CONSTRUCTION QUALITY ASSURANCE PLAN

SHORTSTACK BELMONT 2721-2731 SE BELMONT STREET PORTLAND, OREGON ESCI SITE ID#5731

Prepared for

SHORTSTACK BELMONT LLC

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Prepared by Maul Foster & Alongi, Inc. 3140 NE Broadway Street, Portland, OR 97232



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The material and data in this plan were prepared under the supervision and direction of the undersigned.

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ACRONYMS AND ABBREVIATIONS

CES Cascade Environmental Solutions
CQA construction quality assurance
CQAP construction quality assurance plan

DEQ Oregon Department of Environmental Quality

HDPE high-density polyethylene
MFA Maul Foster & Alongi, Inc.
Owen Gabbert Owen Gabbert LLC

psi pound-force per square inch

QA quality assurance QC quality control

RFI Request for Information
Shortstack Shortstack Belmont LLC

the Site 2721-2731 SE Belmont Street, Portland, Oregon

INTRODUCTION

This construction quality assurance plan (CQAP) was prepared on behalf of Shortstack Belmont LLC (Shortstack), to ensure that the remediation and redevelopment of the Shortstack Belmont site located at 2721-2731 SE Belmont Street, Portland, Oregon (the Site) fulfills the requirements of the Oregon Department of Environmental Quality (DEQ) and that the remedy meets or exceeds all performance standards, design criteria, and plans.

The proposed remediation activities will include the following:

- Installation of an impervious vapor barrier under the building slabs
- Installation of a passive vapor venting system under the vapor barrier consisting of flat vent pipe in a rock trench, connected to aboveground vent stacks
- Installation of vapor monitoring probes installed below building slab and above sub-slab vapor barrier
- Installation of geocomposite along a retaining wall
- Installation of trench dams to prevent migration of vapors through utility trenches

This CQAP summarizes minimum quality assurance (QA) and quality control (QC) requirements for the vapor collection and barrier system components, and materials established in the design report and design plans (which includes technical specifications). If alternative materials are used for construction, acceptable construction quality assurance (CQA) procedures must be implemented to meet the intent of this CQAP.

1.1 Construction Quality Assurance Plan Scope and Purpose

This CQAP describes the CQA necessary to ensure that proper construction techniques and procedures are used during construction of the remedial action activities for the Site. The CQAP contains the procedures for verifying that the materials used, and the installations of those materials, comply with the construction drawings, including the technical construction notes.

Construction requirements are established by the plans and are outlined in this document only as they pertain to QA. The criteria for acceptance will be as defined in the plans. This CQAP does not establish procedures for controlling or guiding the operations of the manufacturer of materials or the construction contractors, nor does it relieve them of their contractual responsibility to set up the necessary procedures and controls within their organizations to produce the quality of work called for in the plans. This CQAP is not intended to function as or replace the contractors' internal QA procedures.

2 responsibilities and authorities

This section provides the project team organizational structure, responsibilities, and lines of authority. Project activities will be performed within the framework of the organization and the functions presented in this section. The project team organizational structure is presented in the attached figure. Contact information for key project individuals is provided in the attached table.

2.1 Oregon Department of Environmental Quality

The DEQ administers the overall cleanup of the Site and is the lead agency for remedial actions completed by the owner. The DEQ will review and authorize the project design, as well as this CQAP. The DEQ may participate in preconstruction site walks, site visits during remedy implementation, and prefinal inspections. The DEQ will be consulted prior to any work changes to determine if additional review or approval is needed. See Section 3 for more information about project communications. The DEQ project manager will also review the final completion report for the project (see the attached table for contact information).

2.2 Owner

Shortstack is the owner of the Site as of April 28, 2023. Shortstack has contracted with the following organizations to complete the project, specifically relating to the vapor collection and barrier system installation:

- Maul Foster & Alongi, Inc. (MFA) as the design engineer and the CQA engineer for all components related to the vapor collection and barrier system construction and installation
- Cascade Environmental Solutions (CES) are the project environmental consultant and will be part of the CQA team, supporting MFA
- Owen Gabbert LLC (Owen Gabbert) as the general contractor
- ACF West as the vapor barrier system installer

2.3 Design Engineer and CQA Team

MFA is the design engineer and the CQA engineer for the project. MFA and CES will comprise the CQA team. MFA designed the vapor collection and barrier system and the CQA team will verify that construction is in compliance with the plans and specifications and the design intent.

As the design engineer, MFA is responsible for the design as well as design-related site engineering. Site engineering includes: (1) review and approval of product and construction submittals required by the specifications; (2) addressing technical issues related to construction; (3) providing interpretation

of the plans and specifications; and (4) completing design modifications and technical revisions as necessary.

The CQA team is responsible for certifying to the DEQ that the vapor collection and barrier system construction is in compliance with the plans and technical specifications and the design intent. Specific responsibilities of the CQA team include: (1) providing a professional engineer registered in the state of Oregon; (2) verifying that the construction QA procedures are implemented correctly; (3) coordinating with the contractor for CQA documentation; and (4) preparing the final completion report.

The CQA team, through their assigned CQA inspector(s), will provide limited construction observation (only for installation/construction of the remediation components) and will coordinate with the contractor for the implementation of the CQA program described in this CQAP. Activities identified in the construction notes on the plans as being completed by the design engineer will be completed or coordinated by MFA. The CQA team will keep the owner and the DEQ apprised of the status of the construction work.

Responsibilities of the CQA team related specifically to the remediation components of the construction include the following:

- Preconstruction Meeting: The CQA team will coordinate and attend the preconstruction meeting with the owner and the construction contractors.
- Weekly Progress Meetings during remediation activities: The CQA team will attend weekly coordination meetings with the owner and the construction contractors.
- Stakeholder Coordination: The CQA team will coordinate with other project stakeholders regarding periodic site visits, meetings, and reporting.
- Construction Observation and QA: Through the implementation of the CQA measures described in this plan, the CQA team will document that the contractor's work conforms to the construction documents. The CQA team will witness the contractors' QC program, including any field testing completed by the construction contractors. The CQA team will coordinate with the contractor and document that the contractor is implementing the QA testing and measurements specified in this plan and will verify that materials delivered to the job site are in accordance with construction documents before they are used.
- Submittals and Shop Drawing Review: As the design engineer, MFA will review submittals and shop drawings and provide approval or take other actions, as appropriate. MFA will evaluate consistency with construction documents. MFA will work with the construction contractors to track the submittal schedules and maintain records of the submittals.
- Requests for Information (RFIs) Responses: MFA will receive, track, and respond to all RFIs that are submitted by the construction contractors.
- Evaluation of Substitutions: MFA will evaluate contractor-requested substitutions.

- Change Orders and Work Change Directives: The CQA team will work with the owner
 and the construction contractors, as necessary, to evaluate and negotiate change order
 requests and to prepare work change directives to resolve issues that develop during
 construction.
- Field Notes: during each site visit, the CQA team will prepare field notes documenting observations and project status. The CQA inspectors will include the following minimum information in the daily notes: weather, on-site contractor/subcontractor personnel, equipment used, construction activities being performed, samples collected, field test results, and construction issues (if any).
- Monthly Progress Summary: The CQA team will prepare a summary e-mail describing the
 project progress on a monthly basis, highlighting significant field observations and
 communications. The CQA team will include the following minimum information in the
 monthly progress summary: list of work completed, sampling results, map indicating
 active areas of work and completed work, photos, issues encountered/resolutions, and list
 of upcoming activities.
- Photographic Documentation: The CQA team will photographically document the construction progress, project milestones, and key design components. The photographs will be logged and included in the completion report.
- Record Drawings: throughout construction, MFA will maintain a set of redline drawings
 to document project revisions. These redline drawings will be used for comparison to the
 contractor as-built drawings and will ultimately be used to prepare record drawings for the
 project. A final topographic and bathymetric survey will be performed for the Site when
 remedial work is complete. MFA will produce the record drawings required for submittal
 with the completion report.
- Evaluation of Payment Applications: The CQA team will review construction contractor applications for payment to evaluate whether they align with the construction progress.
- Inspections: The CQA team will coordinate and attend the prefinal and final inspections.
- Completion Report: As the design engineer, MFA will receive and review all closeout
 materials from the contractor and will prepare a completion report, including final record
 drawings.

MFA's project managers for this project are Ted Wall, PE, and Krysta Krippaehne-Stein. CES's project manager is Jennifer Levy. They will be the primary contacts for the owner and will provide overall project direction to the CQA team.

2.4 Construction Contractor Responsibilities

Owen Gabbert has been retained by the owner to perform construction and regular QC tasks required by the project plans. Owen Gabbert will assist the CQA team with documentation of the CQA protocol/testing.

In addition, ACF West, the vapor collection and barrier system installer, will be performing CQA activities as outlined in Section 4 and will report the results to the CQA team daily.

3 PROJECT COMMUNICATIONS AND REPORTING

This section describes the communication protocol and reporting activities for the project.

The CQA team will prepare weekly field notes that document observations and project status. The CQA team will file these notes during weekly progress meeting visits (limited to the remediation activities) so that they are available as a record of project activities. A summary of field activities and progress will be reported to the DEQ on a monthly basis while the remedy implementation is being conducted. The monthly summary will include information regarding work completed, progress map, photos, issues encountered/resolutions, and upcoming activities.

Beyond the weekly notes and monthly summaries, the CQA team will proactively communicate with the DEQ when major project milestones arise (e.g., completion of remedial activity) and at major decision points throughout the project. Contact information for key project individuals is provided in the attached table.

4 QUALITY ASSURANCE PROCEDURES

This section discusses the CQA aspects of the project. It identifies the construction activities that require monitoring and establishes the procedures for monitoring each activity. Performance standards and acceptance criteria have been established by MFA in the project plans. The performance standards and inspection activities are detailed in this section. CQA forms that will be used by the on-site CQA inspectors are included as Appendices A, B, and C. The relevant CQA personnel will complete these forms daily during critical operations, such as the deployment of geomembrane liner, for continuous documentation of materials and workmanship.

4.1 Construction Monitoring

Each unit of construction will be monitored and documented to verify compliance with the plans and specifications and to confirm that construction was executed correctly, using industry standard construction methods and the proper materials. MFA will perform monitoring related to preparation and installation of the sub-slab vapor collection and barrier system.

The CQA inspector will review materials delivered to the Site. Prior to liner installation, the CQA inspector will review the subgrade preparation and the construction of the sub-slab vent piping. The CQA inspector will verify that the subgrade is generally smooth, without protrusions that could damage the membrane.

The vapor collection and barrier system installer shall follow manufacturer's installation instructions for placement, seaming, penetration repair, and perimeter seal, and will implement the vendor-provided CQA protocol as summarized in Section 4.2 in coordination with the design engineer.

4.2 Vapor Collection and Vapor Barrier

4.2.1 Sub-Slab and Sub-Pavement Vapor Barrier Systems

Sub-slab vapor barrier systems are comprised of a collector vent pipe in a collector gravel blanket overlain by an impervious membrane with bottom and top cushion layers.

The vapor collection and barrier system installer will follow the CQA protocol outlined in the following section and will report the CQA notes and testing results to the design engineer daily.

4.2.1.1 Sub-Slab Vapor Collection System

The sub-slab vapor collector piping system is comprised of a 4-inch thick, clean gravel blanket, as identified on design drawings, surrounding a prefabricated strip drain/flat vent. Sub-slab vapor collection piping shall be a geocomposite strip drain composed of a dimpled polymetric perforated core fully wrapped in a non-woven geotextile (SiteDrainTM Strip 6400 or Vapor-Vent).

An inspection checklist for vapor collection system installation is provided in Appendix A. The design engineer will coordinate with the installer to document the installation compliance with the design and specifications.

4.2.1.1.1 Delivery, Storage, and Handling

- A. Deliver materials to project site as specified by manufacturer labeled with manufacturer's name, product brand name and type, date of manufacture, shelf life, and directions for handling.
- B. Store materials as specified by the manufacturer in a clean, dry protected location within the temperature range required by manufacturer. Protect stored materials from direct sunlight.
- C. Remove and replace material that is damaged.

4.2.1.1.2 Subgrade and Gravel Blanket Preparation

- A. With installer present, examine building subgrades, areas, and conditions under which vapor vent system will be installed for compliance with requirements. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Verify building subgrades and gravel blanket surfaces are free of protrusions, debris, and rock greater than 8 inches in diameter.
- C. Verify building subgrades and gravel blanket surface are prepared to the elevations and grades identified in the design drawings.

4.2.1.1.3 Sub-slab Vapor Collection Pipe Installation

- A. Install sub-slab vent piping over substrate material where designated on drawings with the flat base of the core placed down and shall be overlapped in accordance with manufacturer's recommendations.
- B. At areas where sub-slab vent piping intersects, cut and fold back fabric to expose the dimpled core. Arrange the strips so that the top strip interconnects into the bottom strip. Unfold fabric to cover the core, and use reinforcing tape, as approved by the manufacturer, to seal the connection to prevent sand or gravel from entering the core.
- C. Use flat vent to circular pipe adapter with the specified diameter piping as shown on Design Drawings.

4.2.1.1.4 Placement of Overlying and Adjacent Materials

- A. All overlying and adjacent material shall be placed or installed using approved procedures and guidelines to prevent damage to the strip geocomposite.
- B. Equipment shall not be directly driven over, and stakes or any other materials may not be driven through the strip geocomposite.

4.2.1.2 Bottom Cushion Layer for Impervious Membrane

A non-woven needle punched geotextile weighing 12-ounce per square yard is selected for the bottom geomembrane cushion layer, to be placed over the sub-slab vapor collection piping and gravel blanket and immediately below the geomembrane. The following are the CQA procedures to be followed:

4.2.1.2.1 Delivery, Storage and Handling

- A. Upon arrival on site, QA personnel will inventory all materials on-site.
- B. Verify geotextile rolls are delivered with opaque protective coverings.
- C. Verify geotextile rolls are unloaded, handled, and transported with nylon or other cloth straps that do not damage the geotextile rolls or the protective coverings.
- D. Verify geotextile rolls are stored and protected from damage and damaged protective coverings are replaced.
- E. Verify that manufacturer's quality control testing reports for geotextiles delivered to the site.

4.2.1.2.2 Geotextile Installation

- A. Verify underlying gravel blanket and sub-slab vapor collection pipe installation is complete and in accordance with Section 4.2.1.1.
- B. Verify geotextiles are installed with sufficient tension to prevent excessive overlapping, insufficient overlapping, wrinkles, and folds.

- C. Verify geotextile panels are overlapped with sufficient material to create a flat or prayer fold for sewing operations.
- D. Verify rocks, excessive dust, excessive moisture or other materials that could damage, hamper sewing operations, or clog the geotextile are not entrapped under the geotextile or within the overlap.
- E. Verify that all geotextile filter seams are sewn.
- F. Verify geotextiles are adequately ballasted during placement operations and that ballast is left in place until geotextiles are covered with the overlying material.
- G. Verify in-place geotextiles are not left exposed and uncovered beyond the time limitations recommended by the manufacturer.

4.2.1.2.3 Repair

- A. Verify damaged geotextiles are removed entirely or repaired in accordance with the following guidelines:
 - o Repair (patching) material is the same material as the damaged geotextile.
 - Patches extend a minimum of 12 inches in all directions beyond the damaged area. The
 machine direction of the patches aligns with the machine direction of the damaged
 geotextile.
 - o Hand or machine sew patches in place with approved polymeric thread.

4.2.1.2.4 Sewing

- A. Verify all geotextile filter and geotextile cushion seams are sewn.
- B. Verify overlaps are cleaned of soil materials that could adversely affect sewing operations.
- C. Verify flat or prayer fold is made within the overlap.

4.2.1.3 Impervious Membrane Layer

The selected impervious membrane for this project is 30 mil white HDPE geomembrane. Below is the proposed CQA protocol:

4.2.1.3.1 Delivery, Storage, and Handling

- A. Rolls of material shall be unloaded with equipment that will not damage the geomembrane.
- B. Fabric-straps, spreader bars, stinger bars, or other approved equipment shall be used for handling rolls of geomembrane.
- C. Upon arrival on site, QA personnel will inventory all materials on site.
- D. Roll numbers will be logged on the Inventory Check List (Appendix B: Attachment A).
- E. Any visible damage to roll materials should be noted on the roll and Inventory Check List.

4.2.1.3.2 Panel Placement

- A. Each panel will be assigned a number (i.e., 1, 2, 3...). Agreement to a panel numbering system should be made at the pre-construction meeting. However, it is essential that the installer, the owner representative, and QA inspector agree.
- B. Panel numbers shall be written in large block letters in the center of each deployed panel. The roll number, date of deployment, and length should be noted below the panel number. All notes should be made so that they are easily visible from a distance. On long panels it is beneficial to write information on both ends.
- C. Panel numbers shall be logged on the Panel Placement Log (Appendix B: Attachment C) along with the roll number and other information necessary to complete the form.
- D. If there is a partial roll left after deployment, it is important to write the last four digits of the roll number in several locations on the roll along with the estimated length for future identification.
- E. Unroll geomembrane using methods that will not damage geomembrane and will protect underlying surface from damage.
- F. Place temporary ballast, such as sandbags, on geomembrane that will not damage the geomembrane and to prevent wind uplift.
- G. Personnel walking on geomembrane shall not engage in activities or wear shoes that could damage it. Smoking is not permitted on the geomembrane.
- H. Do not allow heavy vehicular traffic directly on geomembrane. Rubber tired and tracked ATV's and equipment are acceptable if contact pressure is less than 8 psi.
 - o Protect geomembrane in areas of heavy traffic by placing protective cover over the geomembrane.
 - Prior to driving on any geomembrane layer, check for sharp edges, embedded rocks, or other foreign objects that may protrude in the tires and tracks.
 - O The path driven on geomembranes shall be as straight as possible with no sharp turns, sudden stops, or quick starts.
 - o Areas where driving occurs shall be continuously and thoroughly inspected throughout the deployment process by the contractor and the CQA inspector.

4.2.1.3.3 Trial Welds

- A. Always perform trial welds in the same conditions that exist on the job. Run the trial welds on the ground, not the installed liner. Do not use a wind break unless you are using one on the job.
- B. Seaming apparatus shall be allowed to warm up a minimum of 10 minutes before performing trial welds.
- C. Each seaming apparatus along with a welding technician will pass a trial weld prior to use. Trial welds to be performed in the morning and afternoon, as a minimum, as well as whenever there is a power shutdown.

- D. Fusion or wedge welds will always be performed or conducted on samples at least 6.0 feet long. Extrusion welds will be done on samples at least 3.0 feet long.
- E. Operating temperatures should be monitored while welding. The welding technician should verify that the equipment is capable of maintaining temperature while welding.

F. Sampling Procedure:

- O Cut five 1-inch-wide specimens from the trial weld sample. Specimens will always be cut using a 1-inch die cutter, so the peel values may be used for qualitative analysis.
- O When cutting coupons from the trial weld samples, the inside and outside tracks on the coupon should be identified to assist in troubleshooting problems in case the weld fails. The outside track will be defined as the track, which would be peeled if pulling the overlap exposed in a typical installation, or the seam that is closest to the edge of the top sheet. The inside track is the seam closest to the edge of the bottom sheet.

G. Cutter:

- Only cut one sample at a time to avoid damaging the die cutter.
- o Samples should be free of sand and grit prior to cutting sample.
- o Inspect the die edge weekly for nicks, dents or signs of dullness. Dullness of the cutting edge may damage the units.
- o Remove die when edge has been dulled and lightly reshape it with a medium hand file. When wear is excessive return it for a replacement die.
- When the cutting board becomes deeply scored and/or interferes with coupon cutting it should be replaced.
- o To adjust the depth of the die cut into the cutting board, after replacing the cutting board or sharpening the die, 0.015-inch-washer shims can be added or removed between the cutting ram and the ram extension. Only add shims when cutting is difficult due to lack of depth of cut.

H. Trial Weld Testing:

- O Allow coupons to cool prior to testing. Avoid separating the coupons while hot as failure of the sheet may be initiated and false readings indicated.
- o In extreme heat the coupons may need to be cooled, using water or an insulated cooler prior to peel testing. Lab conditions specify 70 degrees (plus or minus 4 degrees) Fahrenheit. Coupon temperatures greater than 70 degrees may result in lowered strengths.
- O Visually inspect the coupons for squeeze-out, footprint, pressure, and general appearance.
- O Each of the five coupons will be tested in peel on the field tensiometer at a separation rate of 2 inches per minute. In addition to the peel tests, shear tests will be performed.

4.2.1.3.4 Pass/Fail Criteria

A. Criteria for passing trial welds will be as follows:

- o Seam must exhibit film tear bond. Trial welds should have no incursion into the weld.
- Peel and shear values shall meet or exceed the values as listed in Appendix B: Attachment D, Table 1 for HDPE smooth or textured sheet (at 2 inches per minute).
- O Both tracks of fusion welded samples must pass for the trial weld to be considered acceptable. If any of the five coupons fail due to seam incursion (no film tear bond) or low strength values, the trial weld must be performed again.
- o The QA personnel will give approval to proceed with welding after observing and recording all trial welds.
- B. All trial weld data will be logged on the Trial Weld Log (Appendix B: Attachment E).
- C. When logging fusion welded peel values on the Trial Weld Log indicate the values. for the outside track first, followed by the inside track.
- D. Speed and temperature settings will be recorded for each machine trial weld as appropriate.

4.2.1.3.5 Field Seaming

- A. The seam number takes the identity of the panels on each side. The seam between panels 1 and 2 becomes seam 1/2.
- B. Welding technicians will record their initials, machine number, date and time at the start of every seam and on the Seam Log (Appendix B: Attachment F). The technician should also periodically mark temperatures along the seam and at the end of the seam.
- C. Approved processes for field seaming and repairing are fusion welding and extrusion welding. All welding equipment shall have accurate temperature monitoring devices installed and working to ensure proper measurement.
- D. Fusion welding shall be used for seaming panels together and is not used for patching or detail work. The vapor barrier system installer's site manager (site manager) shall verify that:
 - o The equipment used is functioning properly.
 - All work is performed on clean surfaces and done in a professional manner. No seaming will be performed in adverse weather conditions.
- E. Extrusion welding shall be used primarily for repairs, patching, and special detail fabricating and may be used for seaming. The site manager shall verify that:
 - o Equipment used is functioning properly.
 - Welding personnel are purging the extrusion welders of heat degraded extrudate prior to actual use.
 - O All work is performed on clean surfaces and done in a professional manner. No seaming will be performed in adverse weather conditions.
- F. For seam preparation, the welding technician shall verify that:
 - o Prior to seaming, the seaming area is free of moisture, dust, dirt, sand or debris of any nature.

- o The seam is overlapped properly for fusion welding.
- O The seam is overlapped or extended beyond damaged areas at least 4 inches when extrusion welding.
- o The seam is properly heat tacked and abraded prior to extrusion welding.
- o Seams are welded with fewest number of unmatched wrinkles or "fish mouths".
- G. No seaming will be performed in ambient air temperatures or adverse weather conditions that would jeopardize the integrity of the liner installation.

4.2.1.3.6 Membrane Terminations

A. Stainless steel batten strips along with stainless steel anchor, moldable sealant, and polyurethane-based elastomeric sealant (i.e., SikaFlex 1A) shall be used for geomembrane vertical terminations at the edge of concrete footings, as depicted in Details 3, 4 and 6 on Design Drawing C3.1 and Detail 3 on Design Drawing C3.3. Terminations at the thickened slab edge shall be per Detail 1 on Design Drawing C3.1.

4.2.1.3.7 Non-Destructive Testing

- A. All seams shall be non-destructively tested over their full length using an air pressure or vacuum test. The purpose of this test is to check the continuity of the seam.
- B. For air pressure testing, the following procedures are applicable to those seams welded with a double seam fusion welder.
 - O The equipment used shall consist of an air tank or pump capable of producing a minimum 35 psi and a sharp needle with a pressure gauge attached to insert into the air chamber.
 - O Seal both ends of the seam by heating and squeezing them together. Insert the needle with the gauge into the air channel. Pressurize the air channel to 30 psi. Note time test starts and wait a minimum of 5 minutes to check. If pressure after five minutes has dropped less than 2 psi then the test is successful (Thickness of material may cause variance).
 - o Cut opposite seam end and listen for pressure release to verify full seam has been tested.
 - o If the test fails, follow these procedures.
 - While channel is under pressure walk the length of the seam listening for a leak.
 - While channel is under pressure apply a soapy solution to the seam edge and look for bubbles formed by air escaping.
 - Re-test the seam in smaller increments until the leak is found.
 - Once the leak is found using one of the procedures above, cut out the area and retest the portions of the seams between the leak areas per item B above. Continue this procedure until all sections of the seam pass the pressure test.
 - Repair the leak with a patch and vacuum test.

- C. For vacuum testing, the following procedures are applicable to those seams welded with an extrusion welder.
 - O The equipment used shall consist of a vacuum pumping device, a vacuum box and a foaming agent in solution.
 - Wet a section with the foaming agent, place vacuum box over wetted area. Evacuate air from the vacuum box to a pressure suitable to affect a seal between the box and geomembrane. Observe the seam through the viewing window for the presence of soap bubbles emitting from the seam.
 - o If no bubbles are observed, move box to the next area for testing. If bubbles are observed, mark the area of the leak for repair per Section 4.2.1.3.9 and re-test per this section.
 - o All non-destructive tests will be noted in the Non-Destructive Logs (Appendix B Attachments H-I).

4.2.1.3.8 Defects and Repairs

- A. All seams and non-seam areas of the geomembrane lining system shall be examined for defects.
- B. Identification of the defect should be made using the following procedures:
 - For any defect in the seam or sheet that is an actual breach (hole) in the liner, installation
 personnel shall circle the defect and mark with the letter P alongside the circle. The letter
 P indicates a patch is required.
 - For any defect that is not an actual hole, installation personnel shall circle the defect indicating that the repair method may be only an extruded bead and that a patch is not required.
 - Each suspect area that has been identified as repair shall be repaired in accordance with Section 4.2.1.3.9 and in the non-destructive testing per Section 4.2.1.3.7. After all work is completed, the site manager will conduct a final walk-through to confirm all repairs have been completed and debris removed. Only after this final evaluation by the site manager, the owner, and the agent shall any material be placed over the installed liner.

4.2.1.3.9 Repair Procedures

- A. Any portion of the geomembrane lining system exhibiting a defect that has been marked for repair may be repaired with any one or combination of the following procedures:
 - o Patching—used to repair holes, tears, undispersed raw materials in the sheet.
 - o Grind and Reweld—used to repair small sections of extrusion welded seams.
 - o Spot Welding—Used to repair small minor, localized flaws.
 - o Flap Welding—Used to extrusion weld the flap of a fusion weld in lieu of a full cap.
 - o Capping—Used to repair failed seams.
- B. The following conditions shall apply to the above methods:
 - O Surfaces of the geomembrane which are to be repaired shall be prepared according to this section.

- o All surfaces must be clean and dry at the time of the repair.
- o All seaming equipment used in repairing procedures shall be qualified.
- All patches and caps shall extend at least 4 inches beyond the edge of the defect, and all patches must have rounded corners.
- o All cut out holes in liner must have rounded corners of 3-inch minimum radius.
- C. Patches should be labeled in numerical order, i.e., RP-1, RP-2, etc... This should carry through any layer, and do not start with the number 1 again.

4.2.1.3.10 As-Built Drawings

- A. As-built drawings will be provided at the completion of the project.
- B. As-built drawings will include geomembrane panels and panel numbers with the last four digits of the roll number.
- C. Panel numbers and the full roll numbers will correspond with the Panel Placement Log (Appendix B: Attachment C).
- D. All destructive testing and repair locations will be placed on the as-built drawings.

4.2.1.4 Top Cushion Layer for Impervious Membrane

A non-woven needle punched geotextile weighing 12-ounce per square yard is selected for the top geomembrane cushion layer between impervious geomembrane and bottom of the slab and/or the imported backfill. The following are the CQA procedures to be followed:

4.2.1.4.1 Delivery, Storage and Handling

- F. Upon arrival on site, QA personnel will inventory all materials on-site.
- G. Verify geotextile rolls are delivered with opaque protective coverings.
- H. Verify geotextile rolls are unloaded, handled, and transported with nylon or other cloth straps that do not damage the geotextile rolls or the protective coverings.
- I. Verify geotextile rolls are stored and protected from damage and damaged protective coverings are replaced.
- J. Verify that manufacturer's quality control testing reports for geotextiles delivered to the site.

4.2.1.4.2 Geotextile Installation

- H. Verify underlying geomembrane installation is complete and in accordance with Section 4.2.1.3.
- I. Verify geotextiles are installed with sufficient tension to prevent excessive overlapping, insufficient overlapping, wrinkles, and folds.
- J. Verify geotextile panels are overlapped with sufficient material to create a flat or prayer fold for sewing operations.

- K. Verify underlying geomembrane installations are not damaged by installation equipment or methods and that damaged geomembrane is completely repaired.
- L. Verify rocks, excessive dust, excessive moisture or other materials that could damage, hamper sewing operations, or clog the geotextile are not entrapped under the geotextile or within the overlap.
- M. Verify that all geotextile filter seams are sewn.
- N. Verify geotextiles are adequately ballasted during placement operations and that ballast is left in place until geotextiles are covered with the overlying material.
- O. Verify in-place geotextiles are not left exposed and uncovered beyond the time limitations recommended by the manufacturer.

4.2.1.4.3 Repair

- B. Verify damaged geotextiles are removed entirely or repaired in accordance with the following guidelines:
 - o Repair (patching) material is the same material as the damaged geotextile.
 - Patches extend a minimum of 12 inches in all directions beyond the damaged area. The
 machine direction of the patches aligns with the machine direction of the damaged
 geotextile.
 - o Hand or machine sew patches in place with approved polymeric thread.

4.2.1.4.4 Sewing

- D. Verify all geotextile filter and geotextile cushion seams are sewn.
- E. Verify overlaps are cleaned of soil materials that could adversely affect sewing operations.
- F. Verify flat or prayer fold is made within the overlap.

4.2.1.5 Work over Top Cushion Layer

- A. Verify visually that the entirety of the deployed impervious membrane (white) is covered with top cushion layer (black).
- B. Inspect any visible surface damage to the cushion layer and/or impervious membrane to ensure that there are no penetrations of the membrane.
- C. Verify that care is taken to assure that any underlying layers are not damaged during work above the top cushion layer.
- D. If there are any rebar welding, grinding, or heat generating work to occur, the Contractor shall use wooden panels (or equal) at the active work areas for underlying layer protection. The area of the wooden panel shield shall be inspected after welding or grinding activities are completed with particular attention to the perimeter to verify that sparks/burrs have not damaged the membrane.
- E. Prior to placement of imported backfill, verify that the underlying layers are intact, or repair any damaged area per relevant repair section of this report.

- F. Any backfill material that is placed over or adjacent to any of the specified geosynthetics material shall be placed with care to assure the material is not damaged.
- G. Care shall be taken to minimize any movement of the geotextile and to assure that no tensile stress is induced in the material.
- H. Backfill soils deployed over or adjacent to the geotextile should be free of all sharp objects, sharp rocks, and sticks.

4.2.1.6 Sub-Slab Monitoring Ports and Probes

Verify monitoring probes are installed in general conformance with Detail 1 on Design Drawings C3.3. Also verify that monitoring ports are properly sealed and installed at the general locations shown on Design Drawing C2.0, and in general conformance with Detail 1 on Design Drawing C3.3.

4.3 Retaining Wall Geocomposite

Geocomposite material is proposed to be installed along the vertical face of site retaining walls to provide venting of any vapor that may be collected along the retaining wall as shown on Details 4 and 6 on Design Drawings C3.1 and manufacturer's recommendations.

4.4 Utilities

The design engineer will verify (and confirm compliance with the design drawings) the construction of trench dams for all utilities that will be extended to the building crossing the property line, as shown on Detail 2 on Design Drawing C3.2, and the relevant site-civil utility plan.

5 FIELD CHANGES

All design and field change requests from the construction contractors must be made to MFA in writing in the form of an RFI. Change requests by MFA will be reviewed with the owner before they are issued to the construction contractors. MFA will review changes to ensure that they conform to the performance standards and the design intent, are consistent with cleanup objectives, and are protective of human health and the environment. If the change request is approved, MFA will provide a written change order to the construction contractors.

5.1 Changes Authorized by Owner

Upon review of construction contractor-submitted RFIs or at any time necessary, the owner may use a change order consistent with construction standards to authorize changes in the work.

5.2 Problem Identification and Corrective Measures

MFA will work closely with the owner and the contractor's superintendent to address suspected deviations from the design as they occur, in order to avoid having to note construction problems. A problem is defined as material or workmanship that does not meet the requirements of the plans for the project, or as any obvious defect in material or workmanship. Upon identification of a problem, MFA will note the following information in the daily field notes, as well as include pertinent information on the working as-built marked drawings with as much detail as possible:

- A location and applicable area or volume of the problem
- Description of the problem with sufficient detail and supporting sketches or photographic information
- When and by whom the problem was found, with reference to applicable inspections or a weekly summary report
- Corrective measure(s) taken by the construction contractors
- Entity and person approving any corrective measure(s)

5.3 Problem or Work Deficiency Meetings

A special meeting will be held when a problem or deficiency is present or is likely to occur. At a minimum, the design engineer, the owner, the applicable construction contractor(s), and applicable subcontractors shall attend the meeting. Others may also attend at the request of MFA or the owner. The purpose of the meeting is to resolve the problem as expediently as possible by:

- Defining and discussing the problem or deficiency
- Reviewing alternative solutions
- Implementing an action plan

The meeting will be documented by MFA, and within three days of the meeting, minutes will be distributed to the owner, the applicable construction contractor(s), and other appropriate parties.



During construction, the CQA team will be responsible for compiling and organizing all CQA documentation. This includes a copy of the project construction drawings, technical specifications (listed in the construction notes), this CQAP, submittals, plans, and the installer's CQA test results.

Duplicate digital records will be made on a daily basis to avoid the loss of valuable information that would occur if the originals were destroyed.

6.1 Submittals

The contractor's QC reports, weekly status reports, record data, final field report, and all other submittal items will be submitted to MFA's on-site CQA inspectors. Submittals are classified as:

- SD-01: Preconstruction Submittal
- SD-02: Construction Submittal
- SD-03: Post-construction Submittal

MFA will review submittals from the construction contractors for compliance with the plans. Submittal review codes will be used to indicate approval, revision requirements, and rejection. The code status will be tracked by MFA on the project submittal tracking form. MFA will coordinate communication of code status with the owner and the applicable contractor. The coding will be as follows:

- A—Reviewed No Exceptions
- B—Reviewed Exceptions Noted
- C—Revise and Resubmit
- D—Rejected

6.2 Inspections

Critical components of the work will be inspected by the on-site CQA inspectors before the construction contractors proceed. The results of these inspections will be communicated to the DEQ in the monthly updates discussed in Section 3 and in the project completion report.

6.2.1 Inspection of Materials

All materials, equipment, and supplies that arrive at the Site will be visually inspected by the CQA inspectors to ensure that the products are as ordered or as specified, and any deviations will be relayed to the applicable construction contractor and the owner immediately. As materials are received, they will be documented in the daily field notes and checked against approved material submittals. This documentation will be included with other inspection documentation for the purposes of completing the final completion report.

6.3 Inspection and Testing Records

All observations, results of field tests, and results of laboratory tests performed on or off site will be recorded. Recorded observations may be in the form of notes, charts, sketches, photographs, or any combination thereof. As a minimum, the inspection documentation will include the following information:

- Description or title of the inspection activity, with the date on which the activity was inspected
- Location of the inspection activity or location from which the sample was obtained
- Type of inspection activity and procedure used
- Recorded observation or test data
- Results of the inspection activity (e.g., pass/fail); comparison with specification requirements
- Personnel involved in the inspection besides the individual preparing the data sheet
- Signature of the CQA inspectors, accompanied by the date

In addition to construction-contractor-supplied documentation, the CQA team will generate weekly field notes, monthly reports to the DEQ, and a remedial action completion report, as described in the next section.

6.4 Final Reporting

The owner anticipates providing a completion report to the DEQ within 90 days of demobilization of equipment from the Site. In the report, the MFA project manager and the engineer of record registered in the state of Oregon will state that the project has been constructed consistent with the design and plans, as modified (if applicable), and that the remedial action is complete consistent with the Engineering Design Report.¹ The completion report will summarize the activities of the project and document all aspects of the QA program. At a minimum, the following information will be contained in the report:

- Copies of all QA/QC documentation
- A narrative describing the project's construction
- A set of final as-built drawings for the project
- A description of all construction issues that arose and how they were resolved
- A description of any change orders
- A description of any changes from the plans
- A statement that the project has been constructed in substantial compliance with the design, plans, and related documents

¹ MFA. 2023. Engineering Design Report, Shortstack Belmont, 2721-2731 SE Belmont Street, Portland, Oregon, ESCI Site ID#5731. Maul Foster & Alongi, Inc., Portland, OR. June 21.

LIMITATIONS

The services undertaken in completing this plan were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This plan is solely for the use and information of our client unless otherwise noted. Any reliance on this plan by a third party is at such party's sole risk.

Opinions and recommendations contained in this plan apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this plan.

TABLE



Table Contact List



Shortstack Belmont Remediation Project Shortstack Belmont LLC Portland, Oregon

Contact Name	Title	Company	E-mail	Telephone	Cell Phone
Anna Mackay	Owner's Representative	Shortstack Belmont LLC	anna@sister-city.com	540.846.4299	N/A
Jessy Ledesma	Owner's Representative	Shortstack Belmont LLC	jessy@homework-dev.com	360.927.7488	N/A
Kevin Dana	Project Manager	DEQ	kevin.dana@deq.oregon.gov	503.229.5369	N/A
Brian Purdy	Construction Contractor	Owen Gabbert LLC	brian@cutwaterpdx.com	971.940.3356	N/A
Ted Wall	Senior Engineer	MFA	twall@maulfoster.com	503.501.5210	503.939.4849
Krysta Krippaehne-Stein	Project Engineer	MFA	kstein@maulfoster.com	971.713.3573	503.828.8961
Jennifer Levy	Project Manager	CES	jlevy@cascade-environmental.com	503.805.4846	N/A
TBD	CQA Inspector	MFA/CES	See above	See above	See above
TBD	Vapor Barrier Installer	ACF West	TBD	TBD	TBD

NOTES:

CES = Cascade Environmental Solutions.

CQA = construction quality assurance.

DEQ = Oregon Department of Environmental Quality.

MFA = Maul Foster & Alongi, Inc.

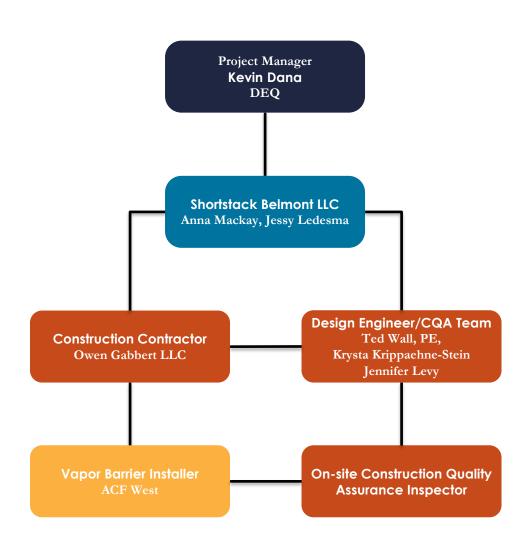
N/A = not applicable.

TBD = to be determined.

FIGURE



Figure SHORTSTACK BELMONT LLC Shortstack Belmont Remediation Project Organization Chart



APPENDIX A VAPOR COLLECTION SYSTEM CQA FORM





VAPOR COLLECTION SYSTEM CQA FORM

Project Name:	Shortstack Belmont				
Project Number:					
Date:					
Weather:					
MFA Inspector:					
Signature:					
High points and low points are checking receiver, or visually ve	Q	•			
Subgrade and Gravel Blanke	t	Yes	No	NA	Note #
 Are the building subgrasurfaces free of protrust than 8 inches in diameter 	ons, debris, and rock greater				
 Are the building subgra surfaces prepared to the identified in the Design 	e elevations and grades				
Vapor Collection Pipe Syster	n				
		Yes	No	NA	Note #
 Is the pipe free of appa debris? 	rent defects, dirt, and				
	undulations in the pipe that ent migration to the risers?				
• Is the pipe a flat vent 1 fittings at riser locations	"x12" with properly installed				
Does the pipe appear to connections and fittings	o be properly joined at all				
• Is there maximum 12.5 pipes?	'spacing between walls and				

					Page 2 of 2
• I	s there maximum 25' spacing between pipes?				
	Are the plan-view layout and location of the pipes in general accordance with C2.0?				
	s the pipe installed in general accordance with the details on sheets C3.0 through C3.3?				
9	Are the vapor collection vent risers installed in general accordance with Detail 1 on sheet C3.2 and Detail 2 on sheet C3.3?				
Geotext	ile Cushion Layers	Yes	No	NA	Note #
S	Are the geotextile cushion layers installed with sufficient tension to prevent excessive overlapping, insufficient overlapping, wrinkles, and folds?				
	Are the geotextile cushion layers overlapped with sufficient material to create a flat or prayer fold?				
	Are the geotextile cushion layers free of dust, excessive moisture, or other materials?				
• A	Are the geotextile filter seams sewn?				
Vapor M	Monitoring System	Yes	No	NA	Note #
9	Are the monitoring probes properly installed at the general locations shown on sheet C2.0 and in general accordance with Detail 1 on sheet C3.3?				
i:	Are the monitoring ports properly sealed and installed at the general locations shown on sheet C2.0 and in general accordance with Detail 1 on wheet C3.3?				

Notes:

APPENDIX B

GEOMEMBRANE INSTALLATION CQA FORMS



ATTACHMENT A

		Used												
	- of													
		Roll #	_											
Date:	Page:	Material												
		Used												
		Roll #												
ger:	ician:	Material												
_Site Manager:	_QA Technician: _	Used												
		Roll #												
		Material												
		Used												
		Roll #												
Project:_	Project #	Material												

Inventory Check List

ATTACHMENT B

Subgrade Surface Acceptance			
Date:			
Project:	Site Manager:		
Project #:			
Location:	Partial:		
Final:			
This document only applies to the acce	This document only applies to the acceptability of surface conditions for installation of geosynthetic products. 🗕	of geosynthetic products. — does not	
accept responsibility			
for compaction, elevation or moisture	for compaction, elevation or moisture content, nor for the surface maintenance during deployment. Structural integrity of the	ng deployment. Structural integrity of the	
subgrade and maintenance of these co	subgrade and maintenance of these conditions are the responsibility of the owner or earthwork contractor.	r earthwork contractor.	
For	 	For Owner / Contractor:	
Acceptance Number:	_ Area Accepted:s.f	Total Area Accepted to date: s.	S.f.

ATTACHMENT C

Panel Placement Log

Project Name:		
Location:	Site Supervisor:	
Job Number:	Type of Materials:	
Q.A. Tech.:	Sheet Thickness:	

Panel Number	Roll Number	Deployment Date	Width (Feet)	Length (Feet)	Squar Feet	Squar Feet (Cumulative)	A/T 1	A/T 2

ATTACHMENT D

TABLE 1. HDPE Seam Strength Properties

Material (Mil)	Shear Strength (PPI)	Fusion Peel (PPI)	Extrusion Peel (PPI)
40	81	65	52
60	121	98	78
80	162	130	104
100	203	162	130

TABLE 1. LLDPE Seam Strength Properties

Material (Mil)	Shear Strength (PPI)	Fusion Peel (PPI)	Extrusion Peel (PPI)
40	60	50	48
60	90	75	72
80	120	100	96
100	150	125	120

ATTACHMENT E

(jad	Pass Fail										
Extrusion (ppi) Min. Peel Min. Sheer	Shear ppi										
Extru in. Pee lin. She	Shear ppi										
	Shear ppi										
Fusion (ppi) Min. Peel Min. Sheer	Shear ppi										
Fusior Min. P Min. SI	Shear										
	Peel										
	Peel										
	Peel										
	Peel										
visor: _ terial: _ kness: _	Peel										
Site Supervisor: Type of Material: Sheet Thickness: _	Speed Preheat										
Sit.	Wedge Mass										
	Welder Type										
	Ambient Temp.										
	Technicians ID Number										
	Time of Trial										
Project Name:	Date of Trial										
Proje Loca Job I Q.A.:	Trial No.										

Trial Weld Log

ATTACHMENT F

Seam Log

Project Name:		
Location:	Site Supervisor:	
Job Number:	Type of Materials:	
Q.A. Tech.:	Sheet Thickness:	

Seam Number	Time of Weld	Date of Weld	Type of Weld	Length of Seam	Machine Num- ber	Technician ID Number

Destructive Test Log

ne: Site Supervisor: Extrusion (ppi)	Type of Material: Min. Peel Min. Peel		
Project Name:	Location:	Job Number:	Q.A.:

is iii														_
Pass	ı —						<u> </u>							
Shear														
Shear														
Shear														
Shear														
Shear														
Peel														
Peel														
Peel														
Peel														
Peel														
Location														
Machine Type & No.														
Technicians ID Number														
Seam Number														
Date Welded														
Sample Number														

ATTACHMENT G

ATTACHMENT H

Repair Log - Vacuum Test

Project Name:		
Location:	Site Supervisor:	
Job Number:	Type of Materials:	
Q.A. Tech.:	Sheet Thickness:	

Repair Number	Weld Date	Machine Number	Tech ID	Location	Test Date	Tech ID	Pass/Fail

ATTACHMENT I

Non-Destructive Log - Air Test

Project Name:	
Location:	Site Supervisor:
Job Number:	Type of Materials:
Q.A. Tech.:	Sheet Thickness:

Seam	Test Technician Date ID Number		Air Pres	sure Test	Test Result	Location			
Number	Date	ID Number	psi start	psi finish	(P or F)				