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LETNIKOF COVE

PIPE FLOAT REPLACEMENT, CONCEPTUAL DESIGN

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1. Introduction

Moffatt & Nichol (M&N) was retained by the Haines Borough to develop conceptual design alternatives for the replacement of the existing steel pipe float. This report briefly summarizes the conceptual design process and is accompanied by conceptual design drawings and a concept summary matrix.

2. Existing Structure and Site Conditions

The facility at Letnikof Cove consists of a small craft floating dock moorage system which is accessed from shore by a pile supported timber trestle and aluminum gangway. The float system includes a steel pipe float which was constructed in 1979 and has been repaired and modified over the years. The steel pipe float provides access to a pair of timber floating docks. The timber floating docks are removed each winter, and the gangway is raised, while the pipe float remains in place year-round. The pipe float is secured in place by a system of anchors and chains. The anchor chains were recently replaced.

The site at Letnikof Cove is exposed to a long fetch and is subject to significant wind waves. A 2017 Memorandum prepared by PND Engineers, Inc, indicates a maximum fetch of 5.4 Nautical Miles and a corresponding 5.5-foot significant wave height. The memorandum was prepared relating to a possible floating breakwater at the site but contains relevant background information for the pipe float.

3. Conceptual Design Criteria

M&N solicited preliminary feedback from the Port and Harbor Advisory Committee and the Harbormaster. The urgent need for a replacement float system was highlighted due to the continued deterioration of the existing pipe float. The following design criteria and constraints were noted:

- Conceptual design should consider replacement of the pipe float only.
- The existing anchor chain system should be retained.
- Design should be heavy duty and durable.
- The stability of the single pontoon is a concern.
- High stress areas at the float connections have been prone to failure.
- Current general arrangement and freeboard are preferred.
- Longer pipe extensions are desired.
- Skiffs moored to the pipe float can get caught under the edge of the float.
- Pipe float is used only in the summer months but remains in place all year.
- A removable float system is not desired.

- There is a variable vessel mix from wide range of users. Generally consisting of small craft and fishing vessels.
- Wave attenuation is not a primary design constraint, but improved attenuation will be beneficial.
- Consider Ice Floes and Isostatic Rebound.

4. Conceptual Design

Three discrete design concepts were developed for replacement of the pipe float. The first concept is similar to the existing pipe float and includes a single steel pipe pontoon. The second concept includes widened double pontoon floats. The third concept uses monolithic concrete floats instead of steel pipe pontoons.

Each of the concepts retains the general original layout of the existing pipe float. Alternative layouts were briefly considered however they were limited due to the location of the existing anchor system, gangway landing float, and timber floats. Shortening the legs of the float is possible as a cost savings measure but will result in reduced moorage area.

Alternative construction materials were also evaluated. Timber floats are very common in Alaska; however, they typically have shorter design lives and are not well suited for exposed wave environments like Letnikof cove unless removed seasonally. HDPE plastic pontoons were also considered. HDPE pontoons are common in the floating dock industry and can support steel superstructures in light duty applications. HDPE pontoons were not strongly considered as an alternative because the long spans and infrequent anchor points at Letnikof cove do not work well with HDPE. HDPE is a flexible material and is subject to thermal expansion. HDPE pipe floats would likely require a heavy-duty steel superstructure and/or additional more frequently located anchor points. Because of the inherent challenges with HDPE pontoon and timber float systems, they were not chosen for further evaluation for Letnikof Cove.

4.1. Concept #1

The facility has been long served by the existing steel pipe float, given its 40+ years of service. Replacement with a similar single pontoon system can be expected to provide a similar life-span with design refinements to mitigate the need for repairs and to improve accessibility and vessel moorage.

The connection point where each of the legs join the head walk float has been identified as a weak point in the existing system. This location is likely subject to high stress and fatigue due to the constant motion of the float from vessel moorage, wind, wave, and tidal conditions. Bending stresses at these corner locations may be reduced by a pinned and braced connection. The connection would allow for limited rotation before engaging struts bracing the float segments together. The connection will incorporate the use of rubber blocks or bushings which are pliable. These bushings serve to dampen motion and to reduce wear on steel components. The connection will need to resist the torsion/twist in the pipe segments in order to prevent them from listing. Alternatively, the connection points may be of rigid construction similar to the existing system. A rigid connection would likely necessitate the use of heavier walled material and would include struts to brace the connection. Regardless of the configuration, the head walk float is not currently secured by its own anchor, so these connection points are required to transmit significant loads.

The single steel pipe pontoons will support a steel frame overlaid with a grated deck. The deck width is anticipated to remain at a nominal width of 6-feet. The deck width may be increased somewhat, however increasing the width will not improve the stability of the float.

Steel cross pipes and even outriggers were considered in order to mitigate twisting and listing of the float segments. These measures could be successful in stabilizing the float segments; however, they would present an obstacle to side tie vessel moorage.

Additional details and optional features related to the steel pontoon floats are described in section 4.4 below.

4.2. Concept #2

Concept #2 includes widened double pontoon float segments. The concept shows a 16-foot-wide head walk, 16-foot-wide southern leg segment, and a 6-foot-wide northern leg. The 16-foot-wide float sections rely on a pair of steel pipe pontoons with periodic cross pipe segments. These wider segments are significantly more stable and will provide improved wave attenuation over the single pontoon floats. Similar to the single pontoon concept, the connection points will need to be robustly designed.

The northern leg segment is shown with a 6-foot-wide deck. The width of the float is left narrow to better align with the existing gangway landing float and the timber floats. It is possible to install a wider float at the north leg, however it will reduce the clear width between the float legs and will mis-align with the timber float. Although mis-aligned the timber float will still be readily accessible.

Additional details and optional features related to the steel pontoon floats are described in section 4.4 below.

Concept #2, or a variation incorporating wider float segments is the recommended alternative due to the increased deck space, stability, and wave attenuation.

4.3. Concept #2A

Concept #2A includes the widened head walk float with both of the float legs remaining at 6-feet wide. This concept is a hybrid of Concept#1 and Concept#2.

Concept #2A is one of the alternatives preferred by the community.

4.4. Concept #3

Concept #3 considers the use of monolithic concrete floating dock segments instead of the pipe float. These concrete floats would consist of a polystyrene core cast in a reinforced structural concrete shell. Due to the exposed location, a segmental float joined by a waler, and thru-rod system is not recommended. Monolithic or match cast post-tensioned modules may be suitable. These modules are joined with robust structural connections and behave monolithically.

Concrete floats can be designed with 30–50-year design lives. The longer design life requires the use of marine concrete mix designs and increased concrete cover over reinforcing steel. This slows the initiation of corrosion in the reinforcing steel. Reinforcing steel is typically epoxy coated, galvanized, or even stainless steel to further delay corrosion. Corrosion of reinforcing steel is a common cause of failure in marine structures. As the steel corrodes, it expands resulting in cracks and spalls in the surface of the concrete.

Maintenance activities for monolithic concrete floats typically include occasionally tightening and replacement of connection hardware and appurtenances. As the concrete is damaged over time, spalls and cracks will have to be repaired. Typically, this is done with repair mortar and epoxy. Significant damage is difficult to repair and typically results in the casting of a replacement module which must then be shipped to the site and replaced. A steel float could periodically be removed from service for structural repairs and/or rehabilitation.

Concrete floats are adjustable in terms of width, depth, and freeboard. They can be designed to sit deeper in the water to provide improved wave attenuation. The width and mass of concrete makes them stable. Concrete floats can be outfitted with a variety of bullrail and rub board options similar to steel pontoon floats.

Concrete floats can be more costly to transport and install due to their increased weight. There are also limited options for companies that cast monolithic concrete floating dock modules, meaning prices may not be as competitive as other materials. There can be long lead times in the production of concrete floats. Because of their size and weight, production outside of the Pacific Northwest is not likely to be practical.

4.5. Float Options and Features

Pipe Extensions:

Each of the concepts shows 50-foot-long cantilevered float extensions. These extensions will provide additional wave attenuation for vessels moored along the exterior faces of the float legs. The final length of the float extensions should be adjusted during the project design phase based on results of a wave analysis. The pipe extensions may be decked to provide additional effective moorage space.

Deck:

The existing float deck is constructed of steel grating. Galvanized steel bar grating may be used for both of the float concepts. The use of fiberglass reinforced pultruded grated decking should be considered. Fiberglass grating is not impacted by corrosion and creates a non-slip ADA compliant walking surface. Fiberglass and Fiberglass reinforced plastic grating is secured by stainless steel hardware. The hardware needs to be sized and spaced appropriately to prevent sections of grating from becoming displaced as the float flexes and moves.

Timber decking secured to a steel frame is a suitable alternative. Timber has a traditional feel and is a lower cost alternative to the grating options at a reduced service life.

Fiberglass pultruded or steel bar grating is recommended.

Bullrail and Cleats:

Several options for bullrails and cleats are included in the conceptual drawings. Bullrails offer increased flexibility in vessel mooring and create a curb around the perimeter of the float. Bullrails may be constructed of glulaminated timber, galvanized steel HSS or galvanized steel pipe. Glulaminated timber is the lower cost option with a shorter design life. Glulaminated timber is considered over sawn timbers due to the cost and limited availability of large treated structural timbers. The steel bullrail segments are stronger and will have longer design lives although they tend to be more expensive.

Cleats placed periodically along each float may be used for vessel moorage. Galvanized steel cleats are cost effective and can be readily replaced when damaged. They offer less flexibility for vessel line configurations.

Steel HSS bullrails are recommended.

Rub boards.

Rub boards may be constructed of treated sawn timbers or HDPE plastic lumber secured to the float framing. Timber is lower cost and requires more frequent maintenance and replacement. The timber surface is softer and may be preferred by float users.

HDPE rub boards are more expensive but are not susceptible to rot or decay. They are more resistant to damage than timbers. HDPE is subject to thermal expansion so HDPE rub boards require more frequent mounting hardware with oversized holes and may require more frequent joints and spacing between segments.

Extruded rubber D fenders may be used in lieu of rub boards. Rubber D fenders provide a measure of energy absorption. They are susceptible to wear and tear from vessel impact but are generally considered to be durable. Rubber D fenders protrude further from the float and can catch gunwales of small vessels in a high wave environment.

The inner face of the north float leg may include additional framing to extend the rub board closer to the water surface. This will reduce the risk of the rub board catching on small vessels and will help keep them from going under the framing.

Timber or HDPE rub boards are recommended.

Safety Features:

Haines should consider the installation of a fire suppression system on the floating dock consistent with NFPA. A suppression system may include dry standpipes which can be charged by a seawater pump.

Fire extinguishers, life rings, and safety ladder appurtenances should be installed on the float. These items are relatively low cost and may be removed seasonally when the float is not in use.

Safety features are not included in the conceptual cost estimates.

Anchor Chain System

The anchor chain system has been assumed to be adequate and in good condition. A detailed analysis of the floating dock system should evaluate the capacity of the anchor chain system relative to the design wind, wave, and mooring conditions.

Installation of additional anchors and chains will better secure the float, potentially reducing stresses on the float connection point and provide increased capacity in the event of a large storm event. The project should include an allowance budget for the installation of additional anchor chains securing the head walk float.

It is likely that the anchor chain system is adequate for an in-kind replacement system. The larger and wider floats, and especially the heavy concrete floats, are likely to increase the load on the anchor chain system. It is likely that proceeding with alternatives other than Concept#1 may necessitate recommended changes or upgrades to the anchor system.

5. Conceptual Opinion of Probable Construction Cost

M&N has developed a preliminary opinion of probable construction cost for each of the concepts. The costs are estimated based on the expected scope of the project and based on input from float manufacturers, historical data, and experience. These values are based on a preliminary level of design. It is recommended to apply accuracy ranges consistent with an AACE Class 4 estimate including a low range of -15% and a high range of +50%. A 15% design contingency is included in the estimate below for each concept to account for unknowns in the project. The contingency value is not applied to the estimated mobilization cost. As the project design is advanced, the design contingency and accuracy ranges may be reduced.

Item	Concept #1	Concept #2	Concept #2a	Concept #3	Unit
Mobilization	$ 471,000.00	$ 585,000.00	$ 481,000.00	$ 711,000.00	LS
Demolition and Removal	$ 90,000.00	$ 90,000.00	$ 90,000.00	$ 90,000.00	LS
Furnish and Install Floating Dock	$ 2,166,000.00	$ 3,709,000.00	$ 3,018,000.00	$ 4,400,000.00	LS
Furnish and Install Additional Anchor	$ 100,000.00	$ 100,000.00	$ 100,000.00	$ 250,000.00	Allow
15% Design Contingency	$ 354,000.00	$ 585,000.00	$ 482,000.00	$ 711,000.00	Allow
Total	**$ 3,181,000.00**	**$ 5,069,000.00**	**$ 4,171,000.00**	**$ 6,162,000.00**	

It is understood that Haines desires to replace the north timber floating dock and would like to add a lifting device for the gangway. The cost for that work is not included in the above estimates.

It is anticipated that a preferred concept will be developed following the review of this report and the included conceptual design figures. The preferred concept may include a combination of elements from each of the concepts presented above or additional elements not previously considered.

6. Preferred Alternative Development

After a conceptual design meeting on3/14/2024, Haines identified a preference for design concept #2A and design concept #3. Each of these concepts has been revised and updated to include feedback from the design review meeting.

The updates include shortening of the north float extensions due to possible grounding concerns, noting that Haines is experiencing isostatic rebound.

Drawings for Concept #2A have been provided to include two widened 8-foot wide legs, braced connections, additional anchor points, and a shortened northern pipe float extension.

The Drawing sheet for Concept #3 has been updated to show a 12-foot wide head float. The float legs are shown as separate units accessed by transition plate, additional anchor points have been added, and a shortened north float extension has been shown.

The costs for Concept #2A and Concept #3 have been updated as shown in the table below:

Item	Concept #2A R1	Concept #3 R1	Unit
Mobilization	$ 494,000.00	$ 679,000.00	LS
Demolition and Removal	$ 90,000.00	$ 90,000.00	LS
Furnish and Install Floating Dock	$ 3,104,000.00	$ 4,184,000.00	LS
Furnish and Install Additional Anchor	$ 100,000.00	$ 250,000.00	Allow
15% Design Contingency	$ 495,000.00	$ 679,000.00	Allow
Total	**$ 4,283,000.00**	**$ 5,882,000.00**	

The costs for each of the two revised comments have changed somewhat to accommodate the change in float dimensions. The cost of Concept #2A went up due to the wider legs. The cost of Concept #3 went down due to the reduced length of head float.

The table below qualitatively compares the cost, longevity, maintenance, and wave attenuation properties associated with each of the options.

7. Preferred Alternative Comparison

Concept	Cost	Lifespan	Maintenance	Wave Attenuation
#2A R1- Steel Pontoon with widened head float	**$ 4,283,000.00**	• 50 -years. • indefinite with rigorous maintenance. • Eventual failure due to corrosion of steel structure.	• Periodic Coating repair and anode replacement required. • Damage can be patched. • Can be removed for rehab.	• Fair, can be improved with additional pontoons.
#3 R1 Concrete Float	**$ 5,882,000.00**	• 50-years. Once design life is reached, replacement likely required.	• Periodic connection hardware. replacement. • Seal spalls and cracks. • Patching of damage difficult. Significant damage requires replacement.	• Fair, can be improved with wider/deeper floats.

Based on the above, both alternatives are likely to meet the design intent of the facility. Due to the lower cost, history of performance, repairability, concept #2A R1 is recommended.