

# **Harris Avenue Shipyard In-water Condition Assessment Report**

**Port of Bellingham  
Harris Avenue Shipyard**

**Submitted to**

**Anchor QEA  
Bellingham, Washington**

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**Submitted by**

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## EXECUTIVE SUMMARY

To support the Port of Bellingham and the Washington State Department of Ecology's Executed Agreed Order No. DE 19450 dated February 2021, WSP USA is pleased to present this facility condition assessment report of the Harris Avenue Shipyard, specifically addressing in-water structures, located within the Cleanup Action Plan site.

The purpose of this report is to present the current overall condition assessment rating of the marine structures, provide a summary of observations and findings resulting from the facility condition assessment, and provide concept level repair recommendations for structures that were found to be deficient for their current use. General structural findings are as follows.

### West Dock

The West Dock is in **fair** condition. Advanced deterioration consisting of severe damage was observed at a few timber framing elements.

### West Dock Dolphins

The West Dock Dolphins are in **poor/fair** condition. Minor corrosion was noted in the steel H piles.

### Ecology Wall

The Ecology Wall is in **fair** condition. Material loss/voids behind the wall were observed.

### West Marine Walkway

The West Marine Walkway is in **serious/poor** condition. Advanced deterioration consisting of severe damage was observed at multiple timber framing elements. It is recommended that walkway use is discontinued at this time.

### Marine Railway

The Marine Railway is in **fair** condition. However, advanced deterioration consisting of major damage was observed at multiple timber beam and pile cap elements.

## 1.0 INTRODUCTION

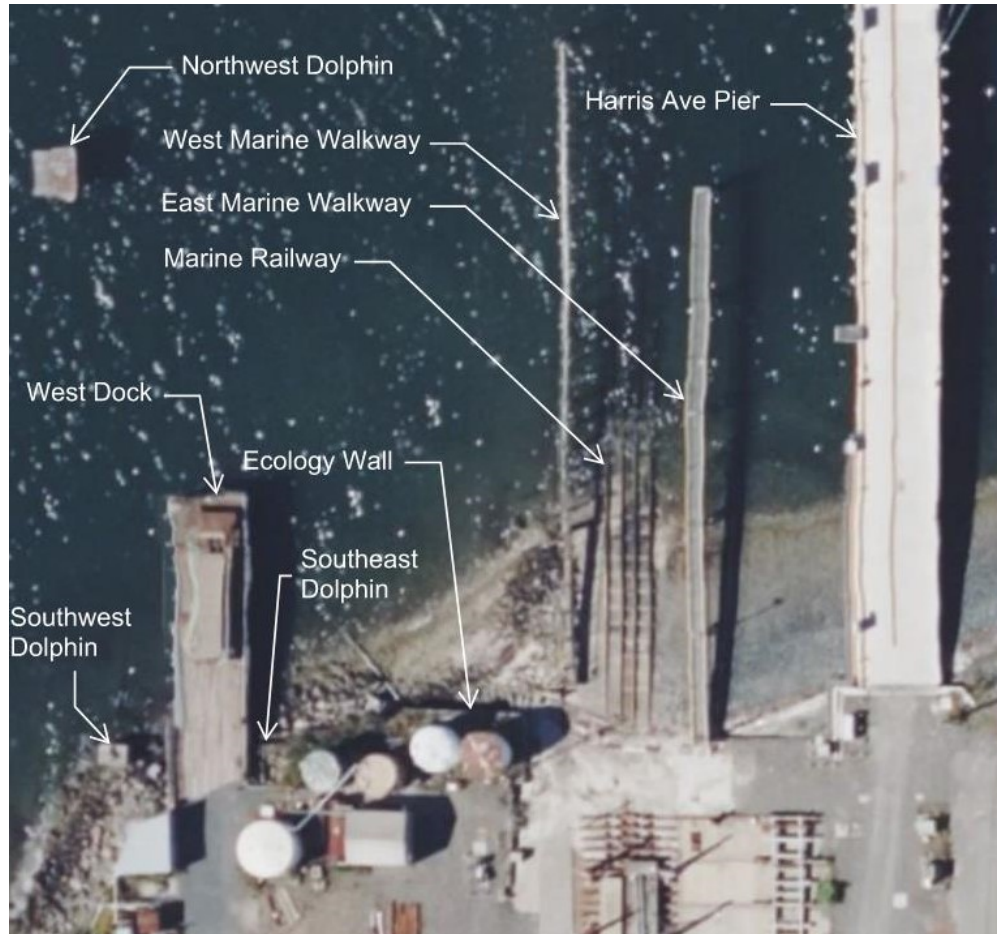
In support of the Port of Bellingham and the Washington State Department of Ecology's Agreed Order No. DE 19450, Anchor QEA retained WSP USA (WSP) to perform a facility condition assessment (FCA) of the Harris Avenue Shipyard marine structures. The purpose of the facility condition assessment report (FCAR) is to identify the current overall condition assessment rating of the various structures located within the Cleanup Action Plan (CAP), provide a summary of the observations and findings from the FCA effort, and provide concept level repair recommendations for assets that were found to be deficient. For a complete listing of all above-deck and below-deck/above-water damage observed, see Appendix C.

WSP obtained the information necessary to complete the FCAR by performing the following tasks.

- Performed a general condition assessment of the above-deck portions of the structures.
- Performed a general condition assessment of the below-deck/above-water portions of structural framing elements.
- No underwater inspection was included within this scope.

## 2.0 DESCRIPTION OF STRUCTURES

The Harris Avenue Shipyard is located at 201 Harris Avenue in Bellingham's Fairhaven neighborhood. The shipyard consists of multiple in-water structures, including a marine railway, piers, and dolphins. From west to east, the in-water area is made up of the West Dock, the Ecology Wall, West Marine Walkway, Marine Railway, East Marine Walkway, and Harris Avenue Pier. The West Dock consists of a timber pier and a concrete bulkhead wall. In addition, it is associated with three dolphins, identified as the Northwest Dolphin, Southwest Dolphin, and Southeast Dolphin. See Figure 1 for a plan area of the shipyard's in-water structures.



**Figure 1. Harris Avenue Shipyard Site**

## **2.1 WEST DOCK**

The West Dock is oriented perpendicular to the shoreline and is approximately 105 feet long by 26 feet wide. The dock and associated dolphins, described below, were recently used to moor a steel float dry dock that is no longer at the shipyard. The dock deck consists of two layers of timber decking spanning across timber stringers with an approximate 30-inch spacing on center. The lower deck boards are nominal 6-inch by 12-inch dimension that run perpendicular to the stringer. The second top layer of decking runs parallel to the stringer and is a nominal 3-inch by 12-inch deck board. Stringers are supported by 18- by 18-inch nominal pile caps with a typical bent spacing of 10 feet on center. Five 12-inch-diameter timber piles are evenly spaced at each bent, with the exception of the furthest outboard bent, that contains 10 batter timber piles. Piles located at the last four outboard bents are laterally braced with timber cross bracing. Three rubber tires are hung on the outboard end of the dock and appear to be used for fendering in the past. A concrete bulkhead/retaining wall is located at the approach of the dock. (See Photo 2 in Appendix A.)

## **2.2 NORTHWEST DOLPHIN**

The Northwest Dolphin is located northwest of the West Dock, and the concrete cap is approximately 18 feet by 16 feet in plan and 6 feet thick. The dolphin was recently used as a breasting dolphin for a steel floating dry dock. The concrete pile cap is supported by six plumb and six battered steel HP12x63 piles. The fender system consists of a large steel plate panel with timber fender piles.

## **2.3 SOUTHWEST DOLPHIN**

The Southwest Dolphin is located along the shoreline to the west of the West Dock and is approximately 7.25 feet by 10 feet in plan. The 6-foot-thick concrete pile cap contains one mooring bollard and is supported by three plumb and two battered steel H-12 piles. (See Photo 11 in Appendix A.)

## **2.4 SOUTHEAST DOLPHIN**

The Southeast Dolphin is identical to the Southwest Dolphin in geometry and located to the eastside of the West Dock along the shoreline.

## **2.5 ECOLOGY WALL**

The Ecology Wall runs in the east/west direction along the shoreline between the Southeast Dolphin and the Marine Railway. The first 40 feet near the Southeast Dolphin is a steep armored slope consisting of concrete rubble, ecology blocks, and timber piling. The armored slope then transitions to a uniform 2x2 by 6-foot interlocked concrete ecology block system that is approximately 8 feet tall at its maximum height. At the east end, the wall returns to the south along the Marine Railway for approximately 70 feet. (See Photo 12 in Appendix A.)

## **2.6 WEST MARINE WALKWAY**

The West Marine Walkway is oriented perpendicular to the shoreline, located on the west side of the Marine Railway and is approximately 250 feet long. The walkway consists of timber planks spanning between timber piles with minimal timber bracing/supports and a timber handrail. (See Photo 13 in Appendix A.)

## **2.7 MARINE RAILWAY**

The Marine Railway is oriented perpendicular to shore consisting of a series of four parallel rails. Rails are supported on at-grade steel beams that bear on timber or steel pile caps. The pile caps are supported by timber piles, though the piles were visible during the assessment. The beams and ties below Elevation +7 mean lower low water (MLLW) are constructed of steel and timber. Beams and ties located upland of Elevation +7 MLLW are constructed with timber members only. (See Photo 14 in Appendix A.)

## **2.8 EAST MARINE WALKWAY**

The East Marine Walkway is oriented perpendicular to the shoreline and located east of the Marine Railway. The walkway is approximately 200 feet long by 5 feet wide. The walkway consists of fiber reinforced plastic grating situated between steel girders that span between steel pile cap bents. Pile caps are supported by two steel piles per bent.

## **2.9 HARRIS AVENUE PIER**

The Harris Avenue Pier is located east of the East Marine Walkway and runs perpendicular to the shoreline and is approximately 870 feet long. It is approximately 50 feet wide at the northern section of the pier and 30 feet wide at the south section of the pier. The pier consists of a concrete deck supported by steel piles with steel fender piles.

### 3.0 FACILITY CONDITION ASSESSMENT APPROACH

WSP performed a routine condition assessment of above-deck and below-deck/above-water assets at the Harris Avenue Shipyard specific to the cleanup efforts at the site. See Appendix C for a list of assets observed to be damaged during this effort. Above- and below-deck assessments were performed in accordance with the following American Society of Civil Engineers (ASCE) publication.

- ASCE Manuals and Reports on Engineering Practice No. 130, “*Waterfront Facilities Inspection and Assessment*”

## 4.0 FACILITY CONDITION ASSESSMENT METHODOLOGY

In accordance with the ASCE publication stated above, condition assessment of elements included both visual observation and hands-on assessment. An element level damage rating was assigned to each observed element, with damages defined as minor, moderate, major, or severe. For instances where damage was not observed, elements were classified as “no damage.” These damage ratings are defined in Chapter 2 of the ASCE 130 manual and have been standardized to provide a qualitative and consistent description of an elements level of damage. See Appendix B for a detailed description of damage ratings.

Following completion of the field work, element level damage ratings in combination with visual observations were used to assign an overall FCA rating. In accordance with Table 2-14 of the ASCE 130 manual, a summary of the FCA ratings is shown below.

<b>Good</b>	No visible damage or only minor damage noted.
<b>Satisfactory</b>	Limited minor to moderate defects or deterioration observed.
<b>Fair</b>	All primary structural elements are sound but minor to moderate defects or deterioration observed.
<b>Poor</b>	Advanced deterioration or overstressing observed on widespread portions of the structure.
<b>Serious</b>	Advanced deterioration, overstressing, or breakage may have significantly affected the load-bearing capacity of primary structural components.
<b>Critical</b>	Very advanced deterioration, overstressing, or breakage has resulted in localized failure(s) of primary structural components.

### 4.1 ABOVE-DECK ASSESSMENT

The above-deck assessment evaluated the general condition of the timber decking, concrete surfaces, bullrail, mooring fittings, fender elements, and miscellaneous appurtenances. The assessment was performed by walking along surface of the pier or dolphins and visually observing the condition of the above-deck elements. At areas where deterioration was suspected, the material was sounded with a hammer.

### 4.2 BELOW-DECK ASSESSMENT

The below-deck assessment evaluated the structural framing elements (pile caps, stringers, deck soffits, and exposed portions of piles between the mudline and pile caps). Steel and concrete elements were inspected visually. All timber piles and pile caps were inspected visually and by sounding with a hammer. Timber elements indicating signs of significant deterioration were further evaluated by drilling a core sample to determine the extent of deterioration.

### 4.3 IN-WATER ASSESSMENT

No in-water assessment/diving was performed during this assessment.



## 5.0 CONDITION ASSESSMENT FINDINGS

Condition assessment ratings for in-water structures are described in the following sections. Ratings have been assigned based on field observations and element level damage ratings for individual elements. All damage noted during the assessment is tabulated in Appendix C.

### 5.1 WEST DOCK

#### 5.1.1 Deck Surface

In general, the timber decking is in **fair/poor** condition. The first layer of deck boards are worn down in multiple areas of the dock. (See Photo 1 in Appendix A.)

#### 5.1.2 Bullrail

The timber bullrail is in **satisfactory** condition with only minor defects observed, such as small naturally occurring checks and general weathering of timber.

#### 5.1.3 Fender System

The fender system is in **poor** condition as the system only consists of three large rubber tires on the north outboard face of the dock, attached by chain to timber elements of the dock. The tires were not effective for a fender system as mechanical damage to the pier structure was noted in that region. (See Photo 7 in Appendix A.)

#### 5.1.4 Railing

The railing is in **fair** condition with mostly minor defects observed. The railing was weathered and contained small checks throughout. The railing at the northeast corner of the dock has more serious damage with one of the railing posts leaning laterally.

#### 5.1.5 Timber Stringers

Timber stringers are in **fair/satisfactory** condition. Minor defects, such as small checks, were observed throughout.

#### 5.1.6 Timber Pile Caps

The timber pile caps are in **poor/fair** condition. Severe damage was observed at Bent 2 Pile D, Bent 4 Pile D, Bent 7 Pile B, Bent 8 Pile C, Bent 9 Pile A, and Bent 10 Pile B. These locations are severely crushed and/or are hollow. Checking and splitting were observed at multiple locations. (See Photo 6 in Appendix A.)

#### 5.1.7 Bulkhead Wall

The bulkhead wall is in **fair** condition. Minor cracking is present on the wall face. A void is present under the wall that is approximately 20 feet wide. At the most severe location, the void is 3.5 feet deep and 14 inches high. (See Photo 8 in Appendix A.)

#### 5.1.8 Timber Piles

The timber piles are in **fair** condition. The piles generally showed minor to moderate signs of deterioration, including a few locations with splits and checks present. Pile 2D located at the second pile bent has experienced 80 percent section loss. (See Photos 2 through 5 in Appendix A.)

### 5.1.9 Timber Pile Cross Braces

Timber pile cross braces located at the outboard bents of the structure are in **critical** condition. Almost all the braces have completely broken off or deteriorated to a point that cross braces provide no lateral benefit to the system.

## 5.2 NORTHWEST DOLPHIN

### 5.2.1 Concrete Pile Cap

The concrete pile cap is in **satisfactory** condition. Minor cracking is present at multiple locations.

### 5.2.2 Steel Piles

The steel piles are in **poor/fair** condition. Major corrosion and/or local buckling are present in two of the piles. Remaining piles have moderate corrosion concentrated within the tidal zone. (See Photo 9 in Appendix A.)

### 5.2.3 Timber Fender Piles

The timber fender piles are in **critical/serious** condition. Multiple piles have broken off and detached from the dolphin. Eight piles with major damage remain. (See Photo 10 in Appendix A.)

### 5.2.4 Steel Fender Panel

The steel fender panel is in **fair** condition. Minor to moderate corrosion is present.

## 5.3 SOUTHWEST AND SOUTHEAST DOLPHINS

### 5.3.1 Mooring Hardware

The mooring hardware is in **satisfactory** condition. Minor surface corrosion is present.

### 5.3.2 Concrete Pile Cap

The concrete pile cap is in **fair/satisfactory** condition. Moderate cracking damage was identified on the south face of the southwest dolphin cap and minor cracking is present at multiple locations.

### 5.3.3 Steel Piles

The steel piles are in **satisfactory** condition. Minor corrosion is present near the mudline at multiple locations.

## 5.4 ECOLOGY BLOCK WALL

### 5.4.1 Ecology Blocks

The concrete ecology blocks are in **fa+-ir** condition. Minor cracking and minor corrosion stains are present at multiple locations. Local settlement and material loss behind the wall were noted near the storm drainpipe that penetrates through the wall and where the wall transitions to an armored slope.

## **5.5 WEST MARINE WALKWAY**

### **5.5.1 General**

All observations for the West Marine Walkway were performed via boat for safety concerns. However, due to the simplicity of the structure, observations typically recorded during above-deck inspection was captured.

### **5.5.2 Timber Deck Planks**

The timber deck boards are in **poor** condition. The deck boards spanning between piles were sagging between pile spans in multiple locations.

### **5.5.3 Timber Piles**

The timber piles are in **serious/poor** condition. Significant lateral displacement (leaning) was observed for many of the piles. One of the piles had broken off and was missing. (See Photo 13 in Appendix A.)

### **5.5.4 Railing**

The timber railing is in **poor** condition. The guardrail is broken and/or missing at multiple locations along the walkway.

## **5.6 MARINE RAILWAY**

### **5.6.1 Steel Rails, Beams, and Ties**

The steel rails, beams, and ties are in **satisfactory** condition. The sections observed during low tide show some signs of corrosion and significant marine growth.

### **5.6.2 Timber Beams and Ties**

The timber beams and ties are in **fair** condition. Some timber ties and beams located within the tidal zone show signs of advanced deterioration, such as open cavities due to marine borer activity. (See Photo 15 in Appendix A.)

## **5.7 EAST MARINE WALKWAY**

The East Marine Walkway was not included in this scope and not inspected at this time.

## **5.8 HARRIS AVENUE PIER**

Harris Avenue Pier was not included in this scope and not inspected at this time.

## 6.0 RECOMMENDATIONS

The Harris Avenue Shipyard structures are unique and have been used for specific purposes during past tenant activities. Given the poor condition of some of these in-waters structures and lack of known capacities, it is recommended that repairs consider future use and are modified to account for future use. Depending on the tenants plans for future use, load rating analysis may be necessary to reestablish repaired/retrofitted capacity. Specific repair recommendations for each structure are described below.

### **West Dock**

The West Dock is in **fair** condition and requires moderate repairs to the structural framing elements and appurtenances. The following repairs are recommended.

- Replace or post the timber piles that have major/severe damage.
- Address material loss/undermining at bulkhead/approach wall and backfill.
- Replace pile caps with severe damage.
- Replace damaged deck boards.
- Reestablish cross bracing at outboard pile bents.

In addition, it is recommended that a new fender system be installed at the outboard end of the pier prior to installation of a floating dry dock.

### **Northwest Dolphin**

To repair the breasting dolphin, the following measures are recommended.

- Perform repairs to the pile coating system.
- Install sacrificial anodes on piles.
- Repair steel piles that have buckled and have flanges that have corroded through the member.
- Replace fender system with new steel piles and fender panel system.

If the tenant intends to install a new graving dock, it is recommended that a mooring analysis be performed based on the new graving dock's geometry and the current condition of the dolphin.

### **Southwest and Southeast Dolphins**

No recommendations at this time.

### **Ecology Wall**

The ecology wall is problematic from a maintenance standpoint. Material loss between block wall segments will continue and voids behind the wall or settlement at the top of the wall will occur. In addition, the current wall will not likely perform well during a seismic event. Therefore, it is recommended that a new sheet pile wall system be installed that would comply with current codes and allow for proper protection and utilization of the upland laydown area.

**West Marine Walkway**

The West Marine Walkway does not function in its current state and would be hazardous if used during marine railway operation. The structure should not be used in its current state. If marine railway operations are still desired, it is recommended that the structure in its entirety be replaced with a new walkway similar to the East Marine Walkway.

**Marine Railway**

Observations at the Marine Railway noted deteriorated timber members and the loss of cathodic protection. The following recommendations are advised if the tenant intends to continue using the Marine Railway.

- Install sacrificial anodes on rail system.
- Replace timber sections that were rated as major or severe.

Lastly, if the tenant intends to continue use of the Marine Railway, it is recommended that a dive inspection be performed prior to finalizing repair documents at this facility.

# APPENDIX A

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## PHOTOGRAPHS





Photo 1 – West Dock Deck Surface



Photo 2 – West Dock Below Deck





Photo 3 – Typical Pile with Minor Damage





Photo 4 – Bent 2 Pile D (80% Section Loss)



Photo 5 – Bent 2 Pile C (Mechanical Split)





Photo 6 – Bent 10 (Splitting and Crushing)



Photo 7 – Bent 11 (Mechanical Damage)



Photo 8 – Soil Undermining Bulkhead Wall





Photo 9 – Northwest Dolphin Corroded and Buckled Pile



Photo 10 – Northwest Dolphin Fender Piles





Photo 11 – Southwest Dolphin





Photo 12 – Ecology Wall



Photo 13 – West Marine Walkway





Photo 14 – Marine Railway





Photo 15 – Rotted Timber Tie

## **APPENDIX B**

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### **ELEMENT LEVEL DAMAGE RATING SYSTEM**

**Table 2-4. Damage Rating for Timber Elements\***

<b>Damage Rating</b>		<b>Existing Damage*</b>	<b>Exclusions (defections requiring elevation to next higher damage rating[s])</b>
NI	Not Inspected	Not inspected, inaccessible, or passed by <sup>b</sup>	
ND	No Defects	<ul style="list-style-type: none"> <li>• Sound surface material</li> </ul>	
MN	Minor	<ul style="list-style-type: none"> <li>• Checks, splits, and gouges less than 0.5 inches wide</li> <li>• Evidence of marine borers or fungal decay</li> </ul>	Minor damage not appropriate if <ul style="list-style-type: none"> <li>• Loss of section</li> <li>• Marine borer infestation</li> <li>• Displacements, loss of bearing, or connections</li> </ul>
MD	Moderate	<ul style="list-style-type: none"> <li>• Remaining diameter loss up to 15%</li> <li>• Checks and splits wider than 0.5 inches</li> <li>• Cross section area loss up to 25%</li> <li>• Corroded hardware</li> <li>• Evidence of marine borer or fungal decay, with loss of section</li> </ul>	Moderate damage not appropriate if <ul style="list-style-type: none"> <li>• Displacements, loss of bearing or connections</li> </ul>
MJ	Major	<ul style="list-style-type: none"> <li>• Remaining diameter loss 15% to 30%</li> <li>• Checks and splits through full depth of cross section</li> <li>• Cross section area loss 25% to 50%; heavily corroded hardware</li> <li>• Displacements and misalignments at connections</li> </ul>	Major damage not appropriate if <ul style="list-style-type: none"> <li>• Partial or complete breakage</li> </ul>
SV	Severe	<ul style="list-style-type: none"> <li>• Remaining diameter loss more than 30%</li> <li>• Cross section loss more than 50%</li> <li>• Loss of connections and/or fully nonbearing condition</li> <li>• Partial or complete breakage</li> </ul>	

\*Taken from ASCE Waterfronts Facilities Inspection and Assessment Manual No 130, 2015

a = any defect listed is sufficient to identify relevant damage grade.

b = if not inspected due to inaccessibility or passed by, note as such.

**Table 2-5. Damage Rating for Steel Elements\***

<b>Damage Rating</b>		<b>Existing Damage*</b>	<b>Exclusions (defections requiring elevation to next higher damage rating[s])</b>
NI	Not Inspected	Not inspected, inaccessible, or passed by <sup>b</sup>	
ND	No Defects	<ul style="list-style-type: none"> <li>Protective coating or wrap intact</li> <li>Light surface rust</li> <li>No apparent loss of material</li> </ul>	
MN	Minor	<ul style="list-style-type: none"> <li>Protective coating or wrap damaged and loss of thickness up to 15% of nominal at any location</li> <li>Less than 50% of perimeter or circumference affected by corrosion at any elevation or cross section</li> <li>Loss of thickness up to 15% of nominal at any location</li> </ul>	Minor damage not appropriate if <ul style="list-style-type: none"> <li>Changes in straight line configuration or local buckling</li> <li>Corrosion loss exceeding fabrication tolerances at any location</li> </ul>
MD	Moderate	<ul style="list-style-type: none"> <li>Protective coating or wrap damaged and loss thickness 15% to 30% of nominal at any location</li> <li>More than 50% of perimeter or circumference affected by corrosion at any elevation or cross section</li> <li>Loss of thickness 15% to 30% of nominal at any location</li> </ul>	Moderate damage not appropriate if <ul style="list-style-type: none"> <li>Changes in straight line configuration or local buckling</li> <li>Loss of thickness exceeding 30% of nominal at any location</li> </ul>
MJ	Major	<ul style="list-style-type: none"> <li>Protective coating or wrap damaged and loss of nominal thickness 30% to 50% at any location</li> <li>Partial loss of flange edges or visible reduction of wall thickness on pipe walls</li> <li>Loss of nominal thickness 30% to 50% at any location</li> </ul>	Major damage not appropriate if <ul style="list-style-type: none"> <li>Changes in straight line configuration or local buckling</li> <li>Perforations or loss of wall thickness exceeding 50% of nominal at any location</li> </ul>
SV	Severe	<ul style="list-style-type: none"> <li>Protective coating or wrap damaged and loss of wall thickness exceeding 50% of nominal at any location</li> <li>Structural bends or buckling, breakage, and displacements at supports, lose or loss connection</li> <li>Loss of wall thickness exceeding 50% of nominal at any location</li> </ul>	

\*Taken from ASCE Waterfronts Facilities Inspection and Assessment Manual No 130, 2015

a = any defect listed is sufficient to identify relevant damage grade.

b = if not inspected due to inaccessibility or passed by, note as such

**Table 2-6. Damage Rating for Reinforced Concrete Elements\***

Damage Rating		Existing Damage*	Exclusions (defections requiring elevation to next higher damage rating[s])
NI	Not Inspected	Not inspected, inaccessible, or passed by <sup>b</sup>	
ND	No Defects	Good original hard surface, hard material, sound	
MN	Minor	<ul style="list-style-type: none"> <li>Mechanical abrasion or impact spalls up to 1 inch in depth</li> <li>Occasional corrosion stains or small pop-out corrosion spalls</li> <li>General cracks up to 1/16" in width</li> </ul>	Minor damage not appropriate if <ul style="list-style-type: none"> <li>Structural damage</li> <li>Corrosion cracks</li> <li>Chemical deterioration<sup>c</sup></li> </ul>
MD	Moderate	<ul style="list-style-type: none"> <li>Structural cracks up to 1/16" in width</li> <li>Corrosion cracks up to 1/4" in width</li> <li>Chemical deterioration: random cracks up to 1/16" in width; "soft" concrete and/or rounding of corners up to 1" deep</li> <li>Mechanical abrasion or impact spalls greater than 1" in depth</li> </ul>	Moderate damage not appropriate if <ul style="list-style-type: none"> <li>Structural breakage and/or spalls</li> <li>Exposed reinforcement</li> <li>Loss of cross section due to chemical deterioration beyond rounding of corner edges</li> </ul>
MJ	Major	<ul style="list-style-type: none"> <li>Structural cracks 1/16" to 1/4" in width and partial breakage (through section cracking with structural spalls)</li> <li>Corrosion cracks wider than 1/4" and open or closed corrosion spalls (excluding pop-outs)</li> <li>Multiple cracks and disintegration of surface layer due to chemical deterioration</li> <li>Mechanical abrasion or impact spalls exposing the reinforcement</li> </ul>	Major damage not appropriate if <ul style="list-style-type: none"> <li>Loss of cross section exceeding 30% due to any cause</li> </ul>
SV	Severe	<ul style="list-style-type: none"> <li>Structural cracks wider than 1/4" or complete breakage</li> <li>Complete loss of concrete cover due to corrosion of reinforcing steel with more than 30% of diameter loss for any main reinforcing bar</li> <li>Loss of bearing and displacement at connections</li> <li>Loss of concrete cover (exposed steel) due to chemical deterioration</li> <li>Loss of more than 30% of cross section due to any cause</li> </ul>	

\*Taken from ASCE Waterfronts Facilities Inspection and Assessment Manual No 130, 2015

a = any defect listed is sufficient to identify relevant damage grade.

b = if not inspected due to inaccessibility or passed by, note as such.

c = Chemical deterioration: sulfate attack, alkali-silica reaction, alkali-aggregate reaction, alkali-carbonate reaction ettringite distress, or other chemical/concrete deterioration.

**Table 2-8. Damage Rating for Mooring Hardware\***

Damage Rating		Existing Damage*	Exclusions (defections requiring elevation to next higher damage rating[s])
NI	Not Inspected	Not inspected, inaccessible, or passed by <sup>b</sup>	
ND	No Defects	<ul style="list-style-type: none"> <li>Material sound, surfaces smooth without indications of corrosion, surface coating in good condition, connections sound</li> <li>Bolt countersinks grouted or sealed</li> </ul>	No Defects Rating not appropriate if <ul style="list-style-type: none"> <li>Surface coatings worn or damaged</li> <li>Visible corrosion on fasteners</li> </ul>
MN	Minor	<ul style="list-style-type: none"> <li>Fitting has surface corrosion over 10% to 25% of area</li> <li>Minor wear marks or pitting on surface of fittings are less than 1/8" deep</li> <li>Fasteners have corrosion with less than 25% loss of section</li> </ul>	Minor damage not appropriate if <ul style="list-style-type: none"> <li>Deep pits, gouges, or wear on fitting surfaces</li> <li>Any noticeable loss of section of fastener threads, if visible</li> </ul>
MD	Moderate	<ul style="list-style-type: none"> <li>Fitting had moderate surface corrosion with loose scale over less than 50% of its area</li> <li>Significant surface wear marks or pitting on fitting are up to 1/4" deep</li> <li>Fasteners have corrosion with less than 25% loss of section</li> </ul>	Moderate damage not appropriate if <ul style="list-style-type: none"> <li>Loose scale on fasteners</li> <li>Inability to remove fasteners due to heavy corrosion, if accessible</li> </ul>
MJ	Major	<ul style="list-style-type: none"> <li>Fitting has surface corrosion with loose scale over 50% or more of its surface area and/or less than 25% section loss</li> <li>Significant surface wear marks or pitting on fitting 1/4" deep or greater</li> <li>Fasteners have corrosion with loose scale or loss of section greater than 25%</li> </ul>	Major damage not appropriate if <ul style="list-style-type: none"> <li>Displaced, damaged, or broken fitting components</li> <li>Loose or missing fasteners</li> </ul>
SV	Severe	<ul style="list-style-type: none"> <li>Fitting has heavy surface corrosion and loose scale with greater than 25% loss of section at critical areas of the fitting</li> <li>Structural displacement, deformation, or rotation of the fitting are present; fitting components are broken, cracked or delaminated</li> <li>Loose, broken, or missing fasteners</li> </ul>	

\*Taken from ASCE Waterfronts Facilities Inspection and Assessment Manual No 130, 2015

a = any defect listed is sufficient to identify relevant damage grade.

b = if not inspected due to inaccessibility or passed by, note as such.



Table 2-9. Damage Rating for Mooring Foundations\*

Damage Rating		Existing Damage*	Exclusions (defections requiring elevation to next higher damage rating[s])
NI	Not Inspected	Not inspected, inaccessible, or passed by <sup>b</sup>	
ND	No Defects	<ul style="list-style-type: none"> <li>Good original hard surface, hard material, sound</li> </ul>	No Defects Rating not appropriate if <ul style="list-style-type: none"> <li>Weathering on timber, steel, or composite fenders</li> <li>Hairline cracks in concrete elements</li> </ul>
MN	Minor	<ul style="list-style-type: none"> <li>Timber Foundations: Weathered timber; evidence of fungal decay; minor checks, splits, and gouges up to 1/4" wide</li> <li>Steel Foundations: Weathering of steel coating, light surface corrosion</li> <li>Concrete Foundations: No significant section loss to load bearing areas, hairline cracking of the concrete due to corrosion of the mooring hardware</li> <li>Composites: Weathered surfaces</li> </ul>	Minor damage not appropriate if <ul style="list-style-type: none"> <li>Load-bearing areas around mooring hardware not sound</li> <li>Displacement, loss of bearing, or connections</li> <li>Fungal decay, insect infestation with or adjacent to the bearing area on timber elements</li> <li>Corrosion loss exceeding fabrication tolerances at any location</li> <li>Structural damage or corrosion cracking on concrete elements</li> </ul>
MD	Moderate	<ul style="list-style-type: none"> <li>Timber cracked and checked up to 1/2" wide; weathered surfaces; fungal decay under or adjacent to the mooring hardware, with loss of section (max 1")</li> <li>Corrosion of steel with less than 10% to 25% section loss at any location</li> <li>Noticeable cracking of concrete, larger than hairline but no loss of interlock</li> </ul>	Moderate damage not appropriate if <ul style="list-style-type: none"> <li>Displacements, loss of bearing, or connections</li> <li>Changes in straight-line configuration or local buckling</li> <li>Loss of thickness exceeding 30% of nominal at any location for steel elements</li> <li>Structural breakage, spalls, or corrosion cracks in concrete</li> <li>Chemical deterioration or "softening" of concrete elements</li> </ul>
MJ	Major	<ul style="list-style-type: none"> <li>Timber cracked and checked greater than 1/2" wide, weathered; fungal decay present (max 3" depth); up to 25% loss of bearing</li> <li>Steel corrosion with 25% to 50% section loss at any location</li> <li>Noticeable cracking of concrete, resulting in loss of interlock</li> <li>Composite elements cracked or split</li> </ul>	Major damage not appropriate if <ul style="list-style-type: none"> <li>Breakage or displacements of any element</li> <li>Exposed steel strands in prestressed concrete elements</li> <li>Perforations or loss of section exceeding 50% of steel elements</li> </ul>

Damage Rating		Existing Damage*	Exclusions (defections requiring elevation to next higher damage rating[s])
SV	Severe	<ul style="list-style-type: none"> <li>• Displacement/yielding of any members</li> <li>• Loss of full bearing or fitting under hardware</li> <li>• Fungal decay of timber members (greater than 3" depth)</li> <li>• Significant corrosion of steel members with greater than 50% section loss at any location</li> <li>• Cracking or spalling concrete based under hardware</li> <li>• Composite broken or damaged</li> </ul>	

\*Taken from ASCE Waterfronts Facilities Inspection and Assessment Manual No 130, 2015

a = any defect listed is sufficient to identify relevant damage grade.

b = if not inspected due to inaccessibility or passed by, note as such.

c = Chemical deterioration: sulfate attack, alkali-silica reaction, alkali-aggregate reaction, alkali-carbonate reaction ettringite distress, or other chemical/concrete deterioration.



**Table 2-10. Damage Rating for Fender Piles\***

Damage Rating		Existing Damage*	Exclusions (defections requiring elevation to next higher damage rating[s])
NI	Not Inspected	Not inspected, inaccessible, or passed by <sup>b</sup>	
ND	No Defects	<ul style="list-style-type: none"> <li>Good original surface, sound, no defects observed</li> </ul>	No Defects Rating not appropriate if <ul style="list-style-type: none"> <li>Surface coatings worn or damaged</li> </ul>
MN	Minor	<ul style="list-style-type: none"> <li>Light abrasion less than 1/2" deep, light (surface) fungal decay, minimal marine borer activity observed (less than 5% section loss)</li> <li>Weathering of steel coating, surface corrosion with no significant pitting</li> <li>Hairline cracking of concrete</li> <li>Weathered composite elements</li> </ul>	Minor damage not appropriate if <ul style="list-style-type: none"> <li>"Softening" of concrete</li> </ul>
MD	Moderate	<ul style="list-style-type: none"> <li>Timber cracked and checked up to 1/2" wide, fungal decay (max 1" depth), abrasion up to 2" deep, loss of section due to marine borers less than 10%</li> <li>Corrosion of steel with up to 25% localized section loss</li> <li>Noticeable cracking of concrete but with no less loss of interlock</li> </ul>	Moderate damage not appropriate if <ul style="list-style-type: none"> <li>"Softening" of concrete (up to 1")</li> <li>Prestressed concrete fender piles (with low effective prestress) are expected to crack under load; therefore, should be rated minor if no corrosion and the cracks are closed</li> </ul>
MJ	Major	<ul style="list-style-type: none"> <li>Timber cracked and checked greater than 1/2" wide, fungal decay (max 3" depth), abrasion damage greater than 2" depth, loss of section due to marine borers between 10% to 25%</li> <li>Corrosion of steel elements with 25% to 50% localized section loss, localized buckling of a flange</li> <li>Noticeable cracking of concrete with loss of interlock, softening of the concrete greater than 1" deep</li> <li>Composite elements cracked or split</li> </ul>	
SV	Severe	<ul style="list-style-type: none"> <li>Fungal decay on timber members (greater than 3" depth), loss of section due to marine borers (more than 25% of section broken)</li> <li>Significant corrosion of steel members with more than 50% localized section loss, broken or yielded</li> <li>Broken, exposed reinforcing steel or prestressing strands, spalling of concrete, or softening of concrete (greater than 3" deep)</li> <li>Composite elements broken</li> </ul>	

\*Taken from ASCE Waterfronts Facilities Inspection and Assessment Manual No 130, 2015

a = any defect listed is sufficient to identify relevant damage grade.

b = if not inspected due to inaccessibility or passed by, note as such.

**Table 2-12. Damage Rating for Rubber Fender Elements\***

Damage Rating		Existing Damage*	Exclusions (defections requiring elevation to next higher damage rating[s])
NI	Not Inspected	Not inspected, inaccessible, or passed by <sup>b</sup>	
ND	No Defects	<ul style="list-style-type: none"> <li>• Good original surface, sound</li> <li>• Connections intact and tight</li> </ul>	No Defects Rating not appropriate if <ul style="list-style-type: none"> <li>• Noticeable abrasion or wear of rubber surface</li> </ul>
MN	Minor	<ul style="list-style-type: none"> <li>• Small gouges or surface defects present less than 10% of nominal depth</li> <li>• Connection intact, tight with light corrosion (less than 10% section loss at any location)</li> </ul>	Minor damage not appropriate if <ul style="list-style-type: none"> <li>• Surface cracking or degradation of rubber components</li> </ul>
MD	Moderate	<ul style="list-style-type: none"> <li>• Gouges, wear, or tears less than 25% of nominal depth</li> <li>• Rubber damaged at the connectors of connection plates</li> <li>• Connections loose, a bolt missing, or corrosion with 10% to 25% section loss at any location</li> </ul>	Moderate damage not appropriate if <ul style="list-style-type: none"> <li>• Permanent deformation or misalignment of rubber elements</li> </ul>
MJ	Major	<ul style="list-style-type: none"> <li>• Cracks, gouges, or tears between 25% and 50% of nominal depth</li> <li>• Rubber torn at the connectors or connection plates</li> <li>• Connections loose, two bolts missing, or corrosion with 25% to 50% section loss at any location</li> </ul>	Major damage not appropriate if <ul style="list-style-type: none"> <li>• Rubber element is split or torn through</li> </ul>
SV	Severe	<ul style="list-style-type: none"> <li>• Cracks, gouges, or tears greater than 50% of nominal depth</li> <li>• Rubber torn through at the connectors or connection plates</li> <li>• Connections with loose or missing bolts, or corrosion with greater than 50% section loss at any location</li> </ul>	

\*Taken from ASCE Waterfronts Facilities Inspection and Assessment Manual No 130, 2015

a = any defect listed is sufficient to identify relevant damage grade.

b = if not inspected due to inaccessibility or passed by, note as such.

**Table 2-13. Damage Rating for Fender Panels\***

<b>Damage Rating</b>		<b>Existing Damage*</b>	<b>Exclusions (defections requiring elevation to next higher damage rating[s])</b>
NI	Not Inspected	Not inspected, inaccessible, or passed by <sup>b</sup>	
ND	No Defects	<ul style="list-style-type: none"> <li>• Good original surface</li> <li>• Connections intact</li> <li>• Backing panel sound</li> <li>• Support chains intact and in good condition</li> </ul>	No Defects Rating not appropriate if <ul style="list-style-type: none"> <li>• Coatings damaged</li> <li>• Visible surface corrosion</li> </ul>
MN	Minor	<ul style="list-style-type: none"> <li>• Small cracks or gouges (less than 10% of nominal)</li> <li>• 90% of panel connections intact</li> <li>• Backing frame with surface corrosion with no significant loss of section</li> <li>• Surface chains intact with light surface corrosion</li> </ul>	Minor damage not appropriate if <ul style="list-style-type: none"> <li>• Panels worn or damaged</li> </ul>
MD	Moderate	<ul style="list-style-type: none"> <li>• Cracks or gouges (less than 25% of nominal)</li> <li>• 75% of panel connections intact</li> <li>• Panels displaced from the backing panel</li> <li>• Backing frame corroded</li> <li>• Support chains intact, with less than 25% section loss</li> </ul>	Moderate damage not appropriate if <ul style="list-style-type: none"> <li>• Panels displaced or misaligned</li> <li>• Any loose or missing hardware</li> </ul>
MJ	Major	<ul style="list-style-type: none"> <li>• Cracks or gouges (less than 50% of nominal)</li> <li>• 50% of the panel connections intact or multiple panels displaced from the backing panel</li> <li>• Backing frame corroded or with loose scale, but panel substantially in place</li> <li>• Support chains heavily corroded with more than 25% section loss</li> </ul>	Major damage not appropriate if <ul style="list-style-type: none"> <li>• Panel/frame system sagging, misaligned, or with limited bearing</li> </ul>
SV	Severe	<ul style="list-style-type: none"> <li>• Cracks or gouges (more than 50% of nominal)</li> <li>• Less than 50% of the panel connections intact or multiple panels displaced from the backing panel</li> <li>• Backing frame heavily corroded with loose scale</li> <li>• Sagging/displacement of panel/frame system</li> <li>• Support chains heavily corroded with loose scale and/or missing or broken</li> </ul>	

\*Taken from ASCE Waterfronts Facilities Inspection and Assessment Manual No 130, 2015

a = any defect listed is sufficient to identify relevant damage grade.

b = if not inspected due to inaccessibility or passed by, note as such.

**Table 2-14. Condition Assessment Ratings**

<b>Rating</b>		<b>Description</b>
6	Good	No visible damage or only minor damage noted. Structural elements may show very minor deterioration, but no overstressing observed. No repairs are required.
5	Satisfactory	Limited minor to moderate defects or deterioration observed but no overstressing observed. No repairs are required.
4	Fair	All primary structural elements are sound but minor to moderate defects or deterioration observed. Localized areas of moderate to advanced deterioration may be present but do not significantly reduce the load-bearing capacity of the structure. Repairs are recommended, but the priority of the recommended repairs are low.
3	Poor	Advanced deterioration or overstressing observed on widespread portions of the structure but does not significantly reduce the load-bearing capacity of the structure. Repairs may need to be carried out with moderate urgency.
2	Serious	Advanced deterioration, overstressing, or breakage may have significantly affected the load-bearing capacity of the primary structural components. Local failures are possible, and loading restrictions may be necessary. Repairs may need to be carried out on a high-priority basis with urgency.
1	Critical	Very advanced deterioration, overstressing, or breakage has resulted in localized failure(s) of primary structural components. More widespread failures are possible or likely to occur, and load restrictions should be implemented as necessary. Repairs may need to be carried out on a very high-priority basis with strong urgency.

# APPENDIX C

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## TABULATED FIELD DATA

Legend

Tag	Description
Conc	Concrete
MN	Minor damage
MD	Moderate damage
MJ	Major damage
SV	Severe damage
NI	Not Inspected

West Dock

Asset Information				Damage Information					Comments
Type	Material	Bent	Grid Line	Description	Approximate Size	From	To	Rating	
Pile	Timber	1	D					MN	
Pile	Timber	1	E					MN	
Pile	Timber	2	B					MN	
Pile	Timber	2	C	Mechanical Split	Entire length			MD	
Pile	Timber	2	D	80% section loss				SV	
Pile	Timber	2	E					MN	
Pile	Timber	3	C					MN	
Pile	Timber	3	D					MN	
Pile	Timber	4	B					MN	
Pile	Timber	4	E					MN	
Pile	Timber	5	A					MN	
Pile	Timber	5	B					MN	
Pile	Timber	5	C					MN	
Pile	Timber	5	D					MN	
Pile	Timber	5	E					MN	
Pile	Timber	7	A					MN	
Pile	Timber	9	C					MN	
Pile	Timber	9	E					MN	
Pile	Timber	11	B	Worn batter				MN	
Pile	Timber	11	B	2" deep split	4 ft long			MD	
Pile	Timber	11	D	Worn batter				MN	
Pile	Timber	11	E	2" deep split	4 ft long			MD	
Braces	Timber	8	A-C	Broken				SV	
Braces	Timber	8	C-E	70% section loss				SV	
Braces	Timber	9	A-C	Advanced deterioration				SV	
Braces	Timber	9	C-E	Broken				SV	
Braces	Timber	10	A-C	Advanced deterioration				SV	
Braces	Timber	10	C-E	Broken				SV	
Pile Cap	Timber	1	E	Checking	1" wide	E	Edge	MD	
Pile Cap	Timber	2	C	50% section loss with crushing		B	D	MJ	
Pile Cap	Timber	4	D	50% section loss		C	E	MJ	
Pile Cap	Timber	6	D	Soft core				MD	
Pile Cap	Timber	7	A	Checking	1" wide	Edge	A	MD	
Pile Cap	Timber	7	B	40% section loss with crushing		A	C	MJ	
Pile Cap	Timber	8	C	50% section loss		B	D	MJ	
Pile Cap	Timber	9	A	Some crushing				MD	
Pile Cap	Timber	10	B	Top broken and crushing		A	B	MJ	
Pile Cap	Timber	10	E	Splitting	< 0.5" wide			MN	
Pile Cap	Timber	11	B	Mechanical damage		A	C	MJ	

### West Dock (Continued)

Asset Information				Damage Information					Comments
Type	Material	Bent	Grid Line	Description	Approximate Size	From	To	Rating	
Bulkhead Wall	Conc	0	C	Vertical crack				MN	Soil undermining bulkhead wall
Bulkhead Wall	Conc	0	D	Vertical Crack				MN	Soil undermining bulkhead wall
Decking	Timber			Worn elements in many spots around deck	1" worn away			MD	Worn regions allow for water to pool

### Northwest Dolphin

Asset Information			Damage Information			Comments
Type	Material	Location	Description	Approximate Size	Rating	
Pile Cap	Conc	Entire cap	Minor cracking		MN	
Fender Panel	Steel	East Face	Surface Corrosion		MN	
Pile	Steel	W1 <sup>1</sup>	Buckled and corroded through flange		SV	
Pile	Steel	W2 <sup>1</sup>	Moderate corrosion.		MN	
Pile	Steel	W3 <sup>1</sup>	Moderate corrosion.		MN	
Pile	Steel	W4 <sup>1</sup>	Moderate corrosion.		MN	
Pile	Steel	W5 <sup>1</sup>	Minor buckling from debris impact. Minor to moderate corrosion		MD	
Pile	Steel	C1 <sup>1</sup>	Moderate corrosion.		MN	
Pile	Steel	C2 <sup>1</sup>	Moderate corrosion.		MN	
Pile	Steel	C3 <sup>1</sup>	Moderate corrosion.		MN	
Pile	Steel	C4 <sup>1</sup>	Moderate corrosion.		MN	
Pile	Steel	E1 <sup>1</sup>	Bent flange. Moderate corrosion		MD	
Pile	Steel	E2 <sup>1</sup>	Moderate corrosion.		MN	
Pile	Steel	E3 <sup>1</sup>	Moderate corrosion.		MN	
Fender Pile	Timber	1 <sup>2</sup>	90% section loss		SV	
Fender Pile	Timber	2 <sup>2</sup>	60% section loss		SV	
Fender Pile	Timber	3 <sup>2</sup>	90% section loss		SV	
Fender Pile	Timber	4 <sup>2</sup>	80% section loss		SV	
Fender Pile	Timber	5 <sup>2</sup>	Broken		SV	
Fender Pile	Timber	6 <sup>2</sup>	80% section loss		SV	
Fender Pile	Timber	7 <sup>2</sup>	90% section loss		SV	
Fender Pile	Timber	8 <sup>2</sup>			MD	

1. Structural steel piles are labeled East (E), Central (C), and West (W), and numbered from south to north starting with #1
2. Fender Piles are numbered starting with #1 at the south end of the dolphin



### Southwest Dolphin

Asset Information			Damage Information			Comments
Type	Material	Location	Description	Approximate Size	Rating	
Pile Cap	Conc	North Face	Minor cracking		MN	
Pile Cap	Conc	East Face	Minor cracking		MN	
Pile Cap	Conc	South Face	1/16" crack		MD	
Pile Cap	Conc	West Face	Minor cracking		MN	
Pile Cap	Conc	Top Face	Minor corrosion		MN	
Capstan	Conc	Top Pile Cap	Minor corrosion @ base		MN	
Pile	Steel	NW <sup>1</sup>	Minor corrosion		MN	
Pile	Steel	NC <sup>1</sup>	Minor corrosion.		MN	
Pile	Steel	NE <sup>1</sup>	Minor corrosion.		MN	
Pile	Steel	SE <sup>1</sup>	Minor corrosion.		MN	
Pile	Steel	SW <sup>1</sup>	Minor corrosion.		MN	

1. Structural steel piles are labeled East (E), Central (C), West (W), North (N), and South (S)

### Southeast Dolphin

Asset Information			Damage Information			Comments
Type	Material	Location	Description	Approximate Size	Rating	
Pile Cap	Conc	North Face	Rust and cracking		MD	
Pile Cap	Conc	East Face	Long horizontal crack		MN	
Pile Cap	Conc	South Face			NI	Buried by soil
Pile Cap	Conc	West Face			NI	Buried by soil
Pile Cap	Conc	Top Face	Corrosion stains at contact points with mooring hardware		MN	
Capstan	Conc	Top Pile Cap	Minor corrosion @ base		MN	
Pile	Steel	NW <sup>1</sup>			NI	Buried by soil
Pile	Steel	NC <sup>1</sup>			NI	Buried by soil
Pile	Steel	NE <sup>1</sup>			NI	Buried by soil
Pile	Steel	SE <sup>1</sup>			NI	Buried by soil
Pile	Steel	SW <sup>1</sup>			NI	Buried by soil

1. Structural steel piles are labeled East (E), Central (C), West (W), North (N), and South (S)

### West Marine Walkway

Asset Information			Damage Information			Comments
Type	Material	Location	Description	Approximate Size	Rating	
Piles	Timber	0	Large lateral displacements		MJ	
Pile	Timber	1			MN	
Pile	Timber	2			MN	
Pile	Timber	3			MN	
Pile	Timber	4			MN	
Pile	Timber	5	Large lateral displacements		MJ	
Pile	Timber	6			MN	
Pile	Timber	7	Broken		SV	
Pile	Timber	8			MN	
Pile	Timber	9			MN	
Pile	Timber	10	Large lateral displacements		MJ	
Pile	Timber	11			MN	
Pile	Timber	12			MN	
Pile	Timber	13			MN	
Pile	Timber	14			MN	
Pile	Timber	15			MN	
Pile	Timber	16			MN	
Pile	Timber	17			MN	
Pile	Timber	18			MN	
Pile	Timber	19			MN	
Pile	Timber	20			MN	
Pile	Timber	21			MN	
Guardrail	Timber	1 to 2	Broken		SV	
Guardrail	Timber	14 to 17	Broken off and missing		SV	
Decking	Timber	0	Warping		MJ	

1. Structural steel piles are numbered starting with #0 from south to north

NOTE: Elements were only visually inspected

### Marine Railway

Asset Information			Damage Information			Comments
Type	Material	Location	Description	Approximate Size	Rating	
Beams	Steel	E to 20 <sup>23</sup>	Marine growth and minor corrosion		MN	
Ties	Steel	1 to 20 <sup>2</sup>	Marine growth and minor corrosion		MN	
Beam	Timber	(I)E-F <sup>13</sup>			MD	
Beam	Timber	(II)E-F <sup>13</sup>			MD	
Beam	Timber	(III)E-F <sup>13</sup>			MD	
Beam	Timber	(III)F-G <sup>13</sup>	10% section loss		MD	
Beam	Timber	(IV)E-F <sup>13</sup>			MJ	
Tie	Timber	(IV)C <sup>13</sup>	Moderate section loss at top of tie		MD	
Tie	Timber	(IV)D <sup>13</sup>	Moderate section loss at top of tie		MD	
Tie	Timber	(IV)E <sup>13</sup>	Major damage at top of tie		MJ	

1. Rail beams are numbered I to IV from west to east
2. Steel ties are numbered starting with 1 from south to north
3. Timber ties are lettered starting with A from north to south