature by the Port and Contractor. A copy of the design changes must also be distributed to the CQA Monitors. Design change documentation must be filed in the project record documents.

Where these change orders modify the Construction Drawings and Technical Specifications it is the responsibility of the Port's RE to issue revised documents to the Port's PM, Contractor, and the CQA Monitors, and to recall documents that have not been revised to reflect the change.

3.12 CQA Program Modifications

Changes to CQA procedures may be required during construction. CQA procedural changes can only be made by written agreement of the Designer, and Port. These changes must be made in writing by the Designer and must identify the CQA procedural change and its justification. The Designer will distribute CQA procedural changes to the Port's PM, Port's RE, CQA Manager, CQA Monitors and Contractor. CQA procedural changes must be filed in the project record documents.

3.13 As-Built Conditions

During each progress meeting the CQAC must compile as-built information obtained by the CQAC, Contractor, and Project Surveyor into one set of "as-built" Record Drawings and Technical Specifications, which must be maintained at the project site. The Contractor should do this independently. These "as-built" Construction Drawings and Technical Specifications must be clearly marked as "Project As-built Record Drawings" and "Project As-built Technical Specifications." At the completion of the project, the Contactor will supply all as-built information and Record Drawings that will be included in the Implementation Report.

3.14 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 record documents.

3.15 Photographic Documentation

Construction activities must be photographed by the CQA Monitors. Photographs may include significant problems encountered during the work, and corrective actions taken to correct the problem. Photos may also be taken to document project progress. Photos must be taken with a digital camera and be downloaded on a daily basis for review and filing. The digital photo must have a date and time stamp. Selected photographs may be used in the CQA Report or attached to daily reports.

3.16 Project Record Filing

The CQAC 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 CQA Monitors and Port's RE, which will be kept on site, one for the Port's PM, which will be kept in his office, and one for the CQA Manager, which will be kept at the CQA Manager's office. These records must be made available to Ecology upon request. The files must contain the information listed in Table 3-1.

TABLE 3-1
PROJECT RECORD FILING

Record to be Filed	On Site CQA / Port's RE File	CQA Manager's Off Site File	Port's PM off-site File	Copy to Contractor
MQC Data	Yes	Yes	Yes	No
CQC Data	Yes	Yes	Yes	No
CQA Data	Yes	Yes	Yes	Upon request
Submittals from Contractor	Yes	Yes	Yes	No
Submittals Returned with Comments, etc.	Yes	Yes	Yes	Yes
Accepted Submittals	Yes	Yes	Yes	Yes
Photographs	Yes	Yes	Yes	Upon request
Progress reports	Yes	Yes	Yes	Upon request
Communications, faxes, e-mails, etc.	Yes	Yes	Yes	Upon request
CQA Modifications	Yes	Yes	Yes	Yes
Design Modifications	Yes	Yes	Yes	Yes

3.17 Calibrating Test Equipment

Before a CQA Laboratory, or on-site laboratory, places testing equipment into service, the accuracy of each piece of equipment must be verified by calibration. Types of onsite equipment requiring calibration include nuclear gauges, and scales. The calibration procedures and frequencies must be completed per the manufacturer's instructions and/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.

3.18 Test Standards

The CQA Laboratories and CQAC must perform various field and CQA Laboratory tests in accordance with applicable standards as specified in the Technical Specifications and this CQA Manual. In most instances the applicable test procedure is an ASTM standard. Test standards that apply to specific elements of work are listed in Sections 4 through 11.

3.19 Conformance and Construction Testing

The CQAC will perform conformance and construction testing listed in table form in Sections 4 through 12. Conformance testing is laboratory testing performed by the CQAC on a proposed product prior to its installation to assure it meets quality standards established in the Technical Specifications. Construction testing is testing to assure delivered products meet quality standards defined in the Technical Specifications and meet specified installation requirements.

3.20 Control of Construction Documents

The Port's RE will control Construction Documents, including Technical Specifications, Construction Drawings, and change orders. Upon issuance of new copies or revisions of Technical Specifications or Construction Drawings, it is the responsibility of the Port's RE to notify the Contractor, Designer and CQAC of the revisions, to provide revised versions, and to recall all copies of Technical Specifications and Construction Drawings that do not include the latest revisions.

3.21 Control of CQA Forms

The CQA Manager will maintain a master of each CQA form used on the project. Upon issuance of a new or modified form, the CQA Manager will recall and remove all superseded copies along with the master, and provide new copies to the CQA Monitors for their use.

3.22 CQA Report

At the completion of the project, the CQAC will prepare a CQA Report for submittal to the Port's PM and Ecology. This CQA Report will document the extent to which the work was performed in compliance with the Construction Drawings and Technical Specifications.

At a minimum, the CQA Report will contain the following:

- An introduction;

- A summary of all parties responsible for completing the project;
- A brief summary of all major construction activities;
- A copy or 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 registered in the state of Washington.

The as-built record drawings must accurately document the constructed locations of Cleanup Action components. All surveying required to develop Record Drawings must be performed by the Project Surveyor. The Designer who stamps and signs the CQA Report must review and accept the as-built record drawings before they are included in the final CQA Report.

4.0 WORK ELEMENT – GENERAL REQUIREMENTS

4.1 Summary of Work

This Section describes CQA procedures related to work that applies to all elements of the project. They include:

- Surveying;
- Protection of utilities and monitoring systems designated to remain;
- Temporary erosion, sediment and dust control;
- Soil and aggregate stockpiling;
- Highly Contaminated Soil Management;
- Handling and treating impacted water; and
- Handling and treating stormwater.

4.2 Monitoring and Testing Requirements

Perform the observation, testing and documentation summarized in Table 4-1.

TABLE 4-1

GENERAL REQUIREMENTS

SPECIFIED ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
Surveying				
Establish site survey control.	Section 01052	Confirm correct control points and benchmarks are used, and that temporary benchmarks TBM's are established.	Visually verify prior to beginning field work for each activity that requires surveying.	Confirm with Port.
		Verify same datum, and TBM's are utilized throughout project.	Periodic.	Observation
Facility Protection				
Protect constructed facilities designated to remain.	Multiple references in the Technical Specifications.	Verify required utility locates are completed. Visually inspect items that require protection to verify protection is accomplished. Items include: • Adjacent buildings/structures, • Roads and paved areas, • Monitoring wells and vapor probes, • Sanitary and storm sewers, manholes and catch basins, and • Telephone, fiber optic, gas, water, electric utilities.	During utility locates, and daily during performance of the work.	Observation

TABLE 4-1

GENERAL REQUIREMENTS

SPECIFIED ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
Erosion Sediment and Dust Control				
Temporary erosion and sediment control (TESC) measures – performance checks.	Multiple references in the Technical Specifications.	Visually inspect TESC BMP's to ensure systems are installed as detailed in Contractor's Work Plan, as shown on the Drawings and as described in the Technical Specifications.	Prior to breaking ground in any portion of the site, and prior to initiating stockpiling operations including crushing and screening of asphalt and concrete.	Observation.
		Visually inspect to document performance of TESC measures.	Daily	
		Document any maintenance, repair or cleaning to maintain proper function	Daily	
Stormwater permit compliance.	Stormwater Permit conditions. Section 02770.	Request submittal of monitoring records required by permit.	Weekly	Observation.

TABLE 4-1

GENERAL REQUIREMENTS

SPECIFIED ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
Dust control.	Multiple section references.	Document dust is controlled as specified.	Continuously during work.	Observation.
Stockpiling				
Stockpiling soil that is not highly contaminated, highly contaminated soil, asphalt and concrete.	Multiple Drawing and Specification references.	Verify that separate stockpiles are established inside bermed areas that divert run on away from individual stockpiles developed for: • Soil that is not highly contaminated; • Highly contaminated soil; • Broken, crushed and screened concrete; • Broken, crushed, and screened asphalt; • Removed pipeline; and • Other demolition debris.	Visually verify areas are ready to receive products prior to beginning stockpiling activities.	Observation.
		Verify the Port's EMS determines which soils are designated as highly contaminated soil.	Daily	Observation.
		Verify all soil and aggregate products are stockpiled over specified plastic sheeting and covered at the end of each working day with specified plastic sheeting.		
		Verify that facilities are in place and functioning for collection and management of drainage from stockpiled materials, especially for soil being excavated from below the water table.		

TABLE 4-1

GENERAL REQUIREMENTS

SPECIFIED ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
Highly Contaminated Soil Management				
Managing highly contaminated soil.	Section 02332.	Verify the following: • The Port's EMS determines which soils are designated as highly contaminated soil. • That highly contaminated soil is placed in separate stockpiles and not commingled with other stockpiled soil and debris. • Soil profiling is completed per Section 02405 and soil is transported off-site for disposal. • Management of soil and debris intended for reuse within the AOC is managed per Section 02332. • Highly contaminated soil is not used for backfill. • Trip tickets and disposal records for highly contaminated soil are provided to the CQAC by the Contractor.	Daily during any handling of highly contaminated soil.	Observation Trip Tickets Disposal Records.
Handling and Treating Impacted Water				
Permits Handling and Treating Impacted Construction Water.	Section 02405.	Verify required King County Metro permits for discharge of treated groundwater to the sanitary sewer are obtained and posted on site.	Prior to allowing discharge to sewer.	Observation.
		Verify monitoring and testing required by the permit is completed and documented per the permit requirements.	Progress meetings.	Review Contractor reporting documentation.

TABLE 4-1

GENERAL REQUIREMENTS

SPECIFIED ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
Handling and Treating Stormwater				
Work Plan Submittals.	Section 02270.	Review Stormwater Pollution Prevention Plan (SWPPP) prepared as required by Construction Stormwater General Permit (CSWGP) and as part of the Contractor's Work Plan that provides sufficient detail to ensure discharge of stormwater complies with Ecology requirements.	Prior to initiating stormwater management work.	Observation.
Submittals during construction.	Section 02270.	Verify that during each day that the system discharges water, a daily log of water treatment activities is completed that includes: • the results of the daily system inspection. • daily and cumulative discharge volumes from a totalizing water meter, • hours of treatment system operation. • discharge, and other pertinent data in accordance with CSWGP requirements.	Daily observations and during progress meetings.	Observation.
Operator training.		Verify that if onsite construction stormwater treatment is selected the designated operator meets the specified qualifications:	Daily.	
Performance Requirements.	Section 02270.	Verify BMPs and treatment system is designed and operated to meet the discharge requirements listed in the appropriate discharge permits.	Before initiating operation.	Observation and records review.

TABLE 4-1

GENERAL REQUIREMENTS

SPECIFIED ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
		Verify necessary approvals for construction stormwater treatment and discharge are obtained.		
		Verify compliance with the requirements of the CSWGP for construction stormwater management and approvals regarding treatment, monitoring, and reporting.		
Treatment	Section 02270.	Verify treatment objectives are made by reviewing quality control sampling and analysis specified in SWPPP.	Daily.	Records review.

5.0 WORK ELEMENT – DECOMMISSIONING PIPELINES

5.1 Summary of Work

This Section describes CQA activities related to exposing, cleaning, removing and decontaminating pipelines located inside the TFA, and exposing, cleaning, grouting, and capping pipelines located elsewhere within the TFAA. The construction includes:

- Exposing two ends of each pipeline, or pipeline segment, for access;
- Cleaning the pipelines by removing liquids and sludges/solids;
- Cutting pipelines where exposed for access for cleaning and/or at the limits of the TFA, if pipelines enter the TFA;
- Grouting cleaned pipelines outside the limits of the TFA;
- Capping cleaned and grouted pipelines outside the TFA;
- Removing and decontaminating pipelines found inside the limits of the TFA; and
- Loading, hauling, stockpiling, recycling or disposing of pipelines found inside the limits of the TFA.

5.2 Standards

The work will be performed in accordance with a Work Plan prepared by the Contractor and approved by the Port.

The following test standards will apply to this section.

TEST DESIGNATION	TEST DESCRIPTION
ASTM C942	Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory.

5.3 CQA Monitoring and Testing Requirements

Each element of pipe decommissioning has specific construction requirements that must be monitored, and or tested by the CQAC. These CQA requirements are summarized in Table 5.1.

TABLE 5-1
PIPELINE DECOMMISSIONING

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
Preparation				
Contractor Project Work Plan.	Section 02224.	Review accepted Project Work Plan for liquid and sludge removal, spill control, pipe cleaning and pipeline decommissioning methods.	Prior to and during the work.	Observation.
Site Survey Control.	Appropriate Division 1 Section.	Verify the proper benchmark and datum are used to locate pipeline access points.	Before start of work.	Observation.
Protecting constructed facilities designated to remain in place.	Section 02224.	Verify designated items are located and physically protected.	Daily during performance of work.	Observation.
Operations interference and roadway cleaning.	Section 02224.	Verify that pipeline decommissioning is coordinated with Port's activities to assure minimum disruption of the Terminal's operation.	During meetings and periodically during the work.	Observation.
		Verify that controls are in place to minimize interference to public access, that traffic controls are provided and that roadway cleaning keeps roads clean.		Observation.
Obstruction of terminal roadways, sidewalks, or hydrants.	Section 02224.	Verify that terminal roadways, sidewalks, or hydrants are not closed or obstructed without required permits or approvals from Port.	Prior to and periodically during the work.	Observation.

TABLE 5-1
PIPELINE DECOMMISSIONING

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
Temporary barriers and security devices.	Appropriate Division 1 Sections and Section 02224.	Outside the TFA verify that temporary barriers and security devices are erected and maintained. Inside the TFA verify that Secured Zone, Exclusion Zone, Contaminant Reduction Zone, and processing area for decontaminating removed pipeline materials are established.	Prior to and periodically during the work.	Observation.
Permits	Section 02224.	Verify required King County Metro permits are obtained for discharge of treated water to the sanitary sewer system.	Prior to initiating work.	Document review.
Product Storage Area.	Section 02224.	Verify secure containers are provided for material removed from pipelines in accordance with SPCC Plan	Prior to removing material from pipeline.	Observation.

TABLE 5-1
PIPELINE DECOMMISSIONING

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
Exposing Pipelines				
Exposing Pipelines.	Section 02224.	Verify that pipelines designated for cleaning and/or for removal are located based on locations shown on the drawings or by physical locator methods.	Prior to asphalt removal and soil excavation.	Observation.
	Section 02222.	Within the TFA, verify overlying structures are removed per Section 02222 to expose pipelines that require cleaning and/or removal.	Periodically during work.	Observation.
	Section 02332 and 02337.	Verify soil is excavated and stockpiled to expose pipelines per Sections 02332 and 02337.		Observation.
	Section 02224.	Verify that each end of the pipeline being decommissioned is exposed.	Prior to and periodically during the work.	Observation.
Roadway Cleaning.	Section 02224.	Verify roadways are cleaned as required to remove construction materials.	Periodically during the work.	Observation.
Pipeline Cleaning, Product Removal and Video Verification				
Pipeline Decommissioning.	Section 02224.	Verify liquids and sludges/solids and residues are removed from pipelines shown on the Drawings or otherwise discovered during the work.	Periodically during work.	Observation.

TABLE 5-1
PIPELINE DECOMMISSIONING

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
		Notify Designer if product or product residuals cannot be removed from identified sections of pipelines, or if pipeline is plugged or otherwise damaged to a point that decommissioning from end to end is not possible.	Upon discovery.	
Pipeline Decommissioning.	Section 02224.	Verify decommissioning starts at one end of the pipeline working to the opposite end.	Periodically during work.	Observation.
Recovered product storage.	Section 02224, and 02405.	Verify liquids and sludges/solids that are removed from pipelines are placed in containers (drums, tanks, bins, tank cars, etc.) and staged in accordance with applicable regulations, existing spill prevention countermeasures and control plans, and Section 02405.	Periodically during work.	Observation.
Pipeline Decommissioning.	Section 02224.	Verify that sludge/solids and liquid removal is conducted without spreading contaminants.	Periodically during work.	Observation.
Pipeline Decommissioning.	Section 02224.	Verify that liquids and solids/sludges are removed from the entire pipe length.	For each located pipeline.	Observation.
Sludge stabilized and transportation.	Section 02405.	Observe that Contractor performs stabilization of recovered product that meets disposal site and transportation regulatory standards.	Prior to removing from site.	Observation.

TABLE 5-1
PIPELINE DECOMMISSIONING

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
Video Verification of Pipe Cleaning.	Section 02224.	Verify that Contractor furnishes and operates a video camera to verify that products have been removed from pipelines.	Periodically during the work	Observation
		Verify video is obtained from a minimum of 10 percent of the pipeline lengths following cleaning with the 10 percent split evenly among the various pipeline diameters.	Periodically during the work	Observation
		Verify that approximately 75 percent of the video work is performed early in the project to verify that the proposed cleaning method meets the requirements of Section 02224.	Periodically during the work	Observation
		Work with Contractor to receive notification 24 hours in advance of the work so that the CQAC may witness the video camera feed.	Periodically during the work	Observation
		If the video camera feed indicates that the pipelines are not being cleaned as defined in this Section, stop work until a new method has been demonstrated to work.	Periodically during the work	Observation
		Verify that the remaining 25 percent of the video work is completed randomly as the remaining pipelines are cleaned.	Periodically during the work	Observation

TABLE 5-1
PIPELINE DECOMMISSIONING

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
Grouting				
Grout mix design.	Section 02224.	Verify cement grout mix is prepared as follows: • Minimum 15% Portland cement by volume; • Mixed to a consistency suitable for pumping; • Displaces water and free liquids; • Can cure in presence of residual moisture or hydrocarbons; • Fills voids to prevent free flow of water or hydrocarbons within the pipe; and • Provides minimum of 50 psi and maximum of 100 psi compressive strength upon curing.	Minimum of 5 days prior to initiating grouting.	Supplier test records. ASTM C942.
Pipe Grouting.	Section 02224.	Document each line is completely grouted. Record equipment used, grout type, start and finish times, volume grout injected.	Each line grouted.	Document start and finish times and grout volume.
Pipe Grouting.	Section 02224.	Verify grout is pumped through the entire decommissioned portion of the pipe, providing a solid waterproof plug completely bonded to the interior of pipe walls, and that contractor measures volume of grout pumped into each pipe section	Each line grouted.	Observation and volume calculation.

TABLE 5-1
PIPELINE DECOMMISSIONING

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
Pipe Grouting.	Section 02224.	Verify pipelines are completely filled by pumping the grout mixture into the pipelines from the downstream or low end using a grout pump.	Each line grouted.	Observation.
Capping				
Pipe Capping Outside TFA.	Section 02224.	Verify the ends of grouted pipe segments are capped with a cap compatible with pipe material.	Each grouted pipe segment.	Observation.
Pipelines Extending Outside TFAA.	Section 02224.	Verify that exposed pipelines that extend outside of the TFAA are temporarily capped, or install isolation valves until these pipes are decommissioned.	Each pipeline determined to continue outside the TFAA.	Observation.
Pipeline Cutting, Removal, Recycling, Disposal				
Pipeline identification.	Section 02224.	Verify approximate locations and lengths of pipelines designated for removal in the TFA, are shown on the drawings. Notify Contractor that these locations have not been physically verified, but are based on historical record drawings.	Each line grouted.	Observation.
Pipeline cutting and removal.	Section 02224.	Verify that after cleaning pipelines inside the TFA they are exposed, cut and removed.	Each line grouted.	Observation.
Precautions.	Section 02224.	Verify flammable liquids, welding/cutting equipment, or compressed gases are not used to cut and remove pipelines.	Each line grouted.	Observation.

TABLE 5-1
PIPELINE DECOMMISSIONING

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
Removal.	Section 02224.	Verify pipelines and pipeline components are loaded, hauled and stockpiled at the designated stockpile location.	Each removed pipeline segment.	Observation.
Salvage.	Section 02224.	Verify items designated for salvage/recycling are separated from those designated for disposal.	Each removed pipeline segment.	Observation.
Remaining pipelines.	Section 02224.	Verify that remaining pipelines that extend outside of the TFLP are decommissioned, grouted and capped.	Each pipeline segment.	Observation.
Product disposal.	Section 02224.	Verify that liquids and sludges/solids that cannot be recycled are disposed of per Section 02405.	Each removed pipeline segment.	Observation.
Product stabilization.	Section 02405.	Verify that sludges/solids and liquids removed from pipelines are stabilized to meet the disposal site requirements and the regulatory agency governing transportation standards.	Each container.	Observation.
Pipeline disposal.	Section 02224.	Verify that pipeline products that cannot be recycled are disposed of at a Port approved facility per Section 02405.	Each removed pipeline segment.	Observation.
Product recycling.	Section 02224.	Verify that recoverable products are recycled by a facility approved by the Port.	Each container.	Observation.

TABLE 5-1
PIPELINE DECOMMISSIONING

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
On site disposal.	Section 02224.	Verify pipeline products are not disposed of on site.	Each pipeline segment.	Observation.
Debris removal.	Section 02224.	Verify all debris is removed from work areas.	After field work is completed.	Observation.
Quality Control				
As built Survey Outside TFA.	Section 01052.	Upon completion of capping and before backfill verify that the exposed pipeline segment alignment and the horizontal and vertical position of the pipe caps are surveyed and that the survey notes identify the pipe type and size.	Each pipeline segment.	Observation. Review of survey notes.

6.0 WORK ELEMENT – SWMU 30 EXCAVATION AND BACKFILL

6.1 Summary of Work

This Section describes CQA activities related to SWMU 30 excavation and backfill on Pier 91. Excavating and backfilling will take place in two distinct areas where LNAPL and elevated concentrations of residual petroleum hydrocarbons have been observed. These two areas are designated SWMU 30 North and SWMU South. The construction includes:

- Establishing and operating stormwater BMPs;
- Locating and protecting existing utilities;
- Preparing a traffic control plan and rerouting traffic around work area;
- Decommissioning existing monitoring wells;
- Removing existing asphalt, crushed base rock and base course;
- Providing and installing sheeting and shoring to isolate the areas being excavated and prevent lateral movements of soil, and in conjunction with dewatering, soil heave within the excavations;
- Managing water in the excavation;
- Supporting and protecting encountered utilities including power, natural gas, water, and sanitary sewers;
- Exposing and protecting existing bulkheads, tiebacks and anchorages;
- Removing tiebacks and anchorages in the South area;
- Removing some of the exposed tiebacks and anchorages in the North area;
- Performing a condition assessment of the tiebacks and anchorages designated to remain in place in the North area.
- Setting up and operating soil stockpiling and soil profiling areas;
- Establishing truck access routes from SWMU 30 to the stockpiling locations;
- Excavating, loading, hauling and stockpiling soil that is not highly contaminated;
- Excavating, loading, hauling, profiling and disposing of highly contaminated soil;
- Removing, treating and disposing of LNAPL impacted groundwater that may accumulate in the excavation;
- Installing geotextile separator against subgrade sides of excavation;
- Backfilling the excavation with gravel fill and engineered fill;
- Placing controlled density fill under utilities;
- Removing temporary sheeting and shoring;

- Furnishing and installing crushed base rock, base course and asphalt concrete over the engineered fill; and
- Restore traffic and parking pavement markings to original condition.

6.2 Test Standards

The following test standards apply to this section:

TEST DESIGNATION	TEST DESCRIPTION
ASTM A572	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
ASTM C138	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C143	Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C1064	Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM D422	Standard Test Method for Particle-Size Analysis of Soils.
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort [56,000 ft-lbf/ft3 (2,700 kN-m/m3)].
ASTM D2216	Standard Test Method for determining water content of soil aggregate mixtures.
ASTM D4643	Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Heating.
ASTM D4832	Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders
ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
AASHTO T 230	Standard Method of Test for Determining Degree of Pavement Compaction of Bituminous Aggregate Mixtures.

6.3 CQA Monitoring and Testing Requirements

Each element of the SWMU 30 excavation and backfill has specific construction requirements that must be monitored, and or tested. These CQA requirements are summarized in Tables 6.1, and 6.2.

TABLE 6-1

SWMU 30 EXCAVATION AND BACKFILL

TASK OR ITEM	SPECIFICATION OR DRAWING REFERENCE	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
PREPARATION				
Submittals	Appropriate Division 1 Sections and Sections 02339, 02771.	Review accepted Work Plan including sheeting and shoring plan. Review Traffic Control Plan including proposed rerouting or detours of roadways through area. Verify installed sheeting and shoring complies with the accepted submittal. Review accepted submittals for backfill soil, collector pipe and geotextile.	Prior to initiating work and as systems are installed.	Document review. Observation.
Groundwater well decommissioning	Sections 02227 and 02333.	Verify decommissioning of one (1) monitoring well in South Area and two (2) monitoring wells in North Area prior to initiating asphalt removal.	Continuously during work.	Observation.
		Review Contractor well decommissioning documentation prior to submitting records to Ecology.	File Ecology documentation.	Records review. WAC 173-360.
Stockpile preparation	Section 02337	Verify stockpile areas are completed and prepared for stockpiling of soil and highly contaminated soil that will be excavated.	Prior to initiating work.	Observation.
Protect facilities to remain.	Section 02333.	Verify utilities and monitoring systems designated to remain are located, identified, and protected.	Prior to initiating work.	Observation.

TABLE 6-1

SWMU 30 EXCAVATION AND BACKFILL

TASK OR ITEM	SPECIFICATION OR DRAWING REFERENCE	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
Dust control	Section 02333	Verify dust is controlled.	Continuously during work.	Observation.
Surveying	Section 01052	Verify surveys are performed to define excavation limits.	Prior to initiating work.	Observation and documentation of control points.
Survey to establish excavation limits.	Appropriate Division 1 Section	Verify correct benchmark, or TBM is used to define horizontal and vertical position of excavation. Verify staked excavation limits comply with the drawings by making physical measurements from known items such as monitoring wells.	Following installation of staking and prior to initiating asphalt removal.	Observation.
TESC's	Section 02270	Verify temporary erosion and sediment control (TESC) measures are installed specific to soil being excavated from the SWMU 30 excavation. Verify stockpile areas for asphalt, base course, clean soil and contaminated soil removed from the excavation are constructed. Verify stockpile areas are lined with plastic liners and containment berms are completed as shown on the Drawing, and the accepted Work Plan.	Prior to initiating asphalt removal. Daily as long as stockpile area is active, and at the end of each day.	N/A

TABLE 6-1

SWMU 30 EXCAVATION AND BACKFILL

TASK OR ITEM	SPECIFICATION OR DRAWING REFERENCE	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
		Verify TESC measures are inspected to document performance and to assure maintenance, repair and cleaning are completed to maintain proper function.	Daily reports, weekly meetings.	Review of Contractor records.
EXECUTION				
Base Course and Asphalt Removal				
Asphalt demolition and stockpiling.	Section 02228. Section 02339.	Verify asphalt is cut around limits of excavation prior to installing sheeting and shoring.	Prior to installing sheeting/shoring.	Observation.
		Verify asphalt is stockpiled per accepted stockpiling plan and is covered with plastic at day's end.	At the end of each working day.	
Base course removal and stockpiling.	02332, 02339.	Verify base course removal per section 02332. Verify base course is stockpiled per accepted stockpiling plan and is covered with plastic at day's end.	Periodically during the work, and at the end of each working day.	Observation.
Excavation				
Sheeting and shoring.	Appropriate Division 1 Sections, Section 02333 and Accepted	Review accepted Work Plan regarding sheeting and shoring and verify installed sheeting and shoring complies with the accepted submittal as excavation proceeds.	Periodically during the work, and at the beginning and end of each working day.	Review and observation.

TABLE 6-1

SWMU 30 EXCAVATION AND BACKFILL

TASK OR ITEM	SPECIFICATION OR DRAWING REFERENCE	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
	Work Plan	For material specified in work plan, visually inspect or confirm that the following sheeting properties comply with the Contractors Work Plan: • Mass, Length, Thickness, Width, and Straightness	Verify material quality upon arrival at site.	Observation.
Sheeting and shoring relative to excavation limits.	Drawings C005 to C009. Appropriate Division 1 Section.	Verify sheeting and shoring location and excavations comply with lines and grades shown on the Drawings.	During installation of sheeting and shoring.	Survey.
Piles	Accepted Work Plan	Prepare pile log documenting length of each pile, and final top and tip elevations for each pile.	Continuously during driving.	Pile log.
Walers	Accepted Work Plan	Visually inspect walers to ensure they are installed at design elevations, with connections between walers and bracing per Contractors Work Plan	Upon installation.	Observation.
Bulkhead protection	Section 02333.	Verify bulkhead protection is in place per accepted Work Plan and is maintained throughout excavation until backfill is complete.	Periodically during work.	Observation.
Tie back and anchorage – South Area	Drawings C005 to C008. Section 02333.	Document that tie-backs and anchorages (piles and lagging) are removed within excavation.	Periodically during work.	Observation.

TABLE 6-1

SWMU 30 EXCAVATION AND BACKFILL

TASK OR ITEM	SPECIFICATION OR DRAWING REFERENCE	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
Tie back and anchorage – North Area South of N 34425	Drawings C009 to C011. Section 02333.	South of N 34425 - Document that tie-backs and anchorages (piles and lagging) are removed within excavation.	Periodically during work.	Observation.
Tie back and anchorage – North Area North of N 34425	Drawings C009 to C011. Section 02333.	Verify tieback protection is in place per accepted Work Plan and is maintained throughout excavation until backfill is complete.	Periodically during work.	Observation.
		Inspect condition of tie-backs and anchorage.	When all components are exposed.	Engineering Inspection.
		Verify tie backs are connected to anchorage and bulkhead and tensioned to remove slack during backfilling operations.	Periodically during work.	Observation.
Bulkhead protection	Section 02333.	Verify bulkhead protection is in place per accepted Work Plan and is maintained throughout excavation until backfill is complete.	Periodically during work.	Observation.

TABLE 6-1

SWMU 30 EXCAVATION AND BACKFILL

TASK OR ITEM	SPECIFICATION OR DRAWING REFERENCE	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
Excavation above elevation 10.5 ft.	Drawings C006 and C010 Section 02233. Section 02237. Section 02405.	Identify any highly contaminated soil during excavation. Coordinate with Port EMS.	Continuous.	Observation.
		Verify that soil that is not highly contaminated and soil that is highly contaminated is managed separately and correctly. Verify soil is stockpiled per accepted stockpiling plan and is covered daily with plastic.		
Excavation below elevation 10.5 ft.	Drawings C006 and C010. Section 02333.	Verify that all soil is managed as highly contaminated soil.	Continuous.	Observation.
		Verify soil is stockpiled per accepted stockpiling plan and is covered with plastic at day's end.	Daily.	
		Measure and document groundwater elevations at monitoring well(s) outside excavation.		Groundwater probe.
		Document water levels in excavations are maintained at correct elevation relative to groundwater level outside excavation in accordance with Sheeting and Shoring Plan.	Continuous.	Measure.
		Observe and document the presence of oily sheen or LNAPL in excavation.		Observation.

TABLE 6-1

SWMU 30 EXCAVATION AND BACKFILL

TASK OR ITEM	SPECIFICATION OR DRAWING REFERENCE	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
All excavation in SWMU 30	Drawings C005 to C011. Section 02333.	Document that excavation is coordinated with installation of sheeting and shoring in accordance with Sheeting and Shoring Plan.	Continuous.	Observation.
		Document that excavation is coordinated with the uncovering of utilities and in situ support of utilities designated to remain in place during excavation and backfilling, in accordance with Sheeting and Shoring Plan	Each supported utility for initial support.	Observation.
		Verify that supported utilities are protected and are being monitored and reviewed.	Deflection monitoring 2 times/week.	Survey.
		Document location and condition of bulkhead wall, tie backs and anchorage.	Upon exposure of element.	Observation and survey.
Sheeting and shoring removal.	Drawings C008 and C011. Section 02333.	Verify sheeting and shoring is removed in accordance with approved plan.	During removal.	Observation.
Supporting and Protecting Utilities				
Utilities	Work Plan 02333.	Verify utilities designated to remain are protected from damage per accepted Work Plan.	Periodically during work.	Observation

TABLE 6-1

SWMU 30 EXCAVATION AND BACKFILL

TASK OR ITEM	SPECIFICATION OR DRAWING REFERENCE	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
Utilities	Work Plan 02333.	Verify utilities that cross the excavation are suspended and supported to prevent damage.	Periodically during work.	Observation.
Water Management				
Managing contaminated water in excavation.	Sections 02405 and 02333.	Verify water in excavation is managed per Section 02405 to minimize collection, treatment and off-site disposal. If collection is necessary, verify collection, hauling and treatment per Section 02405.	Periodically during work.	Observation review of treatment records.
Backfilling				
Non-woven Geotextile Separator.	Section 02771 and Table identifying material quality.	Review Contractor's approved submittal and manufacturer's quality control test data. Compare roll numbers of delivered material with roll numbers on MQC data. Document MQC test results indicate the materials meet specified requirements prior to installation.	See Table in Section 02771.2.01 for MQC testing frequencies. There are no CQA testing requirements.	No CQA testing requirements.
		Visually inspect to assure that geotextile is placed as shown on Drawings.	As material is being installed.	Observation.
		Visually inspect to assure that seams are sewn for underwater deployment.		
		Visually inspect to assure that seams are sewn or overlapped for above water deployment.		

TABLE 6-1

SWMU 30 EXCAVATION AND BACKFILL

TASK OR ITEM	SPECIFICATION OR DRAWING REFERENCE	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
		Visually inspect to assure ballast applied to submerge geotextile holds geotextile in place until covered.		
Gravel fill.	Section 02333.	Review Contractor's Work Plan for equipment and methods to installing and compacting gravel fill below groundwater.	Prior to NTP.	Submittal.
		Review 40-pound material sample and supplier gradation. Perform conformance test gradation per Table 6-2.	14 days prior to installation.	Submittal.
		Perform gradation test of representative sample of material delivered for installation at the frequency listed in Table 6-2.	1 per 100 cy.	ASTM D422 or ASTM C136.
		Verify gravel placed to a minimum of 1 ft above groundwater surface.	As material is being installed.	Observation.
		Verify groundwater elevation managed inside excavation as gravel placed.		

TABLE 6-1

SWMU 30 EXCAVATION AND BACKFILL

TASK OR ITEM	SPECIFICATION OR DRAWING REFERENCE	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
Engineered fill backfill.	Sections 02333, 02339.	Verify backfill of excavation with engineered fill per section 02339. Perform conformance and construction CQA tests per Table 6-2. Verify engineered fill: • is placed to the lines and grades shown on the Drawings; • is placed and spread in horizontal lifts of uniform thickness, in a manner that avoids segregation; • is placed in loose lift thickness not exceeding 8 inches; • is moisture conditioned as needed to achieve specified compacted dry density; • lifts are compacted to a minimum relative compaction of 92% as determined by ASTM D1557; • soil fill does not yield under equipment loads; • moisture is maintained within specified range until covered with subsequent lifts; • does not desiccate; • is graded to a vertical tolerance of plus 0.0 feet, and minus 0.2 feet.	Periodically during work. Perform tests per Table 6-2.	ASTM D1557, ASTM D2216 ASTM D6938 CQA Test reports.

TABLE 6-1

SWMU 30 EXCAVATION AND BACKFILL

TASK OR ITEM	SPECIFICATION OR DRAWING REFERENCE	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION		INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
Controlled Density Fill					
Controlled Density Fill	Drawing C008. Section 03310	Review trial batches and historical strength data for similar mix designs. Verify Contractor performs the following quality control tests during installation:		Prior to first use	Review test results
		Test Designation	**Required Results**		
		Unit weight (pcf) ASTM C138	90 to 145 pcf	Each truck load by Contractor.	Review test results.
		Slump ASTM C143	8 to 14 in.		
		Air Content (%) ASTM C231	12 to 18 percent		
		Temperature (F) ASTM C1064	None		
		Compressive strength at 7 days ASTM D4832	>= 25 psi	Every 50 cy delivered.	
		Compressive strength at 28 days ASTM D4832.	>= 50 psi and <= 100 psi		
		Verify CDF vibrated to remove voids and place uniformly around utility to spring line.		As installed.	Observation.

TABLE 6-1

SWMU 30 EXCAVATION AND BACKFILL

TASK OR ITEM	SPECIFICATION OR DRAWING REFERENCE	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
Base Course and Asphalt Repair				
Base course	Drawing C008. Section 02722.	Verify base course installation per Section 02722. Verify base course: • is placed to the lines and grades shown on the Drawings; • is placed and spread in horizontal lifts of uniform thickness, in a manner that avoids segregation; • is placed in loose lift thickness not exceeding 8 inches; • is moisture conditioned as needed to achieve specified compacted dry density; • is compacted in lifts to a minimum relative compaction of 92% as determined by ASTM D1557; • fill does not yield under equipment loads; • moisture is maintained within specified range until covered with subsequent lifts; • does not desiccate; • fill is graded to a vertical tolerance of plus 0.0 feet, and minus 0.2 feet.	Periodically during work. Perform tests per Table 6-2.	ASTM C136, ASTM D1557, ASTM D2216, ASTM D6938 CQA Test Reports.

TABLE 6-1

SWMU 30 EXCAVATION AND BACKFILL

TASK OR ITEM	SPECIFICATION OR DRAWING REFERENCE	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA OBSERVATION OR TEST METHOD
Asphalt repair.	Drawing C008. Section 02743.	Verify asphalt repair per 02743. Verify CQC testing is performed per Section 02743 and request copies of test data.	Periodically during work. Review CQC field density test data as it is obtained daily.	Complete optional CQA testing per table 6-2.
Temperature		Temperature above 250 deg F	Each load.	Measurement.
Thickness		Thickness	Continuously.	Measurement. or coring.
Contractor quality control testing		Data.	During installation.	Review CQC field density test data as it is obtained daily
Compaction		Compaction greater than 92% of maximum theoretical specific gravity (Rice density).	1 per 1,000 square feet and a minimum of two per excavation area.	AASHTO T230.

TABLE 6-2
SWMU 30 SOIL CONFORMANCE AND CONSTRUCTION TESTING

Required Tests	Test Designation	Test Frequency	Estimated Total Number of Tests	Actual Number of Tests Performed
Engineered Fill Conformance Testing				
Moisture / Density Relationship	D1557	1 per material type	1	
Engineered Fill Construction Testing				
Density, Nuclear Method	D6938	1 per 12-inch thick lift in each excavation area	8 per excavation area	
Moisture Content, Nuclear Method	D6938	1 per density test.	8 per excavation area	
Aggregate Base and Base Course Conformance Testing				
Moisture / Density Relationship	D1557	1 per material type	1	
Base Course Construction Testing				
Density, Nuclear Method	D6938	1 per 500 square feet per lift.	8	
Moisture Content, Nuclear Method	D6938	1 per density test.	8	
Gravel Backfill Placed Below Water Table Conformance Testing				
Gradation	C-136	1 per source		
Gravel Backfill Placed Below Water Table Construction Testing				
Gradation	C-136	1 per 100 cubic yards installed		
Optional Asphalt In-Place Density Testing				
Density, Nuclear Method	AASHTO T230	1 per 1,000 square feet and a minimum of two per excavation area.	4	

7.0 WORK ELEMENT - TANK FARM AREA SITE PREPARATION

7.1 Summary of Work

This Section describes CQA activities related to demolition and other activities necessary to prepare the TFA for construction of the cutoff wall and final cover system. The construction includes:

- Establishing and operating stormwater BMPs;
- Setting up and operating water treatment systems;
- Setting up perimeter security fencing;
- Preparing a traffic control plan and rerouting traffic around work area;
- Decommissioning monitoring wells and vapor probes;
- Locating, re-routing, removing, and protecting existing utilities;
- Demolishing existing stormwater pumping systems
- Demolishing fencing;
- Demolishing former foam hydrants and piping;
- Demolishing buildings M-25, and M-27, and electrical Substation 11;
- Removing existing asphalt pavement and underlying base course and stockpiling for reuse as engineered fill;
- Excavating, loading, hauling, profiling and disposing of highly contaminated soil;
- Excavating, loading, hauling, stockpiling and reusing, for engineered fill, soil from within the AOC that is not characterized as highly contaminated;
- Demolishing and decontaminating tank bases;
- Excavating and removing oil saturated sand at tank bases;
- Installing sheeting and shoring around some subsurface structures that require removal;
- Demolishing concrete slabs, footings, walls and concrete structures associated with stormwater sumps, oil/water separators, and other structures;
- Salvage or recycling of demolished items.
- Removing, treating and disposing of LNAPL impacted groundwater that accumulates in excavations;
- Exposing, cleaning, decontaminating and removing pipelines (see Section 5.0)
- Removing, loading, hauling, cleaning, crushing, screening and stockpiling existing concrete slabs and foundations;

- Excavating the exploratory trench along the alignment of the cutoff wall to explore for any manmade objects not encountered by the other site preparation activities; and
- Placing engineered fill to the grade required to construct the cutoff wall.

7.2 Test Standards

The following test standards apply to this section:

TEST DESIGNATION	TEST DESCRIPTION
ASTM A572	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
ASTM D422	Standard Test Method for Particle-Size Analysis of Soils.
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 determining water content of soil aggregate mixtures.
ASTM D4643	Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Heating.
ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

7.3 CQA Monitoring and Testing Requirements

Each element of the TFA area site preparation has specific construction requirements that must be monitored, and or tested. These CQA requirements are summarized in Table 7.1.

TABLE 7-1
TFA SITE PREPARATION

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA TEST METHOD OR REFERENCE DOCUMENT
Preparation				
Submittals	Appropriate Division 1 Section and Section 02222.	Review accepted Work Plan including sheeting and shoring plan. Review accepted engineered fill product and sample submittals.	Prior to initiation of work.	Document review.
		Verify TFA site preparation activities performed in accordance with sequence in Work Plan.	During work.	Document review.
Electrical rerouting and hazardous materials abatement.	Port and Argus Pacific.	Verify all electrical components in TFA have been removed or permanently disconnected and required hazardous materials abatement has been completed.	Before start of work.	In writing from Port, and observation.
Monitoring Well Decommissioning.	Drawing C014. Section 02222. Section 02227.	Verify decommissioning of 12 monitoring wells and 6 vapor probes prior to initiating asphalt removal.	Continuously during work.	WAC 173-360.
		Review Contractor documentations and prepare record for submittal to Ecology	File Ecology documentation	Document review.
Temporary Erosion and Sediment Control (TESC).	Section 02270.	Verify stormwater BMPs are installed.	Prior to initiating work. Daily during work.	Observation.
Stockpile areas.	Section 02337.	Verify stockpile areas are prepared for placement of asphalt, concrete, soil and highly contaminated soil.	Prior to excavation.	Observation.

TABLE 7-1
TFA SITE PREPARATION

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA TEST METHOD OR REFERENCE DOCUMENT
Building M-28 Monitoring.	Appropriate Division 1 Section	Perform a preconstruction condition survey of Building M-28	Prior to construction.	Photograph or otherwise record condition.
		Review condition during construction to monitor changes.	Periodically based on adjacent construction activity.	Photograph or otherwise record condition.
Site Controls.	Section 02211.	Verify secured zone, CRZ, and exclusion zone are established, and traffic controls in place.	Prior to and periodically during construction.	Observation.
TFA Limits.	Drawings C012 to C019 and Appropriate Division 1 Section.	Verify limits of TFA have been established and asphalt is saw-cut to reduce overbreak and limits are surveyed to check perimeter elevation relative to Construction Drawings.	During construction.	Survey and observation.
Above Surface Demolition				
Dust control.	Section 02083.	Document dust is controlled.	Continuously during work.	Observation.
Above ground Demolition.	Drawing C014. Section 02211. Section 02222.	Verify all above ground items are demolished, including: Buildings M-25 and M-27, electrical Substation 11, loading ramp, foam risers, exposed	After removal.	Observe.

TABLE 7-1
TFA SITE PREPARATION

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA TEST METHOD OR REFERENCE DOCUMENT
		vaults, piping, and fences.		
Asphalt removal and stockpiling.	Drawing C015. Section 02222. Section 02228. Section 02337.	Verify asphalt cut around limits of TFA.	Prior to removing.	Observation.
		Verify free product contamination removed from asphalt surface.	Prior to asphalt removal.	Observation.
		Verify asphalt is removed, transported and stockpiled per accepted stockpiling plan and is covered with plastic at day's end.	At the end of each working day.	Observation.
Base course removal and stockpiling.	Section 02232. Section 02333.	Verify base course is excavated. Verify base course is stockpiled per accepted stockpiling plan and is covered with plastic at day's end.	At the end of each working day.	Observation.
Soil Excavation.	Section 02332. Section 02339	Verify soil previously placed as subgrade for existing asphalt pavement is excavated until underlying tank bases, concrete slabs, footings and foundations are uncovered. Verify this soil does not include any highly contaminated soil.	Continuously during excavation.	Observation and as directed by the Port's EMS.
		Verify soil is categorized as highly contaminated, or not highly contaminated and loaded, hauled and stockpiled separately.	Continuously during excavation.	Observation and as directed by the Port's EMS.

TABLE 7-1
TFA SITE PREPARATION

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA TEST METHOD OR REFERENCE DOCUMENT
Highly contaminated soil.	Sections 02332, 02337 and 02405.	Verify subgrade exposed below concrete structures is examined and any highly contaminated soil is over-excavated to remove it above the water table and that excavation does not continue below ground water table.	Below all concrete structures.	Observation. Document areas requiring soil removal.
		Provide guidance to Contractor regarding designation of soil as being highly contaminated or not highly contaminated.	Continuous below all concrete.	Document areas with highly contaminated soil.
		Verify highly contaminated soil is loaded, hauled and stockpiled in a separately designed area within the stockpile area and in compliance with the accepted Work Plan and Section 02405.	Whenever highly contaminated soil is moved outside the TFA.	Document quantity hauled.
		If floating LNPL is encountered, verify it is handled per Section 02405.	Continuous below all concrete.	Observation.
Removal of Subsurface Structures				
Sheeting and shoring.	Appropriate Division 1 Sections, Section , 02333, 02222, 02337 and Accepted	Review accepted Work Plan regarding sheeting and shoring and verify installed sheeting and shoring complies with the accepted submittal as excavation proceeds.	Periodically during the work, and at the beginning and end of each working day.	Review and observation.

TABLE 7-1
TFA SITE PREPARATION

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA TEST METHOD OR REFERENCE DOCUMENT
	Work Plan.	For material specified in work plan, visually inspect or confirm that the following sheeting properties comply with the Contractors Work Plan: • Mass, Length, Thickness, Width, and Straightness	Verify material quality upon arrival at site	Observation.
Sheeting and shoring relative to excavation limits.	Drawings C012 to C020, Appropriate Division 1 Sections, accepted work plan.	Verify sheeting and shoring location and excavations comply with lines and grades shown on the Drawings.	During installation of sheeting and shoring	Survey.
Piles associated with sheeting and shoring .	Accepted Work Plan.	Prepare pile log documenting length of each pile, and final top and tip elevations for each pile.	Continuously during driving	Pile log.
Walers associated with sheeting and shoring.		Visually inspect walers to ensure they are installed at design elevations, with connections between walers and bracing per Contractors Work Plan	Upon installation.	Observation.
Tank Base Demolition.	Section 02211. Section 02222. Section 02405.	Verify tank bases are exposed.	Prior to starting tank base demolition.	Observation.
		Verify tank bases are decontaminated per Section 02221.	Prior to removal from exclusion	Observation.

TABLE 7-1
TFA SITE PREPARATION

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA TEST METHOD OR REFERENCE DOCUMENT
			zone.	
		Verify tank bases are cut to sizes that allow loading, hauling and stockpiling.	Prior to removal from exclusion zone.	Observation.
		Verify flammable liquids, welding/cutting equipment, and compressed gases are not used to cut and remove tank bases.	During demolition.	Observation.
		Verify Items designated for salvage/recycling are separated from those designated for disposal.	During loading and/or stockpiling.	Observation.
		Verify steel products are recycled or disposed of per Section 02405.	During demolition.	Disposal records.
Concrete Demolition.	Sections 02211, 02222, 02228, 02337.	Verify existing foundations designated to remain (Buildings 19 and 28) are protected during the removal of adjacent structures.	Prior to starting demolition.	Observation
		Verify that former containment wall/foundation forming east wall/foundation of Building M-28 is saw cut at north and south ends.	Prior to demolishing adjacent portions of containment wall foundation.	Survey saw cut locations.
		Verify concrete demolition is coordinated with sheeting and shoring for removal of identified structures.	Prior to starting concrete demolition.	Observation.

TABLE 7-1
TFA SITE PREPARATION

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA TEST METHOD OR REFERENCE DOCUMENT
		Verify free product contamination is removed from surface of concrete before demolishing per Section 02211.	Observe all exposed concrete surfaces.	
		Verify that all concrete associated with the following is demolished: • Foundations below Buildings 24, 25, 26, 27 and 30 and Substation 11; • Tank foundations; • Concrete slabs in the three oil yards; • Containment wall foundations around the three oil yards; • Other concrete walls inside and outside the three oil yards; • Foam distribution stations; • Oil water separators; • Storm water vaults; • Miscellaneous other below grade structures; and • Former steam vault.	Continuous during demolition.	Observe each all concrete has been removed from each portion of the TFA.
		Verify broken concrete is loaded, hauled, crushed, screened and stockpiled within the TFA if used for backfill. If not used for backfill verify it is loaded, hauled and placed in the stockpile area.	Continuous during demolition.	Observation.

TABLE 7-1
TFA SITE PREPARATION

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA TEST METHOD OR REFERENCE DOCUMENT
		Verify concrete is processed per Section 02228	Continuous during demolition.	Observation.
		Recycle metal components per Section 02211.	Continuous during demolition.	Observation.
Exploratory Trench				
Exploratory trench.	Construction Drawing C019. Sections 02222, 02469, and 02335.	Verify survey is completed to define alignment of center line of cutoff wall and elevation control established along alignment.	Before excavating a new segment of the exploratory trench.	Observation.
		Verify exploratory trench excavated to a minimum elevation of 11 ft. If subgrade elevation following concrete removal is lower than elevation 11 ft, then an exploratory trench is not required at that location.	During excavation.	Observation and measurement based on survey control.
		Verify Contractor complies with Port's EMS designation of highly contaminated soil excavated from working trench. Document location of highly contaminated soil.	Continuously during excavation.	Observation.

TABLE 7-1
TFA SITE PREPARATION

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA TEST METHOD OR REFERENCE DOCUMENT
		Verify that if highly contaminated soil, if encountered it is managed in accordance with Section 02332.	Continuously during excavation.	Observation.
		If any man-made objects are encountered in the exploratory trench, document location and notify Port immediately. Additional actions to be based on nature of material encountered.	As required.	Observation and survey location.
		Verify exploratory trench is backfilled with soil that is not highly contaminated that was excavated from the exploratory trench or is obtained from close to the exploratory trench.	Continuous.	Observation
Backfill and Grading				
Engineered Fill.	Drawing C028 Section 02339.	Verify engineered fill placement begins only when underlying subgrade has been accepted by the CQAC.	Before backfilling in new location.	Observation.
		Verify to the extent practical, that the surface on which fill is being placed is free of water.	Before backfilling.	Observation.
		In areas below groundwater elevation, verify gravel fill is used in accordance with Section 02339.	During backfilling.	Observation.
		Perform conformance testing per Table 7-2.	See table 7-2. per material type.	ASTM D422 & ASTM D1557.
		Verify engineered fill is placed to the grade required to construct the cutoff wall, and is not above	Continuously during	Survey.

TABLE 7-1
TFA SITE PREPARATION

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA TEST METHOD OR REFERENCE DOCUMENT
		adjacent grades outside the TFA.	placement.	
		Verify soil is placed and spread in loose lift thickness not exceeding 8 inches.	During placement.	Observation and field testing per Table 7-2.
		Verify soil is moisture conditioned as needed to achieve specified compacted dry density.	During placement.	Observation and field testing per Table 7-2.
		Verify lifts are compacted to a minimum of 92% of maximum dry density determined by ASTM D1557 and does not yield under equipment loads.	During placement.	Observation and field testing per Table 7-2.
		Check moisture content determined with nuclear gauge	During placement.	Observation and field testing per Table 7-2.
		Verify moisture is maintained within specified range until covered with subsequent lifts	Periodic.	Observation

TABLE 7-2
TFA SITE PREPARATION SOIL CONFORMANCE AND CONSTRUCTION TESTING

REQUIRED TESTS	TEST DESIGNATION	TEST FREQUENCY	ESTIMATED TOTAL NUMBER OF TESTS	ACTUAL NUMBER OF TESTS PERFORMED
Engineered Fill Conformance Testing				
Moisture / Density Relationship	D1557	1 / material type	1	
Gradation	D422	1 / material type	1	
Engineered Fill Construction Testing				
Density, Nuclear Method	D6938	1 per 250 cubic yards placed and a minimum of one in each individual excavation area being backfilled.		
Moisture Content, Nuclear Method	D6938	1 per density test.		

8.0 WORK ELEMENT - ASPHALT AND CONCRETE CLEANING CRUSHING AND SCREENING

8.1 Summary of Work

This Section describes CQA activities related to cleaning, crushing, screening and stockpiling asphalt and concrete. The asphalt and concrete will be generated during TFA site preparation in the AOC, SWMU 30 excavation, exposing of pipelines, and constructing the LNAPL trenches. The construction activities will include:

- Cleaning asphalt concrete pavement removed from the TFA area;
- Cleaning concrete slabs, footings, and structures removed from the TFA area;
- Potentially cleaning asphalt concrete pavement that was removed from the TFAA and SWMU 30 to complete other work; and
- Crushing, screening, and stockpiling cleaned asphalt and concrete.

8.2 Test Standards

The following test standards apply to this section:

TEST DESIGNATION	TEST DESCRIPTION
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
ASTM D1140	Standard Test Methods for Amount of Material in Soils Finer than No. 200 (75-μm) Sieve.

8.3 CQA Monitoring and Testing Requirements

Each element of work has specific construction requirements that must be monitored, and or tested. These CQA requirements are summarized in Table 8.1.

TABLE 8-1
ASPHALT AND CONCRETE CLEANING, CRUSHING, SCREENING AND STOCKPILING

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA TEST METHOD OR REFERENCE DOCUMENT
Preparation				
Submittals.	Appropriate Division 1 Section, and Section 02337.	Review accepted Work Plan including Stockpiling Plan.	Prior to initiation of work.	Document review.
Erosion and Sediment Controls.	Section 02270.	Verify stormwater BMPs are installed at stockpile areas.	Prior to using stockpile areas.	Observation.
Stockpile and processing areas.	Section 02337.	Verify asphalt and concrete stockpile and processing areas are prepared either inside or outside of the TFA.	Prior to using stockpile areas.	Observation.
Crushing, Screening and Stockpiling				
Asphalt and Concrete Processing.	Sections 02228, 02337, and 02211.	Provide guidance to Contractor regarding asphalt and concrete that requires surface cleaning.	During demolition activities.	Observation.
		Verify observable free product contamination is removed from surface of asphalt and concrete before it is crushed, screened and stockpiled. • Existing surface asphalt can be processed and stockpiled either inside or the AOC or outside the AOC. • Concrete generated outside the AOC.	During demolition activities.	

TABLE 8-1
ASPHALT AND CONCRETE CLEANING, CRUSHING, SCREENING AND STOCKPILING

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA TEST METHOD OR REFERENCE DOCUMENT
		• Concrete generated inside of the AOC must remain in the outside of the AOC will be processed and stockpiled • AOC at all times during crushing, screening, and stockpiling.		
		Verify wash water is managed in accordance with Section 02211 and Contractor's Work Plan.	During demolition activities.	
		Verify asphalt and concrete is mechanically crushed and screened to produce pieces with a maximum size of 1.5 inches. Verify that concrete processed outside of the AOC stays outside of the AOC.	Periodically during material processing and crushing operations.	
		Verify material retained on the 1.5-inch screen is re-crushed and re-screened until all pieces pass through the 1.5-inch screen.	Periodically during work.	
		Verify that concrete processing equipment removes all reinforcing steel from the concrete.	Periodically during work.	
		Verify broken asphalt and concrete designated for fill inside the cutoff wall alignment remains within the AOC at all times prior to placement.	Periodically during work.	
Gradation testing.	Contractor Work Plan.	Verify Contractor performs quality control gradation testing ensuring crushed product passes through a 1.5-inch screen.	Per Contractor Work Plan.	Review CQC testing.

9.0 WORK ELEMENT – CUTOFF WALL

9.1 Summary of Work

This Section describes CQA activities related to constructing a vertical cutoff wall around the perimeter of the TFLP. The construction activities will include:

- Furnishing fine-grained soil that will be used as part of the cutoff wall backfill;
- Furnishing dry bentonite that will be used as part of the cutoff wall backfill;
- Constructing a vertical cutoff wall by continuous trenching method that results in a vertical soil-bentonite barrier that is at least 24-inches wide, is constructed to the design depth, and has a hydraulic conductivity no greater than 1 x 10^{-7} cm/sec;
- Furnishing ordinary Portland cement that will be mixed with the constructed soil-bentonite wall in the uppermost 2 feet to create a soil-cement-bentonite plug.

9.2 Test Standards

The following test standards apply to this section:

TEST DESIGNATION	TEST DESCRIPTION
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
ASTM C138	Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
ASTM C143	Test Method for Slump of Hydraulic-Cement Concrete.
ASTM C150	Standard Specification for Portland Cement.
ASTM D422	Standard Test Method for Particle-Size Analysis of Soils.
ASTM D1126	Standard Test Method for Hardness in Water.
ASTM D1140	Standard Test Methods for Amount of Material in Soils Finer than No. 200 (75-µm) Sieve.
ASTM D1293	Standard Test Methods for pH of Water.
ASTM D1633	Standard Test Methods for Compressive Strength of Molded Soil-Cement Cylinders.
ASTM D2216	Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

ASTM D4380	Standard Test Method for Density of Bentonitic Slurries.
ASTM D4381	Standard Test Method for Sand Content by Volume of Bentonitic Slurries.
ASTM D4643	Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Heating.
ASTM D4832	Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
ASTM D5084	Hydraulic Conductivity Using a Flexible Wall Permeameter.
ASTM D5907	Standard Test Methods for Filterable Matter (Total Dissolved Solids) and Non-filterable Matter (Total Suspended Solids) in Water.

9.3 CQA Monitoring and Testing Requirements

Each element of cutoff wall work has specific construction requirements that must be monitored, and or tested. These CQA requirements are summarized in Tables 9-1, 9-2, and 9-3.

TABLE 9.1
CUTOFF WALL

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	MONITORING OR TESTING FREQUENCY	CQA TEST METHOD
Preparation				
Submittals and Work Plan reviews.	Appropriate Division 1 Section.	Review Cutoff Wall Construction Plan and Cutoff Wall Operating Plan.	Prior to start of work.	Document review.
Execution				
Trench Width.	Drawings C038 to C040. Section 02469.	Verify installed dimensions of cutoff wall as follows: 2 foot minimum width, except 6 ft minimum width in upper 2 feet.	Monitor continuously.	Observe and field measure. Make independent measurements. Document with record survey and record drawings
Cutting boom orientation.	Section 02469.	Verify cutting boom is rotated to vertical position to designed bottom elevation before starting to advance the trench. Verify cutting boom is maintained in vertical position for remainder of trenching.	Monitor continuously.	Observation.
Bottom of trench elevation.	Drawing C021.	Verify bottom elevation of boom is maintained to design elevation.	Record at 25 ft intervals.	Set up elevation reference points around site perimeter at 25-foot intervals and make hand level or engineers level

TABLE 9.1
CUTOFF WALL

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	MONITORING OR TESTING FREQUENCY	CQA TEST METHOD
				checks based on boom position.
Settlement of soil-bentonite backfill following completion of cutoff wall.	Section 02469.	Confirm that settlement of top of cutoff wall has stopped.	Check entire alignment, several days to week after construction.	Observe settlement for 5 calendar days.
		Verify sufficient extra soil-bentonite slurry is kept available to compensate for settlement.		
		Verify additional soil-bentonite is added as needed to compensate for settlement.		
Soil-bentonite-cement-backfill.	Section 02469.	Verify weight of cement added to soil bentonite. Estimate in place volume of soil-cement-bentonite mix based on field volume measurements.	Every 25 ft.	Record quantity of cement added on a dry weight basis and calculate cement addition on a percent dry weight basis. Record in daily reports.
Minimum cement content of 8% by dry unit weight	Section 02469.	Perform microwave moisture content measurement prior to hydrating soil-cement-bentonite backfill.	75-foot intervals.	Record volume water added to achieve mix design slump. ASTM D4643 per tables 9-2 and 9-3.

TABLE 9.1
CUTOFF WALL

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	MONITORING OR TESTING FREQUENCY	CQA TEST METHOD
Soil-bentonite slump 4 to 6 inches Density/Unit Weight.	Section 02469.	Observe CQC testing and perform independent CQA tests at CQA Monitor's discretion. Distribute documentation daily. Document sample locations.	75-foot intervals.	ASTM C143, and ASTM C138 per Tables 9-2 and 9-3.
Soil-cement-bentonite slump 4 to 6 inches Density/Unit Weight.	Section 02469	Observe CQC testing and perform independent CQA tests at CQA Monitor's discretion. Distribute documentation daily. Document sample locations.	150-foot intervals	ASTM C143, and ASTM C138 per Tables 9-2 and 9-3.
Mixing per approved Work Plan.	Appropriate Division 1 Section. Work Plan and 02469.	Verify that cement is thoroughly mixed into the soil-bentonite to create a homogeneous blend, using equipment and methods in Work Plan.	Continuous observation.	Observation.
Settlement and curing.	Section 02469	Monitor soil-bentonite-cement mix for settlement and curing which results in compressive strength.	Periodically monitor for 14 days.	ASTM D1633 per tables 9-2 and 9-3.
Desiccation Control.	Section 02469.	Verify top of soil-bentonite and top of soil-cement-bentonite is covered with plastic for minimum of 1 week after material placed.	After completion of each section. Periodically monitor for 14 days.	Observation.

TABLE 9.1
CUTOFF WALL

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	MONITORING OR TESTING FREQUENCY	CQA TEST METHOD
Top of wall protection.	Section 02469.	Verify that trench plates are deployed over the cutoff wall for all equipment crossings until subgrade elevations achieved. No direct vehicular contact with top of cutoff wall permitted.	Periodically monitor for 14 days.	Observation.
Quality Control / Quality Assurance				
Verify that the Contractor completes the following quality control work.				
Fine soil addition to soil bentonite backfill.	Section 02469.	Verify that Contractor computes the volume of fine soil added to the soil/bentonite backfill. Target fine soil proportion is 30 percent by dry weight of soil basis.	Every 25 feet.	Observation and CQC documentation review. Perform independent calculations.
Bentonite addition to soil/bentonite backfill.	Section 02469.	Verify Contractor CQC personnel computes percentage of bentonite added to the soil bentonite mix on a dry weight basis. Target percentage is based on the accepted mix design. Calculate percentage of bentonite added to soil in the cutoff wall on a dry weight basis.	Continuously during installation.	Review CQC calculation for bentonite addition. Perform independent monitoring and calculation of bentonite addition. Use form provided in Appendix A.

TABLE 9.1
CUTOFF WALL

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	MONITORING OR TESTING FREQUENCY	CQA TEST METHOD
Quality Control Testing.	Section 02469	Verify quality control testing summarized in Table 9-2 is completed at the frequencies listed in the table.	See Table 9-2.	Perform independent CQA testing per Table 9-3.
Horizontal Alignment.	Section 02469.	Verify record survey is performed to document the installed alignment of the cutoff wall. Target tolerance is within 1 foot of the designed horizontal alignment.	Survey at 25 ft intervals.	Observation and review of survey documentation plotted on record drawings.

TABLE 9-2
CUTOFF WALL QUALITY CONTROL TESTING

MATERIAL	TEST DESCRIPTION	TEST STANDARD	MINIMUM FREQUENCY	TOTAL NUMBER OF PLANNED TESTS	ACTUAL NUMBER OF TESTS PERFORMED
Random Sampling and Field Testing					
City water	Hardness	ASTM D1126	1 test	1	
	pH	ASTM D1293	1 test	1	
Bentonite Slurry	Viscosity – Marsh funnel	API RP 13B-1	2 per shift	N/A	
	Unit Weight	ASTM D4380	2 per shift	N/A	
Soil-bentonite backfill (immediately after mixing and placement)	Slump	ASTM C143	Every 75 linear ft of cutoff wall	19	
	Unit Weight	ASTM C138	Every 75 linear ft of cutoff wall	19	
Soil-cement bentonite backfill (immediately after mixing and placement)	Slump	ASTM C143	Every 150 linear ft of cutoff wall	10	
	Unit Weight	ASTM C138	Every 150 linear ft of cutoff wall	10	

TABLE 9-2
CUTOFF WALL QUALITY CONTROL TESTING

MATERIAL	TEST DESCRIPTION	TEST STANDARD	MINIMUM FREQUENCY	TOTAL NUMBER OF PLANNED TESTS	ACTUAL NUMBER OF TESTS PERFORMED
Random Sampling and Laboratory Testing					
Soil-bentonite Backfill	Hydraulic Conductivity.	ASTM D5084	Every 150 linear ft of cutoff wall	10	
	Atterberg Limits.	ASTM D4318	Every 150 linear ft of cutoff wall	10	
	Gradation.	ASTM D422	Every 150 linear ft of cutoff wall	10	
	Density/Unit Weight.	ASTM C138	Every 150 linear ft of cutoff wall	10	
	Moisture Content and Dry Unit Weight.	ASTM D2216.	Every 150 linear ft of cutoff wall	10	
Soil-cement-bentonite backfill	Compressive Strength at 7, 14, 28 and 56 days.	ASTM D4832 and ASTM D2166	Every 300 linear ft of cutoff wall	6	
	Density/Unit Weight.	ASTM C138	Every 300 linear ft of cutoff wall	6	
	Moisture Content and Dry Unit Weight.	ASTM 2216	Every 300 linear ft of cutoff wall	6	

TABLE 9-2
CUTOFF WALL QUALITY CONTROL TESTING

MATERIAL	TEST DESCRIPTION	TEST STANDARD	MINIMUM FREQUENCY	TOTAL NUMBER OF PLANNED TESTS	ACTUAL NUMBER OF TESTS PERFORMED
	Hydraulic Conductivity.	ASTM D5084	Every 300 linear ft of cutoff wall	10	
	Gradation.	ASTM D422	Every 300 linear ft of cutoff wall	6	

TABLE 9-3
CUTOFF WALL QUALITY ASSURANCE TESTING

MATERIAL	TEST DESCRIPTION	TEST STANDARD	MINIMUM FREQUENCY	TOTAL NUMBER OF PLANNED TESTS	ACTUAL NUMBER OF TESTS PERFORMED
Random Sampling and Field Testing					
Soil-bentonite Backfill (immediately after mixing and placement)	Slump	ASTM C143	Every 75 linear ft of cutoff wall	19	
	Unit Weight	ASTM C138	Every 75 linear ft of cutoff wall	19	
Soil-cement bentonite backfill (immediately after mixing and placement)	Slump	ASTM C143	Every 150 linear ft of cutoff wall	10	
	Unit Weight	ASTM C138	Every 150 linear ft of cutoff wall	10	
Random Sampling and Laboratory Testing					
Soil-bentonite Backfill	Hydraulic Conductivity	ASTM D5084	Every 150 linear ft of cutoff wall	10	
	Atterberg Limits.	ASTM D4318	Every 150 linear ft of cutoff wall	10	
	Gradation.	ASTM C136 / ASTM D4381	Every 150 linear ft of cutoff wall	10	

TABLE 9-3
CUTOFF WALL QUALITY ASSURANCE TESTING

MATERIAL	TEST DESCRIPTION	TEST STANDARD	MINIMUM FREQUENCY	TOTAL NUMBER OF PLANNED TESTS	ACTUAL NUMBER OF TESTS PERFORMED
	Density/Unit Weight.	ASTM C138	Every 150 linear ft of cutoff wall	10	
	Moisture Content and Dry Unit Weight.	ASTM D2216.	Every 150 linear ft of cutoff wall	10	
Soil-cement-bentonite backfill	Compressive Strength at 7, 14, 28 and 56 days.	ASTM D4832 and ASTM D2166	Every 300 linear ft of cutoff wall	6	
	Gradation.	ASTM D422	Every 300 linear ft of cutoff wall	6	
	Hydraulic Conductivity.	ASTM D5084	Every 300 linear ft of cutoff wall	6	
	Density/Unit Weight.	ASTM C138	Every 300 linear ft of cutoff wall	6	
	Moisture Content and Dry Unit Weight.	ASTM 2216	Every 300 linear ft of cutoff wall	6	

10.0 WORK ELEMENT – LNAPL RECOVERY TRENCHES

10.1 Summary of Work

This Section describes CQA activities related to constructing LNAPL recovery trenches inside of and west of the TFLP. Construction activities associated with these trenches includes:

- Establishing and operating stormwater BMPs;
- Surveying to establish horizontal and vertical location of the LNAPL trenches;
- Decommissioning existing monitoring wells;
- Locating, and protecting existing utilities;
- Providing, installing and maintaining trench safety systems;
- Excavating, loading, hauling, and stockpiling soil excavated from the trenches;
- Excavating, loading, hauling, stockpiling, profiling and disposing of highly contaminated soil from the trenches;
- Backfilling the trenches with permeable gravel, collection piping, collection sumps, riser pipes, and clean soil;
- Installing access vaults and riser pipe completions; and
- Repairing crushed aggregate base, base course and asphalt pavement.

10.2 Test Standards

The following test standards apply to this section:

TEST DESIGNATION	TEST DESCRIPTION
ASTM C857	Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
ASTM C858	Standard Specification for Underground Precast Concrete Utility Structures.
ASTM C891	Standard Practice for Installation of Underground Precast Concrete Utility Structures
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 D1785	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

TEST DESIGNATION	TEST DESCRIPTION
ASTM D2216	Standard Test Method for determining water content of soil aggregate mixtures.
ASTM D2434)	Standard Test Method for Permeability of Granular Soils (Constant Head)
ASTM D2657	Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
ASTM D4491	Test Methods for Water Permeability of Geotextiles by Permittivity.
ASTM D4533	Test Method for Trapezoid Tearing Strength of Geotextiles.
ASTM D4716	Test Method for Constant Head Hydraulic Transmissivity of Geotextiles and Geotextile Related Products.
ASTM D4751	Test Method for Determining Apparent Opening Size of a Geotextile.
ASTM D4833	Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
ASTM D4884	Standard Test method for Strength of Sewn or Thermally Bonded Seams of Geotextiles.
ASTM D5261	Test Methods for Mass Per Unit Area.
ASTM D6241	Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.
ASTM D6938	Standard Test Method for in-place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
ASHTO T230	Standard specification for determining degree of pavement compaction of bituminous aggregate mixtures.

10.3 CQA Monitoring and Testing Requirements

Each element of LNAPL Recovery Trench work has specific construction requirements that must be monitored, and or tested. These CQA requirements are summarized in Table 10.1, and 10.2.

TABLE 10-1
LNAPL RECOVERY TRENCHES

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA TEST METHOD
Preparation				
Temporary Erosion and Sediment Control (TESC).	Section 02270.	Verify stormwater BMPs are installed.	Prior to initiating work. Daily during work.	Observation.
Stockpile preparation.	Section 02337.	Verify Stockpile areas are completed and prepared for stockpiling of soil and highly contaminated soil.	Prior to initiating work. Daily when active and at end of day.	Observation.
Protection.	Section 02621.	Verify utilities are located and protected.	Prior to beginning excavation.	Observation.
		Verify monitoring wells and vapor probes are located and protected.		
		Verify traffic controls as in place to maintain commercial traffic through construction zone on Coontz Avenue.		
		Verify bench marks, existing structures, fences, paving, and stormwater control systems designated to remain are protected.		
		Verify open holes or trenches and other depressions occurring as part of the Work are barricaded and warning signs or lights are posted on property adjacent to or with public access.	Daily during work.	

TABLE 10-1
LNAPL RECOVERY TRENCHES

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA TEST METHOD
Alignment	Section 02621.	Verify surveys are completed to locate horizontal and vertical position of trenches and pipe collectors.	Prior to beginning excavation.	Observe and field measure.
Execution				
During LNAPL Recovery Trench Installation verify the following:				
Dust control.	Section 02621.	Dust is controlled.	Continuously during work.	Observation.
Sheeting and shoring.	Section 02621.	Sheeting and shoring necessary for protection of the Work and for the safety of personnel is installed in accordance with OSHA rules and regulations, and the accepted Work Plan.	Each LNAPL trench.	Observation.
Excavation.	Section 02621.	Existing asphalt pavement is saw cut where required to begin trenching as indicated on the Drawings, and Underlying aggregate is removed and saved	Trench 5.	Observation.

TABLE 10-1
LNAPL RECOVERY TRENCHES

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA TEST METHOD
		The bearing splay of building foundations are not interfered with.		
		The trench is excavated to the minimum width necessary for proper installation and inspection of the gravel backfill and collector pipe installation, with sides as nearly vertical as possible.	Each LNAPL trench.	Measure width and observation.
	Drawings C026 and C027.	The correct minimum separation is maintained from the cutoff wall alignment.	Each LNAPL trench.	Measure separation and observe.
	Section 02405. Section 02621.	Water or materials that interfere with Work are removed and handled in accordance with Section 02405.		Observation.
	Section 02405. Section 02621.	Highly contaminated soil removed from the trenches is handled per Section 02405.		
Backfill and Collector Pipe Installation.	Section 02339 Section 02621. Section 02722. Drawings C026 and C027.	Backfill is not compacted or consolidated by jetting with water or other means.	Each LNAPL trench.	Observation and testing per table 10-2.
		The trenches are backfilled with materials indicated on the Drawings.		

TABLE 10-1
LNAPL RECOVERY TRENCHES

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA TEST METHOD
		Gravel backfill is placed to the dimensions, thickness and elevations indicated on the Drawings per Section 02621.		
		A placement method is used that does not disturb or damage collector pipe, sump, and risers.		
Collector Pipe and Sump.	Section 02621. Drawings C026 and C027.	During PVC pipe installation verify the following: 1. Select proper solvent cement and primer.	Each LNAPL Trench.	Observation.
		2. Condition pipe and fittings at the same temperature before starting assembly.		Observation per ASTM 2657.
		3. Assemble pipes and fittings above ground where possible or in areas of good air circulation.		
		4. Cut the pipe square to desired length, remove burrs, and chamfer the pipe end using a factory bevel as a guide to the length and taper.		Observation.
		5. Clean and dry the pipe and fitting to remove all dirt, moisture, and grease using a clean and dry rag.		

TABLE 10-1
LNAPL RECOVERY TRENCHES

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA TEST METHOD
		6. Check dry fit by inserting pipe into half depth of the socket. 7. Apply primer to the inside of the socket and to the spigot following manufactures instructions. Select an applicator that is at least ½ the size of the socket. 8. Apply solvent cement while the primer is still wet following manufacturer's instructions. Select and applicator that is at least ½ the size of the socket. 9. Assemble the socket and spigot while cement is still wet. Push and twist the socket onto the spigot until it bottoms out, and hold together until the cement sets to avoid pushout. Additional holding or restraint of pipe may be required for the larger sizes. 10. Remove all excess cement from the outside of the joint using a clean dry rag. Avoid disturbing the joint. Excess cement may cause		

TABLE 10-1
LNAPL RECOVERY TRENCHES

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA TEST METHOD
		weakening of the joint and additional cure time. 11. Allow joint to set before disturbing. 12. Do not pressurize or test until the appropriate cure time has been achieved. Refer to manufacturers cure time recommendations.		
Backfill and Asphalt Repair.	Section 02621. Section 02771. Drawings C026 and C027.	Review Contractor's approved submittal for geotextile separator and manufacturer's quality control test data. Compare roll numbers of delivered material with roll numbers on MQC data. Document MQC test results indicate the products meet specified requirements prior to installation.	Document review before use.	MQC data review.
		Monitor geotextile installation to verify it is installed correctly per Section 02771.	Each LNAPL trench.	Observation.
	Section 02339 Section 02621 Section 02722. Drawings C026 and C027.	Verify engineered fill is placed and compacted in continuous layers not exceeding 12 inches to a minimum relative compaction of 92 percent as determined by ASTM 1557.	Each lift.	Table 10-2.

TABLE 10-1
LNAPL RECOVERY TRENCHES

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA TEST METHOD
		Optimum moisture content is maintained in fill materials to attain required compaction density.		
		A placement method is used that does not disturb or damage collector piping in trench		Each lift.
		Base course aggregate backfill is placed and compacted in continuous layers not exceeding 8 inches to a minimum relative compaction of 95 percent as determined by ASTM 1557.	Each lift.	Table 10-2.
		Optimum moisture content of fill materials is maintained to attain required compaction density.		
	Section 02743.	Asphalt is repaired per Section 02743.	Each trench.	Observe CQC testing (Rice density as determined by AASHTO T 230).

TABLE 10-1
LNAPL RECOVERY TRENCHES

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA TEST METHOD
Controlled Density Fill				
Controlled Density Fill	Drawing C008. Section 03310	Review trial batches and historical strength data for similar mix designs. Verify Contractor performs the following quality control tests during installation:	Prior to first use	Review test results

TABLE 10-2
LNAPL RECOVERY TRENCH SOIL CONFORMANCE AND CONSTRUCTION TESTING

REQUIRED TESTS	TEST DESIGNATION	TEST FREQUENCY	ESTIMATED TOTAL NUMBER OF TESTS	ACTUAL NUMBER OF TESTS PERFORMED
Engineered Fill Conformance Testing				
Moisture / Density Relationship.	D1557	1 / material type	1	
Engineered Fill Construction Testing				
Density, Nuclear Method.	D6938	1 per 12-inch thick lift in each trench	Up to 10	
Moisture Content, Nuclear Method.	D6938	1 per density test.	Up to 10	
Aggregate Base and Base Course Conformance Testing				
Moisture / Density Relationship.	D1557	1 per material type	1	
Base Course Construction Testing				
Density, Nuclear Method.	D6938	1 per 8-inch thick lift per trench	Up to 10	
Moisture Content, Nuclear Method.	D6938	1 per density test.	Up to 10	
Optional Asphalt In-Place Density Testing				
Density, Nuclear Method.	ASHTO T230	1 per 1,000 square feet and a minimum of one per trench	Up to 10	

11.0 WORK ELEMENT – TANK FARM AREA GRADING, FINAL COVER AND STORMWATER MANAGEMENT SYSTEMS

11.1 Summary of Work

This Section describes CQA activities related to constructing an asphalt final cover and stormwater management systems in the TFA. Construction activities associated with the cutoff wall include:

- Placing, grading and compacting clean engineered fill to create subgrade for the final cover;
- Furnishing, placing, grading and compacting crushed aggregate base and base course;
- Furnishing, placing and compacting asphalt paving; and
- Furnishing and installing stormwater management systems including catch basins, drain pipes and treatment systems.

11.2 Test Standards

The following test standards apply to this section:

TEST DESIGNATION	TEST DESCRIPTION
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 D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).
ASTM D 4643	Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Heating.
ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
WSDOT 2012	Standard Specifications for Road, Bridge, and Municipal Construction.

11.3 CQA Monitoring and Testing Requirements

Each element of the final cover and stormwater system work has specific construction requirements that must be monitored, and or tested. These CQA requirements are summarized in Tables 11-1 and 11-2.

TABLE 11-1
TANK FARM GRADING AND FINAL COVER

TASK OR ITEM	SPECIFICATION SECTION, DRAWING OR PLAN	REQUIRED OBSERVATION, TESTING OR DOCUMENTATION	INSPECTION OR TESTING FREQUENCY	CQA TEST METHOD
Preparation				
Dust control.	Sections 02083, 02337, 02339.	Verify dust is controlled during all activities	Continuously.	Observation.
Survey.	Sections 01052 and 02339.	Verify necessary surveys (slope staking) are performed to define the final cover grading.	Before initiating grading.	Observation.
Steel Plates.	Section 02339.	Verify steel plates are used to bridge cutoff wall alignment at all places where equipment will cross the cutoff wall alignment.	Before initiating equipment crossings.	Observation.
Gravel Fill.	Section 02339. Drawing C019.	Review Contractor's Work Plan for equipment and methods for installing and compacting gravel fill below groundwater.	Prior to NTP.	Submittal.
		Review 40-pound material sample and supplier gradation. Perform conformance test gradation per Table 11-2.	14 days prior to installation.	Submittal.
		Perform gradation test of representative sample of material delivered for installation at the frequency listed in Table 11-2.	1 per 100 cy.	ASTM D422 or ASTM C136 per Table 11-2
		Verify gravel placed to a minimum of 1 ft above groundwater surface.	As material is being installed.	Observation.
		Verify groundwater elevation managed inside excavation as gravel placed.		

Engineered Fill Execution				
Placing Soil Engineered Fill.	Drawings C019 and C028. Section 02339.	Perform conformance tests per Table 11-2 to determine gradation and compaction characteristics of soil.	1 per material type.	ASTM D422 & ASTM D1557 per table 11-2.
		Verify engineered fill placed if elevation more than 1 ft above groundwater level.	During placement.	Observation.
		Verify surveys are performed that define perimeter tie in grades consistent with the Construction Drawings.	Prior to starting grading.	Survey.
		Verify subgrade complies with Section 02339 prior to initiating fill placement.	Following completion of cutoff wall.	Observation of subgrade.
		Verify soil is placed and spread in loose lift thickness not exceeding 8 inches.	During placement.	Observation and field measurement.
		Verify soil is moisture conditioned as needed to achieve specified compacted dry density.	See Table 11-2.	ASTM D1557, D6938 per Table 11-2.
		Verify lifts are compacted to a minimum of 92% of maximum dry density determined by ASTM D1557.	See Table 11-2 for test frequencies.	ASTM D6938. As an option, in place density may at CQAC's discretion be assessed using observational procedures, such as proof-rolling with dump trucks, or assessment of compaction equipment after field determined minimum number of passes.

Engineered Fill Execution				
Placing Crushed Concrete and Asphalt as Engineered Fill	Sections 02228, 02339	Check crushed asphalt or concrete is compacted using a smooth-drum roller with a minimum drum diameter of 5 feet, a minimum drum width of 5 feet, and a minimum drum weight of 4,000 pounds per foot of drum width, making a minimum of 3 one-way passes over each lift.	Each lift of crushed asphalt or concrete.	Observe equipment and operation.
		Following crushed asphalt or concrete compaction verify lift is proof-rolled with a loaded dump truck, or equipment with equivalent ground pressure, is driven over each compacted lift in cross-directions. If yielding of more than 2 inches occurs, verify that the yielding fill is scarified; moisture conditioned and re-compacted until yielding no longer occurs.		Observe each lift of fill for yielding.
		Verify moisture is maintained within specified range until covered with subsequent lifts	Periodic.	Observation or ASTM D4643.
Top of Cutoff Wall Treatment.	Section 02339. Section 02722. Section 02773. Drawing C040.	Verify engineered fill grading performed adjacent to cutoff wall in preparation for geogrid deployment.	Prior to starting top of cutoff wall treatment.	Observation.
		Verify a minimum of 14 days since soil-cement-bentonite (SCB) was placed, and SCB meets target compressive strength.	After 14 days of curing.	Review laboratory data.
		Verify anchor trenches are excavated correctly.	Prior to deploying geogrid.	Observe, measure trenches, survey locations.

		Verify uniaxial geogrid is deployed into anchor trenches and across cutoff wall SCB in correct orientation.	Prior to covering geogrid.	Observe and document location of geogrid placed.
		Verify anchor trenches are backfilled with Base Rock per Section 02722.	Prior to covering anchor trenches.	Observation.
		Verify fill specified in 02773 is placed above uni-axial geogrid.	During backfilling.	
		Verify compaction equipment is not operated over the soil-cement-bentonite, unless over 2 ft of fill is in place.		
		Verify tri-axial geogrid is deployed over Base Rock per Section 02722 across cutoff wall alignment where less than 2 ft of Gravel Fill is present over the uniaxial geogrid.	Prior to covering geogrid.	Observe and document location of geogrid placed.
Concrete Block Gravity Wall				
Delivered blocks	Drawing C034. Section 02660	Verify correct number and types of concrete block are delivered.	Upon delivery.	Observation.
Base of wall grading		Verify subgrade is graded level with minimum toe embedment of at least 12-inches.	Before setting blocks	
		Verify subgrade is compacted to minimum of 95 percent of standard Proctor minimum dry density.	Minimum 2 tests prior to placing leveling gravel	ASTM D6938

		Verify leveling pad is installed to correct thickness and surface profile, and is compacted to a minimum of 95 percent of the modified Proctor maximum dry density	Minimum 2 tests prior to placing blocks.	Thickness check. ASTM D6938
Block Placement.		Verify blocks are placed in correct interlocking positions to correct height, are free of protrusions and debris.	All blocks.	Observation. Confirm top of wall elevation by survey.
Drainage gravel.		Verify a minimum 12-inch wide zone of drainage gravel is placed behind wall and drainage gravel keys into TFA soil below the leveling pad.	Entire length of wall.	Observation and measurement of width.
Geotextile separator	Section 02771	Verify geotextile separator is placed between drainage gravel and retained engineered fill.	Entire length of wall.	Observation.
Crushed Aggregate Base and Base Course Execution				
Crushed Base Rock and Base Course.	Construction Drawings. Section 02722.	Determine gradation and compaction characteristics of crushed base rock and base course per Table 11-2.	1 per material each type.	ASTM C136 & ASTM D1557.
		Verify material gradation and type corresponds to WSDOT Standard Specifications based on contractor submittals and conformance tests in Table 11-2.	1 per material type.	ASTM C136.
		Verify subgrade surface has been accepted by the CQAC and all testing on the engineered fill documents its installation complies with the Technical Specifications. Verify a survey has been performed to document the installed subgrade complies with the elevations and grades shown on the Construction Drawings.	Prior to laying pavement base.	Observation, testing per table 11-2, and survey.

		Verify aggregates are placed in two distinct lifts to the thickness shown on the Construction Drawings, and are placed and spread in horizontal lifts, not exceeding 4 inches thick, in a manner that avoids segregation, and each lift is compacted with a vibratory compactor or roller adequate to provide compaction and obtain the specified density for each lift while still moist.	During placement.	Observation and testing per table 11-2.
		Verify each lift is compacted to a relative compaction of 95% as determined by ASTM D1557, and does not yield under equipment loads.	Per Table 11-2.	ASTM D1557, D6938.
		Water is added as needed to facilitate compacting.	During compaction.	Observation.
		Thickness.	Spot check thickness throughout cover areas or provide method to monitor placement thickness.	Observation and physical measurement.
		Verify soil Is placed to the lines and grades shown on the Drawings, with a thickness tolerance for both layers of plus 0.2 feet, and minus 0.0 feet and a grade tolerance of plus or minus 0.1 feet.	Completion of grading.	Survey.

Asphalt Pavement Execution				
Asphalt	Construction Drawings. Section 02743.	Verify all storm system elements are installed prior to placing asphalt, including: piping, catch basins, manholes, drainage swale grading.	Prior to paving.	Observation.
		Verify all existing elements including: manhole covers, catch basin covers, clean out covers, monitoring well covers are protected and are adjusted to the design grade.		
		Verify that planned paving grades will drain to existing or planned catch basins and manholes.		Observation with survey verification.
		Verify existing pavement edges that are broken or irregular where new pavement will abut are saw cut.		Observation.
		Verify joint sealer is applied to the edges of new paving joints, catch basins, manholes, etc.	During paving.	
		Verify HMA is placed only during dry weather and when the atmospheric temperature is above 40 deg. F.	Time of paving.	Document weather conditions.
		Verify HMA is delivered to the site in covered truck beds.	Each load.	Observation.
		Measure temperature upon placement to verify it exceeds 250 deg. F	Each load during placement.	Measurement.
		Verify HMA is placed in two 2-inch thick compacted lifts.	Provide method to monitor placement thickness. If suspect inadequate thickness core after placing.	Observation or coring.

		Data.	Periodically during work. Review CQC field density test data as it is obtained daily.	Test data review.
		Verify that test results indicate compaction no less than 92% of maximum theoretical specific gravity (Rice density).	Per Table 11-2.	AASHTO T230.
		Verify that unnecessary traffic is not allowed on the HMA until it has completely cooled and set.	Each paving event	Observation.
		Verify that the completed surface is uniform smooth, tight, and true to the lines, grades and cross sections shown on the Drawings.	Entire paved surface.	Observation.
		Surface variations: a maximum of 1/4 inch in 10 feet.		Survey or field grade check with straight edge.
		Document area requiring asphalt to be replaced.	As needed.	Document area.
Stormwater Systems Execution				
Stormwater Systems – General.	Section 02630.	Verify monitoring systems and utilities designated to remain are located and protected.	Prior to starting work.	Observation.
		Verify surveys are performed to establish line and grade of pipes and structures.	Throughout work.	Observation.
Stormwater Systems – Trenching.	Section 02630.	Verify the following:		
		If applicable, existing asphalt pavement is saw cut where required to begin trenching and it is saw cut to the widths indicated on the Drawings or as needed to complete the Work. Underlying aggregates are removed and saved.	As needed.	Observation.

		Trenches are excavated to the minimum width necessary for proper installation and inspection of storm pipes with sides as nearly vertical as possible.	Periodic.	Observation.
		Trenches are excavated to 6 inches below pipe invert and hand trimmed for accurate placement of pipes to design elevations.		
		Water or other materials in trenches that interfere with Work are removed and handled per Section 02405.		
		Soft areas of trench bottom are cut out in locations where it is not practical to compact in place.		
		Hand trimming is completed for bell and spigot pipe joints.		
		Loose soil, lumped subsoil, boulders, and rock is removed.		
		Highly contaminated soil, if encountered is managed per Section 02332 and 02405.	As needed.	
		Over excavated areas are corrected by placing bedding material compacted to a minimum relative compaction of 85 percent as determined by ASTM D1557.		ASTM D6938 per Table 11-2.

Stormwater Systems Execution				
Stormwater Systems – Bedding.	Section 02630.	Verify the following:		
		Bedding is placed at trench bottom in one continuous layer not exceeding 6 inches compacted depth.	See Table 11-2.	Observation and testing.
		Bedding is placed around sides and to top of pipe with bedding materials tamped in place and compacted to a minimum of 90 percent relative compaction as determined by ASTM D698.		
		Optimum moisture content is maintained to attain required compaction density.		
Stormwater Systems – Pipe Placement.	Section 02630.	Verify the following:		
		Pipe and accessories are installed in accordance with manufacturer's instructions.	Each pipe section.	Observation.
		Pipe is lifted or rolled into position and not dropped over prepared bedding.		
		Pipe is shored to the required position; and retained in place until after compaction of adjacent fill materials.		
		Pipe remains in correct lateral position and at the designed slope.		
		Pipe has a full and solid bearing on bedding for its entire length.		
		Pipe is not supported on blocks or mounds of any nature.		

Stormwater Systems – Pipe Backfill.	Section 02630.	Soil backfill materials are installed as shown on the Drawings and compacted to a minimum relative compaction of 90 percent as determined by ASTM D1557.	Per Table 11-2.	ASTM D6938.
		A minimum 12-inch thick cover is provided over the pipe, unless ductile iron, in which case lesser thicknesses are acceptable.	Periodic.	Observation.
		Surface of backfilling under paved areas and access roads is placed to a tolerance of plus or minus 0.1 feet from design elevations.		Survey.
Stormwater Systems – Catch basins, manholes and inlets.	Section 02630.	Verify the following:		
		Catch basins and inlets are placed to the elevations and locations indicated on the Drawings and on bedding.	Each structure.	Survey.
		The inlet frame is either cast into a concrete collar or set flange down on concrete adjustment blocks and mortared, and is not grouted to final grade until the final elevation of the pavement, gutter, ditch, or sidewalk in which it is to be placed has been established.		Observation.
		Pipe inserts are grouted tightly in place at openings in catch basin walls after culvert pipe has been placed to its final position.		
		The socket end of the pipe is placed through catch basin wall so that it is backed against the outside surface of the catch basin as closely as practicable for the angle of entrance.		
		The spigot end of the pipe is square cut flush with the inside wall surface.		

		Bank-run gravel or crushed rock is packed around the openings in the catch basin inlets to provide uninterrupted drainage from the adjacent roadway subgrade into the catch basin.		
Stormwater Systems – Quality Control.	Section 02630.	Bedding is fine-graded so the pipe can be initially placed with a variation from true line or grade, measured at each joint, of not more than 1/32 inch per inch diameter or 1/2 inch maximum, provided that; a resulting level or back-sloping length of pipe does not occur; and, no more than one-half of the permissible variation accumulates between successive joints.	Periodic.	Observation.
		Grade is measured at the pipe invert, not the top of the pipe.		
		Backfilling operations do not begin until all pressure testing, pipeline decommissioning and other utility inspections have been completed and approved by the CQAC.		

TABLE 11-2
TANK FARM GRADING AND FINAL COVER TESTING

REQUIRED TESTS	TEST DESIGNATION	TEST FREQUENCY	ESTIMATED TOTAL NUMBER OF TESTS	ACTUAL NUMBER OF TESTS PERFORMED
Engineered Fill Conformance Testing				
Moisture / Density Relationship	D1557	1 / material type	1	
Engineered Fill Construction Testing				
Density, Nuclear Method	D6938	1 per 500 cubic yards placed	Up to 20	
Moisture Content, Nuclear Method	D6938	1 per density test.	Up to 20	
Aggregate Base and Base Course Conformance Testing				
Moisture / Density Relationship	D1557	1 per material type	1	
Aggregate Base and Base Course Construction Testing				
Density, Nuclear Method	D6938	1 per 5,000 square feet per 4-inch thick lift.	30	
Moisture Content, Nuclear Method	D6938	1 per density test.	30	
Engineered Fill Trench Backfill Conformance Testing				
Moisture / Density Relationship	D1557	1 per material type	1	
Engineered Fill Trench Backfill Construction Testing				
Density, Nuclear Method	D6938	1 per 200 lf of trench per 12-inch lift.	14	
Moisture Content, Nuclear Method	D6938	1 per density test.	14	

TABLE 11-2
TANK FARM GRADING AND FINAL COVER TESTING

REQUIRED TESTS	TEST DESIGNATION	TEST FREQUENCY	ESTIMATED TOTAL NUMBER OF TESTS	ACTUAL NUMBER OF TESTS PERFORMED
Optional Asphalt In-Place Density Testing				
Density, Nuclear Method	ASHTO T230	1 per 10,000 square feet and a minimum of one per trench	15	

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TERMINAL 91 TANK FARM CLEANUP

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