

NOVEMBER 2015
GREELEY AND HANSEN LLC

SOUTHWEST BROOKLYN MARINE TERMINAL STATION BULKHEAD INVESTIGATION

ANNUAL BULKHEAD INSPECTION

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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 (MTS), located in Brooklyn, New York. The purpose of the inspection was to perform a 100% 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 also to be determined.

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/splash zone, and minor coating loss with surface corrosion to isolated areas of the below water steel sheet piles. Additional advanced to severe 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 splash zone repair failures below water at the cellular cofferdams.

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 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 failures have occurred, the steel should be assessed by a qualified professional to determine if structural repairs are required.
	Install and coat a steel patch plate (6 inches by 6 inches) over the 1 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 Mean Low Water (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 failures have occurred, the steel should be assessed by a qualified professional to determine if structural repairs are required.
	Clean and recoat the steel sheet piles from Mean Low Water (MLW) to the top of the element.
	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 for that section of bulkhead.
	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 for that section of bulkhead.
East Bulkhead	Clean and patch the observed open spalling located at Station 0+66.
	Clean and recoat the steel sheet piles from Mean Low Water (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 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 (MTS), located in Brooklyn, New York. The inspection was performed on November 23, 2015, 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% 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 cellular cofferdams, if accessible, was to be observed and noted. 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 is constructed of steel sheet pile cells forming cellular cofferdams (approximately 75 LF) (Photograph 7), which then transitions to Z-shape steel sheet piles to the south (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 sheet piles were reportedly installed as overshooting for the steel sheet pile cellular cofferdams that were once the shoreline retaining structure at this site.

At the time of the inspection, approximately 234 LF of concrete deck and curb had been removed due to the ongoing construction inshore of the steel sheet pile bulkhead (Photograph 10). A reinforced concrete bulkhead had been installed 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). Embedded epoxy coated reinforcement is visible along the full length of this section (Photograph 13). The southern 9 LF of existing bulkhead and demolished curb and deck is adjacent to the new construction, but at the time of the inspection only excavation had been performed. 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 except for a 39 inch by 20 inch section where the North and East Bulkheads intersect. This section of deck and curb has apparently been removed to allow for the installation of a transition element between the North and East bulkheads to allow for the installation of steel sheets that extend to the west (Photograph 14 and Photograph 15). Construction has occurred below water along the full length of the offshore face of the North Bulkhead. At each outer and inner flange, a minimum of two (2) elevations of shear bolts have been installed, beginning approximately 3 to 4 feet below the steel wale (Photograph 16). At the northern extent of the steel sheet pile bulkhead, threaded rods and steel brackets have been installed at each offshore double section (Photograph 17 and Photograph 18). 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 North Bulkhead along the south end and creates a corner returning inshore to the east for approximately 144 LF (Photograph 19). Approximately 14 LF of the inshore section of this bulkhead has been partially demolished, with the concrete deck and curb removed (Photograph 20). A small portion of steel sheet pile bulkhead is visible along this demolished segment (Photograph 21). 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 have been put in place.

The steel anchor rod tie-backs for both the North and East Bulkheads presumably connect 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 elevations of 12 inch by 12 inch timber wales, and steel brackets which tie the system into the steel sheet pile bulkhead (Photograph 22).

3 OBSERVED CONDITIONS

The bulkhead sections are in overall Fair condition with widespread moderate to advanced corrosion of the steel in the tidal/splash zone, and minor coating loss with surface corrosion to isolated areas of the below water steel sheet piles. 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 splash zone repair failures 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 zone of the steel sheet piles and cellular cofferdams. Below mean low water, the steel sheet pile bulkhead was typically sound with isolated areas of failed coating and surface corrosion, and isolated coating loss and splash zone failures with surface corrosion on the steel sheet pile cellular cofferdams (Photograph 23 through Photograph 26). The steel sheet pile cellular cofferdams located at the western extent of the bulkhead have been repaired with an epoxy coating along the entire exposed face of the sheets. No access hatches for the cofferdams were exposed, so the sand levels could not be verified. 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 27).

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 zone of the steel sheet piles and steel cellular cofferdams, and steel anchor tie-backs (Photograph 28 and Photograph 29). Below mean low water, the steel sheet pile bulkhead was typically sound with isolated areas of failed coating and surface corrosion (Photograph 30), and isolated coating loss and splash zone failures with surface corrosion on the steel sheet pile cellular cofferdams. The steel sheet pile cellular cofferdams located at the western extent of

the bulkhead have been repaired with an epoxy coating along the entire exposed face of the sheets. Cut outs through the bulkhead noted during the previous inspection at Station 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 sound with moderate corrosion (Photograph 31). 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 32).

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 33 and Photograph 34), and isolated spalling of the concrete curb (Photograph 35). 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 36). 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. Severe deterioration due to rot and weathering was observed at the upper wale and at the top foot of the timber planks (Photograph 37 and Photograph 38).

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.

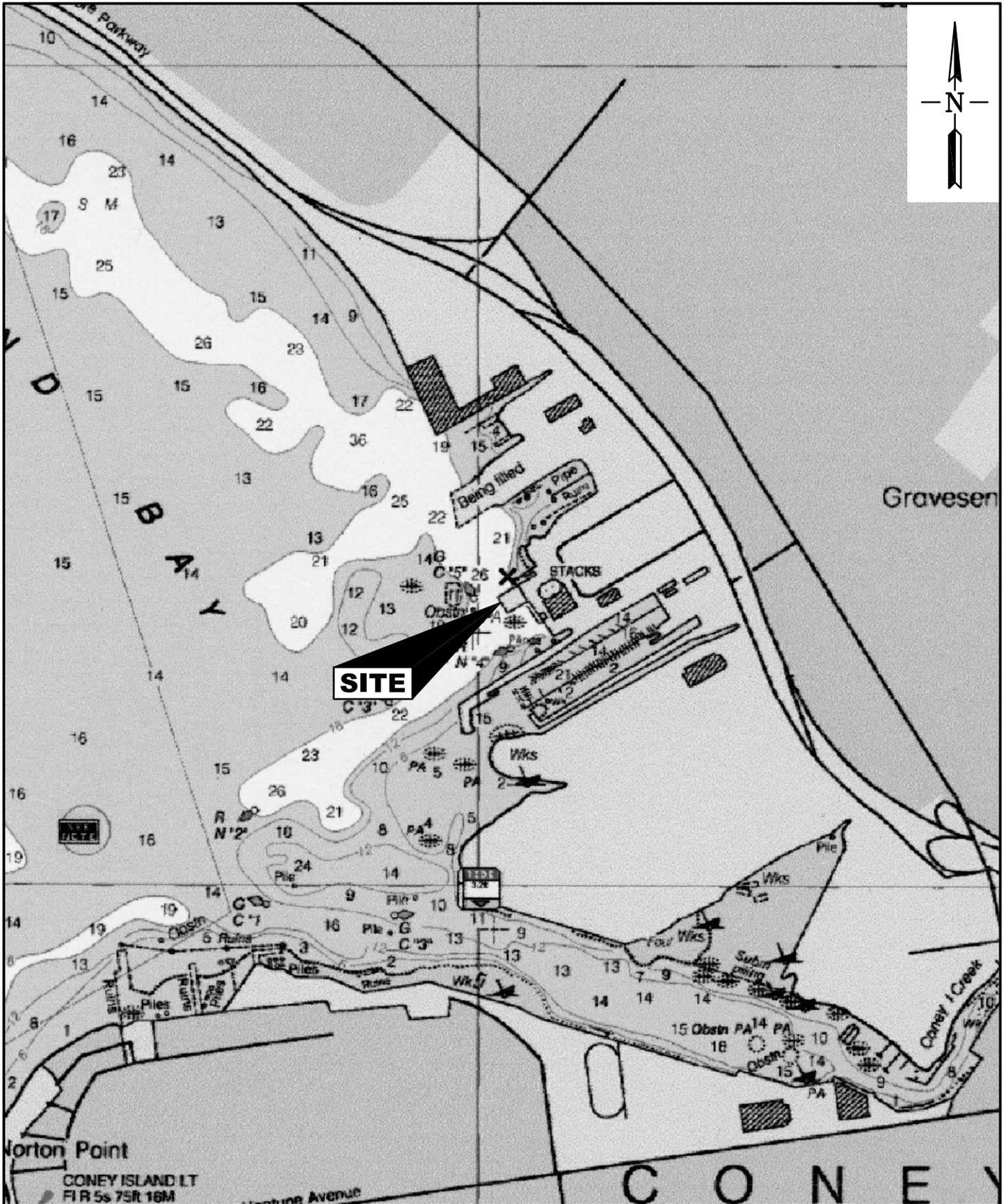
- › Clean and recoat all steel sheet piles from Mean Low Water (MLW) to top of pile at each of the three bulkheads. It is our understanding that the entire length of the North Bulkhead is scheduled to be encased in concrete pursuant to the U.S. Army Corps of Engineer's permit issued for the construction 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 failures have occurred, the steel should be assessed by a qualified professional to determine if structural repairs are required.
- › Install and coat a steel patch plate (6 inches by 6 inches) over the 1 inch diameter hole observed at the intermediate cell adjacent to Cell F-1.
- › 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.
- › 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.

- › 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. It is our understanding that the existing fender system is scheduled to be replaced 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 at the East Bulkhead. 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

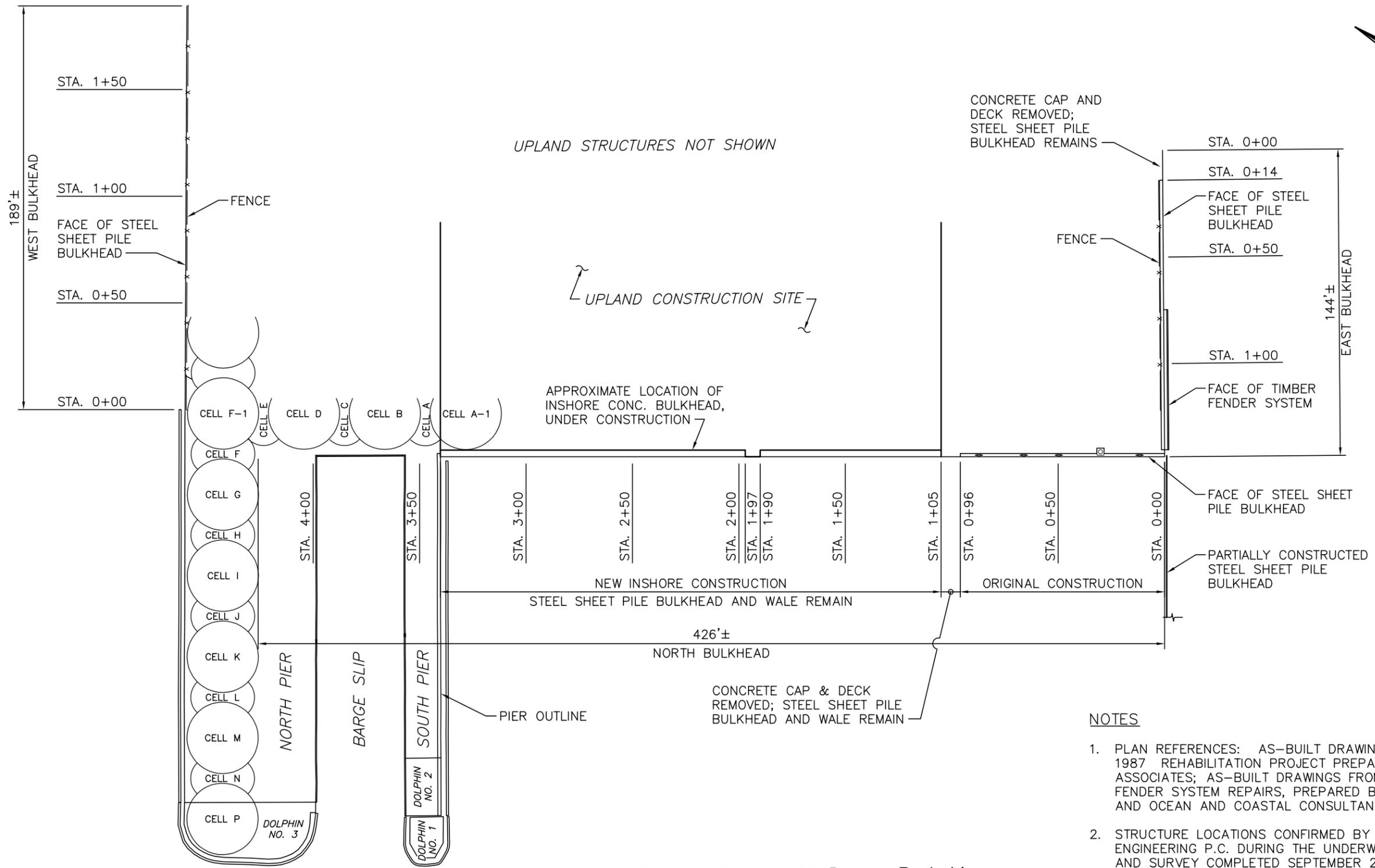
SOUTH WEST BROOKLYN
MARINE TRANSFER STATION

VICINITY MAP

SCALE N.T.S.	REVISION
DATE 11/25/15	

SKETCH NO.
SK-01

\\cowi.net\projects\A075000\A077181\CAD\Task 2\Sk02.dwg Sk-02 Rey Bizeta Tue, 24 Nov 2015 1:36pm



UPLAND STRUCTURES NOT SHOWN

UPLAND CONSTRUCTION SITE

APPROXIMATE LOCATION OF INSHORE CONC. BULKHEAD, UNDER CONSTRUCTION

NEW INSHORE CONSTRUCTION
STEEL SHEET PILE BULKHEAD AND WALE REMAIN

CONCRETE CAP AND DECK REMOVED;
STEEL SHEET PILE BULKHEAD REMAINS

CONCRETE CAP & DECK REMOVED;
STEEL SHEET PILE BULKHEAD AND WALE REMAIN

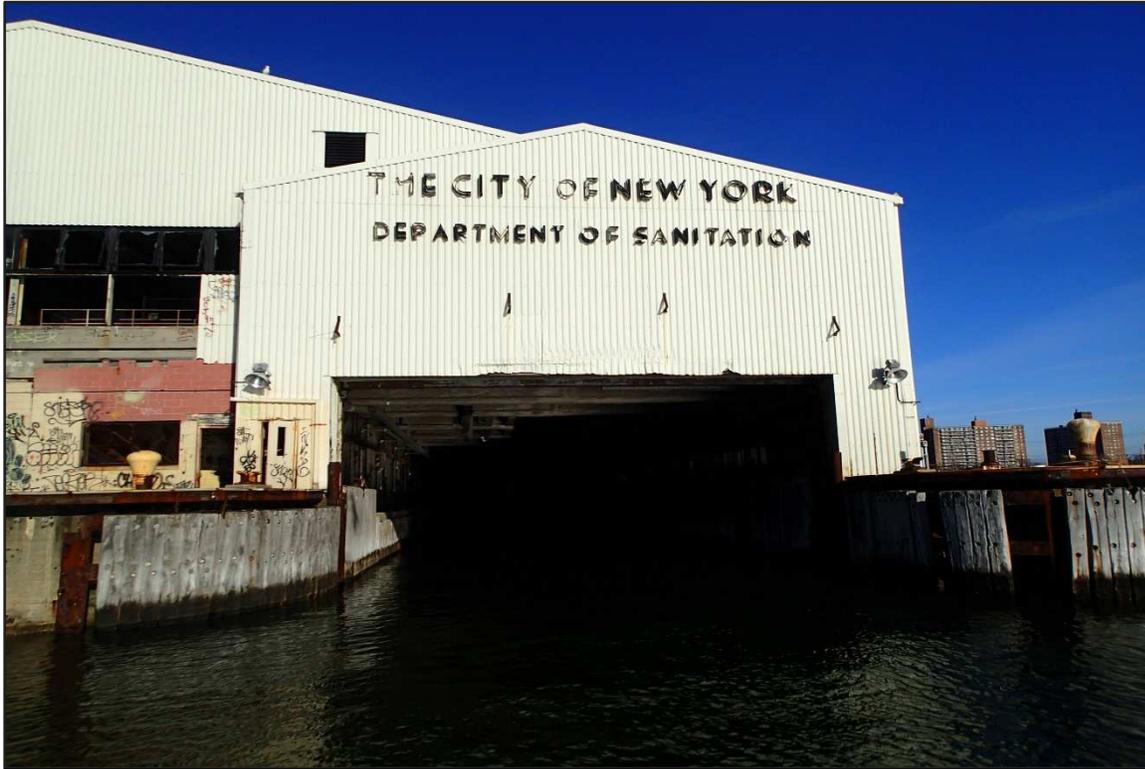
NOTES

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.

G R A V E S E N D B A Y

		SOUTH WEST BROOKLYN MARINE TRANSFER STATION		SCALE 1"=50'-0"	REVISION
		EXISTING GENERAL PLAN		DATE 11/25/15	SKETCH NO. SK-02
DESIGNED BY: DDJS	DRAWN BY: REBU	CHECKED BY: JOAC			

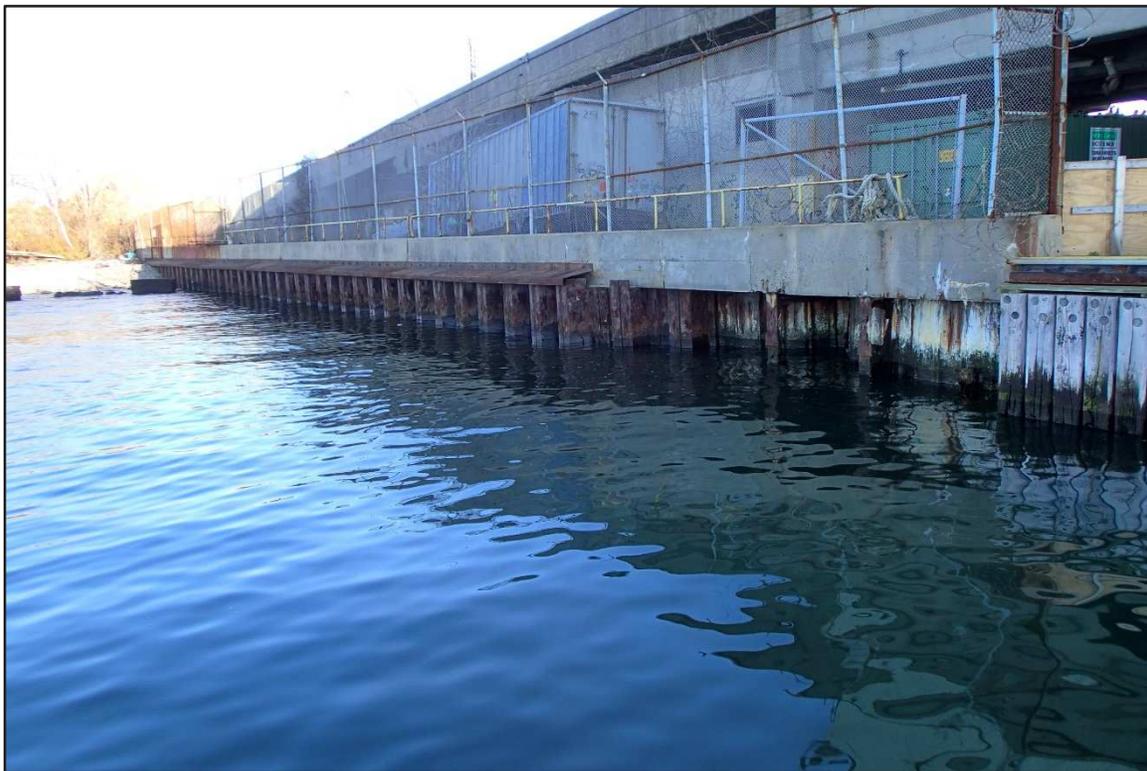
Appendix B Photographs



Photograph 1: Southwest Brooklyn Marine Transfer Station (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 south)



Photograph 5: West Bulkhead – Steel sheet pile bulkhead (Looking southwest).



Photograph 6: Overview of the North Bulkhead (Looking east)



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



Photograph 8: North Bulkhead – Steel sheet pile cell interface with steel sheet pile bulkhead return (looking east)



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



Photograph 10: North Bulkhead – Removed curb and deck interface with active construction



Photograph 11: North Bulkhead – Concrete bulkhead with partially filled annulus between concrete and steel sheet pile bulkheads



Photograph 12: North Bulkhead – Extended concrete bulkhead between Sta. 1+90 and 1+97



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



Photograph 14: North Bulkhead – Interface between North bulkhead, East bulkhead, and new section of steel sheet pile to the west (looking north)



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 – Upper elevation shear bolts on outer flanges



Photograph 17: North Bulkhead – Threaded rod installed between shear bolt elevations



Photograph 18: North Bulkhead – Steel bracket installed below shear bolts



Photograph 19: Overview of the East Bulkhead (Looking northeast)



Photograph 20: East Bulkhead – Demolished concrete curb and deck at Sta. 0+14 (looking northwest)



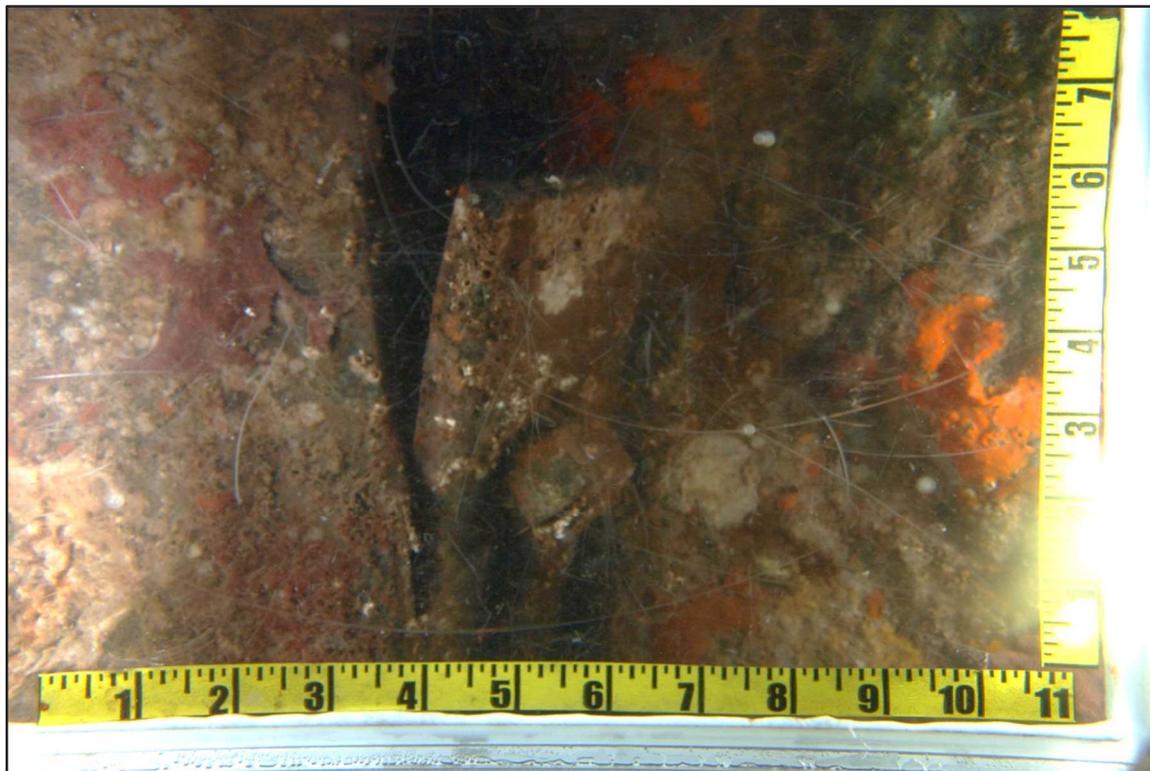
Photograph 21: East Bulkhead – Exposed steel sheet pile bulkhead where curb and deck have been removed



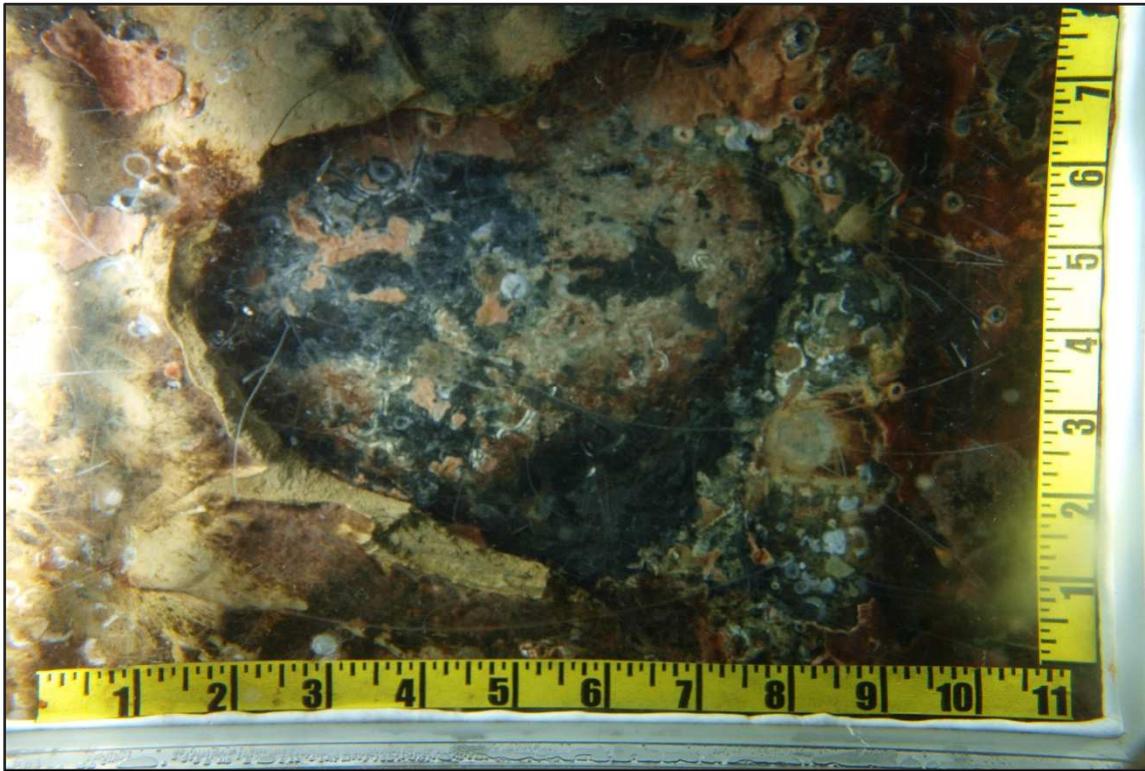
Photograph 22: East Bulkhead – Timber fender system (looking northwest)



Photograph 23: West Bulkhead – Hole through splash zone epoxy repair and steel sheet pile cell with exposed fill at intermediate cell adjacent to Cell F-1



Photograph 24: West Bulkhead – Loose bracket at interface between steel sheet pile bulkhead and steel sheet pile cell



Photograph 25: West Bulkhead – Typical splash zone epoxy repair failure with moderate corrosion of exposed steel sheet pile



Photograph 26: West Bulkhead – Typical coating failure with moderate corrosion of steel sheet pile in splash/tidal zone



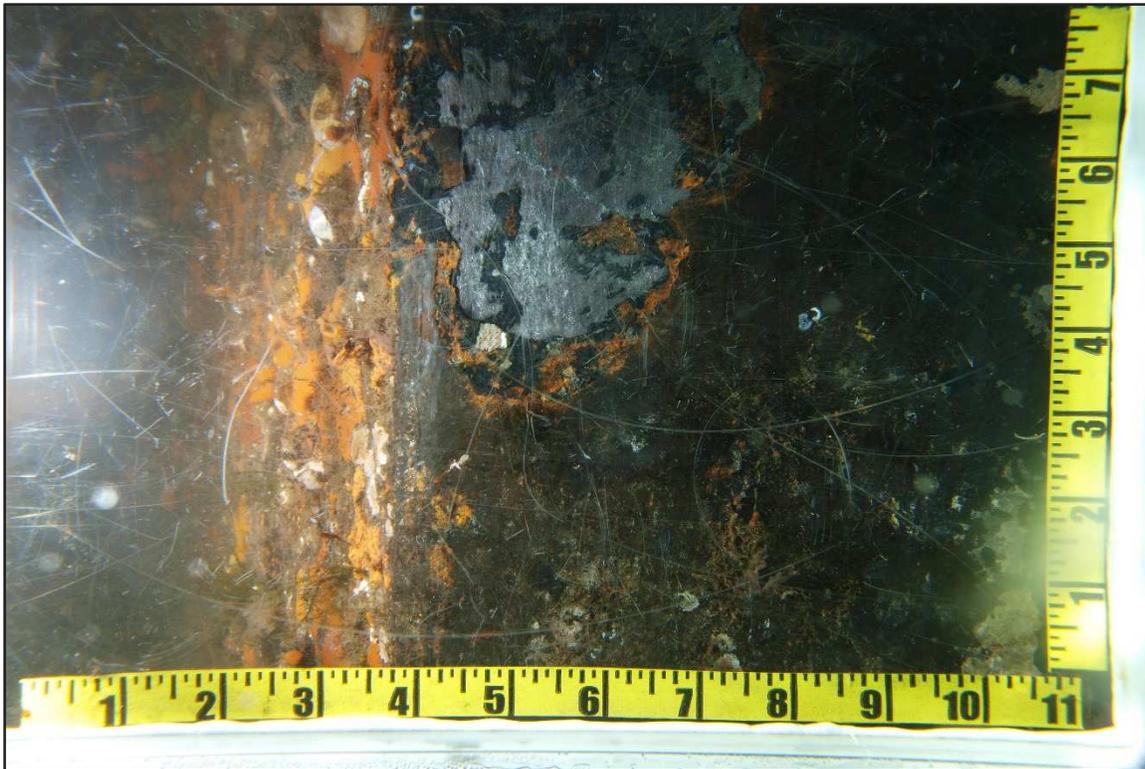
Photograph 27: West Bulkhead - Missing steel pile cap (Looking south)



Photograph 28: North Bulkhead - Typical coating failure with moderate corrosion of steel sheet pile in splash/tidal zone



Photograph 29: North Bulkhead – Typical coating failure with moderate corrosion of steel channel wale, anchor rod, and hardware in splash/tidal zone



Photograph 30: North Bulkhead - Typical coating failure with moderate corrosion of steel sheet pile underwater



Photograph 31: North Bulkhead - Typical light to moderate corrosion of mooring hardware cleat



*Photograph 32: North Bulkhead – Construction material storage in area of cofferdam cell hatches.
Note: Previous inspections found no access to sand fill.*



Photograph 33: East Bulkhead - Typical coating failure and moderate corrosion in the splash/tidal zone



Photograph 34: East Bulkhead - Typical coating failure with moderate corrosion of steel channel wale, anchor rod, and hardware in splash/tidal zone



Photograph 35: East Bulkhead – Open spalling with exposed reinforcement at Sta. 0+66



Photograph 36: East Bulkhead - Typical coating failure with moderate corrosion of steel channel wale inshore of timber fender system in splash/tidal zone



Photograph 37: East Bulkhead - Failed timber panel upper connections due to rot



Photograph 38: East Bulkhead - Heavy rot of the upper timber horizontal wale and panels

Appendix C Condition Assessment Rating (CAR)

Rating	Repairs	Description
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.