Port of Seattle
P.O. Box 1209
Seattle, WA 98111-1209
Tel: 787-3000

www.portseattle.org

SUSTAINABLE DESIGN APPROACH / SUSTAINABLE DESIGN STRATEGY
HARBOR ISLAND MARINA DOCK-E FLOATS AND NORTH PIER IMPROVEMENTS

PURPOSE

This serves as a summary document for the sustainable design coordination for the Harbor Island Marina (HIM) Dock-E Floats and North Pier Improvements project. Additional information can be found in Project Management's Notebook.

SUSTAINABLE DESIGN APPROACH

The HIM Dock-E Floats and North Pier Improvements projects has been identified as a Tier 2 project under the Sustainable Evaluation Framework Policy Directive (SEF Policy Directive) adopted by the Port of Seattle Commission in January 2020. Tier 2 projects are described as:

> *Tier 2: Medium-sized, or more complex, projects that have opportunities for sustainability benefit would be subject to targeted sustainability analyses and strategies. Tier 2 projects may receive a cost per ton of carbon calculation.*

The HIM Dock-E Floats and North Pier Improvements project consists of the following elements (see Figure 1):

- Complete replacement of 23 (out of 78 total) of Dock-E's existing float sections with new heavier duty floats, steel piles, and appurtenances designed for larger vessel berthing and higher load mooring capability.
- Refurbishment of 55 (out of 78 total) of Dock-E's existing float sections consisting of replacing all remaining timber guide piles with higher load capacity steel piles; replacement of damaged walers and cleats; nominal leveling; and concrete surface crack repairs and sealing.
- Demolition and replacement of Dock-E's existing North Pier to restore vehicle access to it.

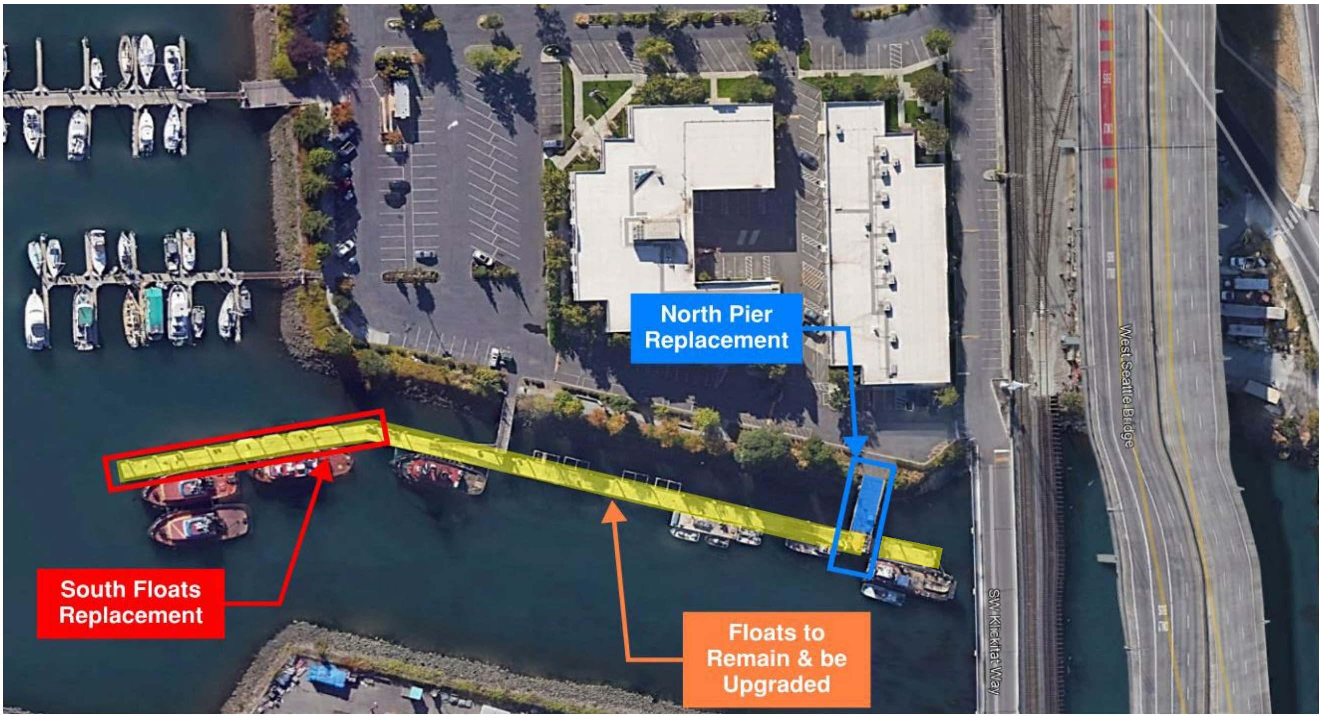

Figure 1. HIM Dock-E Floats and North Pier Improvements

Following the project kickoff meeting, the Project Manager and Sustainability Coordinator assembled a *Sustainable Project Assessment and Review Collaboration* (SPARC) team. The SPARC team leverages port expertise and knowledge of existing and emerging sustainability practices to:

(1) Identify, review, brainstorm, and recommend sustainability concepts and ideas for project and operational teams to consider and evaluate during the development and design stage of port projects.

(2) Encourage project and operational teams to evaluate and consider innovative strategies to reduce emissions and energy use beyond traditional approaches.

(3) Select and apply the relevant Sustainable Evaluation Framework criteria to highlight tradeoffs and benefits during development of the Sustainable Design Approach (SDA).

PROJECT GOALS

The SPARC team met in January 2020 to solidify project goals which were shared with the designer to identify potential design alternatives/strategies to move forward into the 30% design process. Given the limited nature of the project's scope, only a few sustainability goals were concentrated on. However, though sustainability aspects such as well-being and equity are not addressed directly, they are included in the project's general requirements.

- **Sustainable Asset Management**
  - Upgrade structural integrity and load capacities to meet existing uses
    - Restore vehicle access to North Pier
    - Avoid future structural damage to dock

- **Habitat**
    - Look for cost effective opportunities to enhance habitat, such as
        - Including light transmissivity elements such as "open grating"
        - Removing angular rock from bankline to increase potential for shoreline vegetation
        - Removing debris from the bankline and seabed
    - Consider use of Reinhall piles to reduce underwater noise during pile driving
- **Materials**
    - Consider alternative design materials for replaced structures
        - Low-embodied carbon concrete
        - Alternatives to concrete
        - Alternative flotation materials
- **Water Quality**
    - Look into options to address spill containment where feasible
- **Financial Sustainability**
    - Balance project cost and function against environmental benefits

SUSTAINABLE EVALUATION FRAMEWORK CRITERIA
The goals identified by the SPARC team support three of the seven criteria articulated in the SEF Policy Directive:

- **Reduce GHG Emissions.** The design acknowledges the need for shore power and will accommodate the existing system during float replacement. We will prioritize locally sourced and recycled materials where possible to reduce lifecycle emissions.
- **Increase Resilience.** The proposed improvements will upgrade the existing system to provide necessary structural support, limiting future damage to the existing structures and allowing for the docks to meet current and future intended function.
- **Protect Health and the Environment.** This project focuses on the replacement and upgrade of existing infrastructure while limiting environmental impacts. Goals focus on materials, habitat, and water quality.
- **Support Local Economic Development/Advance Equity.** Prioritize WMBE and local business use in contracting and material sourcing.

THIRD PARTY CERTIFICATION
The SDA is required to include a recommendation as to whether a project should pursue an applicable third-party sustainability certification (such as LEED or Envision.) Staff does not recommend pursuing certification for this project due to its limited scope but may apply principles from the American Society of Civil Engineers "Envision" rating system to help inform the design as appropriate.

SUSTAINABLE DESIGN STRATEGY

A Sustainable Design Meeting was held on February 22, 2021. The Project Manager and Sustainability Coordinator worked with our design consultant, Reid Middleton, to create a Sustainable

Design Report for the project. Based on the objectives above, Sustainable Asset Management and Habitat objectives will be met regardless of project alternative. Water Quality, Materials, and Financial Sustainability were evaluated for the float guide piling system, replaced South Float System, and replaced North Pier.

FLOAT GUIDE PILING
Current system: steel piling and treated timber, treated timber to be removed and replaced

Infeasible replacement alternatives:

- Composite piling is not feasible structurally due to proposed loads and substrate conditions
- Concrete piling is not feasible unless all piles are replaced (cannot mix concrete piles with steel piles)
- Reinhall piling not feasible due to size (Reinhall available at 18” diameter)
- Treated timber pile is not recommended due to environmental concerns
- Thicker steel piles not feasible unless all piles are replaced (cannot mix pile sizes)

Feasible steel pile replacement alternatives:

Alternatives	Water Quality Impacts	Materials	Financial Sustainability	
			Cost	Design Life
12” ½” Wall Steel Pile	None identified	Needs to be replaced quicker, wasting more material	$60,000	25 years
12” ½” Wall Steel Pile: Galvanized	Release of zinc into the environment	Longer design life	$66,000	45 years
12” ½” Wall Steel Pile: Epoxy-coated	**None identified**	**Longer design life, coating maintenance due to abrasion**	**$77,000**	**35 years**
12” ½” Wall Steel Pile: Galvanized and Epoxy-coated	Can release zinc into environment if coating is abraded	Longer design life, coating maintenance due to abrasion	$165,000	60 years
12” ½” Wall Steel Pile: Galvanized and HDPE Sleeve	Increases submerged land impact, can release zinc into environment if sleeve fails	Longer design life, sleeve maintenance	$99,000	55 years

NOTE: Alternatives analyses in this document use color coding to help identify the tradeoffs between alternatives. Green shading represents an alternative that advances project goals, yellow represents neutral impact, and red represents an alternative that does not advance goals. The highlighted row is the recommended alternative.

Alternative selection:
There are environmental concerns with having galvanization exposed to the environment. High levels of zinc have been found in stormwater, which has been attributable to galvanized metal surfaces, motor oil and hydraulic fluid, and tire dust. The Department of Ecology has an initiative to remove zinc from the environment as part of its purview over stormwater and the Port of Seattle strives to limit the amount of galvanized materials in the environment by recommending the use of regular steel, stainless steel, or coatings over galvanized metal. This has typically been discussed in the context of upland applications and we are currently exploring application of this standard to in-water projects.

The upfront cost and life of both galvanized steel and epoxy-coated steel is similar. However, long-term maintenance costs of epoxy-coated steel could be higher since there is the potential for coating abrasion due to rubbing of the floating dock against the pile. This also reduces its expected design life. The Port of Seattle does not typically use coated steel and we therefore have no information on life and maintenance costs for coated piles. Washington State Ferries commonly uses coated steel and we have requested information from them. This information and other research will inform the Port's final approach.

In consultation with the Port Stormwater Utility, Engineering, and Marine Maintenance, we propose this project as a pilot using coated steel. Its life and condition will be assessed yearly. This is a good location for a pilot since the piles are easily accessible for repair and maintenance purposes.

SOUTH FLOAT REPLACEMENT
Current system: concrete floats

Infeasible replacement alternatives:

- Aluminum and plastic float systems are not feasible due to the design loads for the facility
- Concrete floats are not feasible since they cannot allow for light penetration (code compliance)
- Composite frame is not feasible due to structural integrity
- Uncoated steel is not feasible due to corrosion, aesthetics, and safety concerns
- Coated steel decking is not a common product and is therefore not analyzed

Feasible float replacement alternatives:

Design Component	Alternatives	Water Quality Impacts	Materials	Financial Sustainability	
				Cost	Design Life
Frame	Galvanized Steel Frame	Release of zinc into the environment	Longer design life	$95,000	45 years
	Steel Frame with Epoxy Coating	**None identified**	**Longer design life, coating maintenance due to abrasion**	**$110,000**	**35 years**
	Galvanized Steel Frame with Epoxy Coating	Can release zinc into environment if coating is abraded	Longer design life, coating maintenance due to abrasion	$190,000	60 years
Decking	Galvanized Grated Steel Decking	Release of zinc into the environment	Longer design life	$65,000	50 years
	Fiberglass Grated Decking	**None identified**	**Longer design life, low maintenance, light weight, durable**	**$44,000**	**50 years**
Floats	Float Tub	Thin cover around flotation prone to expose foam to environment	Shorter design life	$36,000	30 years
	Galvanized Steel Filled with Flotation	Release of zinc into the environment	Longer design life	$125,000	35 years

Design Component	Alternatives	Water Quality Impacts	Materials	Financial Sustainability	
				Cost	Design Life
	Coated Galvanized Steel Filled with Flotation	Can release zinc into environment if coating is abraded	Longer design life, coating maintenance due to abrasion	$220,000	50 years
	Coated Steel Filled with Flotation	None identified	Longer design life, coating maintenance due to abrasion	$140,000	35 years
	HDPE Pipe Filled with Flotation	**None identified**	**Longer design life, low maintenance**	**$75,000**	**50 years**

NOTE: Alternatives analyses in this document use color coding to help identify the tradeoffs between alternatives. Green shading represents an alternative that advances project goals, yellow represents neutral impact, and red represents an alternative that does not advance goals. The highlighted row is the recommended alternative.

Alternative selection:

Frame

Float framing options include steel framed systems, which can be designed for commercial loading at a moorage facility and have been used for a long time. Steel frames for the float system should be hot-dip galvanized or coated to protect them from corrosion and provide a longer service life. The Port recommends epoxy coating over galvanization due to concerns with zinc and comparable service life.

Decking

Any grating used should be suitable for ADA accessibility and have no greater than a half-inch gap. From a sustainability perspective, the more open space in the grating, the more light penetration can occur. Generally, grating with 60 percent or more open space is requested for use on floating docks to provide environmental benefits. There are fiberglass gratings that provide both ADA accessibility and have 60 percent or more open space. Steel grating could be used but adds significant weight to the float system and would need to be galvanized or coated to provide corrosion and slip resistance. Since no commercial operations are conducted on the float deck and heavy equipment is not used on the float deck, fiberglass decking is recommended from both a sustainability and a life cycle cost perspective.

Floats

The floats will require flotation units that are fully encased. Four potential options include standard manufactured float tubs, flotation with sprayed-applied coating, steel pipes or pontoons filled with flotation, and High-Density Polyethylene (HDPE) pipes filled with flotation. Standard manufacturer float tubs have relatively thin coverage around the flotation. HDPE pipes have a much thicker wall of protection around the foam flotation. Steel pipes or pontoons would need to be protected from corrosion with galvanizing or coatings. Given the heavy loads, potential for high impact and commercial operations at the facility, and desire for sustainability to reduce zinc in the environment, we recommend HDPE pipes filled with flotation are utilized as the flotation units for the float system.

NORTH PIER REPLACEMENT

Current system: treated timber pier

Infeasible replacement alternatives:

- Grating is not recommended as a feature due to heavy equipment use on pier

- Composite piling not feasible structurally due to proposed loads and substrate conditions
- Reinhall piling not feasible due to substrate conditions
- Treated timber pile is not recommended due to environmental concerns
- Concrete piling is not recommended due to substrate conditions
- Uncoated steel deck is not feasible due to corrosion, aesthetics, and safety concerns

Feasible north pier replacement alternatives:

Design Component	Alternative	Water Quality Impacts	Materials	Financial Sustainability	
				Cost	Design Life
Deck	**Concrete Deck**	**Consideration of embodied carbon**	**Longer design life**	**$120,000**	**50 years**
	Coated Galvanized Steel Deck	Can release zinc into environment if coating is abraded	Longer design life, coating maintenance due to abrasion	$245,000	60 years
	Galvanized Steel Deck	Release of zinc into the environment	Longer design life	$140,000	50 years
Piles	18” ½” Wall Steel Pile	None identified	Needs to be replaced quicker, wasting more material	$136,000	25 years
	18” 1” Wall Steel Pile	Increases submerged land impact	Increased design life, but limited to no availability	$272,000	50 years
	18” ½” Wall Steel Pile: Galvanized	Release of zinc into the environment	Longer design life	$144,000	45 years
	18” ½” Wall Steel Pile: Epoxy-coated	**None identified**	**Longer design life, coating maintenance due to abrasion**	**$158,000**	**40 years**
	18” ½” Wall Steel Pile: Galvanized and Epoxy-coated	Can release zinc into environment if coating is abraded	Longer design life, coating maintenance due to abrasion	$252,000	60 years
	18” ½” Wall Steel Pile: Galvanized and HDPE sleeve	Increases submerged land impact, can release zinc into environment if sleeve fails	Longer design life, sleeve maintenance	$180,000	55 years

NOTE: Alternatives analyses in this document use color coding to help identify the tradeoffs between alternatives. Green shading represents an alternative that advances project goals, yellow represents neutral impact, and red represents an alternative that does not advance goals. The highlighted row is the recommended alternative.

Alternative selection:

Deck

A concrete deck is recommended for its sustainability, having a long service life and relatively inert material properties once cured. Concrete pier decks are common and durable for the type of operations at the facility. The solid concrete deck will also allow for collection and containment of stormwater runoff that could then be routed upland for treatment prior to discharge. To further improve the sustainability of the project, the solid concrete deck can be precast concrete deck panels to minimize overwater concrete work and construction time. Low embodied carbon concrete may be an option for the pier deck depending on availability, schedule, and cost.

Piles

Potential pile types include different steel treatments. As discussed for the guide piling system, we propose this project as a pilot to use epoxy-coated steel. Its life and condition will be assessed yearly. This is a good location for a pilot since the piles are easily accessible for repair and maintenance purposes.

OVERALL SUSTAINABILITY MEASURES

The following sustainability measures will be considered regardless of the alternatives listed above:

- Demolition and Disposal Plan
- Adherence to a Water Quality Control and Spill Control Plan
- Proper removal and disposal of all treated timber piling, timber pier structure, and other demolition debris
- Consideration of coatings or sleeves for any steel or galvanized components
- Utilization of a fully grated deck for the new South Float System to maximize light penetration
- Maintenance or reduction of the overall footprint of the South Float System
- Addition of supplemental flotation to maintain wood waler system on North Float above water
- Utilization of vibratory hammer where feasible
- Require use of bubble curtain to reduce underwater noise if impact pile driving necessary
- Utilization of sustainable (low-embodied) concrete and concrete products
- Utilization of environmentally friendly sealants
- Utilization of stainless-steel utility hangers
- Limited use of treated timber
- Prioritize WMBE and local business use in contracting and material sourcing
- Prioritize locally sourced and recycled materials where possible
- Designed to be ADA compliant
- Design will accommodate the existing shore power system during float replacement