AECOM

Lower Duwamish Waterway Upper Reach Remedial Action

Water Quality Protection Plan Revision 5

October 7, 2024

Delivering a better world

Quality information

Prepared by	Checked by	Verified by	Approved by	Contractor's Approval
Rachel Johnson	Abby Chin, PE	Darrell Kennedy, PE	Kristine Carbonneau, PE	JC Clark

Revision History

Revision	Revision date	Details
0	June 12, 2024	
1	July 9, 2024	
2	July 19, 2024	
3	August 23, 2024	
4	August 28, 2024	
5	October 7, 2024	

Prepared for:

King County – WTD Construction
Shannon Phipps, Project Representative
2500 W Jameson Street
Seattle, WA 98199-1241

Prepared by:

AECOM
1111 Third Avenue
Suite 1600
Seattle, WA 98101
aecom.com

Prepared in association with:

Pacific Pile and Marine

Table of Contents

Figures

Abbreviations

BODR	Basis of Design Report
BMP	Best Management Practices
CY	Cubic Yard
EMB	Environmental Mitigation Binder
EPA	U.S. Environmental Protection Agency
LDW	Lower Duwamish Waterway
Plan	Water Quality Protection Plan
PPM	Pacific Pile & Marine
RM	River Mile
ROD	Record of Decision
SMA	Sediment Management Area
Site	Lower Duwamish Waterway Superfund Site
USCG	United States Coast Guard
WQMP	Water Quality Monitoring Plan

1. Introduction

This Water Quality Protection Plan (Plan) for the Lower Duwamish Waterway (LDW) Upper Reach describes water quality protection requirements and procedures to be implemented during remedial construction activities for the upper reach of the Lower Duwamish Waterway Superfund Site (Site) in King County, Washington.

1.1 Purpose

The purpose of this Plan is to identify operating procedures and protocols, operational and engineering controls, and barge monitoring requirements for the remedial action activities that ensure compliance with contract documents and regulations and achieve a goal of preventing water quality exceedances to the greatest extent practicable. The following Site documents were used to prepare aspects of this Plan:

- Final (100%) Remedial Design Basis of Design Report (BODR) for Lower Duwamish Waterway Upper Reach (Anchor QEA, 2024);
    - BODR Volume II, Part I, Appendix A Water Quality Monitoring Plan (Anchor QEA, 2024);
- Specification Section 01 35 43 (Environmental Procedures);
- Specification Section 01 41 00 (Environmental Regulatory Requirements);
- Specification Section 35 20 23 (Remedial Dredging, Barge Dewatering, and In-Water Transportation); and
- Specification Section 35 37 10 (Material Placement).

Work for the Site will be performed in accordance with the plans, drawings and specifications or as directed by King County's Project Representative to execute this Plan. If there are inconsistencies between this Plan and the above-named specifications sections, the specifications shall control.

1.2 Key Roles

The Remedial Action Work Plan (RAWP) provides an organizational chart of personnel responsible for compliance with the plans and specifications and includes a description of the personnel, roles, and responsibilities. The following key roles are associated with executing this Plan:

- King County
    - Project Representative
- PPM
    - Project Manager
    - Superintendent
    - Project Engineer
    - Barge Inspection Personnel
- PPM Subcontractors
    - AECOM
        - Contractor Quality Control Officer

    - Marker Offshore
        - Certified Marine Surveyor

Water quality monitoring will be performed by the Independent Quality Assurance Team in accordance with the Construction Quality Assurance Plan and Water Quality Monitoring Plan (Anchor QEA 2024) (WQMP, **Attachment 1**). During the work PPM is responsible for determining and implementing contingency actions to bring water quality back into compliance should there be a confirmed water quality exceedance. PPM subcontractor AECOM will provide contractor quality control and subcontractor Marker Offshore will provide a certified marine surveyor.

2. Best Management Practices

Site operations will be conducted utilizing Best Management Practices (BMPs) that minimize water quality exceedances, prevent pollutants from reaching existing sewers, storm drains, and surface waters (from upland activities), minimize resuspension (from dredging and material placement activities) to control water quality to the extent required for water quality protection as detailed in Specification Section 01 35 43 (Environmental Procedures, articles 3.06 and 3.07) and to prevent/minimize to the extent practicable sediment recontamination within the Site as detailed in Specification Section 01 35 43 (Environmental Procedures, article 3.05). BMPs will be implemented through operational controls, specialized equipment, and sequencing of Site operations.

2.1 Operational Controls

Operational Controls include actions or modifications implemented during in-water work processes that reduce the environmental impact of Site operations. The following operational controls will be implemented at the Site:

- Schedule
    - In-water dredging and placement will occur within the approved in-water work window of October 1st to February 15th to protect threatened and endangered species.
- Equipment
    - Inspections will be performed on equipment prior to use each day by PPMs equipment operator and oiler. The results of the inspection will be reported to PPMs Superintendent.
    - During maintenance and repairs, drip pads or pans will be placed under equipment to contain any leaks of petroleum products or hydraulic fluids.
    - A biodegradable, low toxicity hydraulic oil will be used in all excavators during in-water work to minimize the impacts of leaking hydraulic fluids on the aquatic environment.
    - Dredging equipment, including barges, will be maintained free of leaks.
    - A spill kit will be kept on each vessel in the event of accidental leak, if a leak occurs, it will be cleaned up immediately.
    - Refueling will be conducted in accordance with the Spill Prevention, Control, and Countermeasures Plan.
    - Tugboats shall be sized for the type and load of the vessel it is moving and for the water conditions it is operating in. Tugs significantly oversized or undersized for the operations shall be limited to the extent practical and as determined by PPM and equipment availability.
        - Maneuvering of tugs and barges will be kept to the minimum frequency and power necessary for safe and efficient operation of the dredging and transloading activities to avoid resuspension of sediments due to prop wash.

    - Slow Speed Zones: Establish and enforce slow speed zones near SMAs that are being actively dredged or that are open and awaiting test results.
    - Controlled Throttle Use: Use minimal throttle when maneuvering in shallow waters or near prone areas to reduce propwash.
  - Grounding of vessels will be prohibited.
- Dredging and Re-Dredging Operations
  - In areas of identified large to medium sized debris, non-buried debris that cannot be removed during dredge operations without adversely affecting the closure of the environmental bucket and seals will be removed prior to dredging using a 4 cubic yard (CY) or 3 CY closed clamshell digging bucket. If the debris is too large to grab with either bucket a hydraulic rock grapple will be utilized with Project Representative approval.
  - Dredging will be limited to the approved project depths plus over-dredging in accordance with the plans and specifications.
  - Multiple bites by the dredge bucket on the waterway bed before ascending to the surface will be prohibited.
  - Sweeping or leveling of sediments by dragging with the dredge bucket will be prohibited.
  - Dredging will be conducted using a 5 CY Young environmental (closed) bucket and 3 CY Young environmental (closed) bucket.
  - Overfilling of dredge buckets will be prohibited.
  - Barges will be filled to no less than 24” from side walls and have a minimum freeboard height of 24” to reduce spillage and overflow.
  - Uneven filling and overfilling of barges beyond the top of the side rails will be prohibited to prevent spillage from barges. Barges will be loaded evenly to maintain stability.
  - Interim underwater stockpiling of dredge material will be prohibited.
  - After placing dredged sediment into the contaminated sediment barge, the opened bucket will be held above the contaminated sediment barge for a short period of time as determined by PPM and accepted by the Project Representative to allow residual materials from the bucket to fall into the contaminated sediment barge.
  - The dredge bucket will be washed with a pressure washer, brush, or other means to remove loose residual materials from the bucket before lowering into the water.
  - The bucket swing path from the contaminated sediment barge to the transload facility will occur over a spill apron that will span from the transload facility to the middle of the contaminated sediment barge. The apron will be angled back to the transload facility so in the event of a release from the bucket the dredged material will land on the apron and the material can drain back the transload facilities’ sediment capture area. The bucket will never swing over “open water” as the contaminated sediment barge will serve as the spanning barge.
  - Subsurface release of partially full or full dredge buckets will not be allowed; i.e., once a bucket is closed underwater, it will not be opened until it is positioned over the contaminated sediment barge, even if the operator believes it is empty.
  - Where dredging occurs on a slope, removal will be from higher to lower elevation to reduce sloughing.
  - Dredge cycle times will be monitored and the cycle time slowed down if water quality exceedances are observed.
  - PPM will utilize a contract-compliant silt curtain "moonpool" from the front of the construction barge during SMA12B operations and as needed for other SMAs.

- Contaminated Sediment Barge Dewatering
    - To ensure effective sediment and water management during dredging, each contaminated sediment barge will be equipped with four steel dewatering sumps (30" x 8'), positioned at all four corners of the barge. These sumps will be constructed from slotted steel pipes wrapped in GAC-infused geotextile filter fabric (as detailed in Attachment 3), which will allow water to flow into the sumps while preventing the escape of sediments, thereby ensuring that all material remains contained within the barge during dewatering operations.
    - This system plays a critical role in maintaining water quality, especially within Sediment Management Areas (SMAs), where dredging and barge dewatering can result in increased turbidity. The separated dredge water will be pumped from the sumps and discharged directly into the moonpool or, when the moonpool is not in use, near the active dredging area.
    - This method represents an advanced passive dewatering approach. A compliant silt curtain "moonpool" will be utilized at the front of the dredge barge during operations in SMA 12 and other suitable SMAs, such as those located within navigation channels or areas with moderate depths, to minimize sediment resuspension.
    - The moonpool will be constructed from four 24" steel pipes, forming a 50' x 50' containment area, ensuring that the excavator operates within a controlled environment. The silt curtain, adjustable via reefing lines, will extend up to 15' in depth to effectively control sediment disturbance.
    - Daily inspections of the moonpool and silt curtain will ensure their ongoing integrity, with any necessary repairs promptly addressed and documented in daily reports.
    - In areas where the moonpool cannot be deployed, an unfixed silt curtain will be installed around the barge and excavation area to maintain water quality, especially if other BMPs prove insufficient. This flexible and adaptable sediment control strategy allows for tailored solutions based on specific site conditions, ensuring the protection of water quality across varying environmental conditions. Floating silt curtains will be employed as needed, with specifications suited to the particular water conditions, from calm areas to those with stronger currents.
    - This information can also be found in the Dredging & Excavation Plan, Appendix J of the RAWP.

- Material Placement
    - Materials will be placed from the bottom (toe) of the slope and working up the slope in such a way that allows for complete coverage of the designated area and minimizes the disturbance to the existing sediment bed surface.
    - The clamshell bucket will be lowered through the water column in a controlled and gentle fashion and materials will be released several feet above the existing ground elevation.
    - The cap layers will be released several feet above the existing layer (but below the water surface) in a controlled manner to avoid the "punch in" or mixing of materials.
    - PPM will utilize the moon pool or turbidity curtains during material placement if water quality cannot be maintained.
    - PPM will utilize a contract-compliant silt curtain "moonpool" from the front of the construction barge during SMA12B operations and as needed for other SMAs.
    - PPM will utilize BMPS such as straw wattles, geotextile fabric, turbidity curtains, etc in the

event that stockpiled aggregates on the clean import barge generate turbid discharge into the waterway above the acceptable NTU requirements of the contract.

  -

- Pile Removal
  - A vibratory hammer will be utilized with precise and controlled movements to minimize sediment disturbance during pile extraction.
  - If a vibratory hammer cannot be utilized, the piling will be removed via a clamshell bucket utilizing controlled and gentle movements. Jerking motions that can resuspend sediments and release contaminants will not be allowed.
  - The use of turbidity curtains around the work area will be implemented if water quality becomes a problem during extractions.
  - Capture and contain any sediments dislodged during piling removal on the contaminated sediment barge. The contaminated sediment barge will be the same as those utilized for dredging operations so the sediment will be disposed of at Waste Management.
- Bulkhead Installation
  - Install sheet piles slowly and steadily to minimize resuspension of sediments.
  - Deploy silt curtains or turbidity barriers around the work area if water quality cannot be maintained.
  - Provide secondary containment during grout pours in the event of form failure.
- Waste and Clean Material Management
  - Effluent from the stockpile area(s) will be contained such that no direct discharge of untreated effluent to the receiving waters will be allowed.
  - The Transload Facility will be paved and curbed to direct stormwater to areas that can be collected for treatment at the onsite wastewater treatment system as required in Specification Section 01 35 43 (Environmental Procedures).
- Equipment Decontamination
  - During equipment decontamination, the contaminated sediment barges will be swept and pressure-washed such that no sediment or decontamination water is released to the waterway. The remaining material will be collected and transported to the Waste Management Transload Facility.
  - Prior to placement of clean material or removing the equipment from the site, dredge buckets will be decontaminated over the last contaminated sediment barge, and the wash water will be managed consistent with the contaminated sediment barge dewatering effluents.

PPM will utilize the yard located at 700 S Riverside Dr. in Seattle as described in the Temporary Facilities and Control Plan. The following operational controls will be implemented:

- Good Housekeeping
- Preventive Maintenance
- Spill Prevention and Emergency Response
- Employee Training
- Inspections
- Transloading BMPs

2.2 Mitigation Measures

In the event of a leak, PPM will conduct the following mitigation actions:

- Hydraulic Oil and Fuel Leaks, Spills, and Releases:
  - Stop Equipment: Immediately stop the equipment to prevent further leakage.
  - Contain the Leak: Use spill containment materials such as absorbent pads, booms, and spill kits to contain the leak and prevent it from spreading.
  - Find & Seal the Leak: Personnel will locate the source of the leak and make any necessary repairs (in field and/or at PPM's equipment yard) to correct the problem.
  - Absorb and Remove Spilled Fluid: Use absorbent materials to soak up the spilled hydraulic fluid. Collect and dispose of used absorbents in a sealed drum for disposal at Waste Management.
  - Clean the Area: Clean the spill area thoroughly using cleaning agents that are safe for the environment. Ensure all residues are removed.
- Sediment Leaks, Spills, and Releases:
  - Stop Operations: Immediately cease all operations on the barge to prevent further sediment release.
  - Isolate the Leak: Identify and isolate the source of the sediment leak. Use sand bags or other barriers to stop further sediment leaking. Use booms to contain the spread of sediment in the water.
  - Repair: Perform necessary repairs to fix the leak such as welding or installation of new barge wall materials to patch sources of leak.

Spill kits will be maintained on each working barge and at SMA 5 worksite. In addition, spill kits will be strategically located near working areas and within 100 feet of fueling operations as required in Specification Section 01 35 43 (Environmental Procedures, Article 3.11). Refer to the Spill Prevention, Control and Countermeasures Plan (Appendix Z of the RAWP) for more details on volume, quantity, and location of spill kits.

2.3 Specialized Equipment

PPM has selected specialized equipment specified by the design and based on site-specific conditions. The following specialized equipment will be deployed at the Site:

- An environmental (closed) bucket will be used; and
- A silt curtain and/or moonpool will be used at SMA 12B and will be used at other SMAs to contain the turbidity in the water column unless site conditions (current, water depth, or structures) prevent use.

2.3.1 Environmental Bucket

Dredging will be conducted using a 5 CY Young environmental (closed) bucket and 3 CY Young environmental (closed) bucket. The specifications for the buckets to be used are included as **Attachment 2**. Non-buried debris that cannot be removed during dredge operations without adversely affecting the closure of the environmental bucket and seals will be removed prior to dredging using a 4 cubic yard (CY) or 3 CY closed clamshell digging bucket. If the debris is too large to grab with either bucket a hydraulic rock grapple will be utilized with Project Representative approval.

2.3.2 Silt Curtains

Dredging (which disturbs sediment) and contaminated sediment barge dewatering (turbid water entering the waterway from the contaminated sediment barge) present greater risks for water quality impacts related to contaminant concentrations, while water quality impacts during material placement are primarily associated with conventional criteria such as turbidity.

According to Specification Section 01 35 43 (Environmental Procedures, Article 1.02C, 1.07, and 3.05), PPM will utilize a contract-compliant fixed silt curtain (moonpool) during SMA 12B dredging activities. The use of the moonpool is mandatory for SMA 12B and designed to prevent the migration of resuspended sediments into the waterway. PPM may also choose to use the moonpool in other SMAs where it is deemed suitable, or if operational BMPs are insufficient to meet water quality standards. A Type 2 DOT silt curtain will be used the moonpool and unfixed curtains, and the specification sheet is included as Attachment 3.

The moonpool is designed to move in tandem with the construction barge, ensuring that dredging operations are contained within the moonpool. This system effectively controls the spread of disturbed sediment. The moonpool consists of four pieces of 24" steel pipe pile forming a 50' x 50' working area, similar to the layout shown in Figure 1. It is a floating unit, stabilized by breasting lines attached to the construction barge. The silt curtain mounted to the moonpool extends to a maximum depth of 15' and is equipped with reefing lines to adjust the height, ensuring it does not drag across the riverbed, which could disturb sediments and affect water quality. The curtain will be adjusted to maintain at least 2' clearance above the mudline, and the bottom edge of the permeable silt curtain will be weighted to minimize billowing. Diagrams of the moonpool and its layout are included in Attachment 3.

In areas outside of SMA 12B, PPM may use either a moonpool or an unfixed silt curtain around the construction barge and dig area if deemed appropriate or necessary. If operational BMPs prove insufficient to maintain water quality, the use of a moonpool or unfixed silt curtain will be required. Regardless of which type of silt curtain is employed, PPM will apply the same operational practices established for the moonpool to ensure effective sediment control and compliance with water quality standards.

Figure 1: Typical Moonpool Configuration

The moonpool will be assembled at PPM’s main yard located at 700 S Riverside Dr. Seattle, WA 98108 prior to the start of the project. The 24” steel pile frame will be assembled first. Once the frame is assembled the silt curtain will be attached to the exterior of the frame via ¼” steel cable and shackles. Once the moonpool is assembled fully it will be transported to the project site via a tugboat. During the project the moonpool will be moored alongside the construction barge. When the project team is ready to use the moonpool it will be floated in front of the working end of the construction barge. The frame will be secured against the construction barge using ½" steel cable breasting lines under constant tension to eliminate any drifting of the curtain while dredging or placement activities are underway. The silt curtain will be extended or shortened to meet the depth requirements of the particular work zone.

During daily operations, PPM will conduct the following monitoring, maintenance, and adjustment procedures:

- **Monitoring:** Continuously monitor the curtain to ensure it remains intact and properly positioned. Check for any signs of sediment leakage or damage.
- **Maintenance:** Perform regular maintenance by removing any debris caught in the curtain and repairing any damage immediately to maintain the integrity of the barrier. Repair procedures are detailed in the following sections.
- **Adjustment for Depth Variations:** In water depths less than the curtain height, adjust the curtain height by either using the reefing lines to raise the bottom edge or by adding floatation devices to ensure it does not drag on the seabed. Minimum distance above the seabed is 2 feet.

PPM will implement the following procedures for relocation of the moonpool:

1. Preparation for Relocation
    a. **Site Assessment:** Conduct a site assessment to determine the new location for the moonpool reviewing bathymetric data and tidal conditions to ensure the device will be effective in the new conditions.
    b. **Pre-Relocation Inspection:** Inspect the curtain system for any damages or wear and perform necessary repairs before relocation.
2. Relocation Steps
    a. **Short movements:** Movements under 200' will not require any changes to the mooring or setup of the curtain, and it can be moved in its fully operational configuration.
    b. **Long movements:** For movements over 200' the curtain will be raised up and secured to the 24" frame. The breasting lines will be removed and the frame will be rafted alongside the working construction barge to allow for the tow.
    c. **Curtain Repositioning:** Slowly and carefully move the curtain and construction barge to the new location. Use support boats or equipment to assist in maneuvering the rigid frames and curtain panels if needed.
    d. **Re-Anchoring:** Redeploy the frame and the curtain at the new location, following the same procedures used in the initial deployment. Ensure the curtain is properly extended and secured to maintain an effective sediment barrier.
3. Post-Relocation Inspection
    a. **Alignment Check:** Verify that the curtain is properly aligned and that there are no gaps or openings. Adjust silt curtain or reposition frames as necessary.
    b. **Functionality Test:** Monitor the new setup for a short period to ensure the curtain is functioning correctly and containing sediment as intended.
4. **Special Considerations for Shallow Water:** In water depths less than the height of the silt curtain, it is crucial to adjust the curtain to prevent dragging on the seabed. This can be achieved by raising the bottom edge of the curtain using additional floatation devices or by shortening the curtain height with reefing lines on the frame.

PPM will follow the procedures outlined below for inspection of the moonpool and silt curtain.

1. Daily Inspections

   a. **Visual Checks:** Conduct visual inspections of the moon pool and silt curtain at the start and end of each workday. Look for any signs of wear, damage, or improper alignment.
   b. **Sediment Leakage:** Check for any signs of sediment escaping the containment area, indicating breaches or failures in the curtain system.
   c. **Breasting Line and Float Condition:** Inspect the lines and floats to ensure they are secure and functioning correctly.
2. Continuous Monitoring
   a. **Site Monitoring:** Continuously monitor the condition of the moon pool and silt curtain during construction activities. The operator and deck engineer will observe the curtain, especially during high sediment-generating operations.
   b. **Environmental Conditions:** The operator and deck engineer will pay close attention to changing environmental conditions such as tides, currents, and weather, which may affect the integrity of the moon pool and silt curtain and height from the seabed.

In the event a repair of the silt curtain is needed, PPM will follow the procedures outlined below:

1. Immediate Response
   a. **Damage Identification:** Upon identifying damage or failure in the silt curtain, immediately halt construction activities in the affected area to prevent further sediment release.
   b. **Assessment:** Conduct a quick assessment to determine the extent of the damage and the required repair materials and tools.
2. Repair Process
   a. Minor Repairs
      a. **Patch Kits:** Use silt curtain patch kits to repair small tears or holes. Clean the damaged area, apply adhesive, and attach the patch firmly to ensure a tight seal.
      b. **Temporary Measures:** If immediate repair is not feasible, an additional silt curtain will be deployed to encapsulate the failed curtain to control sediment until permanent repairs can be made.
   b. Major Repairs
      a. **Replacement Sections:** For significant damage, replace the affected section of the curtain. Disconnect the damaged section and securely attach a new section using the manufacturer’s recommended connectors and sealing methods.
      b. **Reanchoring:** Ensure that repaired or replaced sections are properly reanchored and aligned to maintain the moon pool and curtain’s effectiveness.
3. Post-Repair Inspection
   a. **Verification:** After completing repairs, conduct a thorough inspection to verify that the curtain is fully functional and that no gaps or weaknesses remain.
   b. **Testing:** If possible, perform a water test by agitating the water within the containment area to ensure no sediment escapes through the repaired section.
4. Documentation and Reporting
   a. **Record Keeping:** Document all repairs, including the nature of the damage, repair methods used, materials applied, and the date and time of the repair.
   b. **Reporting:** Report significant repairs to the project manager and relevant environmental oversight authorities as required by the project specifications and permits.

In order to protect the moonpool, PPM will implement the following preventative measures:

1. Proactive Maintenance
    a. **Regular Checks:** Perform regular checks and maintenance of the silt curtain system to identify and address issues before they lead to significant damage.
    b. **Reinforcement:** Consider reinforcing high-stress areas of the curtain with additional material or support to prevent damage during intense construction activities.
2. Training
    a. **Crew Training:** Train construction crew members on the importance of the silt curtain system, the common causes of damage, and the procedures for identifying and reporting issues promptly.

For the dewatering of contaminated sediment barges, free surface water will be pumped off through a filter medium of activated carbon consistent with design specifications Section 35 20 23 (Remedial Dredging, Barge Dewatering, and In-Water Transportation) and discharged into the moonpool curtain in the dredge area. This process ensures that suspended solids are contained within the moonpool, allowing for sufficient settling time to meet water quality requirements before the silt is relocated. This method effectively manages water quality by reducing the risk of sediment-laden water re-entering the surrounding environment. During all discharge periods visual turbidity monitoring will be in effect. If abnormal Water Quality conditions are encountered, pumping operations will be halted until water conditions normalize.

2.4 Construction Sequencing

Construction will be sequenced to manage and protect water quality in the LDW. In general, the work will be conducted from upstream to downstream to reduce the risk of recontamination due to suspended sediment with three exceptions. The first exception to that is in Season 1 when SMAs 4-9 will be dredged while dredging is concurrently happening in SMAs 1-3. The second exception is that SMA 5 will be completed last during Season 3. The third exception is SMA 12B being performed at the same time as SMA 14 due to the large volume of the SMAs and scheduling restrictions of the contract.

In areas where SMAs boundaries are connected to another (SMAs 14-16 and 17-18), a buffer of 50' will be created between the active dredge area and the recently capped SMA, with the capped SMA always being upstream of the dredging operations. This buffer will be achieved by having the dredge excavator progress forward with dredging activities to the adjacent SMA as post-dredge survey and testing is being conducted. PPM will also work with the sequencing to limit the frequency of transitioning from dredging to material placement, however with the testing timelines and 12-day material placement requirement, transitions will be necessary.

3. Monitoring During In-Water Work

PPM will conduct monitoring for visual turbidity during all in-water operations (i.e. dredging, material placement, debris removal, and structural work) and will visually inspect silt curtains as described above. At the direction of the Project Manager, the Superintendent, Project Manager, and equipment operator will visually monitor the water within the work area during construction to prevent water quality exceedances. If visual turbidity is observed outside of the silt curtain, PPM will implement the corrective measures identified in Section 5.

Monitoring and sampling for water quality parameters will be conducted by the Independent Quality Assurance Team in accordance with the WQMP (**Attachment 1**).

4. Barge Monitoring

Prior to the start of in-water work for each construction season, a general marine condition survey will be conducted by a certified marine surveyor for each barge proposed for use during that season in accordance with Specification Section 35 10 00 (Navigation Safety and Marine Traffic Control). No barge will be used at the Site until the general marine condition survey report has been reviewed and accepted by the Project Representative. If at any point during construction a barge requires repair, a new general marine conditions survey will be completed.

Maintenance standards for all vessels will be in compliance with applicable laws and regulations including United States Coast Guard (USCG) marine safety requirements. Additional details on the vessel monitoring are included in the Vessel Management Plan in the Remedial Action Work Plan. Maintenance records and reports will be maintained on site and made available within 24 hours if/when requested by the Project Representative.

PPM will employ properly trained and experienced employees to inspect and document each barge prior to transport from the Site to the Transload Facility. Each load of dredge material, debris, and piling will be inspected to ensure the barge is properly loaded, structurally sound, has no observable stability issues, and has no leaks. The daily construction report will document the completion of barge inspections and provide the estimated tonnage and certificates daily for each contaminated material barge.

If at any point leaking is observed the contaminated sediment barge transport operations will be halted and will not resume until repairs are made and approved by the Project Representative. There will be a supply of spare parts, materials, and other resources accessible during operation to implement maintenance and minor repairs on vessels to ensure maintenance and repair minimally impact the project schedule.

5. Water Quality Exceedance Protocol

If a confirmed water quality exceedance occurs as detailed in the WQMP (see **Attachment 1**), the Project Representative will notify EPA and PPM within two hours of the confirmed exceedance. PPM will coordinate with the Project Representative to identify the likely source(s) of the exceedance and identify corrective measures and BMPs to implement to return dredging operation to compliance with water quality criteria.

In accordance with Specification Section 35 20 23 (Remedial Dredging, Barge Dewatering, and In-Water Transportation), the Project Representative will require PPM to adjust dredging operations or implement additional BMPs if visual turbidity associated with the dredging is judged to be come a risk to sensitive locations or if visible plumes occur during dredging and contaminated sediment barge dewatering activities. PPM will also choose to implement additional BMPs based on visual monitoring as described in **Section 3**. PPM will implement the following corrective measures to address water quality exceedances or visual turbidity:

- Decreasing the velocity of the bucket through the water column;
- Stopping the dredge bucket above the sediment surface before dredging;
- Stopping work temporarily then increasing cycle time;
- Dislodging sediment material adhered to the bucket (over the contaminated sediment barge);
- Modifying the contaminated sediment barge loading procedures to reduce material spillage;
- Change of dredge buckets/modification of equipment;
- Monitoring and management of propeller wash;
- Modifying the position of barges to avoid grounding or scouring from the tugs; and
- Modifying moon pool or silt curtain layout and lengths.

PPM will coordinate with the Project Representative and use adaptive management processes to adjust the construction barge and contaminated sediment barge dewatering operations to address the cause of increasing turbidity or the exceedance of the water quality chemical parameters. If the water quality exceedances continue, a path forward will be discussed and may include:

- Implementation of more aggressive BMPs or operational modifications;
- Increasing the compliance boundary distance for turbidity if the chemistry sample testing indicates there are no exceedances of chemical water quality criteria; and
- Temporarily stopping work to further assess the source of the exceedance.

Implementation of contingency actions will be conducted at the direction of PPM's Project Manager. PPM's Superintendent, operator, and Project Manager will monitor for visual turbidity when work resumes. Water quality parameters will be measured by the Independent Quality Assurance Team. PPM will communicate with the Project Representative to determine if the contingency actions are effective at returning water quality criteria to within acceptable limits.

6. Cessation of Operations

Following Specification Section (Environmental Procedures, Article 3.05) construction activities will cease as a result of the first indication of a regulated substance spill (e.g., oil) within the Work area, or at the first indication of distressed or dying fish in the vicinity of construction. When such conditions occur, PPM will cease all operations and take all necessary steps to correct the problem. The Project Representative will be immediately notified of the problem. Operations will resume upon acceptance of the Project Representative after the problem has been corrected.

7. References

Anchor QEA, 2024. Final (100%) Remedial Design Basis of Design Report for Lower Duwamish Waterway Upper Reach. Anchor QEA. January 2024.

Attachment 1: Water Quality Monitoring Plan

Lower Duwamish Waterway Group

City of Seattle / King County / The Boeing Company

100% Remedial Design Volume II, Part I

Construction Quality Assurance Plan for the Lower Duwamish Waterway Upper Reach

Appendix A – Water Quality Monitoring Plan

For submittal to

The US Environmental Protection Agency
Region 10
Seattle, WA

January 17, 2024

Prepared by:

Windward environmental LLC

200 First Avenue West • Suite 500
Seattle, Washington • 98119

in association with

Anchor QEA

1201 3rd Avenue • Suite 2600
Seattle, Washington • 98101

TABLE OF CONTENTS

TABLES

FIGURES

ABBREVIATIONS

7-DADMax	7-day average of the daily maximum temperatures
ARAR	Applicable or Relevant and Appropriate Requirement
BMP	best management practice
BODR	*Basis of Design Report*
COC	contaminant of concern
CQAP	Construction Quality Assurance Plan
CRM	certified reference material
CV-AA	cold vapor-atomic absorption
CV-AFS	cold vapor-atomic fluorescence spectrometry
CWA	Clean Water Act
DO	dissolved oxygen
DQI	data quality indicator
EPA	U.S. Environmental Protection Agency
EQAO	Environmental Quality Assurance Officer
FC	Field Coordinator
FNU	Formazin Nephelometric Unit

FLPE	fluorinated high-density polyethylene
GC-ECD	gas chromatography-electron capture detection
GPS	global positioning system
HDPE	high-density polyethylene
ICP-MS	inductively coupled plasma-mass spectrometry
LCS	laboratory control sample
LDW	Lower Duwamish Waterway
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
NTU	nephelometric turbidity units
PCB	polychlorinated biphenyl
PM	Project Manager
QA/QC	quality assurance/quality control
RD	remedial design
RL	reporting limit
RPD	relative percent difference
SDG	sample delivery group
SMA	sediment management area
SRM	standard reference material
WAC	Washington Administrative Code
WQMP	Water Quality Monitoring Plan

1 Introduction

This draft Water Quality Monitoring Plan (WQMP) is a component of the remedial design (RD) for the upper reach of the Lower Duwamish Waterway (LDW). The upper reach encompasses river mile 3.0 to river mile 5.0 of the LDW. The RD has been prepared consistently with the sediment remedy outlined in the U.S. Environmental Protection Agency's (EPA's) November 2014 *Record of Decision* (ROD) (EPA 2014), as modified by the *Explanation of Significant Differences* (EPA 2021). The purposes of the LDW upper reach WQMP are to obtain water quality data during construction to identify water quality effects that may be caused by remedy construction, and to use those data to identify the need to implement additional best management practices (BMPs) and/or operational measures for dredging and debris removal to address water quality effects in compliance with Applicable or Relevant and Appropriate Requirements (ARARs).

This WQMP, which is an appendix to the Construction Quality Assurance Plan (CQAP), identifies the specific requirements for monitoring water quality during in-water dredging, including steps to be taken to mitigate exceedances of water quality criteria, if any occur. This WQMP also includes monitoring during removal of identified debris[1] below the water line and placement of clean material. This draft final WQMP is included in the Final (100%) RD for the LDW upper reach and will be updated by the Implementing Entity, in coordination with EPA, as necessary to reflect any conditions or requirements in the final Clean Water Act (CWA) §404 ARAR Memorandum. The Implementing Entity's selected water quality monitoring firm will identify key staff in the organizational chart and develop remaining monitoring details.

1.1 Project Description

Remedial activities in the LDW upper reach are described in the *Basis of Design Report* (BODR). Construction BMPs, environmental protection measures, and water quality management controls for the anticipated work activities are described in Section 11 of the BODR.

The in-water components of the upper reach remedy will be conducted within the LDW-designated in-water work window, which is expected to occur between October 1 and February 15, annually. Scheduling will also take into account the tribal net fishery. The total project is estimated to take approximately three construction seasons to complete, as discussed in Section 13 of the BODR.

[1] "Identified debris" refers visible nearshore debris specifically in areas identified in the remedial design drawings. Intensive conventionals monitoring is required during the removal of identified debris below the water line. Water quality effects associated with the removal of smaller debris encountered during dredging will be addressed using the level of monitoring already occuring during dredging. If larger debris is encountered that requires targeted removal from an SMA, intensive conventionals monitoring will be performed for the duration of the debris removal.

The Implementing Entity will designate a Water Quality Monitoring Lead to oversee water quality monitoring during dredging activities to ensure compliance with Washington State water surface water quality criteria. For safety reasons, water quality monitoring will be restricted to daylight hours.

Water quality monitoring will not be performed when land-based excavation alone (i.e., no in-water work) is being conducted. Construction specifications will require the Contractor to use temporary erosion and sediment control measures to minimize spillage of excavation materials into the LDW during land-based excavation.

1.2 Water Quality Effects Assessment

A site-specific water quality modeling evaluation was performed to assess the potential for water quality exceedances during dredging (Appendix M). The conclusion was that water quality criteria are unlikely to be exceeded for contaminants of concern (COCs) from resuspension of sediment during dredging operations, or from barge dredge return water discharge.

The results of Appendix M can be considered by EPA to inform the detailed water quality monitoring requirements in EPA's CWA §404 ARAR Memorandum.

2 Monitoring Personnel and Responsibilities

The individuals responsible for various tasks required for water quality monitoring sample collection and analysis are described here and shown in CQAP Figure 2-1. Persons fulfilling these roles will be designated at least one month prior to the start of monitoring activities, and contact information will be provided to EPA at that time. All monitoring personnel will be experienced in the collection and measurement of water quality data.

2.1 Project Representative

The Project Representative, whose role is described in the CQAP, is assigned by the Owner to oversee the entire construction QA program. The Project Representative is the only person authorized to direct the Contractor and will be kept updated on water quality monitoring results and notified when there is an observed water quality exceedance. The Project Representative will coordinate notifications to EPA of confirmed water quality exceedances. The Project Representative will coordinate with the Contractor and EPA to ensure appropriate construction BMPs are being implemented and strategize ways to use BMPs or enhance the effectiveness of existing BMPs as necessary to mitigate water quality exceedances. The Project Representative will have the authority to stop the Contractor's work when necessary, including for reasons related to water quality exceedance(s).

2.2 Environmental Quality Assurance Officer

The Environmental Quality Assurance Officer (EQAO), whose role is described in the CQAP, is responsible for coordinating, reviewing, and reporting all environmental monitoring activities, including water quality monitoring. The EQAO reports to the Project Representative; key responsibilities for water quality monitoring include:

- Reviewing field reports to verify that appropriate field methods and QC procedures are being implemented in accordance with the procedures specified in this WQMP
- Overseeing coordination of the field sampling and laboratory programs and supervising data review, including coordination with the analytical laboratories and the EPA QA chemist, Don Matheny. Don Matheny is the EPA contact for this sampling and works on behalf of the EPA QA manager, Cindy Fields. Mr. Matheny can be reached as follows:
  - Mr. Don Matheny
    US Environmental Protection Agency, Region 10
    1200 6th Avenue
    Seattle, WA 98101
    Telephone: 206.553.2599
    Email: matheny.don@epa.gov

- Reporting weekly water quality results to the EPA Project Manager
- Notifying EPA if a confirmed water quality exceedance is observed, and working with the Project Representative to coordinate with EPA to assess options for operational adjustments

2.3 Water Quality Monitoring Lead

The Water Quality Monitoring Lead will report to the EQAO and is responsible for the following activities:

- Overseeing all water quality monitoring activities and field personnel
- Overseeing sample collection, preservation, and holding times, and coordinating delivery of water quality samples to the designated laboratories for chemical analyses.
- Verifying that station, sample collection, and conventional field measurement results are properly recorded and forms are completely filled out
- Verifying that appropriate calibration and quality assurance/quality control (QA/QC) field procedures are being implemented
- Notifying the EQAO and Project Representative when water quality exceedances are observed, and providing all necessary supporting field documentation so the Project Representative can identify an appropriate path forward can be determined in consultation with EPA.

2.4 Monitoring Personnel

Under the Water Quality Monitoring Lead's oversight, water quality field monitoring personnel will be responsible for conducting field activities, instrument calibrations, QA/QC procedures, and documentation of results in daily field reports.

2.5 Analytical Laboratory

The analytical laboratory (TBD) will perform all chemical analyses. The laboratory will meet the following requirements:

- Adhere to the methods outlined in this plan, including those methods referenced for each procedure
- Adhere to documentation, custody, and sample logbook procedures
- Implement QA/QC procedures defined in this plan
- Meet all reporting requirements
- Deliver electronic data files as specified in this plan
- Meet turnaround times for deliverables as described in this plan
- Allow EPA and the EQAO, or a representative, to perform laboratory and data audits.

2.6 Data Management

The Data Manager (TBD) will oversee data management; they will ensure that analytical data are incorporated into the LDW database with appropriate qualifiers following review of the data.

3 Water Quality Monitoring Plan

Water quality monitoring during construction will include monitoring conventional parameters and water chemistry. The monitoring plan has been designed to cover the anticipated range of river conditions and construction operations. However, EPA may require additional sampling for conventional parameters and water chemistry.

Monitoring for conventional parameters, described in Section 3.1, will use a tiered-testing approach. Intensive conventionals monitoring for three days will be conducted in the following circumstances:

- At the start of dredging in each sediment management area (SMA)[2]
- The first time that a new type of dredging equipment is used
- During the removal of debris below the water line (identified debris or large debris encountered during dredging)
- During dredging in the western portion of SMA 12B adjacent to the Duwamish River People's Park and Shoreline Habitat restoration area
- If an exceedance of turbidity criteria is confirmed during monitoring associated with dredging, which would trigger an additional two-day intensive monitoring period for conventionals.

Routine monitoring of conventional parameters will occur whenever intensive monitoring is not required (i.e., there are no confirmed exceedances of turbidity criteria during the three-day intensive monitoring period and any additional two-day periods for turbidity exceedances, as well as during placement of clean material). Conventionals monitoring will be conducted if a turbidity plume is observed at the 150-foot compliance station. If there is a confirmed turbidity exceedance associated with dredging, then two days of intensive conventionals monitoring will begin.

The collection and analysis of water samples for chemical analysis is described in Section 3.2. Water chemistry monitoring will occur under three specific conditions:

- Chemistry condition 1: the initiation of dredging (one event per season)[3]
- Chemistry condition 2: a confirmed turbidity exceedance associated with dredging (at least three events per season)

[2] The start of dredging is defined as the beginning of dredging in the SMA. If contingency re-dredging is required in the SMA, the initiation of contingency re-dredging will not trigger intensive monitoring of conventionals unless directed by EPA following review of results from missed inventory and residuals sediment samples.
[3] Water chemistry monitoring will occur during the placement of the first lift of cap material in SMA 12B.

- Chemistry condition 3: dredging in an area with elevated COC concentrations in sediment (relative to COC concentrations in other SMAs) or dredging in the vicinity of public access areas.

In addition to the conventionals monitoring and the chemistry monitoring, the construction inspectors will conduct daily visual observation of the Work Site for the following environmental conditions, as described in Section 3.5.1 of the CQAP. Any observations of the following conditions will be communicated to both the Construction Quality Assurance Officer and EQAO for documentation and potential corrective action, as determined by the Project Representative in coordination with EPA:

- Presence of oil sheen associated with construction activities
- Evidence of distressed or dying fish

The Project Representative will direct the Contractor to cease work in the immediate vicinity of construction activities associated with the observed presence of oil sheens or distressed or dying fish.

3.1 Conventional Parameters

The ROD (EPA 2014) states that the LDW is considered marine water under the Washington State's water quality standards regulation, because it meets the salinity threshold described in Washington Administrative Code (WAC) 173-201A-260(3)(e), and because salinity measurements show tidal conditions exist beyond the Turning Basin. The ROD also states that the LDW is not specifically noted in WAC 173-201A-610 and 612, Table 612, but rather is a continuation of Elliott Bay for the purposes of applying marine criteria. Based on the beneficial use classification of the LDW as "excellent quality" to support salmonid migration and rearing, the applicable compliance criteria for conventional parameters are the "excellent quality" Washington State Surface Water Quality Standards for marine waters (WAC 173-201A-210).

The Contractor will be responsible for construction QC including following BMPs with the goal of meeting applicable and relevant state water quality criteria at the designated point of compliance. Dredging effects on water quality are typically assessed by complying with the provisions of EPA's CWA §404 ARAR Memorandum.

The following field conventionals will be monitored during dredging activities at the compliance and background stations:

- Turbidity (in nephelometric turbidity units [NTU])
- Dissolved oxygen (DO) (in mg/L)
- Temperature (in °C)

- Hydrogen ion concentration (in pH units)
- Salinity[4] (in parts per thousand) – informational only.

3.1.1 Conventionals Criteria

3.1.1.1 Turbidity

Expected provisions of the CWA §404 ARAR Memorandum are that in-water construction activities do not increase in-water turbidity 5 NTU above background when background is 50 NTU or less (or 10% above background if background is greater than 50 NTU) at the compliance mixing zone distance. Compliance is typically measured at the edge of the EPA-approved mixing zone 150 feet from the construction work zone (Figure A3-1). The proposed area of mixing for marine waters is a 150-foot radius (i.e., point of compliance) surrounding the in-water activity. The background stations will be upstream and 500 feet away from the influence of the dredging activities occurring in the construction work zone. If there is a preliminary exceedance of the turbidity criteria, the EQAO and Project Representative will be informed, and the turbidity will be measured again at the same station 30 minutes after the original exceedance to determine if there is a confirmed turbidity exceedance requiring corrective action (Section 5). If there are two consecutive turbidity exceedances recorded 30 minutes apart, this will be defined as a confirmed turbidity exceedance.

3.1.1.2 Dissolved Oxygen

The DO criterion in marine waters with "excellent quality" is 6.0 mg/L; the DO at the point of compliance shall not decrease to less than 6.0 mg/L within a 24-hour period, per WAC 173-201A-210: "If the background DO is less than 6.0 mg/L (or within 0.2 mg/L of that criterion) and is due to natural conditions, then human actions considered cumulatively may not cause the DO of the water body to decrease >0.2 mg/L."

3.1.1.3 Temperature

Per WAC 173-201A-210: "When the water body temperature is >16°C (or within 0.3°C of 16°C; one day maximum) and that condition is due to natural conditions, then human actions considered cumulatively may not cause an incremental increase of >0.3°C (7-day average of the daily maximum temperatures [7-DADMax]), per Table 210 (1)(c) of WAC 173-201A-210 for "excellent quality" marine water, wherein the 7-DADMax is the arithmetic average of seven consecutive measures of daily maximum temperatures. The 7-DADMax for any individual day is calculated by averaging that day's daily maximum temperature with the daily maximum temperatures of the three days prior and the three days after that date.

[4] Salinity will be calculated based on specific conductance and temperature readings.

If water body temperature is 16°C (or >0.3°C below 16°C [<15.7°C]), incremental temperature increases resulting from individual point source activities must not, at any time, exceed 12°/(T-2) as measured at the edge of a mixing zone boundary, where T = highest representative ambient background temperature in the vicinity (°C)."

3.1.1.4 pH

In marine waters with "excellent quality," pH must be within the range of 7.0 to 8.5, with a human-caused variation within that range of <0.5 units difference from background, per WAC 173-201A-210.

Table A3-1 summarizes the conventional water quality parameters and criteria.

Table A3-1
Criteria for Conventional Parameters

Parameter	Criteria	Units
Turbidity	If background is ≤50 NTU the criteria is background +5 NTU If background is >50 NTU the criteria is background +10%	NTU
DO	6.0 mg/L[1]	mg/L
Temperature	Water body temperature 16°C (60.8°F): incremental temperature increases must not exceed 12°/(T-2) where T is the highest ambient background temperature[2]	°C
pH	7 to 8.5 pH units	pH units

Notes:
1. If background DO is less than 6.0 mg/L and due to natural conditions, then dredging cannot reduce the background DO by more than 0.2 mg/L.
2. If the water body temperature is greater than 16°C (60.8°F), the incremental increase due to dredging cannot exceed 0.3°C.
DO: dissolved oxygen
mg/L: microgram per liter
NTU: nephelometric turbidity unit
WAC: Washington Administrative Code

3.1.2 Monitoring Stations and Depths

During each monitoring event, conventional parameters will be measured at both the background station (500 feet upriver of the construction work zone) and at the 150-foot compliance monitoring station. When the water depth is at least 10 feet, measurements will be made at two depths: near surface (approximately 3 feet below the water surface) and near bottom (approximately 3 feet above the mudline) (see Figure A3-1). In water deeper than 20 feet, measurements will be made at three depths: the midpoint of the water column and the near-surface and near-bottom depths. In water shallower than 10 feet, one measurement will be made in the middle of the water column. Whenever possible, samples will be collected at a location with a minimum water depth of 10 feet to minimize the potential for disturbance of the sediment bed by monitoring vessels.

Compliance stations will be based on the distance downriver from the construction activity. All compliance stations will be monitored downriver of the construction activity and at least one station each day will be monitored approximately one to two hours after a tide reversal during the ebb tide condition to represent the assumed worst-case condition.

Sediment dynamics during flood and ebb tides, including shear stress, have been assessed in the sediment transport modeling report for the LDW (QEA 2008), sediment transport analysis report for the LDW (Windward and QEA 2008), Duwamish River water quality study (King County 1999), and King County Diagonal Duwamish current meter study (unpublished data). The resuspension potential of dredge residuals is expected to be greater downstream of dredging during the ebb tide (with its higher bottom velocity) than upstream of dredging during the flood tide. Thus, turbidity monitoring downstream likely represents the worst-case scenario.

For SMA 12B, which is adjacent to the northern part of the Duwamish River People's Park and Shoreline Habitat, additional turbidity monitoring will be conducted west of the center line of the FNC during dredging. This monitoring will be conducted during the flood tide at a location 150 feet or less from the dredge location that is closest to the entrance to the marsh habitat area. For this area, the compliance station located near the inlet of the marsh habitat area will be monitored during the flood tide, and the downstream location will be monitored during the ebb tide.

If barge dewatering occurs more than 150 feet from dredging, water quality monitoring will be conducted 150 feet downstream of the barge. Barges will be required to be watertight during transit to the transload facility and during transloading of dredge material, so water quality monitoring will be conducted only during periods of active dewatering.

3.1.3 Monitoring Frequency

Water quality monitoring frequency for conventionals will be based on two tiers—intensive and routine conventionals monitoring.

3.1.3.1 Intensive Conventionals Monitoring

Intensive conventionals monitoring will be conducted the first three days of dredging in each SMA (Figure A3-2) and will be conducted twice per day. The first daily monitoring round will be conducted at least one hour after the start of daily work activities. The second daily monitoring round will be separated from the first monitoring round by a minimum of four hours. For one of the sampling events, monitoring will target one to two hours after tide reversal during the ebb tide condition. No monitoring will be performed if it cannot be completed one hour before dark/during dark hours due to safety concerns.

Intensive conventionals monitoring will also be required: 1) the first time there is a significant change to the Contractor's dredging equipment, such as changes to bucket type (e.g., environmental bucket to open clamshell bucket), 2) if there is a confirmed turbidity exceedance associated with dredging activities at the 150-foot compliance monitoring station, 3) during the removal of identified debris below the water line, and 4) during dredging in the western portion of SMA 12B in the vicinity of the entrance to the Duwamish River People's Park and Shoreline Habitat restoration area.

If no exceedances of the water quality criteria for conventional parameters are identified over three consecutive days, then routine conventionals monitoring will be implemented.

Background stations will be monitored prior to compliance stations. The compliance station(s) will be monitored within one hour of the completion of background station monitoring.

3.1.3.2 Routine Conventionals Monitoring

Routine conventionals monitoring is performed when intensive monitoring is not required. Routine monitoring during dredging will occur once per day, two days per week (Figure A3-3). Monitoring events will target one to two hours after tide reversal during the ebb tide. If a turbidity plume is visually observed at the 150-foot compliance station at any time during dredging, monitoring will be conducted as soon as the monitoring vessel gets to the station.

During the placement of clean material, routine turbidity monitoring will also occur. Turbidity exceedances associated with the placement of clean material will not trigger intensive monitoring, chemistry sampling, or changes in placement operations. EPA will be notified of turbidity exceedances associated with the placement of clean material. After the first six monitoring events associated with the placement of clean material, the Owner, Project Representative, EQAO, and EPA will discuss the data, and EPA will determine whether to discontinue turbidity monitoring during placement of clean material.

3.1.3.3 Exceedance-Triggered Monitoring

If exceedances of the water quality criteria for conventional parameters are confirmed during any dredging monitoring event, two days of intensive conventionals monitoring will occur.

3.1.4 Monitoring Methods

Water quality monitoring of conventionals will be conducted from a boat during daylight hours. Monitoring will be performed using a calibrated multi-probe meter (e.g., Hydrolab, YSI© probe, or similar) and/or a calibrated Hach© turbidity meter (the standard operating procedure will be provided with final WQMP). Turbidity, DO, pH, and salinity[5] will be measured and recorded for each station.

All stations for water column measurements will be positioned relative to the location of the dredging, debris removal, material placement, and barge dewatering activities at the time of

[5] Salinity will be calculated based on specific conductance and temperature readings.

sampling (e.g., 150 feet downriver from the construction activity) (Figure A3-1). Distances from construction activity will be verified using a range finder. Actual differential global positioning system coordinates, times, and depths of all water column sample stations will be recorded.

Monitoring equipment will be calibrated daily and allowed to equilibrate prior to use. Calibration information will be recorded in the field notebooks. Monitoring equipment will be handled according to the manufacturers' recommendations. Unusual or questionable readings will be noted, and duplicate readings will be collected.

3.1.5 Conventional Parameter Compliance

The compliance station results will be compared to those for the corresponding depth intervals at the background station. For example, the near-bottom results for both stations will be compared to one another. If the background station has only one sample because of a water depth of less than 10 feet, the results for all compliance station samples will be compared to the results for the background station sample.

If the water quality criteria are exceeded at the compliance station for one or more of the conventional parameters, the measurements will be repeated at the compliance station 30 minutes after the initial measurements were taken. The exceedance will be considered a confirmed exceedance if the results of the second measurement also exceeds the criteria.

EPA will be notified within two hours of a confirmed conventional parameter exceedance at the compliance station, and conventional parameter monitoring will be conducted approximately every two hours for the remainder of the day until compliance is documented. If there is a confirmed turbidity criteria exceedance during dredge monitoring or debris removal, the Project Representative will coordinate with the Contractor to identify and institute additional BMPs or modify the Contractor's operations to bring its activities back into compliance with water quality criteria. Some potential anticipated BMPs or operational changes that may be proposed by the Contractor include:

- Adjust dredging process by decreasing the velocity of the bucket through the water column and pausing the bucket above the bottom before dredging
- Decrease dredging or debris removal cycle time to reduce suspended sediment loading to water column
- Dislodge material that may adhere to the bucket over the haul barge
- Modify dredged material barge loading to reduce potential dredge material spillage
- Change buckets or modify equipment
- Use adaptive management processes to adjust dredge operations, in conjunction with discussions with EPA and monitoring to confirm that the cause of the exceedance has been addressed.

If the turbidity exceedance continues after implementing additional BMPs and/or operational modifications, the Project Representative will direct the Contractor to stop dredging activities associated with the turbidity exceedance, and EPA will be contacted to determine how to proceed.

3.1.6 Summary of Water Quality Monitoring Plan for Conventional Parameters

The water quality monitoring plan for conventional parameters is summarized in Table A3-2 and Figures A3-2 and A3-3.

Table A3-2
Summary of Conventional Parameter Water Quality Monitoring Plan

Component	Intensive Conventionals Monitoring	Routine Conventionals Monitoring
Conditions	• Contractor begins dredging a new SMA • First time there is a major change in equipment (e.g., dredge bucket type) • Removal of identified debris below the water line • Following confirmed turbidity exceedances during dredging[1] • During dredging in SMA 12B to the west of the center of the FNC as close as possible to the entrance to the Duwamish River People's Park and Shoreline Habitat restoration area	When intensive monitoring is not required during dredging or debris removal During placement of clean material
Duration	• 3 consecutive days if no confirmed exceedance • 2 additional consecutive days following any confirmed exceedance • Daily during dredging in the western portion of SMA 12B	2 days per week
Frequency	2 sampling events per day	1 sampling event per day
Conventional Parameters and Stations	Monitor *in situ* conventional parameters (turbidity, pH, DO, and temperature) per WAC 173-201A-210 at 150-foot compliance monitoring station downriver and background monitoring station 500 feet upriver of the in-water construction work zone. Sampling will occur on the ebb tide whenever possible.	
Preliminary Exceedance Criteria	Preliminary exceedance occurs when the results exceed criteria for any of the conventional parameters at the compliance monitoring station.	
Confirmed Exceedance Criteria	Exceedance is confirmed when two consecutive measured exceedances (30 minutes apart) occur at the same compliance monitoring station.	
Conventionals Water Quality Criteria Exceedance Corrective Action	• After a confirmed conventionals exceedance, Project Representative will notify EPA and Contractor within two hours. In situ conventional parameter testing will be conducted every two hours for the remainder of the day or until compliance is demonstrated (during daylight). If the confirmed exceedance is a turbidity exceedance associated with dredging, Contractor will modify its operations and turbidity monitoring will be conducted every two hours (for the remainder of day or until compliance is demonstrated) after additional BMPs or operational modifications have been implemented by Contractor to demonstrate and document that Contractor's modifications have returned the site to compliance. If the turbidity exceedance continues after implementing the additional BMPs and/or operational modifications, the dredging activities associated with the turbidity exceedance will be ceased, and EPA will be contacted to determine how to proceed. • Intensive monitoring will begin for a 2-day period the next day.	

Notes:

1. Monitoring will occur if a turbidity plume is observed at the 150-foot compliance monitoring station.
BMP: best management practice
DO: dissolved oxygen
EPA: U.S. Environmental Protection Agency
SMA: sediment management area
WAC: Washington Administrative Code

3.2 Chemical Testing

Chemical testing will be conducted based on the chemistry conditions 1 through 3, summarized herein.

Chemistry condition 1: Construction initiation

Chemical testing will be conducted at the initiation of construction for each season to assess whether dredging activities result in a water quality chemical criteria exceedance. Samples will be collected after the Contractor has finished its startup operations and tested its equipment operational methods and has been production dredging for at least one hour to verify that BMPs are working effectively. Sampling will occur under three circumstances: 1) when dredging begins in the first SMA that will require at least four days of dredging in each construction season, 2) when dredging begins in the first SMA in the first season, as samples from this SMA will receive chemical testing regardless of the required dredging duration, and 3) when the first lift of cap material is placed within SMA 12B.

Chemistry condition 2: Confirmed turbidity exceedance

Chemical testing will be conducted as soon as possible after confirmation for each of the first three confirmed turbidity exceedances associated with dredging in each construction season. After the results from the testing are received, the Project Representative or EQAO will consult with EPA to determine if additional chemistry testing is required that season. Example conditions that may necessitate additional sampling include: 1) if any of the results are close to the water quality criteria, or 2) if turbidity exceedances associated with dredging that occur later in the season are significantly greater than those in the beginning of the season.

Chemical testing is intended to document whether a turbidity exceedance may also be associated with elevated chemical concentrations that exceed Washington State Acute Water Quality Criteria. Chemical testing will not be used to initiate real-time construction corrective action, because there is a long lag time between collecting samples for chemical testing and receiving test results from the laboratory. Turbidity measurements are the primary indicator of the potential for water quality chemical exceedance, as described and evaluated in the BODR Appendix M. It is expected that any corrective measures in the field will be based on confirmed turbidity exceedances associated with dredging.

Chemistry condition 3: Dredging in SMAs with elevated sediment concentrations or in the vicinity of public access areas

Chemical testing will occur when dredging begins in SMAs with substantially higher sediment COC concentrations relative to those in other SMAs. A review of the upper reach design dataset identified intertidal SMAs (SMAs 6 and 7) and subtidal SMAs (SMAs 12B and 16) as requiring water chemistry monitoring when dredging is initiated.

Table A3-3
SMAs Selected for Potential Chemical Testing Based on Elevated Sediment Concentrations

SMA	RM	Elevated sediment concentrations
6	4.1E	10 RAL intervals with PCB conc > 1,000 µg/kg 2 locations with vertical intervals with PCB conc > 10,000 µg/kg
12B	3.6	6 locations with vertical intervals with PCB conc > 1,000 µg/kg
7	4.0E	5 locations with RAL intervals with PCB conc > 1,000 µg/kg 1 location with vertical interval >1,000 µg/kg
16	3.1	5 locations with vertical intervals with PCB conc > 1,000 µg/kg

Notes:
µg/kg: microgram per kilogram
PCB: polychlorinated biphenyl
SMA: sediment management area

In addition, chemical testing will occur when dredging occurs within 150 feet of public access areas (i.e., the Duwamish Waterway Park [SMA 18]).[6]

3.2.1 Analytes

Chemicals with water quality criteria values for the protection of aquatic life and sediment concentrations greater than RALs in the UR were identified as analytes for the water quality monitoring. All water chemistry samples will be analyzed for PCBs, arsenic, lead, mercury and zinc. Exceedances of water quality criteria are not anticipated based on the assessment in BODR Appendix M. The Project Representative and EPA will meet to discuss the data prior to the second season of construction to determine if the analyte list should be revised.

3.2.2 Chemistry Criteria

The Washington State Marine Acute and Chronic Water Quality Criteria for the protection of aquatic life (WAC 173-201A-210) are the compliance criteria for chemical parameters (Table A3-4). Dredging will not be conducted over a continuous 24-hour period, and construction equipment will be moved multiple times per day. Therefore, results from water quality samples collected for chemical analyses and compared to acute and chronic water quality criteria will represent very conservative scenarios. Specifically, samples will be collected during active dredging and will not factor in water quality during periods when dredging is not being conducted over a 24-hour or 4-day period.

[6] Condition 3 chemistry sampling during dredging near the Duwamish River People's Park and Shoreline Habitat area is required due to elevated polychlorinated biphenyl (PCB) levels in SMA 12B sediments; for this reason, this area does not require separate sampling as a public access area.

Table A3-4
Marine Chronic and Acute Water Quality Criteria[1]

Chemical	Marine Chronic (µg/L)[2]	Marine Acute (µg/L)[3]
Metals		
Arsenic	36 (dissolved)	69 (dissolved)
Lead	8.1 (dissolved)	210 (dissolved)
Mercury	0.025 (whole water)	1.8 (dissolved)
Zinc	81 (dissolved)	90 (dissolved)
PCBS		
PCBs	0.030 (whole water)	10 (whole water)

Notes:
1. Standards listed are the lowest of National Recommended Water Quality Criteria: Aquatic Life Criteria EPA or Water Quality Standards for Surface Waters of the State of Washington (WAC 173-210A-240, Table 240).
2. Marine chronic criteria for metals are relevant to a 4-day exposure timeframe. The exposure timeframe for PCBs is 24 hours.
3. Marine acute criteria are relevant to a 1-hour exposure timeframe for metals and a 24-hour exposure timeframe for PCBs.
µg/L: microgram per liter
EPA: U.S. Environmental Protection Agency
PCB: polychlorinated biphenyl
WAC: Washington Administrative Code

3.2.3 Monitoring Stations and Depths

The points of compliance for chemical parameters are 150 feet and 300 feet from the construction activity for acute and chronic water quality criteria, respectively. During each monitoring event, samples will be collected at the 150-foot (acute) and 300-foot (chronic) compliance monitoring stations. When the water depth is at least 10 feet, samples will be collected at two depths: near surface (approximately 3 feet below the water surface) and near bottom (approximately 3 feet above the mudline) (see Figure A3-1). In water deeper than 20 feet, samples will be collected at three depths: the midpoint of the water column and the near-surface and near--bottom depths. In water shallower than 10 feet, one sample will be collected in the middle of the water column. The sample with the highest turbidity for each station will be selected for analysis each day. The samples not selected for analysis will be archived. The following conditions will also apply:

- Whenever possible, samples will be collected at a location with a minimum water depth of 10 feet to minimize the potential for disturbance of the sediment bed by monitoring vessels.
- Compliance station stations will be based on the distance downriver from the dredging activity.

3.2.4 Frequency of Chemical Testing

3.2.4.1 Chemistry Conditions 1 and 3

Water chemistry samples will be collected from both the 150-foot and 300-foot compliance stations twice a day for as many as four days[7] at the initiation of dredging (condition 1) and during dredging at SMAs identified as having higher sediment concentrations or as near public access areas (condition 3). At each compliance station, samples will be collected at two water depths and twice a day.

Water chemistry samples will be collected at the 150-foot compliance station one time during placement of the first lift of cap material at SMA 12B. Samples will be collected from two depths. The samples will be archived. If directed by EPA, they will be analyzed following discussion of the water and sediment chemistry results obtained during the dredging of SMA 12B.

On days one and three, the sample associated with the highest confirmed turbidity reading (among the four samples at each compliance station) will be analyzed. The remaining samples collected on days one and three and all samples collected on days two and four will be archived pending the results from the initial analyses.

If the metals concentrations in the sample with the highest turbidity analyzed from the 150-foot compliance station exceed the acute water quality criteria, then the archive sample from the 150-foot compliance station collected at the same time will be analyzed, and the two results will be averaged to represent the one-hour exposure for metals. If the PCB concentrations in the sample analyzed exceed the acute criterion at the 150-foot compliance boundary, then the three archived samples collected at that station from both sampling events that day will be analyzed. If the average PCB concentration of the four samples (representing a portion of the 24-hour acute exposure period) exceeds the acute criteria, that may be considered an exceedance of the acute water quality criteria. In consultation with EPA, a time-weighted concentration will also be evaluated.

If any of the metals concentrations in the sample analyzed from the 300-foot compliance station exceed the chronic water quality criteria, all samples collected over the four-day period will be analyzed, and the average of the samples will be compared to the chronic criteria. If the average concentration for four days exceeds the chronic value, that may be considered an exceedance of the chronic water quality criteria. In consultation with EPA, a time-weighted concentration will also be evaluated.

---

[7] When the analytes are metals and PCBs, sampling will occur for four days because the chronic exposure period for metals is four days. When PCBs are the only analyte, sampling will occur for two days because the chronic exposure period for PCBs is 24 hours.

If the PCB concentration in the sample analyzed from the 300-foot compliance station exceeds the chronic water quality criteria, the three archived samples collected at that station that day will be analyzed to determine if there is a chronic exceedance. If the average exceeds the chronic water quality criteria for PCBs, that may be considered an exceedance of the chronic water quality criteria for PCBs. In consultation with EPA, a time-weighted concentration will also be evaluated.

3.2.4.2 Chemistry Condition 2

If a confirmed turbidity exceedance occurs at the 150-foot compliance station, water chemistry samples will be collected after each of the first three confirmed turbidity exceedances as soon as possible after the confirmation of the turbidity exceedance. Samples will be collected at the near-surface and near-bottom water depths, and the results will be averaged for comparison to acute criteria for informational purposes. A turbidity exceedance generally represents a transient condition. If the turbidity exceedance persists for several days, EPA may require additional water chemistry sampling in addition to corrective measures in the field.

3.2.5 Water Chemistry monitoring methods

3.2.5.1 Field Methods

Water samples for chemical testing will be collected using a 5-L Teflon-lined Niskin bottle sampler, which will be manually lowered on a line to the targeted depth and triggered to close via a messenger. After the end caps of the sampler have been triggered shut, the sampler will be retrieved.

The dissolved metals samples will be filtered within 15 minutes of collection using a 0.45-µm filter and preserved with nitric acid to a pH < 2. Sampling standard operating procedures will be provided in the final WQMP.

Conventional water quality parameters will be measured at the time of chemistry sample collection, as discussed in Section 3.1.

Chemistry samples will be packed in coolers and held at ≤ 4°C (± 2°C). Samples for analysis will be delivered directly to the laboratory.

3.2.5.2 Laboratory Methods

Laboratory methods and sample handling requirements for the water samples are provided in Table A3-5. The selected laboratory will provide specific reporting limits for these analyses. The samples will be analyzed with a targeted one-week (seven days) turnaround time.

Table A3-5
Analytical Methods and Sample Handling Requirements for Water Samples

Parameter	Method	Reference	Laboratory	Container	Preservative	Sample Holding Time
Total PCBs	GC-ECD	EPA 8082	TBD	2 L (amber glass)	None	1 year to extract, 1 year from extraction to analysis
Dissolved metals	ICP-MS	EPA 6020	TBD	250-mL HDPE	nitric acid to pH < 2; dissolved samples filtered with 0.45-µm filter	180 days
Mercury	CV-AA	EPA 7470A	TBD	250-mL HDPE	nitric acid to pH < 2	28 days

Notes:
CV-AA: cold vapor-atomic absorption
EPA: U.S. Environmental Protection Agency
FLPE: fluorinated high-density polyethylene
GC-ECD: gas chromatography-electron capture detection
HDPE: high-density polyethylene
ICP-MS: inductively coupled plasma-mass spectrometry
TBD: to be determined

3.2.6 Summary of Water Quality Monitoring Plan for Water Chemistry

The water quality monitoring plan for water chemistry is summarized in Table A3-6.

Table A3-6
Summary of Water Quality Monitoring Plan for Chemistry

Component	Chemistry Conditions 1 and 3[1]	Chemistry Condition 2
Conditions	• Condition 1 – Initiation of dredging for each construction season • Condition 3 – When dredging an SMA with elevated sediment chemistry or if the SMA is near (within 150 feet of) a public access area	Condition 2 – Associated with the first three confirmed turbidity exceedances during dredging each season
Duration	4 days of sampling (PCBs and metals) 2 days of sampling (PCBs only)	1 day of sampling
Stations	150 feet and 300 feet downstream	150 feet downstream
Collection Frequency	Two sampling events per day	One sampling event
Timing	One of the two sampling events to occur 1 to 2 hours after tide reversal during ebb tide	As soon as possible after confirmed turbidity exceedance (for the first three confirmed exceedances)
Analytical Frequency	• Analyze one sample with the highest confirmed turbidity from each compliance location per day on days 1 and 3 • Archive all other samples pending results from initial samples	Analyze samples from both depth intervals

Component	Chemistry Conditions 1 and 3[1]	Chemistry Condition 2
Chemical Parameters	PCBs and metals	PCBs and metals
Exceedance Criteria	If concentrations in selected analytical sample exceed acute or chronic criteria, analyze archived samples to determine if the average of samples representing acute exposure (24 hours for PCBs, 1 hour for metals) or chronic exposures (24 hours for PCBs, 4 days for metals) exceeds the criteria.	Concentrations compared to acute criteria. The results will be averaged to represent acute exposure (24 hours for PCBs, 1 hour for metals).

Notes:
1. Water chemistry samples will also be collected once from both depth intervals at the 150-foot compliance station during the placement of the first lift of cap material in SMA 12B. The samples will be archived. If directed by EPA, following review of water and sediment chemistry sampling results associated with SMA 12B, the samples will be analyzed.
EPA: Environmental Protection Agency
PCB: polychlorinated biphenyl
SMA: sediment management area

3.3 Analytical Data Quality Objective and Criteria

The analytical data quality objective for the water samples is to develop and implement procedures that will ensure the collection of representative data of known, acceptable, and defensible quality. Parameters used to assess data quality are precision, accuracy, representativeness, comparability, completeness, and sensitivity.

3.3.1 Precision

Precision is the measure of reproducibility among individual measurements of the same property, usually under similar conditions, such as multiple measurements of the same sample. Precision is assessed by performing multiple analyses on a sample; it is expressed as a relative percent difference when duplicate analyses are performed, and as a percent relative standard deviation when more than two analyses are performed on the same sample (e.g., triplicates). Precision is assessed by laboratory duplicate analyses (e.g., duplicate samples, matrix spike duplicates (MSDs), and laboratory control sample [LCS] duplicates) for all parameters. Precision measurements can be affected by the nearness of a chemical concentration to the detection limit, whereby the percent error (expressed as either percent relative standard deviation or relative percent difference) increases. The DQI for precision varies depending on the analyte (Tables A3-7 and A3-8). The equations used to express precision are as follows:

$$RPD = \frac{\text{(measured conc} - \text{measured duplicate conc)}}{\text{(measured conc} + \text{measured duplicate conc)} \div 2} \times 100$$ **Equation 1a**

$$\%RSD = (SD/D_{ave}) \times 100$$

Where:

$$SD = \sqrt{\left(\frac{\sum(D_n - D_{ave})^2}{(n-1)}\right)}$$ **Equation 1b**

%RSD = percent relative standard deviation
D = sample concentration
D_{ave} = average sample concentration
n = number of samples
SD = standard deviation

Table A3-7
DQIs for Conventionals Water Quality Measurements

Parameter	Precision[1]	Accuracy[2]	Completeness
DO	± 20%	± 0.1 mg/L or 1% of reading	90%
pH	± 20%	± 0.2 pH unit	90%
Specific conductance	± 20%	± 0.5% of reading or 0.001 mS/cm	90%
Temperature	± 20%	± 0.05 °C	90%
Turbidity	± 20%	0 to 999 FNU: 0.3 FNU or ±2% of reading (whichever is greater); 1000 to 4000 FNU: ±5% of reading	90%

Notes:
Water quality measurements will be made using a YSI© EXO1 or similar water quality meter.
1. Precision is based on duplicate results for standard solutions following instrument calibration.
2. Accuracy is as reported for YSI© EXO1 instrument specifications.
DO: dissolved oxygen
DQI: data quality indicator
FNU: Formazin Nephelometric Unit

Table A3-8
DQIs for Chemistry Laboratory Analyses

Parameter	Unit	Precision[1]	Accuracy[1]		Completeness
			LCS	Spiked Samples	
Total and dissolved metals	µg/L	± 20%	80–120%	75–125%	90%
Mercury	µg/L	± 25%	80–120%	75–125%	90%
Total PCBs	µg/L	± 20%	51–128%	51–128%	90%

Notes:
1. Values listed are performance-based limits provided by the laboratories.
µg/L: microgram per kilogram
DQI: data quality indicator
LCS: laboratory control sample
PCB: polychlorinated biphenyl
SRM: standard reference material

3.3.2 Accuracy

Accuracy is an expression of the degree to which a measured or computed value represents the true value. Accuracy may be expressed as a percentage recovery for MS and LCS analyses. The DQI for accuracy varies depending on the analyte (Tables A3-7 and A3-8). The equation used to express accuracy for spiked samples is as follows:

$$\text{Percent recovery} = \frac{\text{spike sample result} - \text{unspiked sample result}}{\text{amount of spike added}} \times 100 \qquad \textbf{Equation 2}$$

3.3.3 Representativeness

Representativeness is an expression of the degree to which data accurately and precisely represent an environmental condition. Assuming those objectives are met, the samples collected should be considered adequately representative of the environmental conditions they are intended to characterize.

3.3.4 Comparability

Comparability is an expression of the confidence with which one dataset can be evaluated in relation to another dataset. Therefore, the sample collection and chemical testing will adhere to the most recent Puget Sound Estuary Program QA/QC procedures (PSEP 1997) and EPA analysis protocols.

3.3.5 Completeness

Completeness is a measure of the amount of data that is determined to be valid in proportion to the amount of data collected. The equation used to calculate completeness is as follows:

$$\text{Completeness} = \frac{\text{number of valid measurements}}{\text{total number of data points planned}} \times 100 \qquad \textbf{Equation 3}$$

The DQI for completeness for all components of this project is 90%. Data that have been qualified as estimated because the QC criteria were not met will be considered valid for the purpose of assessing completeness. Data that have been qualified as rejected will not be considered valid for the purpose of assessing completeness.

3.3.6 Sensitivity

Analytical sensitivity is the minimum concentration of an analyte above which a data user can be reasonably confident that the analyte was reliably detected and quantified. For field analyses, the resolution information provided by the probe manufacturer defines the capability of the method to recognize small differences between values. For chemistry, the method detection limit (MDL)[8] will be used as the measure of sensitivity for each measurement process.

Tables A3-7 and A3-8 list specific DQIs for water quality measurements, laboratory analyses of water samples.

3.4 Chemistry Quality Assurance/Quality Control

The types of samples analyzed and the procedures conducted for QA/QC samples collected in the field and analyzed in the laboratory are described in this section.

3.4.1 Field QC Chemistry Samples

Field QA/QC samples, such as field duplicates, filter blanks, and rinsate blanks, are generally used to evaluate the efficiency of field decontamination procedures and the variability attributable to sample handling. One equipment blank will be generated once for each batch of water chemistry samples. An additional Niskin bottle sampler will be used to collect a field duplicate during the multi-day water chemistry monitoring associated with chemistry conditions 1 and 3. Note that the interval with the field duplicate may not be selected for analysis.

3.4.2 Laboratory Chemistry QC

Before analyzing the chemistry samples, the laboratory must provide written protocols for the analytical methods to be used, calculate reporting limits for each analyte in each matrix of interest as applicable, and establish an initial calibration curve for all analytes. The laboratory must also demonstrate its continued proficiency by participation in inter-laboratory comparison studies, and by repeated analysis of certified reference materials (CRMs), calibration checks, laboratory reagent and rinsate blanks, and spiked samples.

3.4.2.1 Chemistry Analysis QC Samples

Method-specific QC measures, such as MSs and MS duplicates or laboratory duplicates, will be analyzed per preparatory or analytical batch as specified in the analytical methods and Table A3-9.

[8] The term method detection limit (MDL) includes other types of detection limits,. Recent revisions to EPA SW846 methods no longer require the calculation of MDLs.

Table A3-9
Laboratory chemistry QC sample analysis summary

Analyte	Initial Calibration	Initial Calibration Verification (second source)	Continuing Calibration Verification	LCS	Laboratory Replicates	MSs	MSDs	Method Blanks	Surrogate Spikes
Dissolved metals	prior to analysis	after initial calibration	every 10 samples and at end of analytical sequence	1 per prep batch	1 per prep batch	1 per prep batch	na	1 per prep batch	na
Mercury	prior to analysis	after initial calibration	every 10 samples and at end of analytical sequence	1 per prep batch	1 per prep batch	1 per prep batch	na	1 per prep batch	na
PCB Aroclors	prior to analysis	after initial calibration	before and after sample analysis, every 10-20 analyses or 12 hours	1 per prep batch	na	1 per prep batch	1 per prep batch	1 per prep batch	each sample

Notes:
A batch is a group of samples of the same matrix analyzed or prepared at the same time, not exceeding 20 samples.
LCS: laboratory control sample
na: not applicable or not available
QC: quality control

3.4.2.2 Laboratory QC Samples

The analyst will review the results of QC analyses from each laboratory prep batch immediately after a sample group has been analyzed. The QC sample results will then be evaluated to determine whether control limits have been exceeded.

If control limits have been exceeded, then appropriate corrective action, such as recalibration followed by reprocessing of the affected samples, must be initiated before a subsequent group of samples is processed. The project QA/QC Coordinator must be contacted immediately by the laboratory Project Manager (PM) if satisfactory corrective action to achieve the DQIs outlined in this WQMP is not possible. All laboratory corrective action reports relevant to the analysis of project samples must be included in the data deliverable packages.

All primary chemical standards and standard solutions used in this project will be traceable to the National Institute of Standards and Technology, Environmental Resource Associates, National Research Council of Canada, or other documented, reliable, commercial sources. Standards will be validated to determine their accuracy by comparing them to independent standards. Laboratory QC standards are verified in a multitude of ways: second-source calibration verifications (i.e., same standard, two different vendors) are analyzed to verify initial calibrations; new working standard mixes (e.g., calibrations, spikes, etc.) are verified against the results of the original solution and must be within 10% of the true value; or newly purchased standards are verified against current data. Any impurities found in the standard will be documented.

The following sections summarize the procedures that will be used to assess data quality throughout sample analysis. Table A3-8 summarizes the QC procedures to be performed by the laboratory, as well as the associated control limits for precision and accuracy.

3.4.2.2.1 Method Blanks

Method blanks are analyzed to assess possible laboratory contamination at all stages of sample preparation and analysis. A minimum of 1 method blank will be analyzed per prep batch or for every 20 samples, whichever is more frequent.

3.4.2.2.2 Laboratory Control Samples

LCSs are prepared from a clean matrix using the same process as the project samples that are spiked with known amounts of the target compounds. The recoveries of the compounds are used as a measure of the accuracy of the test methods. An LCS duplicate will be analyzed for metals, mercury, and PCB Aroclors.

3.4.2.2.3 Laboratory Replicate Samples

Laboratory replicate samples provide information on the precision of the analysis and are useful in assessing potential sample heterogeneity and matrix effects. Laboratory replicates are subsamples of the original sample that are prepared and analyzed as a separate sample, assuming sufficient sample matrix is available. A minimum of 1 laboratory replicate sample will be analyzed for prep batch or for every 20 samples, whichever is more frequent, for inorganic and conventional parameters.

3.4.2.2.4 Matrix Spikes and Matrix Spike Duplicates

The analysis of matrix spike (MS) samples provides information on the extraction efficiency of the method on the sample matrix. By performing MSD analyses, information on the precision of the method is also provided for organic analyses. For organic analyses, a minimum of 1 MS/MSD pair will be analyzed for each prep batch or for every 20 samples, whichever is more frequent, when sufficient sample volume is available, For inorganic analyses (i.e., metals), a minimum of one MS sample will be analyzed for each prep batch, when sufficient sample volume is available.

3.4.2.2.5 Surrogate Spikes

All project samples analyzed for PCBs will be spiked with appropriate surrogate compounds as defined in the analytical methods. Surrogate recoveries will be reported by the laboratories; however, no sample results will be corrected for recovery using these values.

3.4.2.2.6 Internal Standard Spikes

Internal standards may be used for calibrating and quantifying organic compounds and metals using MSs. If internal standards are required by the method, all calibration, QC, and project samples will be spiked with the same concentration of the selected internal standard(s). Internal standard recoveries and retention times must be within method and/or laboratory criteria.

3.5 Instrument/Equipment Testing, Inspection, Calibration, and Maintenance

3.5.1 Conventionals Monitoring Equipment

The Water Quality Monitoring Lead will be responsible for overseeing the testing, inspection, and maintenance of all field equipment. Prior to each sampling event, measures will be taken to test, inspect, and maintain all field equipment. All equipment used, including the multi-parameter water quality meter, range finder, differential global positioning system (GPS) unit, and digital camera, will be tested for accuracy before leaving for the field event.

The multi-parameter water quality meter will be used to collect in situ water quality data (i.e., specific conductance, temperature, DO, pH and turbidity) at each sampling station and associated with each composite sample, as outlined in this WQMP. All sensors, except temperature, require calibration to ensure high performance. The meter will be calibrated daily to ensure that the sensors meet the manufacturer's accuracy specifications for specific conductance, DO, pH, and turbidity.

A range finder will be used to measure the distance from the operations in order to establish the compliance stations. In addition, a Trimble© SPS461 or similar GPS receiver unit will be employed for the various sampling methods outlined in this WQMP. The GPS receiver will be calibrated daily to ensure that it is accurately recording positions from known benchmarks and functioning within the individual unit's factory specifications.

3.5.2 Analytical Equipment

The laboratory PM will be responsible for ensuring laboratory equipment testing, calibration, inspection, and maintenance requirements are met.

Multipoint initial calibration will be performed on each analytical instrument at the start of the project, after each major interruption to the instrument, and when any continuing calibration does not meet the specified criteria. The number of points used in the initial calibration is defined in each analytical method. Continuing calibrations will be performed daily for organic analyses and every 10 samples for inorganic analyses to ensure proper instrument performance.

Calibration of analytical equipment used for chemical analyses includes the use of instrument blanks or continuing calibration blanks, which provide information on the stability of the baseline established. Continuing calibration blanks will be analyzed immediately after the continuing calibration verification, at a frequency of 1 blank for every 10 samples analyzed for inorganic analyses and 1 blank every 12 hours for organic analyses. If the continuing calibration does not meet the specified criteria, the analysis must stop. Analysis may resume after corrective actions have been taken to meet the method specifications. All project samples analyzed by an instrument found to be out of compliance must be reanalyzed.

3.6 Inspection/Acceptance of Supplies and Consumables

The Water Quality Monitoring Lead will gather and check field supplies daily for satisfactory conditions before each field event. Batteries used in any field gear will be checked daily and recharged as necessary. Supplies and consumables for the field sampling effort will be inspected upon delivery and accepted if the condition of the supplies is satisfactory.

3.7 Data Management

All field data will be recorded on field forms, which the Water Quality Monitoring Lead will check for missing information at the end of each field day and amend as necessary. A QC check will be done to ensure that all data have been transferred accurately from the field forms to the database.

The analytical laboratories are required to submit data in an electronic format. The laboratory PM will contact the project Data Manager prior to data delivery to discuss specific format requirements.

A library of routines will be used to translate typical electronic output from laboratory analytical systems and to generate data analysis reports. The use of automated routines will ensure that all data are consistently converted to the desired data structures, and that operator time is kept to a minimum. In addition, routines and methods for quality checks will be used to ensure such translations are correctly applied.

Written documentation will be used to clarify how field and analytical laboratory duplicates and QA/QC samples were recorded in the data tables, and to provide explanations of other issues that may arise. Accurate records of field and laboratory QA/QC samples will be maintained so that project team members who use the data will have appropriate documentation.

4 Reporting

This section presents the daily, weekly, and final reporting of water quality monitoring results.

4.1 Daily Reporting

Field observations and measurement data will be recorded in a Water Quality Monitoring Form, including the following:

- Monitoring station (background or compliance station and approximate river mile)
- Monitoring station coordinates
- Date and time
- Contractor dredging or placement of clean material activity description
- Tidal phase (e.g., flood, ebb, or slack)
- Direction of monitoring, (i.e., downriver from the construction activity during ebb tide condition)
- Water depth at station
- Depth in the water column of each field parameter measurement (near-surface and near-bottom depths)
- Weather and current conditions

Completed forms will be scanned at the end of each field day and emailed to the EQAO.

4.2 Weekly Reporting

The results from each week's water quality monitoring activities will be compiled into a summary table with a comparison to water quality compliance criteria and provided to the EQAO and EPA by close of business on the following Monday. All reporting will include both regularly scheduled monitoring results and any additional monitoring results that may have been triggered by exceedances of water quality criteria.

4.3 Reporting of Exceedances

The Project Representative will notify EPA as soon as possible (within two hours) of a confirmed conventionals exceedance. A confirmed exceedance that occurs at the end of a workday (i.e., less than two hours of dredging remaining) may be reported to EPA at the beginning of the following workday. In the case of a confirmed turbidity exceedance associated with dredging, the Project Representative will also notify the Contractor and will direct the Contractor to implement corrective actions to return dredging operations to compliance with water quality criteria.

Chemical exceedances of acute or chronic criteria will be reported to EPA within one workday of receipt of laboratory test results, and the final laboratory EDD will be provided. Due to the timeframe to obtain chemistry results, any chemical exceedances will represent dredging activities in areas that have already been completed. Chemical exceedances will be discussed with EPA, along with conventionals monitoring data, to help determine whether there is ongoing potential for chemical exceedances and a need to adjust dredging operations or compliance distances.

4.4 Laboratory Records

4.4.1 Chemistry Records

The analytical laboratories will be responsible for internal checks and data verification pertaining to sample handling and analytical data reporting, and they will correct errors identified during the QA review. The analytical laboratories will submit data packages electronically, including the following as applicable:

- **Project narrative**: This summary, in the form of a cover letter, will present any problems encountered during any aspect of sample analyses. The summary will include, but not be limited to, discussion of QC, sample shipment, sample storage, and analytical difficulties. The project narrative will document any problems encountered by the laboratory and their resolutions. In addition, the summary will provide operating conditions for instruments used for the analysis of each suite of analytes and definitions of laboratory qualifiers.
- **Records**: The data package will include legible copies of the chain of custody forms. This documentation will include the time of receipt and the condition of each sample received by the laboratory. These records will also document additional internal tracking of sample custody by the laboratory.
- **Sample results**: The data package will summarize the results for each sample analyzed. The summary will include the following information, as applicable:
  - Field sample identification code and corresponding laboratory identification code
  - Sample matrix
  - Date of sample extraction/digestion
  - Date and time of analysis
  - Weight used for analysis
  - Final dilution volumes or concentration factor for the sample Instruments used for analysis
  - MDLs[9] and reporting limits (RLs)[10]
  - All data qualifiers and their definitions.

[9] The term MDL includes other types of detection limits.
[10] RL values are consistent with the lower limit of quantitation values required under EPA-846.

- **QA/QC summaries:** These summaries will contain the results of all QA/QC procedures. Each QA/QC sample analysis will document the same information required for the sample results (see previous bullet). The laboratory will make no recovery or blank corrections. The required summaries will include the following, as applicable:
  - The calibration data summary will contain the concentrations of the initial calibration and daily calibration standards and the date and time of analysis. This summary will also list the response factor, percent relative standard deviation, relative percent difference (RPD), and retention time for each analyte, as appropriate, as well as standards analyzed to indicate instrument sensitivity.
  - The internal standard area summary will report the internal standard areas, as appropriate.
  - The method blank analysis summary will report the method blank analysis associated with each sample and the concentrations of all compounds of interest identified in those blanks.
  - The surrogate spike recovery summary will report all surrogate spike recovery data for organic analyses, and it will list the names and concentrations of all compounds added, percent recoveries, and QC limits.
  - The MS recovery summary will report the MS or MS/ MSD recovery data for analyses, as appropriate, including the names and concentrations of all compounds added, percent recoveries, and QC limits. The MS recovery summary will also report the RPD for all MS and MSD analyses.
  - The matrix duplicate summary will report the RPD for all matrix duplicate analyses and will list the QC limits for each compound or analyte.
  - The LCS analysis summary will report the results of the analyses of LCSs, including the QC limits for each compound or analyte.
  - The relative retention time summary will report the relative retention times for the primary and confirmational columns of each analyte detected in the samples and the percent differences between the columns, as appropriate.
- **Original data**: The data package will include legible copies of the original data generated by the laboratory, including the following:
  - Sample extraction/digestion, preparation, and cleanup logs
  - Instrument specifications and analysis logs for all instruments used on days of calibration and analysis
  - Enhanced and unenhanced spectra of target compounds detected in field samples and method blanks, with associated best match spectra and background subtracted spectra, for all gas chromatography/mass spectrometry analyses

- Enhanced and unenhanced spectra of target performance reference compounds detected in field samples, field blanks, and method blanks, with associated best match spectra and background subtracted spectra, for all gas chromatography/mass spectrometry analyses
- Quantitation reports for each instrument used, including reports for all samples, blanks, calibrations, MSs/MSDs, laboratory replicates, LCSs, and CRMs.

The analytical laboratories will submit data electronically in EarthSoft EQuIS® standard four-file or EZ electronic data deliverable format, or in an alternative format to be specified prior to the implementation of this WQMP. Guidelines for electronic data deliverables for chemical data will be communicated to the analytical laboratories by the Data Manager. All electronic data submittals must be tab-delimited text files, or a format specified prior to implementation of this WQMP, that include all results, MDLs (as applicable), and RLs consistent with those provided in the laboratory report. If laboratory replicate analyses are conducted on a single submitted field sample, the laboratory sample identifier must distinguish among the replicate analyses.

4.4.2 Data Reduction

Data reduction is the process by which original data (i.e., analytical measurements) are converted or reduced to a specified format or unit to facilitate analysis of the data. Data reduction requires that all aspects of sample preparation that could affect the test result, such as sample volume analyzed or dilutions required, be taken into account in the final result. It is the laboratory analyst's responsibility to reduce the data, which the appropriate project personnel will then subject to further review and reduction. The laboratory will generate the data in a format amenable to review and evaluation. Data reduction may be performed manually or electronically.

4.4.3 Data Storage and Backup

All electronic files related to the project will be stored on a secure server, with server contents backed up regularly

4.5 Water Quality Monitoring Report

After all construction has been completed, the water quality monitoring data for the entire upper reach construction project will be provided to EPA as part of the Remedial Action Project Report. The section on water quality monitoring will contain:

- Any deviations from the WQMP and reasons for the deviations
- Tabular summaries of all water quality monitoring data with comparisons to water quality compliance criteria

- Figures depicting monitoring results over the course of construction for turbidity and chemical analytes, including (to the extent possible) relevant information on dredge areas and any BMPs implemented
- Narrative discussion of any water quality exceedances, probable cause(s) of the exceedance(s) if known, results of follow-up measurements, agency communications and decisions, and actions taken to mitigate the exceedance(s), including implementation of additional or enhanced BMPs
- Lessons learned regarding BMP implementation and effectiveness
- An appendix containing all completed Water Quality Monitoring Forms
- Documentation of instrument calibration (upon request)
- An appendix containing results from any chemistry testing conducted

In addition, a summary and tabulated results of water quality monitoring results will be included in an Annual Construction Summary Technical Memorandum, which will be submitted by the Contractor after each construction season has been completed (see CQAP for more information).

5 Corrective Actions

Corrective actions will be implemented to address water quality exceedances associated with dredging.

In the event of a confirmed turbidity water quality exceedance associated with dredging, the Project Representative will notify the Contractor and EPA Project Manager as soon as possible (within two hours) of the confirmed turbidity exceedance and will direct the Contractor to identify and implement its approach to return dredging operations to compliance with water quality criteria. The approach may involve modifying operations or implementing additional BMPs. Additional corrective actions may be required in the event of continued turbidity water quality exceedances at the compliance station; these actions are described in Section 3.1.6. If the water quality turbidity exceedance continues, even with additional BMPs and/or operational modifications, the Project Representative will discuss next steps with the Contractor and EPA. The path forward could include some or all of the following:

- Implementation of more aggressive BMPs or operational modifications
- Increases in the compliance boundary distance for turbidity by EPA, if the chemistry sample testing indicates there are no exceedances of chemical water quality criteria

If these options are not successful, it may be necessary to temporarily stop work to further assess the source of the exceedance and identify effective mitigation measures.

If a turbidity exceedance continues after implementation of additional BMPs and/or operational modifications, the Project Representative will instruct the Contractor to stop construction activities, and EPA will be contacted to determine how to proceed.

6 References

EPA. 2014. Record of Decision. Lower Duwamish Waterway Superfund Site. US Environmental Protection Agency.

EPA. 2021. Proposed explanation of significant differences. September 2021. Lower Duwamish Waterway Superfund site. US Environmental Protection Agency Region 10, Seattle, WA.

King County. 1999. King County combined sewer overflow water quality assessment for the Duwamish River and Elliott Bay. Vol 1, Appendix B1: Hydrodynamic and fate and transport numerical model. King County Department of Natural Resources, Seattle, WA.

PSEP. 1997. Recommended guidelines for sampling marine sediment, water column, and tissue in Puget Sound. Prepared for the Puget Sound Estuary Program, US Environmental Protection Agency, Region 10. King County (METRO) Environmental Laboratory, Seattle, WA.

QEA. 2008. Lower Duwamish Waterway sediment transport modeling report. Prepared for Lower Duwamish Waterway Group. Quantitative Environmental Analysis, LLC, Montvale, NJ.

Windward, QEA. 2008. Lower Duwamish Waterway remedial investigation. Sediment transport analysis report. Final. Prepared for Lower Duwamish Waterway Group. Windward Environmental LLC, Seattle, WA and Quantitative Environmental Analysis, Montvale, NJ.

Attachment 2: Young Environmental Bucket Specification Sheet

young CORPORATION

Manufacturer of premium attachments and tools since 1902.

PO Box 3522
Seattle, WA 98124
(800) 321-9090

sales@youngcorp.com
www.youngcorp.com

find us on facebook

DIGGING CLAMSHELL BUCKETS

General or Heavy Duty Digging Buckets

Designed for normal to difficult excavation work, demolition, rock handling, dredging and rehandling of materials.

360-Degree Rotation

High torque, heavy duty, continuous 360-degree standard power rotation.

Large Deck Area

Allows for faster clean up.

Twin Cylinders

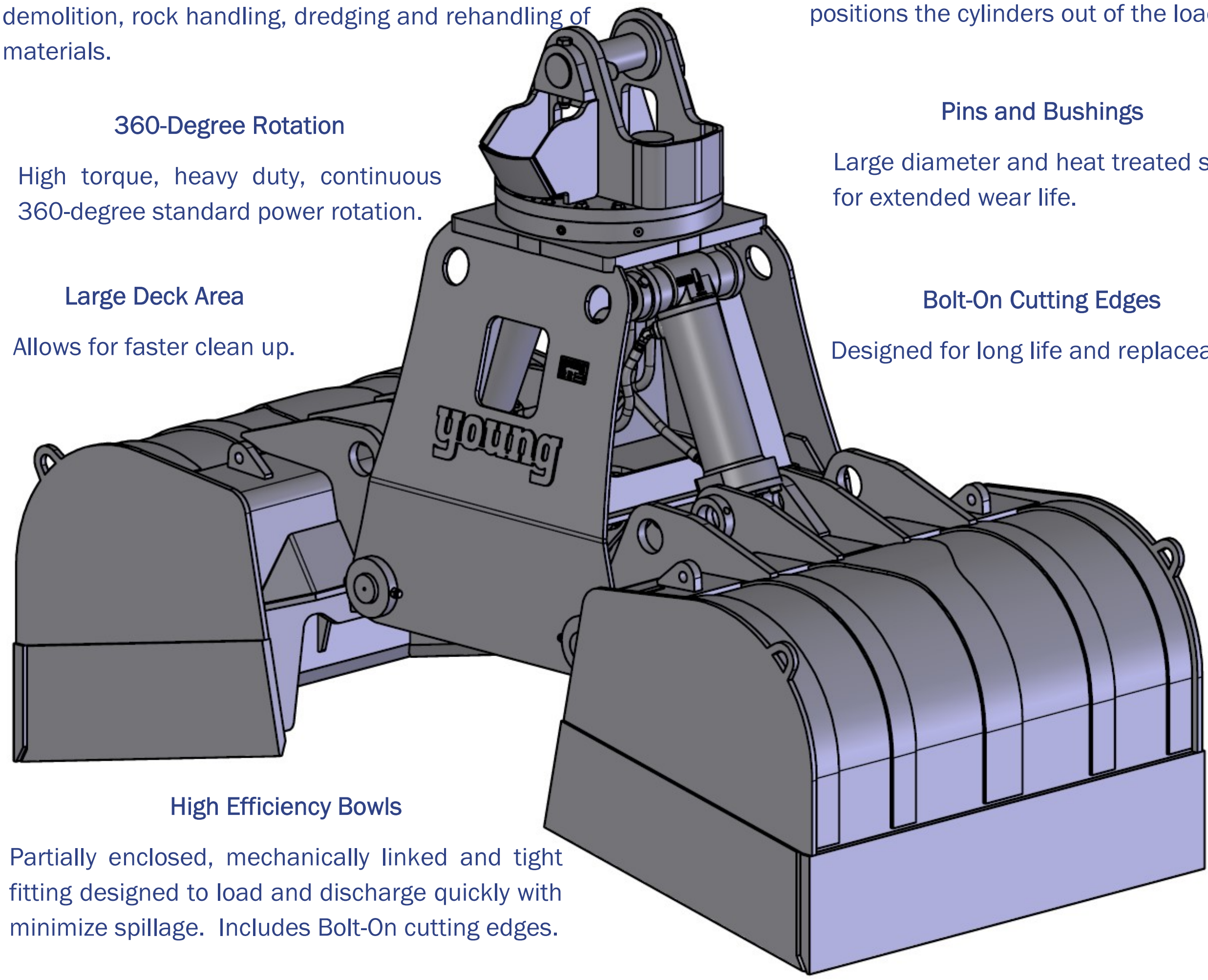
Provides plenty of closing power and positions the cylinders out of the load.

Pins and Bushings

Large diameter and heat treated steel for extended wear life.

Bolt-On Cutting Edges

Designed for long life and replaceable.



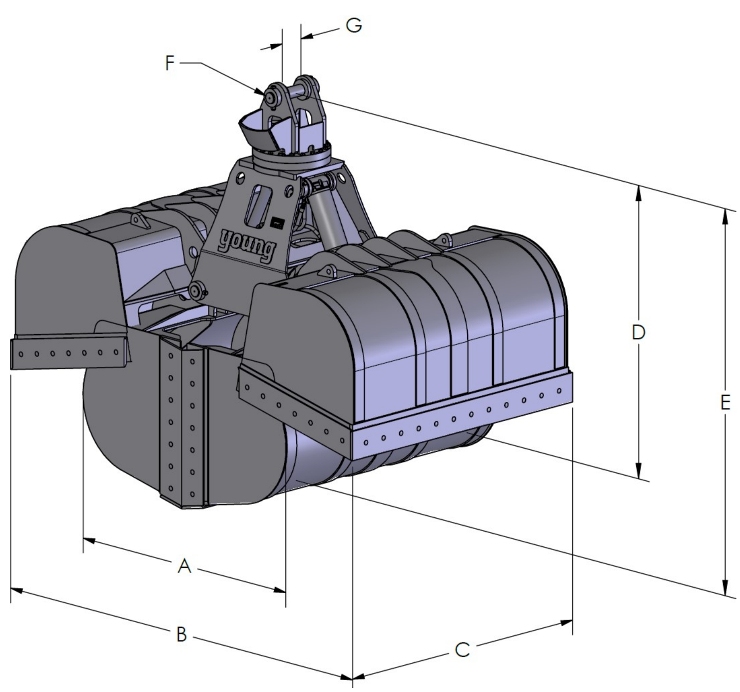
High Efficiency Bowls

Partially enclosed, mechanically linked and tight fitting designed to load and discharge quickly with minimize spillage. Includes Bolt-On cutting edges.

General Purpose Digging Buckets				For materials up to 4500 lbs. per cubic yard.				
Models		DG75C	DG100C	DG125C	DG150C	DG175C	DG200C	DG300C
Struck Capacity		3/4 cu yd	1 cu yd	1 1/4 cu yd	1 1/2 cu yd	1 3/4 cu yd	2 cu yd	3 cu yd
Length Closed	A	50 in	56 in	60 in	63 in	68 in	72 in	75 in
Length Open	B	93 in	100 in	110 in	115 in	125 in	135 in	129 in
Bucket Width	C	34 in	38 in	40 in	45 in	48 in	52 in	64 in
Height Open	D	68 in	70 in	73 in	76 in	80 in	84 in	90 in
Height Closed	E	82 in	86 in	90 in	95 in	103 in	108 in	114 in
Deck Area		22 sq. ft	26 sq. ft	30 sq. ft	36 sq. ft	42 sq. ft	49 sq. ft	57 sq. ft
Tool Weight		4700 lbs.	5300 lbs.	5800 lbs.	6800 lbs.	7200 lbs.	8500 lbs.	9500 lbs.

Heavy Duty Digging Buckets				For materials up to 6500 lbs. per cubic yard.				
Models		DH75C	DH100C	DH125C	DH150C	DH175C	DH200C	DH300C
Struck Capacity		3/4 cu yd	1 cu yd	1 1/4 cu yd	1 1/2 cu yd	1 3/4 cu yd	2 cu yd	3 cu yd
Length Closed	A	50 in	56 in	60 in	63 in	68 in	72 in	75 in
Length Open	B	93 in	100 in	110 in	115 in	125 in	135 in	129 in
Bucket Width	C	34 in	38 in	40 in	45 in	48 in	52 in	64 in
Height Open	D	68 in	70 in	73 in	76 in	80 in	84 in	90 in
Height Closed	E	82 in	86 in	90 in	95 in	103 in	108 in	114 in
Deck Area		22 sq. ft	26 sq. ft	30 sq. ft	42 sq. ft	42 sq. ft	49 sq. ft	57 sq. ft
Tool Weight		5500 lbs.	6300 lbs.	6800 lbs.	8600 lbs.	8600 lbs.	10,000 lbs.	11,500 lbs

Note: Please refer to Young RL or RS Buckets for materials in less than 3500 lbs. per cubic yard.



Optional:

> Custom sizes available upon request

> Digging Teeth

> Fixed, non-rotating heads

> Height Extensions for longer reach

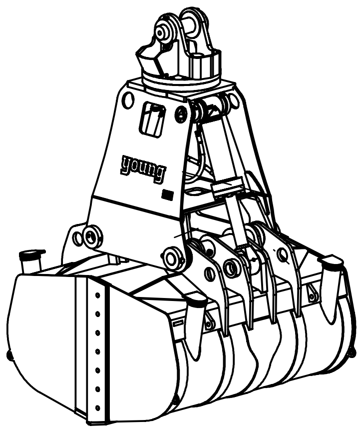
> Special Crossheads to fit OEM booms

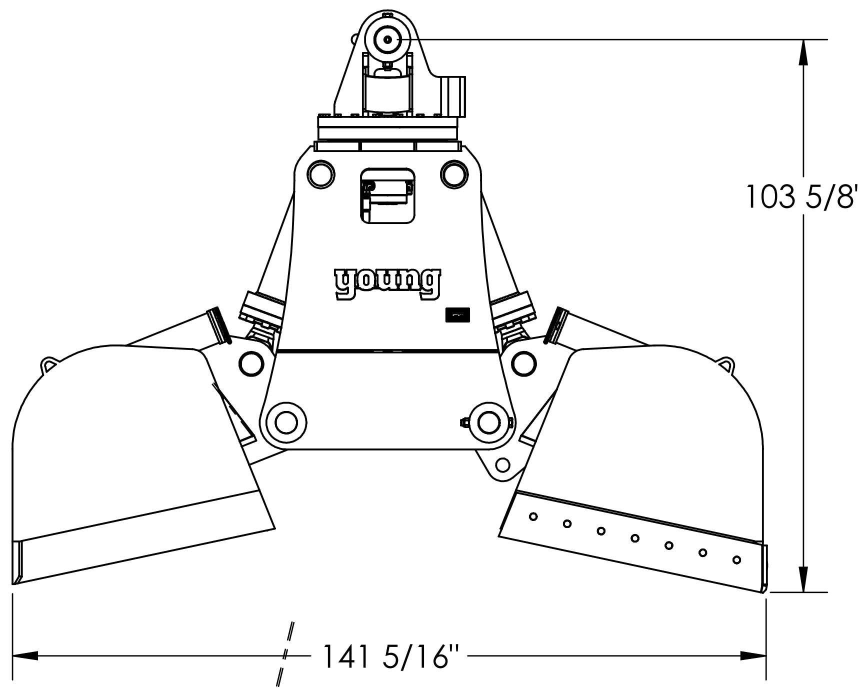
www.youngcorp.com

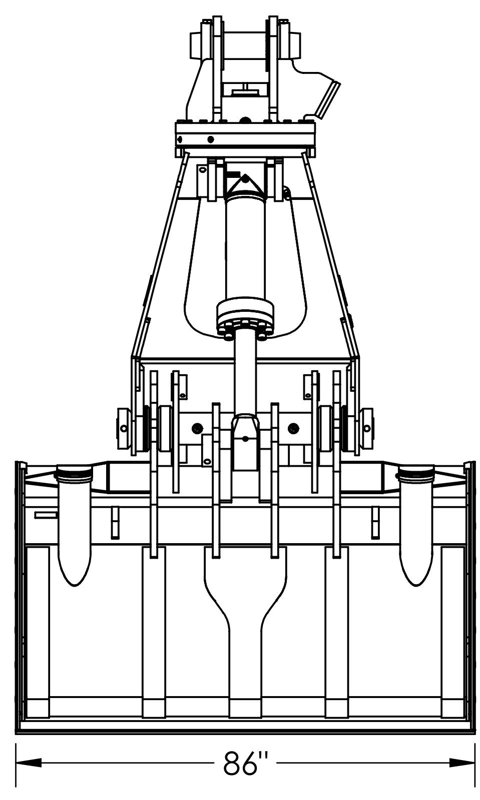
find us on facebook

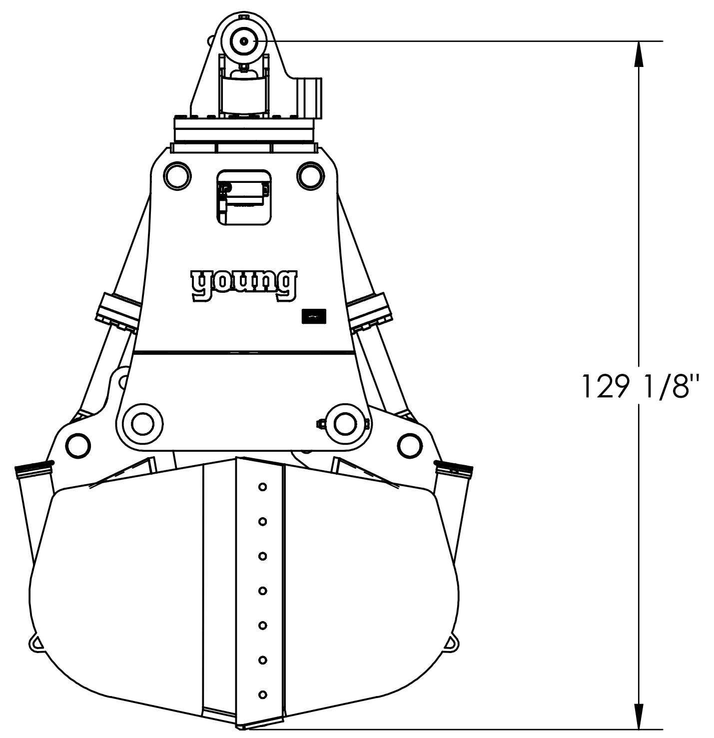
DWG. NUMBER: E-2325	TOLERANCE: EXCEPT WHERE SPECIFIED	DECIMAL: .XX +/- .02 .XXX +/- .010	FRACTIONAL: +/- 1/16 ANGULAR : +/- 1°	STATUS	INITIALS	DATE
				CHECKED		
				PRE-PROD.		
				PRODUCTION		

LTR	CHANGE	BY	DATE









REFERENCE DWG.

THIS DRAWING IS FOR PARTS IDENTIFICATION, INSTALLATION INSTRUCTIONS AND SERVICE

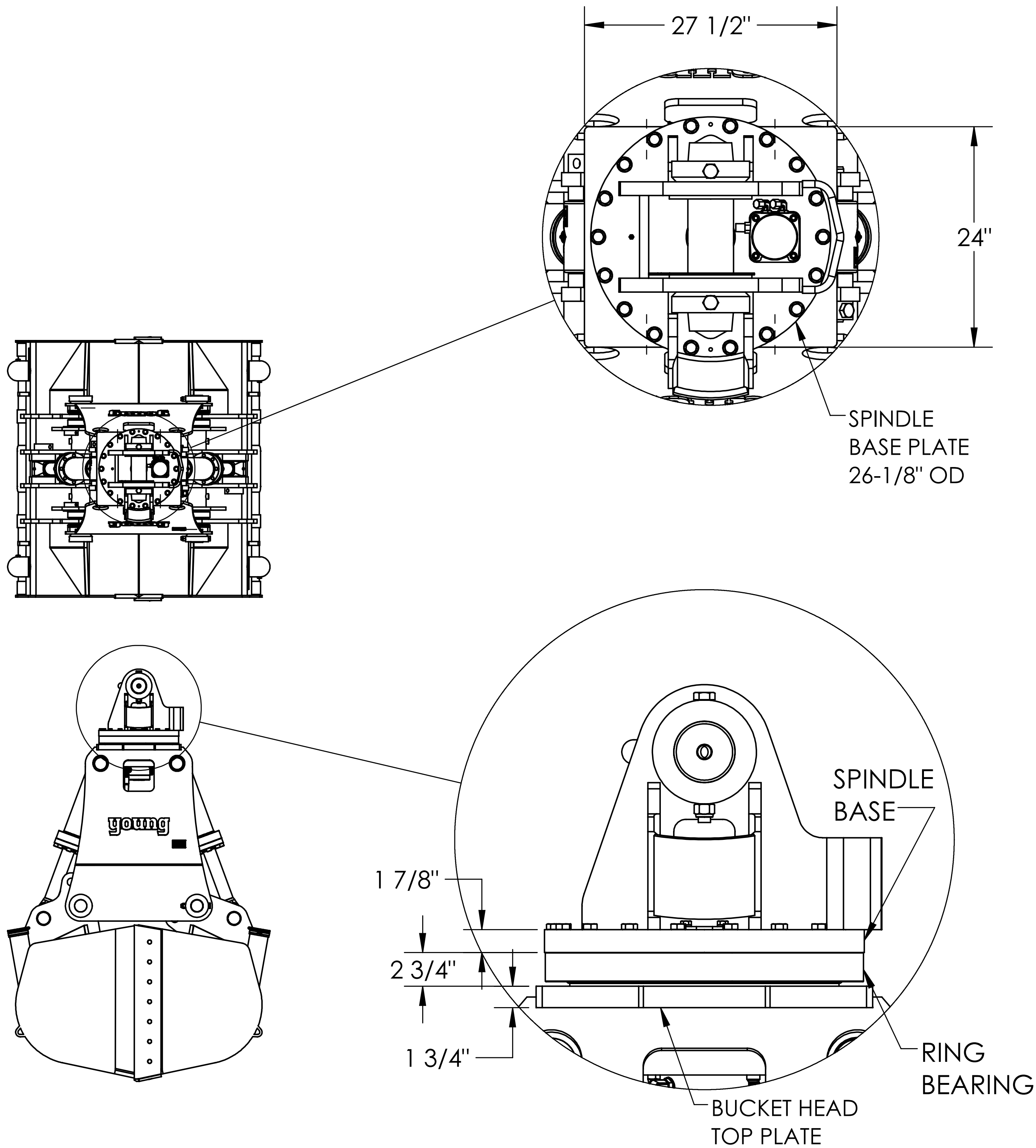
young CORPORATION

V SIZE

RS505CLS-SP LAYOUT

ENG	DWN	DATE	SCALE	SHEET		REV
JS	JS	1/25/16	1:36	1 OF 2	E-2325	X

DWG. NUMBER: E-2325	TOLERANCE: EXCEPT WHERE SPECIFIED	DECIMAL: .XX +/- .02 .XXX +/- .010	FRACTIONAL: +/- 1/16 ANGULAR : +/- 1°	STATUS	INITIALS	DATE
FOR REVISIONS SEE SHEET 1				CHECKED		
				PRE-PROD.		
				PRODUCTION		



PROPRIETARY INFORMATION	THE INFORMATION CONTAINED IN THIS DRAWING IS THE PROPERTY OF YOUNG CORPORATION SEATTLE WA. IT SHALL NOT BE COPIED OR DUPLICATED WITHOUT THEIR WRITTEN CONSENT.

REFERENCE DWG.

THIS DRAWING IS FOR PARTS IDENTIFICATION, INSTALLATION INSTRUCTIONS AND SERVICE

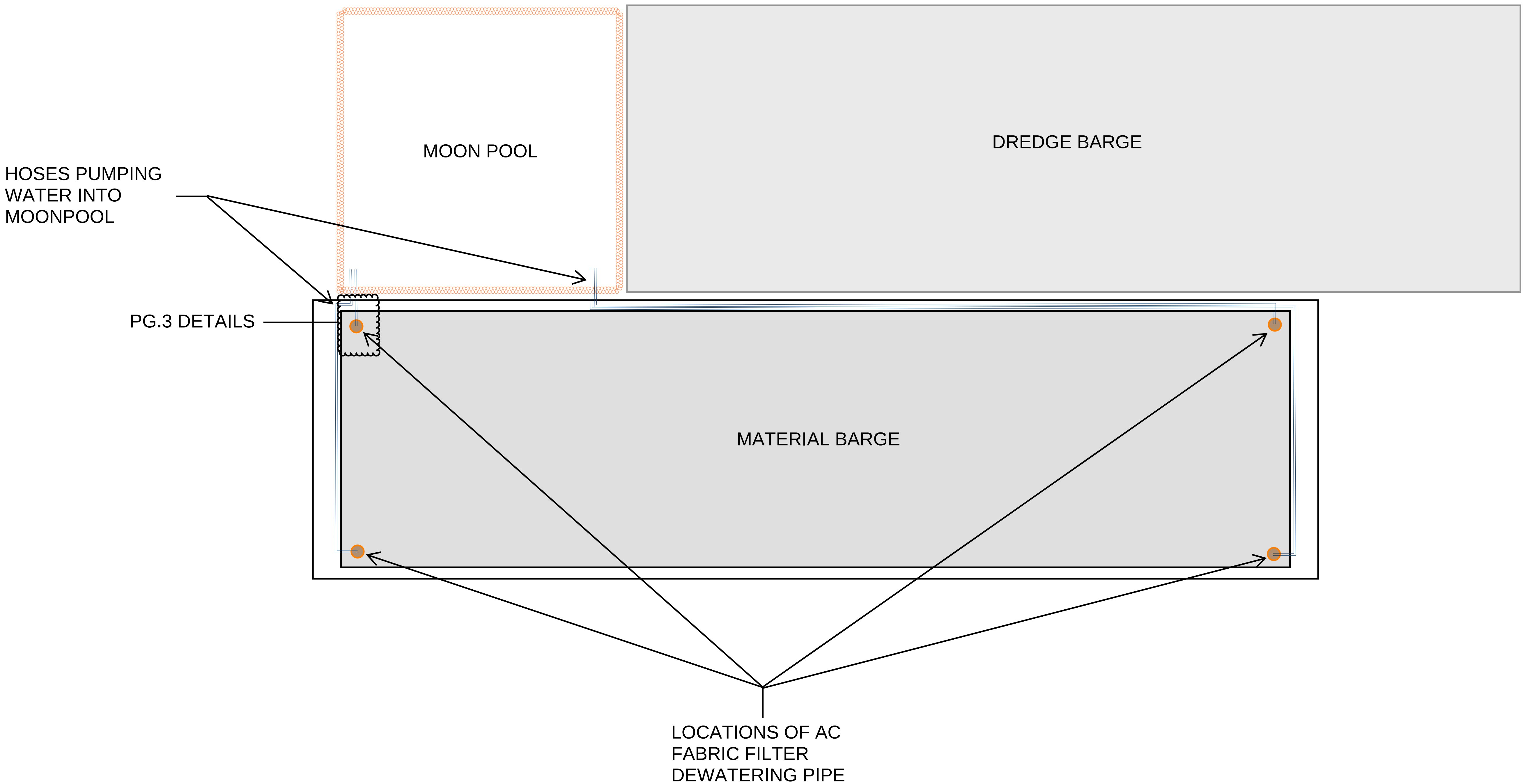
young CORPORATION

V SIZE

RS505CLS-SP LAYOUT

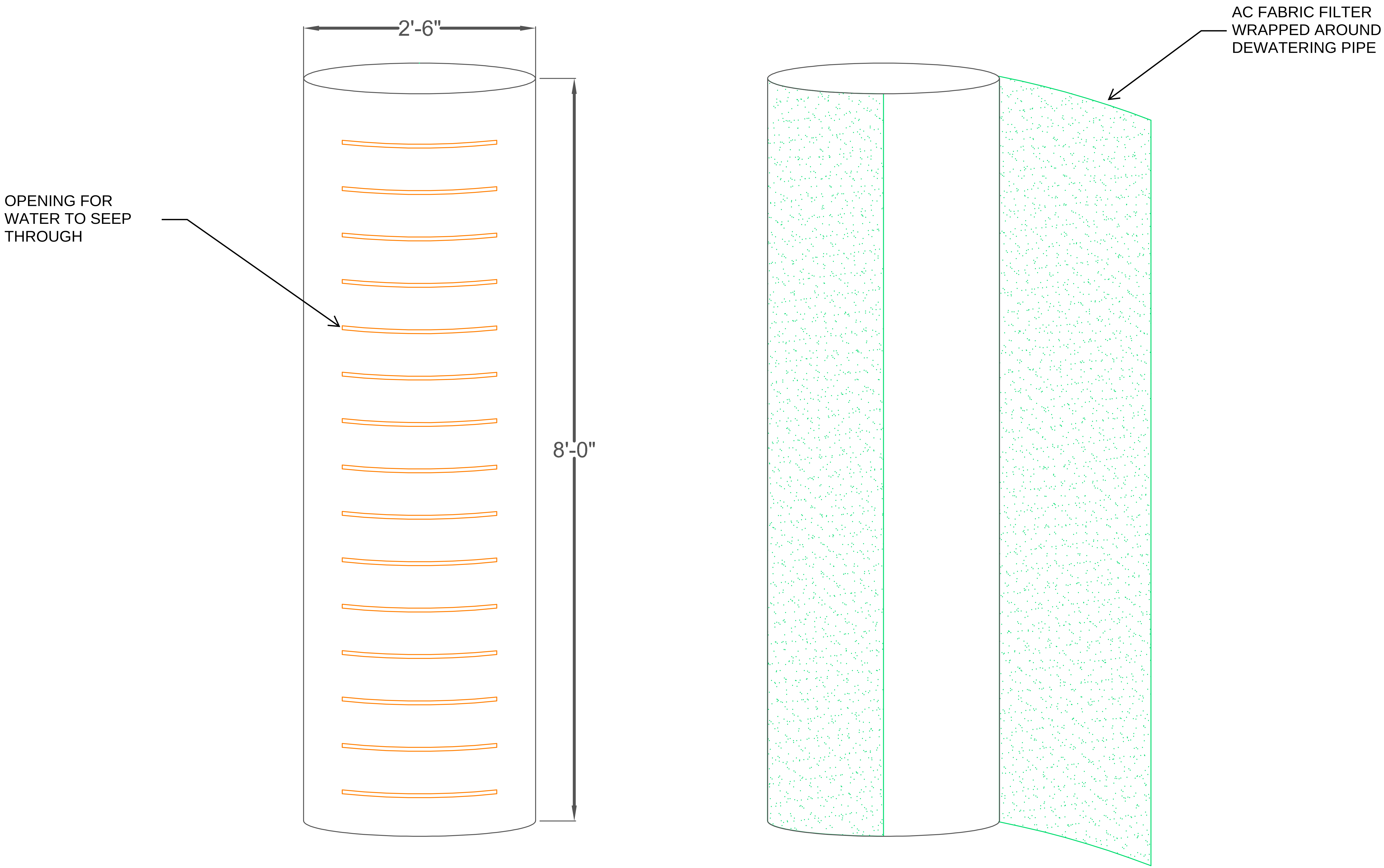
ENG	DWN	DATE	SCALE	SHEET		REV
JS	JS	1/25/16	1:48	2 OF 2	E-2325	X

Attachment 3: Barge Dewatering Details and Silt Curtain Specification Sheet



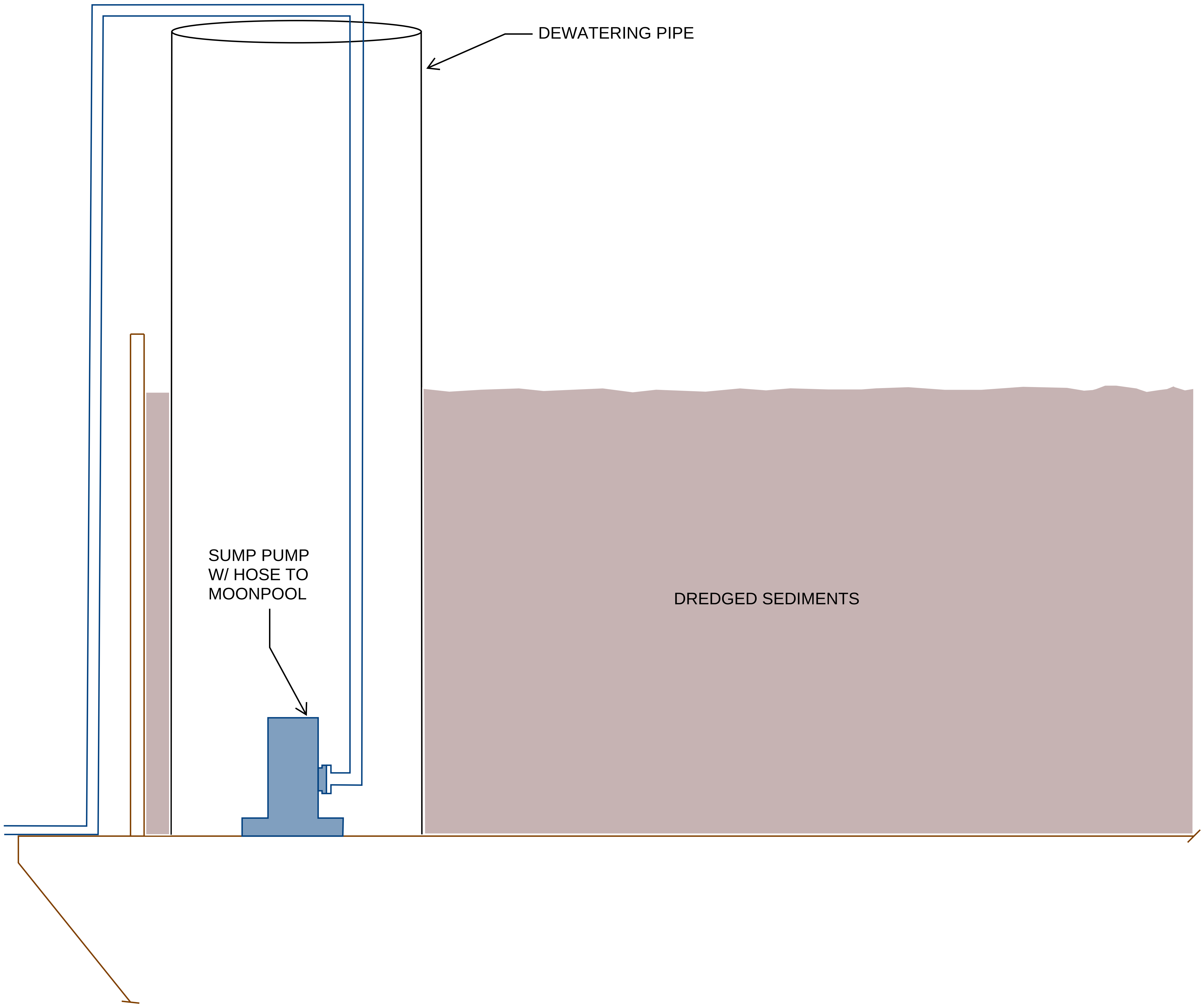
BARGE DEWATERING PLAN

SCALE 1" = 20'



DEWATERING PIPE DETAILS

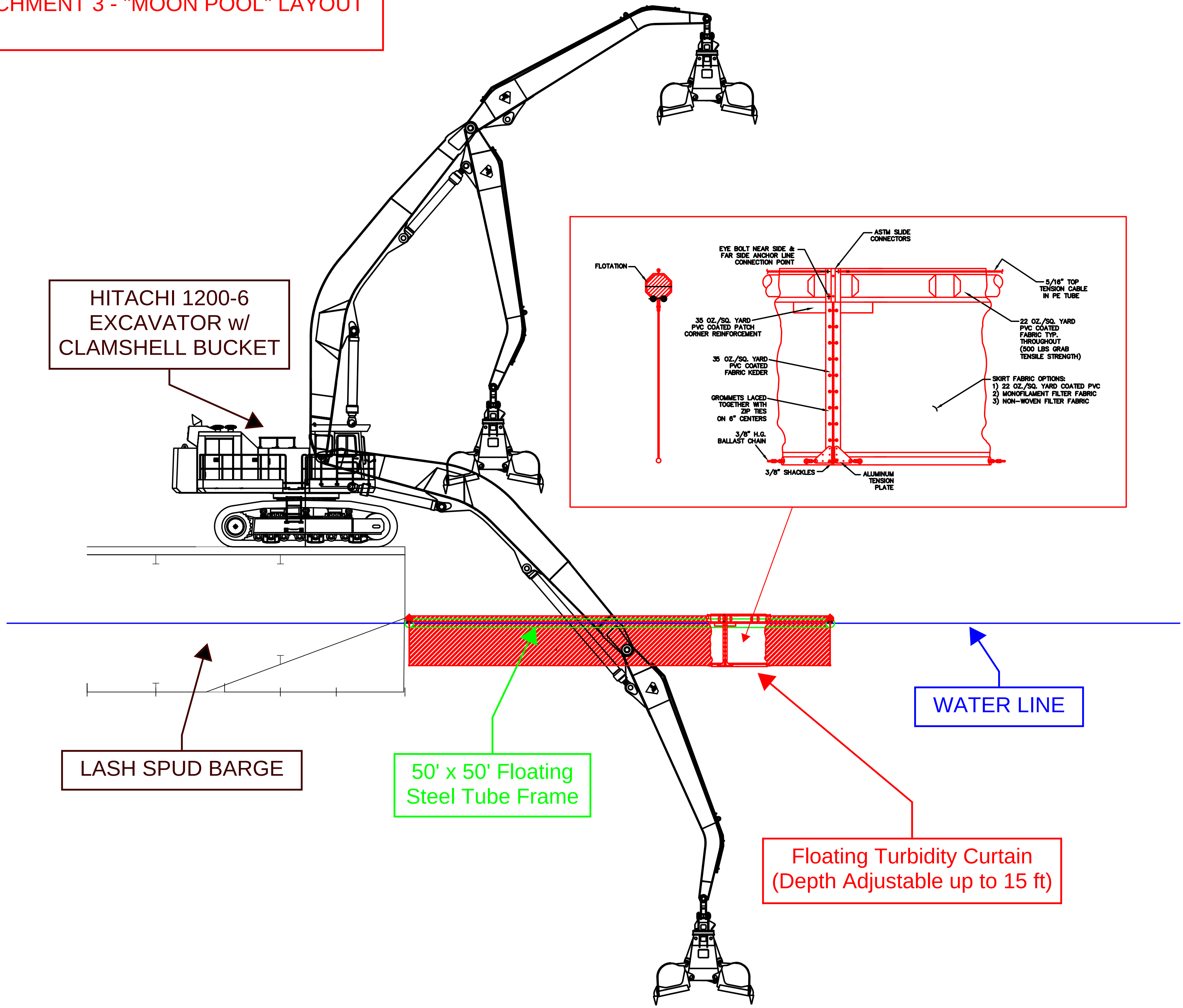
SCALE 1" = 1'



SUMP PUMP DETAILS

SCALE 1" = 1'

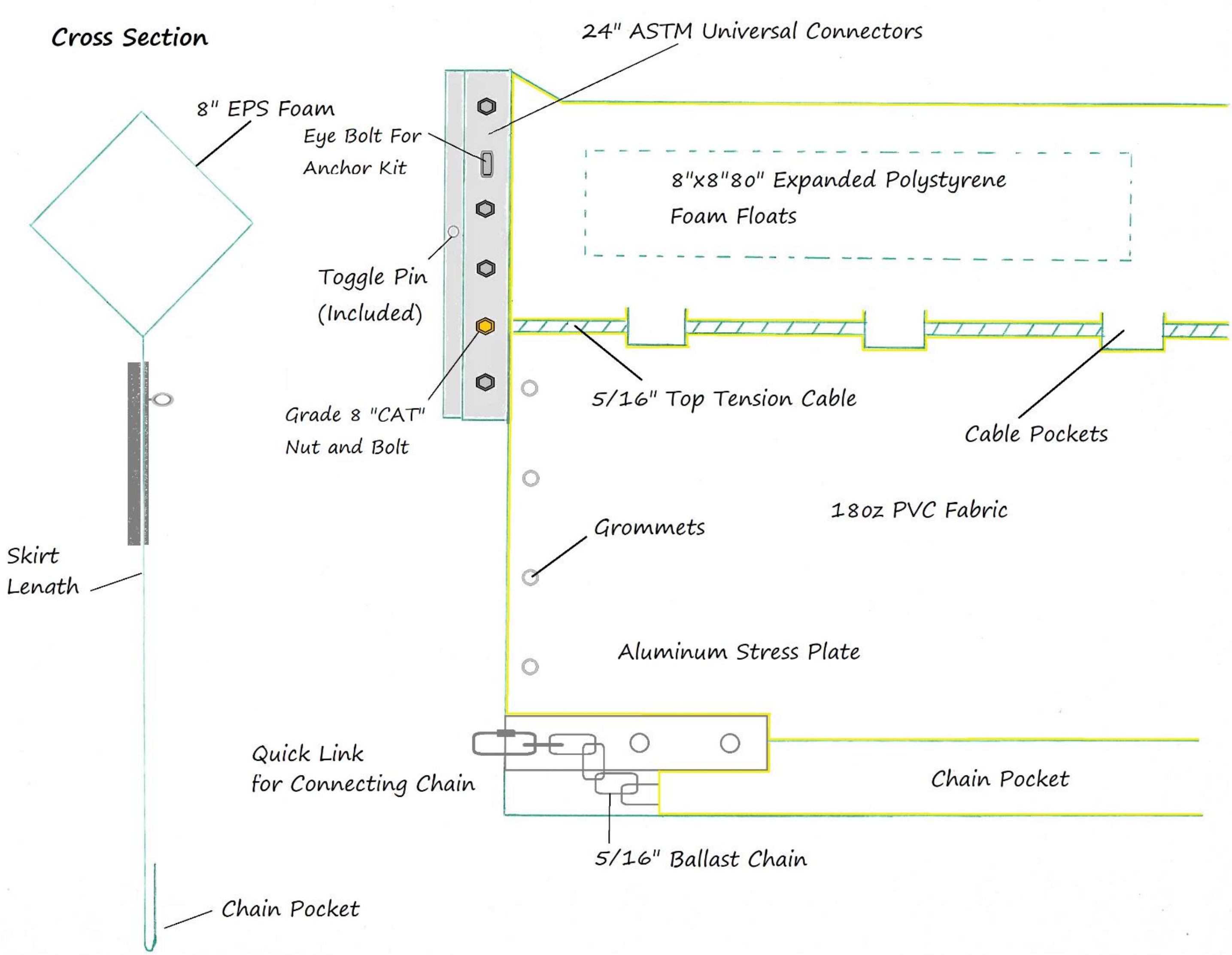
ATTACHMENT 3 - "MOON POOL" LAYOUT



Type 2 DOT Curtain Specification Sheet

Type 2 DOT Turbidity Curtain	
Float Fabric:	18oz PVC Vinyl Coated Polyester Fabric
Body Fabric:	18oz PVC Vinyl Coated Polyester Fabric
Top Connector:	24" ASTM Universal Connectors w/ toggle pin (provided)
Section Size:	50 Feet length X 2.5-15 depth (custom sizes available)
Floatation:	8"x8"x80" Expanded polystyrene (EPS) per 96" – 6 Sections per 50' section of curtain
Net Buoyancy:	20+ lbs per foot
Top Load Carrying Component:	5/16" (7.93mm) dual galvanized cable w/ coating
Ballast:	5/16" Steel Chain
Bottom Connector:	Aluminum stress plates w/ quick connectors
Connection Between Sections:	Reinforced Grommets
Optional:	BMP Supplies 5"x10' Oil Boom that connects to top cable

Type 2 DOT Diagram:



The information contained herein is furnished without charge or obligation and the recipient assumes all responsibility for its use. Because conditions of use and handling may vary and are beyond our control, we make no representation about, and are not responsible or liable for the accuracy and reliability of said information or the performance of any product. Any specification, property or application listed herein are provided as information only and in no way modify, amend, enlarge or create any warranty. Nothing contained herein is to be construed as permission or as a recommendation to infringe any patent.

aecom.com

aecom.com