Haines Lutak Dock

Roll On Roll Off Ramp Condition Assessment Final Report

January 2018

prepared by:

EXECUTIVE SUMMARY

In October 2017 the Haines Borough authorized R&M Consultants, Inc. (R&M) to proceed with the Lutak Dock Roll On Roll Off (Ro Ro) Ramp Condition Assessment and Report. The purpose of the project is to outline alternatives, options, and costs to repair the Ro Ro facility. On Wednesday, November 1, 2017 John Daley PE and Kim Nielsen PE, both senior engineers from R&M, traveled to the site to inspect the dock. During the site visit R&M discussed the project with Borough staff and retrieved historical data including copies of original design drawings and several reports.

Table ES1 below summarizes the priority repairs.

TABLE ES1: PRIORITY RENOVATION REPAIRS

Item	Condition	Repair
Bearing Abutment	Severe Damage	Demo section of abutment and level bearing
North End Berth Dolphin	Severe Damage	Replace timber berthing face and install anodes
Floatation tank	Major Damage	Coat tank and Install anodes
South End Berth Dolphin	Moderate Damage	Replace timber berthing face and install anodes
Side Berth Fenders	Moderate Damage	Replace timber berthing face and install anodes
Transfer Bridge	Moderate Damage	Coat steel members and install new timber wear surface
Air System	No Defects	Coat on float air valve

The project also outlined options and alternatives for renovation and repair including examining new barge berth concepts. A concept level drawing package for these is included in the Appendix.

Option 1 Renovate existing facility. Estimated cost is $2,317,000.

Option 2 Remove existing facility and create a new Ro Ro ramp sited at an angle to the shore line. Estimated cost is $10,933,000.

Option 3 Remove existing facility and create a new Ro Ro ramp parallel to and in line with the face of the existing dock. Estimated cost is $14,056,000.

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LIST OF ACRONYMS AND ABBREVIATIONS

AMHS	Alaska Marine Highway System
AML	Alaska Marine Lines
DOT&PF	Department of Transportation and Public Facilities
R&M	R&M Consultants, Inc.
TAMS	Tippetts-Abbett-McCarthey-Stratton

1.0 INTRODUCTION

The Lutak Dock is in need of repair or replacement as it is nearing the end of its useful life. There are a number of recent condition reports that document serious section loss of the sheet pile cells. In 2002 the interconnection arc sheet piles were found to have holes in them and a project was advanced to drive new sheets in the arc areas. In 2004, cell 4 at the Alaska Marine Highway section of the dock failed when sheets at the face split open spilling the fill into the bay. In 2007, a project was advanced to stabilize the pile cap in the area of cell 4. In 2010, sink holes appeared in the pavement along the length of the structure. A 2014 inspection conducted by Echelon Engineering for PND Engineers reported thickness readings on the main sheet pile cells of significant losses in wall thickness, between 20% and 87%, with an average loss of 37% of the original 0.500-inch wall thickness. With this type of major (30 to 50% section loss at any location) and severe damage (greater than 50% section loss at any location), local failures and buckling are possible and loading restrictions may be necessary. PND Engineers' report stated "*it is the opinion of PND Engineers, Inc. that the structure has reached the end of its credible 60-year service life. Further utilization is effectively on 'borrowed time'*." On a structure with this type of damage, repairs should be carried out with high priority and with urgency.

Based on the history and various reports it is unlikely that the existing dock will remain usable for another 10 years. Localized failure can be expected at any time. Because of this there is concern within the community of the possible loss of critical transportation infrastructure. Since Lutak Dock is Haines' primary marine industrial facility for the importation of freight and fuel, if it were to become nonoperational, freight and fuel would most likely be rerouted and transported via truck or a combination of barge and truck. Alternative transportation means would involve a mode change from barge to truck for at least a portion of the route. Haines Borough residents and businesses could experience increased costs for goods and services based on the anticipated mode shift in freight transportation. It is important to note that both AML and Delta Western have contingency plans for emergency operations. Should Lutak Dock have a localized failure and be taken out of operation, these service providers would likely develop a temporary emergency access plan.

In March 2017 R&M provided a study report outlining alternatives for replacing the dock. Three primary alternatives were outlined. With costs ranging from $21 to $62 million. The Borough has been pursuing funding for this. Since the costs are large, making the local match required for some type of major federal or state funding is challenging. In the interim, the Borough is considering ways to maintain or renovate the Ro Ro ramp. If this part of the facility can remain operational then the marine transportation link to the community can be maintained until if and when funding becomes available to replace Lutak dock.

FIGURE 1 – EXISTING DOCK

2.0 EXISTING BARGE BERTH

Lutak Dock is located in Lutak Inlet near the northern end of Chilkoot Inlet, which is in turn near the northern end of Lynn Canal. The original Lutak Dock was constructed in 1953 by the United States Army Corps of Engineers (USACE). It consists of 15 full circle sheet pile cells connected by interconnecting sheet pile arcs. An L-shaped concrete cap, about 9' high sits on top of the front face of the cells. The depth along the dock is generally about –35'.

The Department of Transportation and Public Facilities (DOT&PF) Alaska Marine Highway System (AMHS) previously owned four of the cells (Cell 1-4) on the east end of this dock, which is used for the Ferry Terminal. These cells along with cell 5 and portions of cells 6 and 7 were recently removed in a ferry berth renovation project. The City and Borough of Haines owns the remaining cells 8 through 15 and the Ro Ro loading ramp to the west. The Borough's dock face is about 550 feet long and is currently used by Alaska Marine Lines (AML) and Delta Western for freight and fuel loading/unloading operations.

FIGURE 2 – CARGO BARGE

The barge berth and Ro Ro ramp were designed by EMPS Engineers of Juneau Alaska in about 1981 (see Appendix C). It is located on the west end of Lutak Dock and consists of a plate girder transfer bridge that is supported by bearings at the abutment and by a pneumatically activated adjustable float on the offshore end. The floatation tank has been modified since the original design. The outer section of each end now has vertical outriggers that mobilize buoyancy under tilting and help prevent a list condition. The bridge is 160 feet long with a 10-foot long apron at the end. It is approximately 19'-4" wide out to out. The plate girders vary from 36 inches high at the ends to 6'-2" high in mid span. There is 4-1/2" steel grate decking that is supported by steel floor beams. There are 2x12 timber runners on top of the steel grating for a wear deck.

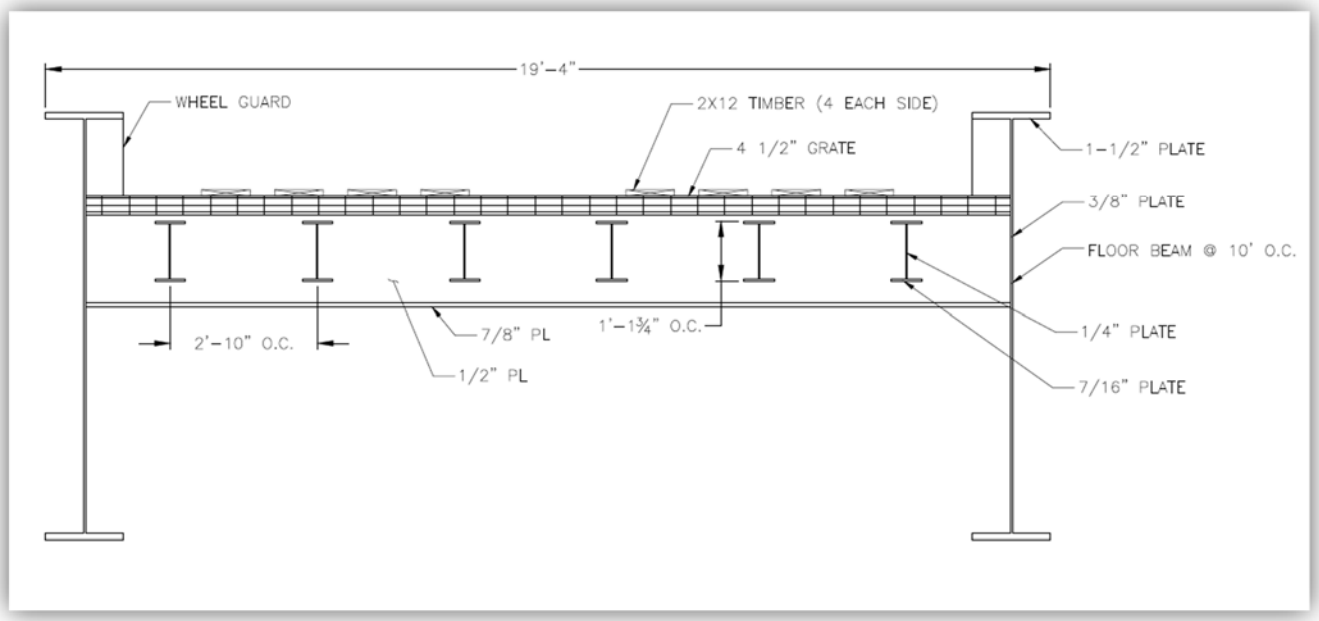

FIGURE 3 – TRANSFER BRIDGE CROSS SECTION

The layout is orientated for end berthing of barges. There are two end berthing dolphins, one on either side of the transfer bridge, approximately 80 feet apart. There are also two side berth dolphins approximately 125 feet apart. There is a small craft float boat launch ramp along the shoreline adjacent to the barge berth.

The original live load capacity of the ramp was specified to be:

> "HS 20-44 (Caterpillar AH60 Forklift or equivalent maximum axial load 130 kips)"

In 1984 Tippetts-Abbett-McCarthey-Stratton (TAMS) produced a stability study of the barge ramp (see Appendix D). The impetus of this was a series of instability events that caused the offshore end of the ramp to list. In at least one case this was very severe and caused damage to the northern bearing. The report outlined a number of causes and conditions.

Some of the primary stability issues include:

1. The center of gravity of the transfer bridge was considerably higher than the center of buoyancy of the floatation tank. The floatation tanks were about the same width as the bridge and therefore quite narrow.
2. The transfer bridge (being constructed of plate girders with floor beams) was not torsionally stiff enough for the eccentric loads. An orthotropic deck made of hollow structural sections (box girders) would have fared better.
3. The bearing system did not allow for any out of plane movement.

The obvious corollary to the above incudes providing a structure with a center of gravity closer to the center of buoyancy and ensuring the float system is wider than the bridge, constructing the bridge so that it is torsionally robust, and providing a bearing system at the abutment that can allow some level of out of plane movement.

In November of 1984 Sverdrup and Parcel provided a set of plans to renovate the floatation tank and other items to correct the stability issues (see Appendix D). There is a lack of complete documentation but the tank was lengthened substantially and two vertical chambers were added, one on each end. These act as outriggers and help to stabilize the float and off shore end of the transfer bridge. The original restraint piling were removed and the end of the transfer bridge has cables that go to each of the end berthing dolphins to help reduce transverse movement.

3.0 CONDITION ASSESSMENT

The condition assessment is based on a field investigation done in November of 2017. Each primary element of the barge berth and Ro Ro ramp were inspected both from on land and from a skiff at low tide. Elements are each given a rating following the general guidelines put forth in the ASCE Manual of Practice No 130 "*Waterfront Facilities Inspection and Assessment"* published in 2015 by ASCE press. The ratings include the follow categories:

- No Defects (Surface rust but little or no section loss);
- Minor (Coating damage with section loss up to 15% of original);
- Moderate (Coating damage with between 15% and 30% section loss);

- Major (coating damage with between 30% and 50% section loss); and
- Severe (Coating damage with section loss of greater than 50% and structural defects such as bent, buckled, or broken members.)

3.1 TRANSFER BRIDGE

The transfer bridge had moderate damage. In general the coatings are at the end of their service life and the members are showing signs of surface rust. The recessed areas of the floor beams show moderately heavy laminations of pack rust. Several of the timber wear strips on the deck are cracked, weathered, and should be replaced. The webs of the primary plate girders had a measured wall thickness of 0.325-inch. It is likely that they were originally 3/8-inch or 0.375-inch. This shows a wall loss of approximately 15%. The floor beams are in similar or slightly worse condition.

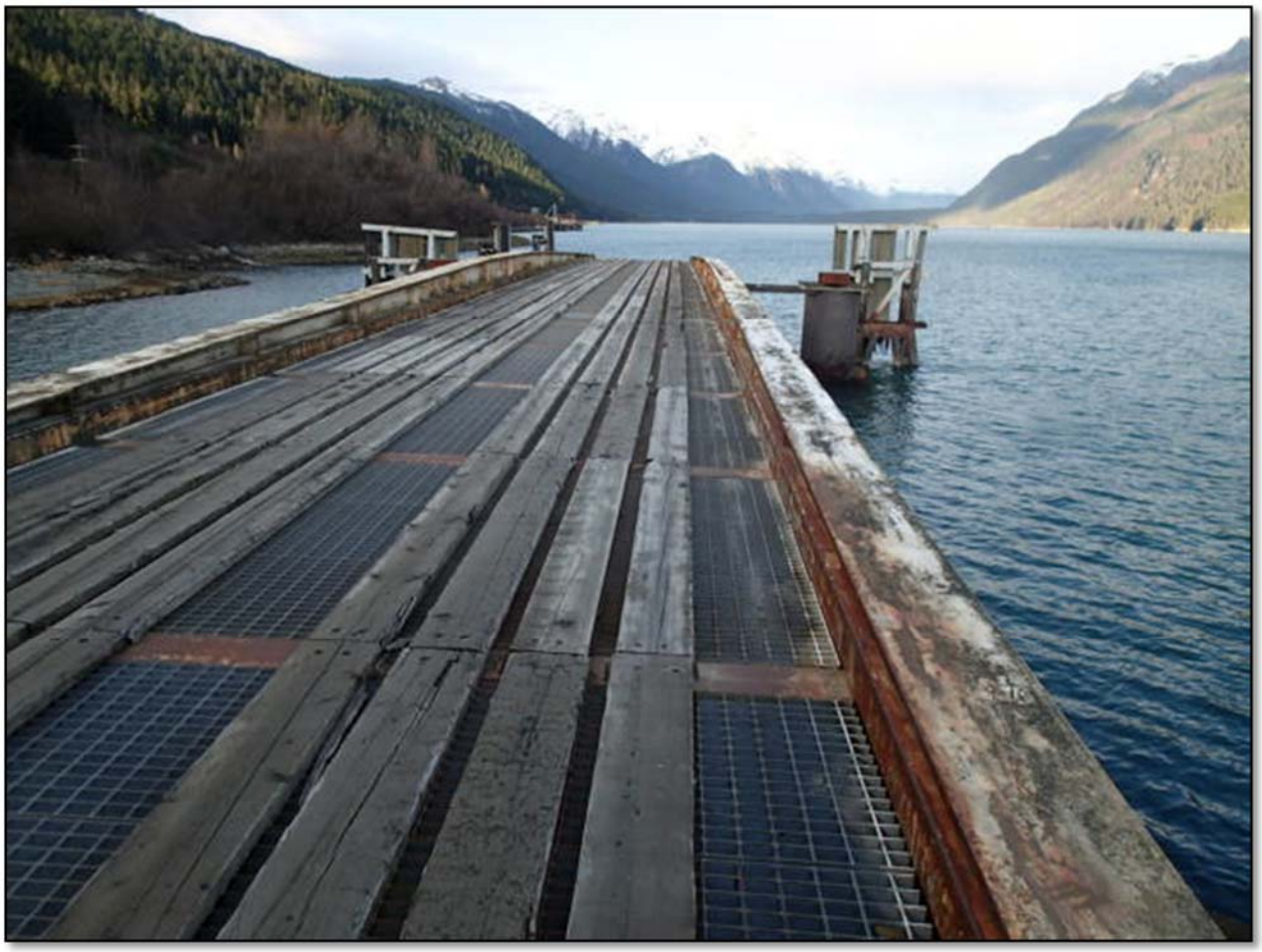

FIGURE 4 – TRANSFER BRIDGE DECK

FIGURE 5 – TRANSFER BRIDGE FLOOR BEAM

FIGURE 6 – TRANSFER BRIDGE FRAMING

3.2 BEARINGS / ABUTMENT

The south bearing appears to have no defects. There is surface rust. It is impossible to inspect the interior of the pin without disassembly which would require heavy equipment.

The north bearing has suffered damage and has settled several inches. Since this is significantly out of place it should be considered severe damage. The base plate of this bearing is below the top of the concrete abutment as opposed to the south bearing which rests on the concrete abutment. The anchor bolt nut is several inches above the top of the steel base plate and is not snug. This may be related to the instability damage that was noted in historical reports and which dates to the early 1980s. Original or as built drawings that detail how the bearings are anchored to the abutment were not located. The 1984 Sverdrup and Parcel drawings show a pair of “existing” batter piling under each bearing. However there are no framing details of the top of these piling. It is possible that the base plate of this bearing experienced a punching shear failure in the concrete abutment. It is also possible that there was a steel weldment cast into the concrete and that part of this failed. The only way to verify the exact type of damage that caused the settlement is through partial demolition of the concrete abutment.

FIGURE 7 – SOUTH BEARING

FIGURE 8 – NORTH BEARING

3.3 FLOATATION TANK

As mentioned previously, the floatation tank has been modified since the original design. The outer section of each end now has vertical outriggers that mobilize buoyancy under a list condition. The majority of the vertical buoyancy tanks have intact coating and no visible damage. The horizontal air chamber has lost much of its coating and shows signs of pitting and active corrosion. The original wall thickness of the original air chamber is unknown. The top section in the splash zone above the water line was measured at 0.215-inch remaining wall thickness. It is possible that this was 3/8-inch or 0.375-inch thick originally. The 1984 Sverdrup and Parcel plans show this 3/8-inch wall for the tanks. This would mean there has been a 43% reduction in wall thickness resulting in a rating of major damage. Sacrificial anodes were observed to have been welded to the mid-section of the submerged portion of the buoyancy tanks. It was not possible to determine the original dimensions of these or the percent remaining (without an underwater investigation.)

FIGURE 9 – FLOATATION TANK FROM SHORE

FIGURE 10 – FLOATATION TANK FROM BERTH

FIGURE 11 – FLOATATION TANK OUTRIGGER

3.4 NORTH END BERTH DOLPHIN

The north end berthing dolphin has severe damage to the timber facing. Virtually all of the timbers on the face are damaged or missing. All should be replaced. The harbormaster reports that this dolphin is used for turning maneuvers at the berth. Therefore it sees considerably more force than the other dolphins. The lower section of each fender framework shows signs of corrosion.

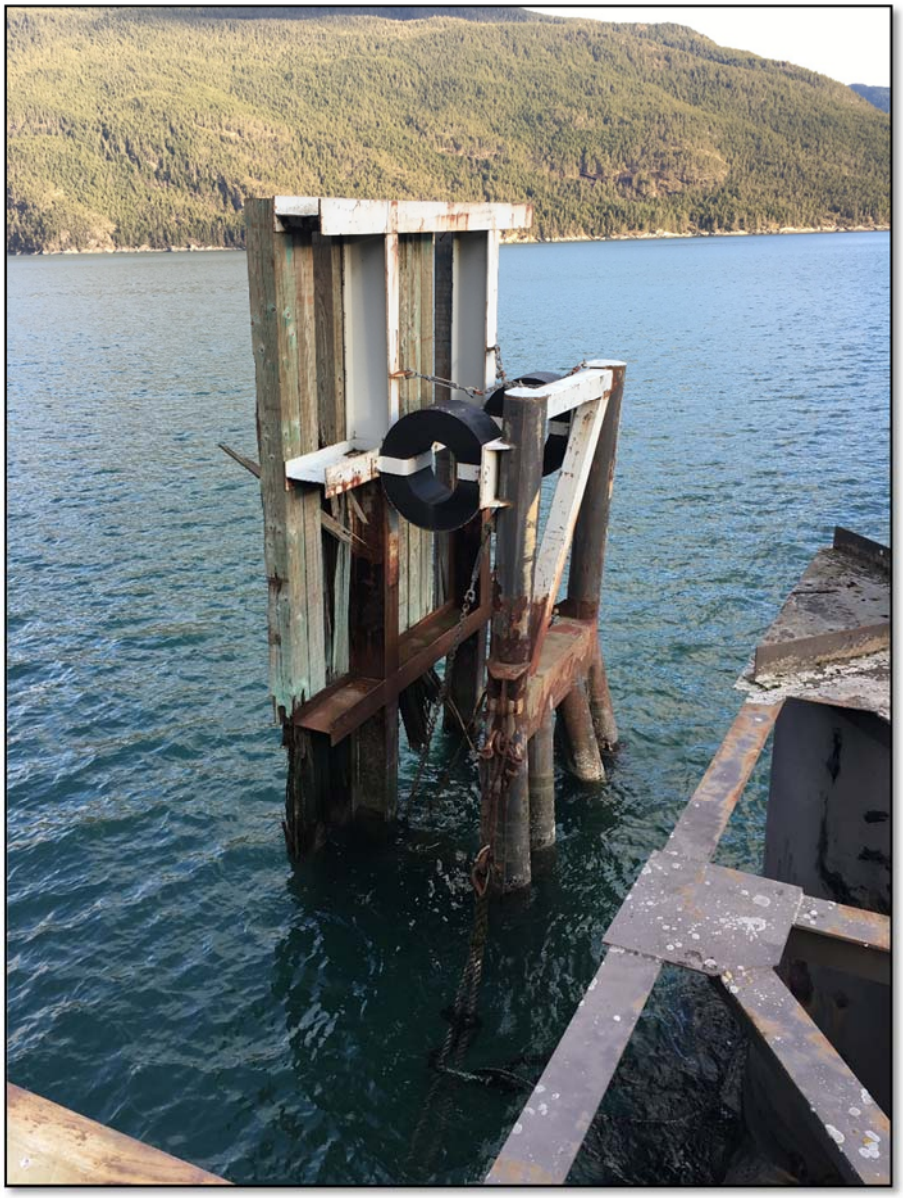

FIGURE 12 – NORTH BERTHING DOLPHIN BACK

FIGURE 13 – NORTH BERTHING DOLPHIN FRONT

3.5 SOUTH END BERTH DOLPHN

The south end berthing dolphin has moderate damage to the lower portion of the timber facing. These are generally in place but show signs of rot and marine growth. The lower section of each fender framework shows signs of corrosion.

FIGURE 14 – SOUTH BERTHING DOLPHIN BACK

FIGURE 15 – SOUTH BERTHING DOLPHIN FRONT

3.6 SIDE BERTH DOLPHINS

The two side berthing dolphin has moderate damage to the lower portion of the timber facing. These are generally in place but show signs of rot and marine growth. The lower section of each fender framework shows signs of corrosion.

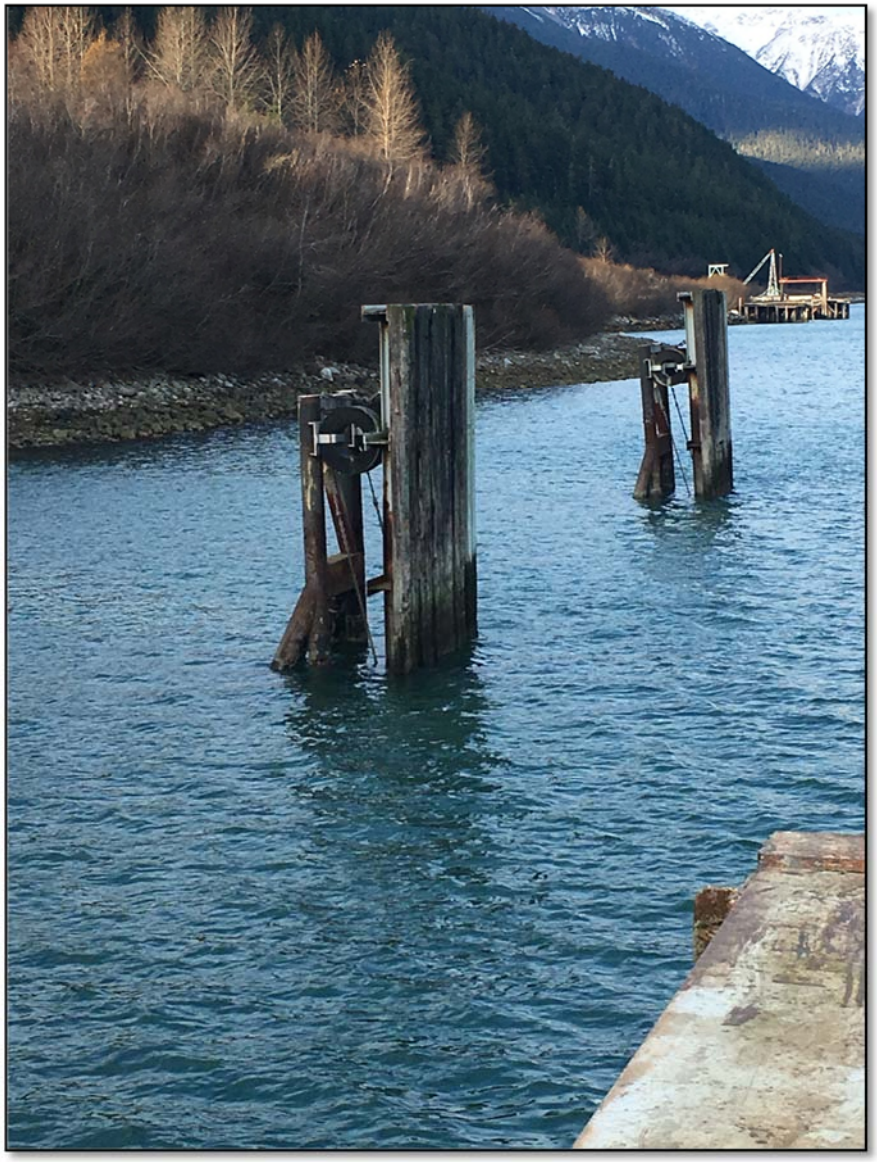

FIGURE 16 – SIDE TIE DOLPHINS

FIGURE 17 – WEST SIDE TIE DOLPHIN

3.7 AIR SYSTEM

No defects were noted in the air system. The valve at the top of the floating air chamber was rusty. The harbor master reported that this valve had recently been repaired. The remainder of the air system including compressors appeared to have no damage and to be in fair and serviceable condition.

FIGURE 18 – COMPRESSORS

FIGURE 19 – AIR PIPE

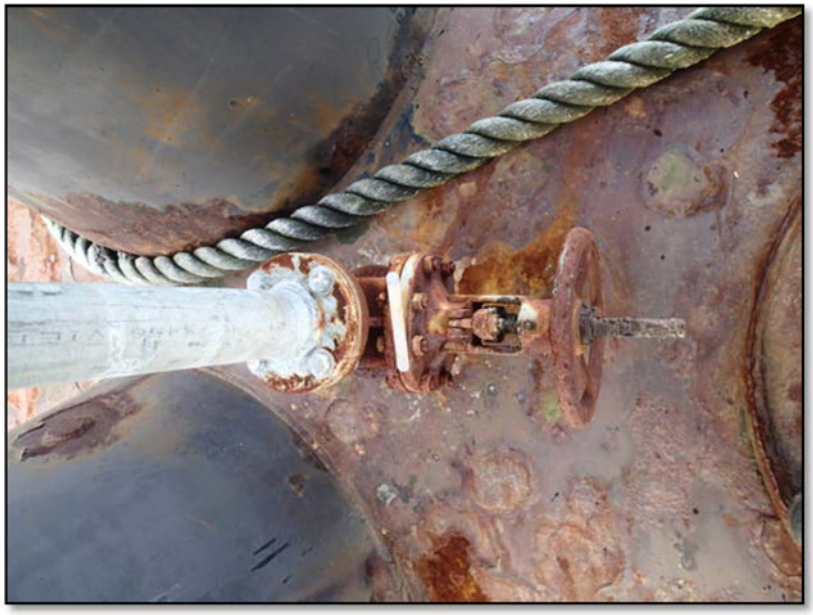

FIGURE 20 – FLOATATION TANK VALVE

3.8 CONDITION SUMMARY

Table 1 below outlines a summary of the major infrastructure items and their respective condition ratings.

TABLE 1: CONDITION SUMMARY

Item	Condition	Comment
Transfer Bridge	Moderate Damage	Section loss due to corrosion
Bearing Abutment	Severe Damage	North bearing has settled several inches
Floatation tank	Major Damage	Section loss due to corrosion
North End Berth Dolphin	Severe Damage	Loss of timber berthing face
South End Berth Dolphin	Moderate Damage	Lower end of timbers are damaged
Side Berth Fenders	Moderate Damage	Lower end of timbers are damaged
Air System	No Defects	Corrosion noted on float air valve

4.0 REPLACEMENT AND REFURBISHMENT ALTERNATIVES

There are several alternatives for renovation and or replacement. These include renovation of the existing facility, replacement of the barge berth with a new system at an angle to the shoreline, and replacement of the barge berth with a new system paralleled to the face of the existing dock.

4.1 RENOVATE EXISTING

The most straight forward alternative is to renovate the existing system. This is also the least costly. Table 1 outlines a summary of the condition assessment. From this a priority list can be produced based on the severity of the condition rating as follows:

TABLE 2: PRIORITY RENOVATION REPAIRS

Item	Condition	Repair
Bearing Abutment	Severe Damage	Demo section of abutment and level bearing
North End Berth Dolphin	Severe Damage	Replace timber berthing face and install anodes
Floatation tank	Major Damage	Coat tank and Install anodes
South End Berth Dolphin	Moderate Damage	Replace timber berthing face and install anodes
Side Berth Fenders	Moderate Damage	Replace timber berthing face and install anodes
Transfer Bridge	Moderate Damage	Coat steel members and install new timber wear surface
Air System	No Defects	Coat on float air valve

The north transfer bridge bearing has a severe damage rating because it is a key structural item that is out of alignment and the bolts are not tight. It should be noted that this bearing does appear to be stable as it is likely to have been damaged a number of years ago and has provided service since the initial damage. It is currently unclear as to what supports this bearing and what part is damaged. It will require partial destruction of the concrete abutment to gain access for inspection. Following inspection a repair can be engineered.

The north end berthing dolphin also has a severe damage rating due to the near complete loss of the timbers on the face. It is nearly un-usable in its current configuration. New pressure treated timbers should be installed as soon as possible. It should be noted that the other dolphin fender faces have similar timber members which are rated as having moderate damage due to rot and decay at the lower sections. If a project is advanced to repair the timber face on the north end berthing dolphin it may make sense to do all the dolphins at the same time for efficiency.

The floatation tank is rated as having major damage due to section loss. It is recommended that this be coated and that additional anodes be installed. Renovating this tank should be a high priority item because there is a risk of it sinking should the wall of the tank be compromised due to corrosion.

Completely coating this tank will not be simple because it needs to be lifted from the water for access. This will require a barge and crane. Mobilizing a barge and crane suitable for this operation to the site will be expensive. It will also include sandblasting and coating over water which is not simple and can be expensive. Note that it may possible to simply replace the entire tank with a new one for an effort that is in line with the cost of over water coating. The tank weighs approximately 85,000 lbs. At $2.50 per pound for materials, fabrication, and coating the cost of a new tank would be about $212,500. This does not include installation.

The top of the horizontal section of the original floatation tank is the area of the floatation tank that has the most corrosion and risk. This is above the water where the sacrificial anodes will do no good and is in the splash zone where corrosion rates are known to be high. It is possible to sand blast and coat this area without lifting the tank from the water with a barge and crane. While this would result in only a partial repair, it is considerably better than doing nothing and should be pursued if a larger project is not advanced soon.

Installing additional anodes to the float may help to prolong its service life. It may make sense to install anodes on all the dolphin piling and lower sections of the fender frameworks. Combining these anode installations into one project for efficiency makes sense.

The transfer bridge is rated as having moderate damage due to section loss. Similar to the floatation tank the repair is to coat the steel members. Sand blasting and coating over water is not simple and can be expensive. It may make sense to combine coating the float and the transfer bridge into one project for efficiency.

Cost estimates for renovations are included in Appendix B.

4.2 OPTION 2 REPLACE WITH BARGE BERTH ANGLED TO SHORELINE

Option 2 is to provide a new barge berth at an angle to the existing shoreline and with the transfer bridge orientated so that it lands on the side of the barge near amidships. R&M outlined this alternative on a scale drawing can be found in Appendix A. An advantage to this option is that it does not require demolition of the face of the existing dock. This option is feasible but is not ideal because the stern of the barge is located in deep water where it becomes impractical to install a berthing dolphin. Therefore the offshore end of the barge is not supported by a dolphin. **This is NOT a recommended berthing arrangement.** Also, the barge extends a long ways over the bulkhead and pier-head line that runs along the face of the dock. This means that a moored barge in this configuration would partially block navigation access to the rest of the dock. More detailed cost estimates for this alternative are included in Appendix B.

4.3 OPTION 3 REPLACE WITH BARGE BERTH PARALLEL TO FACE OF DOCK

Option 3 is to move the barge berth to the face of the dock and orientate it so that the barge is moored parallel to the face and the transfer bridge lands in the center of the barge. Concept level drawings of this option are located in Appendix A. This alternative works in concert with the remaining face of the dock and preserves a continuous bulkhead and pier head line. It also provides all new facilities with an increased level of service. It would require demolition of at least three cells. More detailed cost estimates for this alternative are included in Appendix B.

5.0 RECOMMENDATIONS AND NEXT STEPS

5.1 NEAR TERM STRATEGY

The recommended strategy for the near term is to advance repairs and renovations to the existing barge berth on a prioritized level based on condition rating and based on the Borough's budget. Like work items should be grouped together wherever possible. For example:

- Replace all the timber faces of the dolphins in one project;
- Combine coating the floatation tank and transfer bridge into one project; and
- Install anodes on all the submerged steel items in one project.

The most cost effective way forward is for one large renovation project because the mobilization and administration costs can be shared. However, it is also possible to advance a series of smaller specific projects. In this case separate mobilization and administration costs would be applied.

It should be noted that the repairs to the floatation tank should be carried out with a high priority due to the risk of failure. Should the tank wall be compromised there is a risk that it could sink. As mentioned previously the top portion of the horizontal tank should be coated because it is located in the splash zone where the sacrificial anodes cannot protect it. If funds are not available for a larger comprehensive renovation project then this should be broken out as a separate work items and advanced as soon as possible.

5.2 LONG TERM STRATEGY

For the longer term, the Borough should weigh the alternatives discussed in the recent Lutak Dock planning exercise with the new barge berth replacement options outlined in this report. Obviously this will need to be considered in concert with various funding options. Options and alternatives should take into account the level of service that the renovated or new facilities provide. This is outlined and further discussed below.

5.3 LEVEL OF SERVICE AND ALTERNATIVE COMPARISON

Each of the alternatives and options discussed in this report has a differing level of service. The Borough is faced with making decisions based on available funding and on the ultimate level of service provided. This is similar to decisions made on owning a vehicle. The existing barge berth can be seen as analogous to an old car at the end of its service life and requiring major maintenance. Once major funds are invested in renovation what level of service will it provide and is it worth it? On the other end of the spectrum how much can the Borough afford to spend on a new facility and what level of service will it provide? This is analogous to how much could one afford to spend on a new vehicle?

- **Renovate Existing Berth**. Renovation of the existing berth is the least costly and provides the lowest level of service. The existing end berth configuration remains under this renovation alternative. Some users have stated that access to the side of the barge near mid-point with the transfer bridge is preferred. Also, regardless of the amount of renovation provided the barge berth will still be an old facility.
- **Option 2 Angled Berth**. The angled berth provides a new facility at the existing site without demolition of the face of the existing dock. It provides a moderate level of service. The angled

berth is in somewhat awkward alignment with th face of the existing dock and does not work well with the existing bulkhead and pier head line. The offshore end of the barge does not have any dolphins in this configuration.

- **Option 3 Berth at Dock Face**. The berth at the dock face provide all new facilities in line with the existing bulkhead and pier head line. It allows seamless use of the existing dock and provides a high level of service.

TABLE 3: ALTERNATIVE COMPARISON

Alternative	Cost	Advantages	Disadvantages	Level of Service
Renovation	$2,317,000	Least costly.	Old facility with end berthing.	Low.
Option 2 Angled Berth	$10,933,000	New facilities. No demo of existing dock required.	Somewhat awkward alignment. No support for offshore end of barge.	Moderate.
Option 3 Berth at Dock Face	$14,056,000	New facilities. Aligned with dock face.	Requires demolition of a portion of the uplands.	High.

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