

DECEMBER 2016  
GREELEY AND HANSEN LLC

# SOUTHWEST BROOKLYN MARINE TERMINAL STATION BULKHEAD INVESTIGATION

ANNUAL BULKHEAD INSPECTION

**COWI**





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## EXECUTIVE SUMMARY

At the request of Greeley and Hansen LLC (G-H), Ocean and Coastal Consultants Engineering, P.C. (OCC|COWI) performed an above and below water investigation of three bulkheads at the former Southwest Brooklyn Marine Transfer Station (SWB MTS), located in Brooklyn, New York. The purpose of the inspection was to perform a 100 percent Level I investigation on each of the three steel sheet pile shore retaining structures: The West Bulkhead (Approximately 189 LF), the North Bulkhead (Approximately 426 LF), and the East Bulkhead (Approximately 144 LF).

The bulkhead sections have been assigned an overall Condition Assessment Rating (CAR) of Fair due to widespread moderate to advanced corrosion of the steel in the tidal and splash zones, minor coating loss with surface corrosion to isolated areas of the below water steel sheet piles, and isolated impact damage to the steel tieback system and shear bolts. Additional deterioration is present in isolated locations along the steel cellular cofferdams, which includes the typical above water corrosion described above, one hole in the West Bulkhead with exposed fill, isolated loose hardware, and isolated splash zone repair failures located below water.

The following recommendations have been developed based on the results of the inspection. Due to ongoing construction efforts, pursuant to the U.S. Army Corps of Engineer's permit issued for the construction of the MTS (NAN-2008-0927), some or all of these recommendations may already be included within the current scope of work.

Table 1 SWB MTS Bulkhead Repair Recommendations

Structure	Recommendation
West Bulkhead	Clean and recoat the steel sheet pile cells from Mean Low Water (MLW) to the top of the element at each cell. Additionally, the splash zone repairs located below MLW should be cleaned and patched, as required. Where splash zone coating failures have occurred, the exposed steel should be assessed by a qualified professional to determine if structural repairs are required.
	Install and coat a steel patch plate (approximately 12 inches by 12 inches) over the approximate 6 inch diameter hole observed at the intermediate cell adjacent to Cell F-1.
	Repair loose transition anchor bracket connection between the West Bulkhead and the intermediate cell adjacent to Cell F-1. This repair will require the bearing plate to be realigned, and the nut to be tightened.
	Clean and recoat steel sheet piles from MLW to the top of the element.
North Bulkhead	Clean and recoat the steel sheet pile cells from MLW to the top of the element at each cell. Additionally, the splash zone repairs located below MLW should be cleaned and patched, as required. Where splash zone coating failures have occurred, the exposed steel should be assessed by a qualified professional to determine if structural repairs are required.
	Clean and recoat the steel sheet piles from MLW to the top of the element.
	Remove and replace the damaged portion of double channel tie-back wale (approximately 10 LF) at Station 0+65. It is our understanding that the entire length of the North Bulkhead is scheduled to be encased in concrete, pursuant to the U.S. Army Corps of Engineer's permit issued for the construction of the MTS (NAN-2008-0927). That would adequately address this recommendation.
	Clean and recoat the double channel tie-back wale. It is our understanding that the entire length of the North Bulkhead is scheduled to be encased in concrete, pursuant to the U.S. Army Corps of Engineer's permit issued for the construction of the MTS (NAN-2008-0927). That would adequately address this recommendation.
	Clean and recoat the exposed portions of the steel anchor tie-backs and associated hardware. It is our understanding that the entire length of the North Bulkhead is scheduled to be encased in concrete, pursuant to the U.S. Army Corps of Engineer's permit issued for the construction of the MTS (NAN-2008-0927). That would adequately address this recommendation.

Table 1 cont. SWB MTS Bulkhead Repair Recommendations

Structure	Recommendation
East Bulkhead	Clean and patch the end of the concrete wall at Station 0+14. It is our understanding that this portion of the East Bulkhead is scheduled to be rehabilitated, pursuant to the U.S. Army Corps of Engineer's permit issued for the construction of the MTS (NAN-2008-0927). That would adequately address this recommendation.
	Clean and patch the observed open spalling located at Station 0+66.
	Clean and recoat the steel sheet piles from MLW to the top of the element.
	Clean and recoat the double channel tie-back wale.
	Clean and recoat the exposed portions of the steel anchor tie-backs and associated hardware.
	Remove the existing timber fender system to reduce the dead load on the steel sheet piles, and provide access to the steel sheet pile bulkhead should cleaning and recoating repairs be necessary.
Facility	Install a bulk anode cathodic protection system along each of the three bulkheads. It is our understanding that an impressed current cathodic protection system is scheduled to be installed along the North and East Bulkheads, pursuant to the U.S. Army Corps of Engineer's permit issued for the construction of the MTS (NAN-2008-0927). That would adequately address this recommendation for those sections of bulkhead.

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# 1 INTRODUCTION

At the request of Greeley and Hansen LLC (G-H), Ocean and Coastal Consultants Engineering, P.C. (OCC|COWI) performed an above and below water investigation of three bulkheads at the former Southwest Brooklyn Marine Transfer Station (SWB MTS), located in Brooklyn, New York. The inspection was performed on December 19, 2016 by a three-person Engineer Dive Team, led by a Professional Engineer-Diver, using surface supplied commercial diving equipment. The purpose of the inspection was to perform a 100 percent Level I investigation on each of the three steel sheet pile shore retaining structures: The West Bulkhead (Approximately 189 LF), the North Bulkhead (Approximately 426 LF), and the East Bulkhead (Approximately 144 LF). The level of sand fill within the bulkheads' cellular cofferdams, if accessible, was to be observed and measured. The investigation was performed in general accordance with ASCE Underwater Investigation Practice Manual No. 101, and in accordance with OSHA requirements.

A figure set was developed for the MTS bulkhead (Appendix A), and representative photographs were collected to detail the observed conditions (Appendix B). The MTS bulkhead was given an overall Condition Assessment Rating (CAR), as was each section of bulkhead inspected as part of this investigation (Appendix C). A structural analysis was not included in this scope of work.

## 2 DESCRIPTION OF STRUCTURES

The former Southwest Brooklyn Marine Transfer Station (MTS) is located on the south shore of Brooklyn, New York, west of Coney Island (Sketch 1). The former MTS facility is not currently in use, however the site was formerly used for the transfer of solid waste from trucks onto barges. At the time of the inspection, construction was in progress, inshore of the steel sheet pile bulkhead (Photograph 1 and Photograph 2). The bulkhead at the MTS facility is comprised of the North, East, and West Bulkheads, which form a square peninsula along the shoreline (Sketch 2).

### 2.1 West Bulkhead

The West Bulkhead extends from the shoreline to the west for approximately 189 LF, and is composed of Z-shape steel sheet piles for the eastern 164 LF (Photograph 3). The western 25 LF of the West Bulkhead is constructed of steel sheet pile cells (Photograph 4), and are within the scope of this inspection. To the west of the West Bulkhead, and outside of the scope of this inspection, the steel sheet pile cellular cofferdams continue along the North Pier (Photograph 5).

### 2.2 North Bulkhead

The North Bulkhead is located along the offshore face of the facility, and is parallel to the waterway (Photograph 6). This section of bulkhead intersects the northeast end of the North Pier, and extends south for approximately 426 LF. The northern section of the North bulkhead comprises steel sheet pile cells forming cellular cofferdams (approximately 75 LF) (Photograph 7), which transitions to Z-shape steel sheet piles to the south (approximately 351 LF) (Photograph 8). The steel sheet pile portion of the North Bulkhead is tied back with a series of steel anchor rods, which are attached to an external double channel wale (Photograph 9). The steel anchor rod tie-backs for the North Bulkhead are presumably connected to a deadman system, located inshore of the bulkhead. However, details of the inshore portions of the tie-back system are not known. Additionally, the existing sheet pile was reportedly installed as overshooting, outboard of the original steel sheet pile cells.

Approximately 234 LF of concrete deck and curb is demolished due to the ongoing construction, inshore of the steel sheet pile bulkhead (Photograph 10). A reinforced concrete bulkhead is currently under construction, approximately 3 LF inshore of the

existing steel sheet pile bulkhead (Photograph 11). The annulus between these structures is partially filled with concrete, typically up to the anchor rod elevation, excluding one 7 LF segment, located between Sta. 1+97 and Sta. 1+90, where the reinforced bulkhead extends to the face of the steel sheet pile bulkhead (Photograph 12). Additionally, epoxy coated reinforcement is installed and embedded into the new concrete bulkhead along this segment of demolished bulkhead (Photograph 13).

The southern 9 LF of demolished concrete deck and curb does not have a reinforced concrete bulkhead installed along the inshore face of the steel sheet pile bulkhead. In this area, demolition of the concrete deck and curb, and excavation to the anchor rod elevation is complete. It is not clear what will be installed at this location. The bulkhead to the south of this area (Sta. 0+96 to Sta. 0+00) remains, excluding a 39 inch by 20 inch section of deck and curb where the North and East Bulkheads intersect. This section of deck and curb has been removed to allow installation of a transition element between the North and East bulkheads and the steel sheet pile fender and revetment retaining structure, which extends to the west (Photograph 14 and Photograph 15).

Construction has occurred above and below water along the full length of the offshore face of the North Bulkhead. At each outer and inner flange, typically six (6) to seven (7) elevations of shear bolts are present. The shear bolt are typically grouped in four (4) bolt clusters, excluding the upper cluster which is only two (2) bolts, beginning at the top of the bulkhead (Photograph 16 and Photograph 17). Typically, two (2) clusters are present above the wale system, and two (2) clusters are present below the wale system. At the northern extent of the steel sheet pile bulkhead, threaded rods and steel brackets are present at each offshore double section (Photograph 18 and Photograph 19). Based on previous experience, and typical waterfront construction methods, these elements will likely be utilized as a part of a partial concrete encasement of the steel sheet pile bulkhead, wale, and anchor rods.

## 2.3 East Bulkhead

The East Bulkhead intersects the southern extent of the North Bulkhead, and returns inshore, to the east, approximately 144 LF (Photograph 20). Typically, the bulkhead is composed of Z-shaped steel sheet piles with an external double channel wale, which is secured with a series of steel anchor rods. As stated above, new steel sheet piles, that extend west from the intersection between the East and North Bulkheads, are retaining the stone revetment to the south, and providing fendering to the north (Photograph 21). Additionally, the eastern approximate 14 LF of bulkhead is partially demolished, with the concrete deck and curb removed, and a small portion of steel sheet pile bulkhead is visible (Photograph 22 and Photograph 23).

The steel anchor rod tie-backs for the East Bulkhead are presumably connected to a deadman system, located inshore of the bulkhead. However, details of the inshore portions of the tie-back system are not known. Additionally, the existing sheet pile was reportedly installed as overshooting outboard of the original steel sheet pile cells.

## 2.4 Fender System

The fender system observed during previous inspection efforts has been removed from the North Bulkhead. Remnants of the removed fender system were observed along the mudline offshore of the North Bulkhead. The fender system is still present along the offshore face of the East Bulkhead. The East Bulkhead fender system consists of

6 inch by 12 inch fender planks, two (2) elevations of 12 inch by 12 inch timber wales, and steel brackets, which tie the system back to the steel sheet pile bulkhead (Photograph 24).

### 3 OBSERVED CONDITIONS

The bulkhead sections are in overall Fair condition with widespread moderate to advanced corrosion of the steel in the tidal and splash zones, minor coating loss with surface corrosion to isolated areas of the below water steel sheet piles, and isolated impact damage to the steel tieback system and shear bolts. Additional deterioration is present in isolated locations along the steel cellular cofferdams, which includes the typical above water corrosion described above, one hole in the West Bulkhead with exposed fill, isolated loose hardware, and isolated splash zone repair failures located below water. Though the site is protected from direct ocean swells by Coney Island, it is open to the southwest, across Lower New York Bay. Waves up to two (2) feet have been observed at the site.

#### 3.1 West Bulkhead

Overall, the West Bulkhead is in Poor condition due to an isolated hole within the intermediate cell adjacent to Cell F-1, a loose bracket at the cell-to-bulkhead intersection, moderate corrosion and coating failure located within the splash and tidal zones of the steel sheet piles and cellular cofferdams (Photograph 25 through Photograph 27). Below mean low water, the steel sheet pile bulkhead is typically in moderate condition with isolated areas of failed coating and surface corrosion (Photograph 28), and isolated coating loss and splash zone failures with surface corrosion on the steel sheet pile cellular cofferdams (Photograph 29). The steel sheet pile cellular cofferdams, located at the western extent of the bulkhead, have been repaired with a splash zone coating along the exposed face of the sheets, extending from the mudline to approximately mean high water. Additionally, the missing steel pile cap section, located at the western edge of the Z-shape steel sheet pile bulkhead, noted during the previous inspection is still missing (Photograph 30).

As in previous inspections, no access hatches for the cofferdams were located, so the sand levels could not be verified.

#### 3.2 North Bulkhead

The North Bulkhead is in Fair condition due to moderate to advanced corrosion and coating failure located within the splash and tidal zones of the steel sheet piles, steel cellular cofferdams, and steel anchor tie-backs (Photograph 31 and Photograph 32).

Additional deterioration includes isolated impact damage to the steel wale at Sta. 0+65, isolated deflected and missing shear studs throughout the length of the bulkhead, and isolated disengaged tie-back anchors (Photograph 33 and Photograph 34). Below mean low water, the steel sheet pile bulkhead is typically in moderate condition with isolated areas of failed coating and surface corrosion (Photograph 35), and isolated coating loss and splash zone failures with surface corrosion on the steel sheet pile cellular cofferdams (Photograph 36). The steel sheet pile cellular cofferdams, located at the western extent of the bulkhead, have been repaired with a splash zone coating along the exposed face of the sheets, extending from the mudline to approximately mean high water. Additionally, cut outs through the steel sheet pile bulkhead, noted during the previous inspections, at Sta. 2+80 are still present, but since the steel sheet pile bulkhead at this elevation is no longer retaining fill, due to the inshore concrete bulkhead, these openings are inconsequential. The mooring hardware in place between Sta. 0+96 and 0+00 are in moderate condition with coating loss and corrosion deterioration (Photograph 37). No access hatches for the cellular cofferdams were exposed, so the sand levels could not be observed or measured. The areas where the access hatches would presumably be located appear to have been paved over and are currently staging construction material for the ongoing construction effort (Photograph 38).

### 3.3 East Bulkhead

Overall, the East Bulkhead is in Fair condition due to moderate corrosion and coating failure located within the splash and tidal zone of the steel sheet piles and of the steel anchor tie-backs (Photograph 39 and Photograph 40), and isolated spalling of the concrete curb (Photograph 41). Below mean low water, the steel sheet pile bulkhead is typically sound with isolated areas of failed coating and surface corrosion. The external double channel wale has 100 percent coating loss with moderate corrosion (Photograph 42). No access hatches for the cellular cofferdams inshore of the existing bulkhead were exposed, so the sand levels could not be observed or measured. The areas where the access hatches would presumably be located appear to have been paved over and are currently staging construction material for the ongoing construction effort

### 3.4 Fender System

Inspection of the fender system was outside the scope of work for this investigation, but as stated above, the fender system along the North Bulkhead has been removed. It should also be noted that the East Bulkhead fender system is clearly in Serious condition. Observed deterioration includes severe section loss due to rot and weathering at the upper wale and at the top foot of the timber planks (Photograph 43 and Photograph 44).

## 4 REPAIR RECOMMENDATIONS

OCC|COWI has developed recommendations for repairs in order to maintain the structural integrity and service life of the three bulkheads. Additionally, OCC|COWI recommends the repairs be carried out within the next year to minimize the potential for facility limitations or load restrictions. Due to ongoing construction efforts, some or all of these recommendations may already be included within the current scope of work.

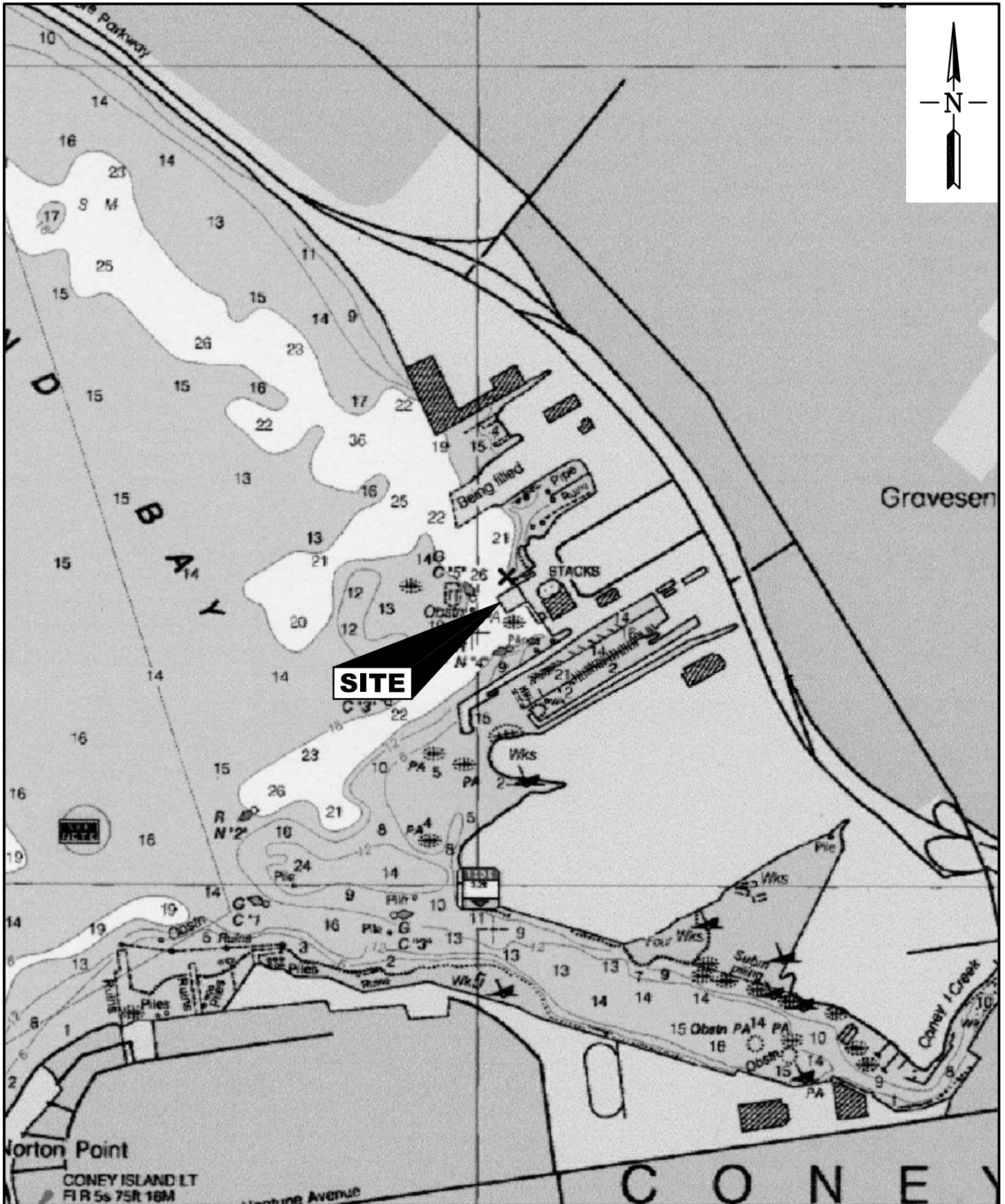
- › Clean and recoat all steel sheet piles from Mean Low Water (MLW) to top of pile at each of the three bulkheads. It is our understanding that the entire length of the North Bulkhead is scheduled to be encased in concrete, pursuant to the U.S. Army Corps of Engineer's permit issued for the construction of the MTS (NAN-2008-0927). That would adequately address this recommendation for that section of bulkhead.
- › Clean and recoat the double channel tie-back wale along the North and East Bulkheads. It is our understanding that the entire length of the North Bulkhead is scheduled to be encased in concrete, pursuant to the U.S. Army Corps of Engineer's permit issued for the construction of the MTS (NAN-2008-0927). That would adequately address this recommendation for that section of bulkhead.
- › Clean and recoat the exposed portions of the steel anchor tie-backs and associated hardware along the North and East Bulkheads. It is our understanding that the entire length of the North Bulkhead is scheduled to be encased in concrete, pursuant to the U.S. Army Corps of Engineer's permit issued for the construction of the MTS (NAN-2008-0927). That would adequately address this recommendation for that section of bulkhead.
- › Clean and recoat the steel sheet pile cells from MLW to the top of the element at each cell. Additionally, the splash zone repairs located below MLW should be cleaned and patched, as required. Where splash zone coating failures have occurred, the exposed steel should be assessed by a qualified professional to determine if structural repairs are required.
- › Install a bulk anode cathodic protection system along each of the three bulkheads. It is our understanding that an impressed current cathodic protection system is scheduled to be installed along the North and East Bulkheads, pursuant to the U.S. Army Corps of Engineer's permit issued for the construction of the MTS (NAN-2008-0927). That would adequately address this recommendation for those sections of bulkhead.

- › Install and coat a steel patch plate (12 inches by 12 inches) over the approximate 6 inch diameter hole observed at the intermediate cell adjacent to Cell F-1 at the West Bulkhead.
- › Repair the loose transition anchor bracket connection between the West Bulkhead and intermediate cell adjacent to Cell F-1. This repair will require the bearing plate to be realigned, and the nut to be tightened.
- › Remove and replace the damaged portion of double channel tie-back wale (approximately 10 LF) at North Bulkhead Station 0+65. It is our understanding that the entire length of the North Bulkhead is scheduled to be encased in concrete, pursuant to the U.S. Army Corps of Engineer's permit issued for the construction of the MTS (NAN-2008-0927). That would adequately address this recommendation.
- › Remove the timber fender system located along the East Bulkhead to reduce the dead load on the steel sheet piles, and provide access to the steel sheet pile bulkhead should cleaning and recoating repairs be necessary.
- › Clean and patch the end of the concrete wall at East Bulkhead Station 0+14. It is our understanding that this portion of the East Bulkhead is scheduled to be rehabilitated, pursuant to the U.S. Army Corps of Engineer's permit issued for the construction of the MTS (NAN-2008-0927). That would adequately address this recommendation.
- › Clean and patch the observed open spalling located at East Bulkhead Station 0+66. If this segment of bulkhead is schedule to be removed as a part of the ongoing construction efforts, this recommendation is not required.



## Appendix A Figure Set

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A New York State Registered Company

DESIGNED BY: DDJS    DRAWN BY: REBU    CHECKED BY: JOAC

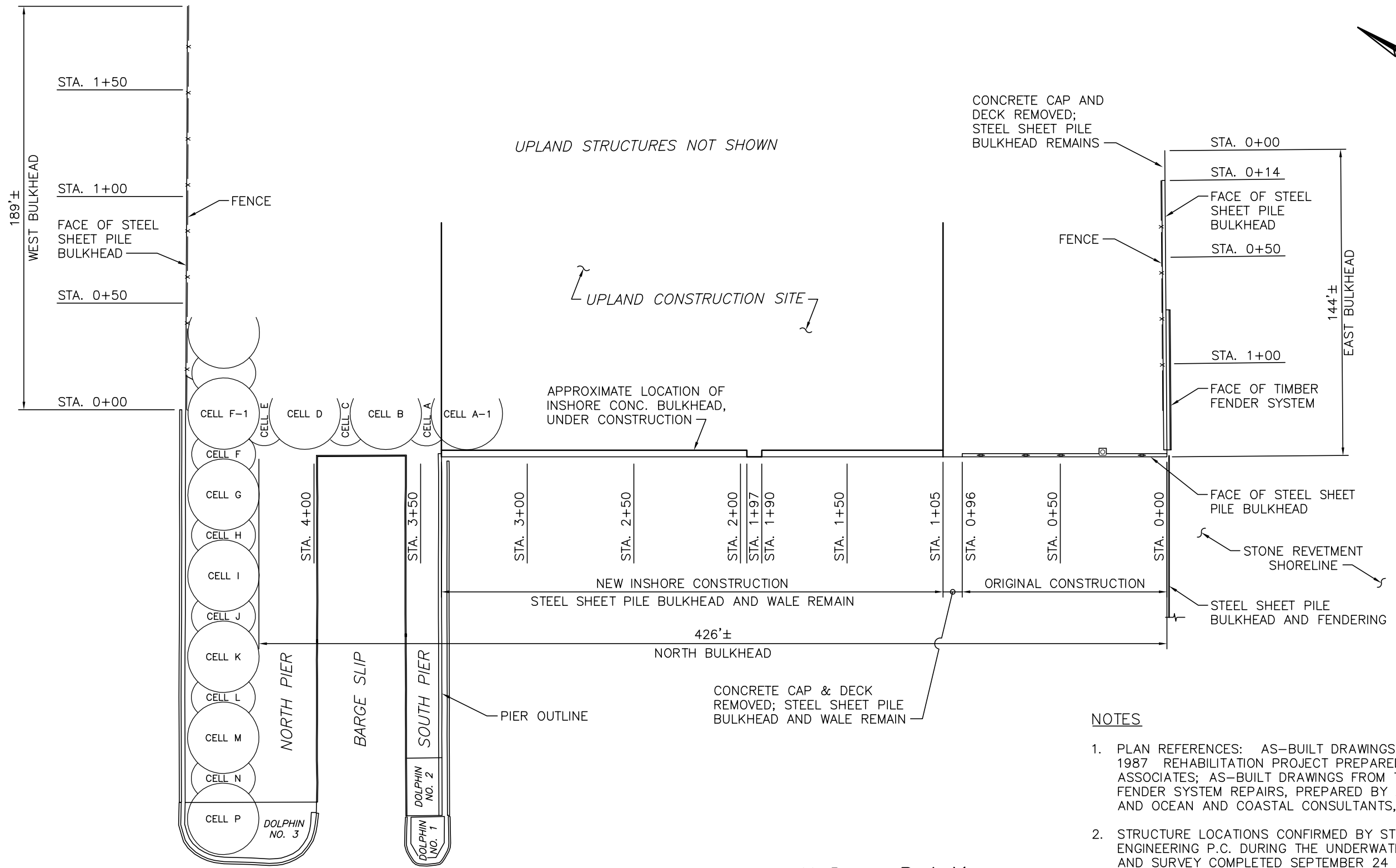
SOUTH WEST BROOKLYN  
MARINE TRANSFER STATION

VICINITY MAP

SCALE N.T.S.	REVISION
DATE 12/21/16	

SKETCH NO.  
SK-01

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GRAVESEND BAY

NOTES

1. PLAN REFERENCES: AS-BUILT DRAWINGS FROM THE 1987 REHABILITATION PROJECT PREPARED BY SOROS ASSOCIATES; AS-BUILT DRAWINGS FROM THE 1993 FENDER SYSTEM REPAIRS, PREPARED BY ATOMETRICS AND OCEAN AND COASTAL CONSULTANTS, INC.
2. STRUCTURE LOCATIONS CONFIRMED BY STANLEY WHITE ENGINEERING P.C. DURING THE UNDERWATER INSPECTION AND SURVEY COMPLETED SEPTEMBER 24 THRU OCTOBER 7, 2003.

		SOUTH WEST BROOKLYN MARINE TRANSFER STATION		SCALE 1"=50'-0"	REVISION
		EXISTING GENERAL PLAN		DATE 12/21/16	SKETCH NO. SK-02
A New York State Registered Company					
DESIGNED BY: DDJS	DRAWN BY: REBU	CHECKED BY: JOAC			

## Appendix B Photographs



*Photograph 1: Former southwest Brooklyn Marine Transfer Station and ongoing inshore construction (Looking east)*



*Photograph 2: Overview of the North Bulkhead and active construction site (Looking southeast)*



*Photograph 3: Overview of the West Bulkhead (Looking southeast)*



*Photograph 4: West Bulkhead - Steel sheet pile cell interface with steel sheet pile bulkhead (looking southeast)*



*Photograph 5: West Bulkhead – Transition between West Bulkhead and North Pier steel sheet pile cofferdams (Looking west)*



*Photograph 6: Overview of the North Bulkhead (Looking northeast)*



*Photograph 7: North Bulkhead – Steel sheet pile cell under North Pier (looking southeast)*

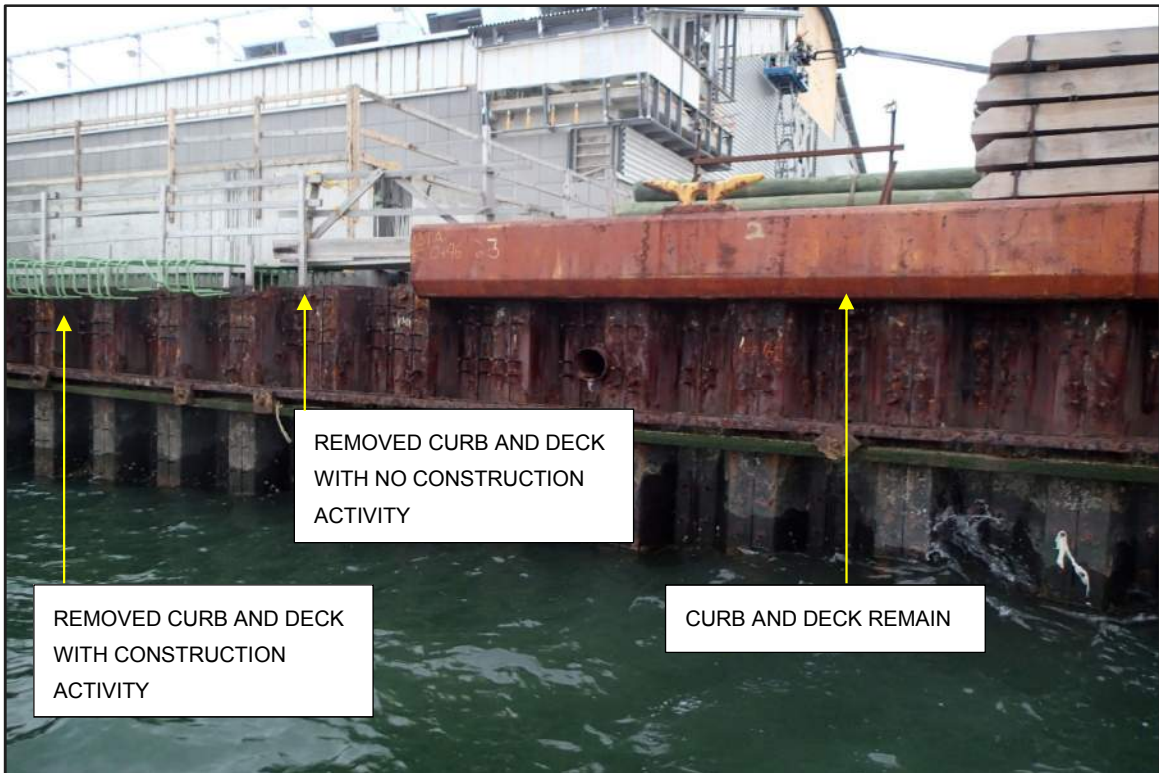


*Photograph 8: North Bulkhead – Transition from steel sheet pile cell to steel sheet pile bulkhead (looking east)*





Photograph 9: North Bulkhead - Typical steel double channel wale, anchor rod, and hardware (Looking southeast)



Photograph 10: North Bulkhead – Removed curb and deck interface with active construction (looking northeast)



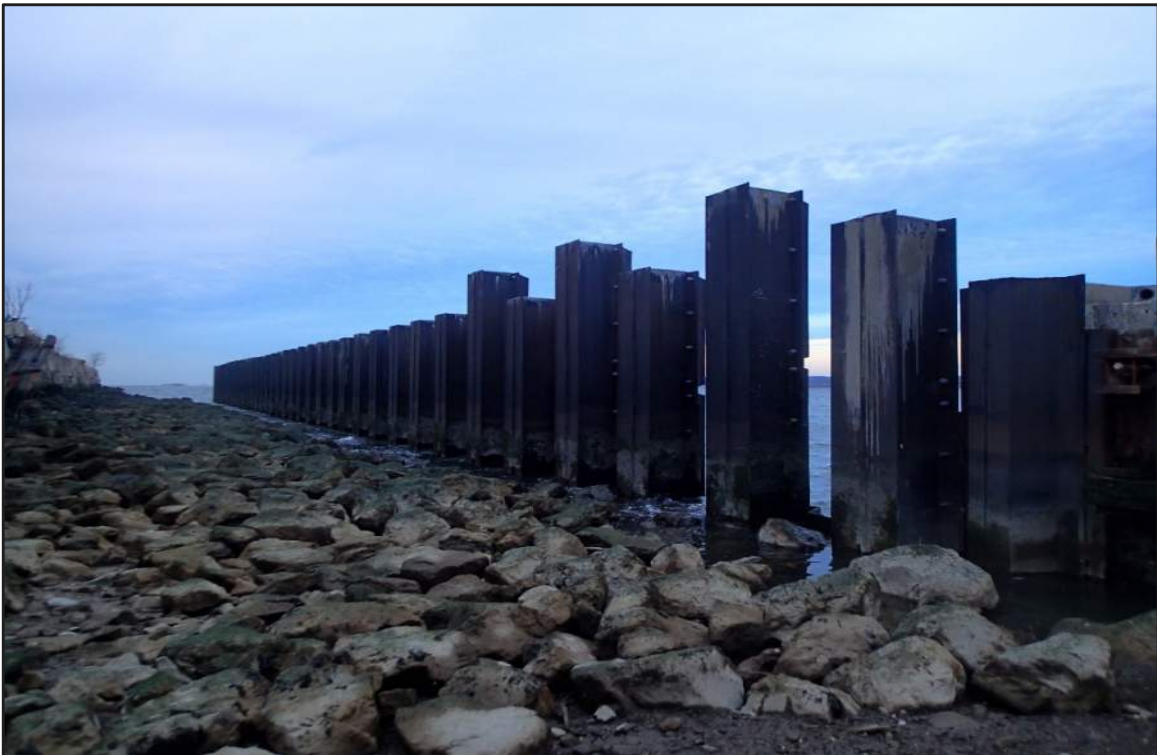
*Photograph 11: North Bulkhead – Concrete bulkhead with partially filled annulus between concrete and steel sheet pile bulkheads (Looking north)*



*Photograph 12: North Bulkhead – Extended concrete bulkhead between Sta. 1+90 and 1+97 (Looking southwest)*



*Photograph 13: North Bulkhead – Partially constructed structure with exposed epoxy coated reinforcement (looking north)*



*Photograph 14: North Bulkhead – Interface between North and East bulkheads and steel sheet pile fender and revetment retaining structure to the west (looking northwest)*



*Photograph 15: North Bulkhead – Deck demolition at North and East bulkhead interface to install transition element for new steel sheet pile to the west*



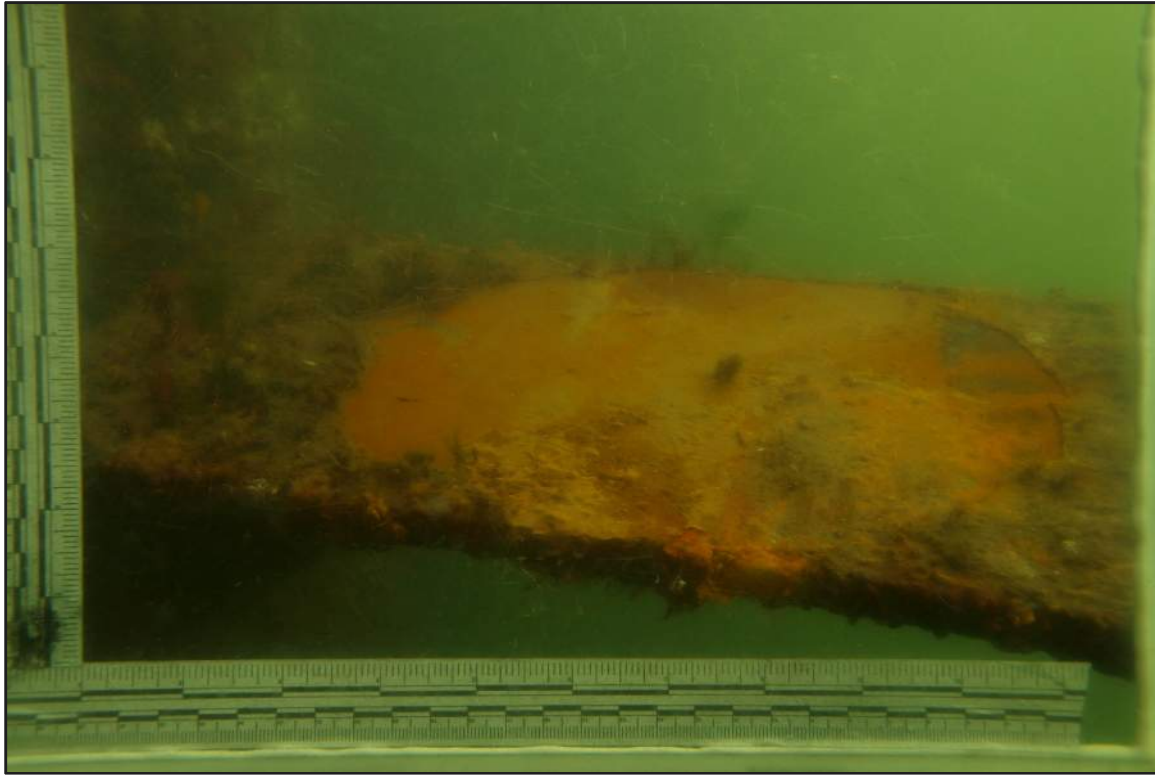
*Photograph 16: North Bulkhead – Typical shear bolt installation above water (Looking southeast)*



*Photograph 17: North Bulkhead –Elevation of shear bolts below wale system on outer flanges*



*Photograph 18: North Bulkhead – Threaded rod installed between shear bolt elevations*



*Photograph 19: North Bulkhead – Steel bracket installed below shear bolts*



*Photograph 20: Overview of the East Bulkhead (Looking northwest)*



*Photograph 21: Overview of revetment and steel sheet piles extending offshore from intersection of North and East Bulkheads (Looking west)*



*Photograph 22: East Bulkhead – Demolished concrete curb and deck at Sta. 0+14 (looking north)*



*Photograph 23: East Bulkhead – Exposed steel sheet pile bulkhead where curb and deck are removed (Looking northwest)*



*Photograph 24: East Bulkhead – Timber fender system (looking north)*





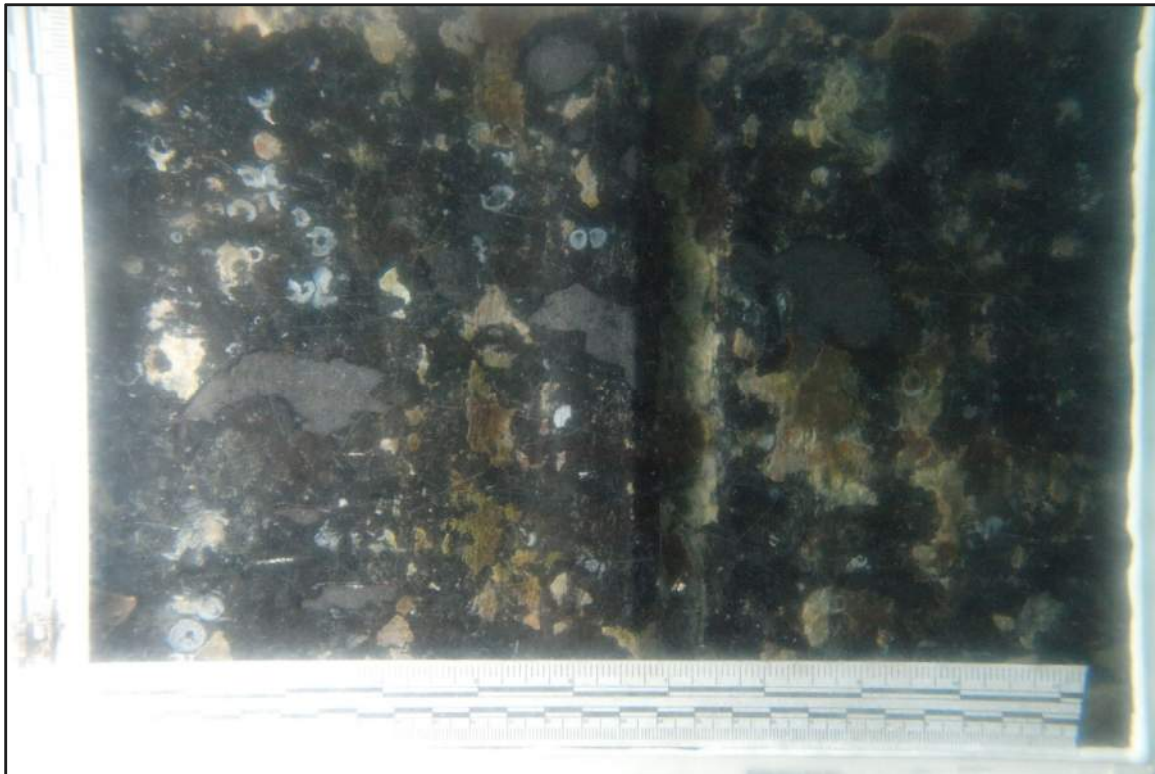
Photograph 25: West Bulkhead – Hole through splash zone repair and steel sheet pile cell with exposed fill and active fill loss at intermediate cell adjacent to Cell F-1



Photograph 26: West Bulkhead – Loose bracket at interface between steel sheet pile bulkhead and steel sheet pile cell



*Photograph 27: West Bulkhead – Typical coating failure with moderate corrosion of steel sheet pile in splash/tidal zone (Looking southeast)*



*Photograph 28: West Bulkhead – Typical isolated coating loss on steel sheet pile bulkhead below water*



Photograph 29: West Bulkhead – Typical splash zone repair failure with moderate corrosion of exposed steel sheet pile



Photograph 30: West Bulkhead - Missing steel pile cap (Looking south)



*Photograph 31: North Bulkhead - Typical coating failure with moderate corrosion of steel sheet pile in splash/tidal zone and an isolated damaged shear stud (Looking northeast)*



*Photograph 32: North Bulkhead - Typical coating failure with moderate corrosion of steel channel wale, anchor rod, and hardware in splash/tidal zone*



Photograph 33: North Bulkhead – Impacted steel wale at approximate Station 0+65 (Looking east)



Photograph 34: North Bulkhead – Isolated disengaged tie-back anchor and washer (Looking northeast)



*Photograph 35: North Bulkhead - Isolated coating failure with moderate corrosion of steel sheet pile below water*



*Photograph 36: North Bulkhead - Typical isolated epoxy failures with corrosion of steel cellular cofferdam in tidal zone (Looking east)*



Photograph 37: North Bulkhead - Typical light to moderate corrosion of mooring hardware cleat (Looking west)



Photograph 38: North Bulkhead – Construction material storage in area of cofferdam cell hatches  
Note: Previous inspections found no access to sand fill (Looking southeast)



*Photograph 39: East Bulkhead - Typical coating failure and moderate corrosion in the splash/tidal zone (Looking northeast)*



*Photograph 40: East Bulkhead - Typical coating failure with moderate corrosion of steel channel wale, anchor rod, and hardware in splash/tidal zone (Looking northeast)*





*Photograph 41: East Bulkhead – Open spalling with exposed reinforcement at Sta. 0+66(Looking north)*



*Photograph 42: East Bulkhead - Typical coating failure with moderate corrosion of steel channel wale inshore of timber fender system in splash/tidal zone (Looking north)*



*Photograph 43: East Bulkhead - Failed timber fender system connections due to rot (Looking west)*



*Photograph 44: East Bulkhead - Heavy rot of the upper timber horizontal wale and panels (Looking west)*

## Appendix C Condition Assessment Rating (CAR)

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

**Routine Condition Assessment Ratings as provided in the American Society of Civil Engineers (ASCE) Underwater Investigations Manual.**