

CONDITION ASSESSMENT REPORT

WATER POLLUTION CONTROL AUTHORITY BULKHEAD City of Stamford Stamford, Connecticut



Existing Bulkhead and Water Pollution Control Facility, Photo Taken April 16, 2019, by RTG

May 2019

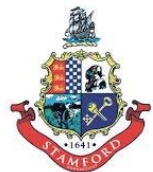
Prepared By:



RTG Project No. 19106.00

Prepared For:

City of Stamford
Engineering Bureau
Stamford Government Center, 7th Floor
888 Washington Boulevard
Stamford, CT 06901



CONDITION ASSESSMENT REPORT

WATER POLLUTION CONTROL AUTHORITY BULKHEAD City of Stamford Stamford, Connecticut

This Report was prepared under the direction of:

Date: _____

May 2019

Prepared By:



RT Group, Inc.

Engineered from the Ground UpSM

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Condition Assessment

This report presents the results of a topside inspection of the steel sheet pile bulkhead located along the Stamford Water Pollution Control Authority's (WPCA's) Facility in Stamford, CT. The WPCA Facility and bulkhead are located along the eastern shore of the East Branch of the Stamford Harbor. The inspection was completed by RT Group, Inc. (RTG) to assess the overall condition of the bulkhead and to provide a basis for making future recommendations related to repairing/replacing the existing bulkhead.

Purpose and Scope

The purpose of this report was to investigate, document, and characterize the existing condition of the WPCA Bulkhead. The Scope-of-Work included:

- ❑ Collecting and reviewing available data on the bulkhead;
- ❑ Completing a topside inspection of the bulkhead; and
- ❑ Preparing this report.

Background

Based on a review of record documents provided by the City of Stamford's (the City's) Engineering Bureau and online resources, the existing site has reportedly been home to a municipal sewage/water treatment plant since 1949. For many years, the plant was situated on a predominantly undeveloped shoreline with a single timber wharf to provide waterfront access to the East Branch of the Stamford Harbor (Photo No. 1).

As the needs of the facility expanded, an anchored timber sheet pile bulkhead was installed across a cove at the north end of the property, and the cove was reportedly filled to provide additional space around 1971 (Photo No. 2). Since that time, the plant has undergone several major upgrades in the mid-1970's, late-1980's, and mid-2000's, including the addition of facilities for the Stamford Recycling and Sanitation Department (SRSD) and the replacement of the timber bulkhead with an anchored steel sheet pile bulkhead.

With respect to the East Branch of the Stamford Harbor, the existing channel is approximately 160-feet wide at the south end of the bulkhead, and narrows to about 95-feet wide at the north end of the bulkhead. A redeveloped mill and a stone aggregate distributor are located on the opposite shoreline from the WPCA facility, which results in both recreational and commercial vessel traffic, including aggregate barges, in the channel along the bulkhead.

Currently, the WPCA provides water and sewage treatment services for the City of Stamford and the nearby Town of Darien at the site, and the SRSD processes waste and refuse in the City Transfer Station located adjacent to the waterfront at the north end of the property. As a result, both of these municipal agencies rely on the bulkhead to protect their critical infrastructure and ability to remain in operation.

Construction History

A chronological history of the known major improvements made along the WPCA facility's shoreline, based on the record documents provided by the City, is summarized below.

- At some time prior to 1972, the previously mentioned timber bulkhead was installed along the northern portion of the property. The timber bulkhead was reportedly comprised of 4" x 12" timber sheeting, which was supported by three levels of 12" x 12" timber wales and driven timber support piles along its outboard face.

The timber bulkhead was anchored at the middle and lower wales with two (2) 1-inch-diameter steel tie-rods connected to a timber pile deadman system at about 10-feet on-center. At two locations along its length, a secondary deadman system was installed and tied back with 1-inch-diameter tie-rods connected to the middle wale.

- Around 1972, what this report refers to as the Type "B" Bulkhead, was constructed at the southern end of the timber bulkhead (Station 5+55 to 7+40) (Figure 1) (Photo No. 3). The Type "B" Bulkhead consists of a US Steel PZ-38 sheet pile wall with a double C10 x 25 channel wale, and is anchored with one (1) 2.25-inch-diameter tie-rod every 6-feet on-center to an MP 115 steel sheet pile anchor wall (Figure 2).
- In 1981, the URS Company, Inc. prepared a Condition Survey Report of the timber bulkhead, indicating that it was in fair to poor condition, with many broken and missing components. One section approximately 110-feet long was noted as being completely missing above the Mean Low Water line, causing significant erosion of the backfill material behind the bulkhead.
- At some point between 1981 and 1989, what this report refers to as the Type "A" Bulkhead, was constructed in front of the timber bulkhead (Station 0+00 to 5+55) (Figure 1). The Type "A" Bulkhead was installed approximately 2'-3" in front of the timber bulkhead (i.e., over-sheeted), and consists of anchored sheet piles of an unknown type and a concrete cap (Photo No. 4).

The anchor system for the Type "A" Bulkhead consists of what appears to be an HP12x63 wale mounted to the interior of the sheet piles (Photo No. 5), and tiebacks. However, it is not known if these are tie-rods or strand anchors, as their heads are fitted with steel caps and encased in concrete (Photo Nos. 6 and 7). Rubber "D" fenders are located on the outboard face of the Type "A" Bulkhead as well (Photo No. 8).

The record documents provided to RTG did not indicate any other modifications and/or repairs to the Type "A" or "B" Bulkheads after the 1980's. Based on this, the Type "A" Bulkhead has been in service for between 30 and 38 years, and the Type "B" Bulkhead has been in service for about 47 years.

Datums

The record documents provided by the City generally reference a local Mean Low Water Datum. However, for the purposes of preparing this Report and maintaining consistency with a universal datum, all elevations have been converted to the North American Datum of 1988 (NAVD 88). The reader is referred to Figure 1 for a Vertical Datum Conversion Diagram.

Authorization

This Report was prepared for the City by RTG in accordance with our Purchase Order dated April 2019.

Limitations

Interpretations summarized in this Report are based on a limited visual topside inspection that reflect conditions only at the time of the inspection. Time may alter the conditions observed up to and prior to any planned repairs/improvements. If significant variations become apparent prior to any planned repairs/improvements, the adequacy of the information contained in this Report should be reviewed.

This Report was prepared in accordance with generally accepted civil engineering practice as an aid to evaluate the condition of the WPCA Bulkhead and develop repair/replacement alternatives, including estimated costs. No other warranties, either express or implied, are made. Interpretations contained herein were based on the applicable standards of the consulting profession at the time and the place this report was prepared.

Inspection Results

A baseline stationing system was established by RTG on April 16, 2019, in order to provide a reference point for locating and documenting observed deficiencies in the bulkhead. The stationing begins at Station 0+00 and extends south along the face of the bulkhead until its termination at Station 7+40 (Figure 1).

The bulkhead was divided into 25-foot-long sections for the topside inspection. Each component of the bulkhead being inspected was given a rating which was considered representative of the entire 25-foot-long section as a whole. The rating system is based on a scale from 0 to 9, with 0 being a "Failed Condition", and 9 being "Excellent Condition" (Table 1).

Table 1 General Condition Rating System		
Rating	Definition	Description
9	EXCELLENT CONDITION	Like new
8	VERY GOOD CONDITION	No problems noted
7	GOOD CONDITION	Some minor problems
6	SATISFACTORY CONDITION	Components show some minor deterioration

5	FAIR CONDITION	Component is structurally sound but may have minor section loss, hairline cracking, or superficial spalls
4	POOR CONDITION	Component has up to 25% section loss or cracks up to 1/16" in width
3	SERIOUS CONDITION	Component has up to 50% section loss or cracks up to 1/8" in width
2	CRITICAL CONDITION	Component has up to 75% section loss or cracks up to 1/2" in width, rebar exposed and corroded
1	IMMINENT FAILURE CONDITION	Component has deteriorated such that signs of movement are visible
0	FAILED CONDITION	Component has failed, broken, or is missing

The topside inspection consisted mainly of a Level I visual inspection which did not involve cleaning of the structural components prior to the inspection. A Level II close-up visual inspection, that did include some spot cleaning, was performed at selected locations only as time allowed.

Topside Inspection

The topside inspection was completed by Mr. Greg Coren, P.E./RTG on April 16, 2019, and included a visual inspection from about Mean Low Water (MLW, El. -3.60) to the top of the bulkhead from land and from a fire-boat provided and operated by the City. The results of the topside inspection are summarized below.

Type A Bulkhead

The Type A Bulkhead is located from about Station 0+00 to 5+55 (Figure 1 and Photo No. 4). A typical section of this bulkhead type is shown in Figure 2. In summary:

Cap: The concrete cap is approximately 24-inches-wide by 12-inches-high with a top elevation of about El. 9.4 (Figure 2). From about Station 0+00 to 3+70, a 4-foot-wide gravel surface treatment slopes upward from the back of the cap to the existing concrete pavement within the WPCA facility, which is about 1-foot higher than the top of the cap (Photo No. 9). A chainlink fence is located at the edge of the concrete pavement along this section.

From about Station 3+70 to 5+55, an approximately 15-foot-tall timber sound barrier is located approximately 4-feet behind the back of the cap. At the time of the inspection, dense vegetation, goose nests, and stowed fishing pots were situated between the cap and the sound barrier from Station 3+70 to 5+25, which prevented access to the top of the bulkhead in this area (Photo Nos. 10 and 11).

The concrete cap is heavily spalled along its outboard edge along its entire length, and rebar is exposed at many locations (Photo No. 12). At Stations 0+10 to 0+17, 2+45 to 2+51, and 5+53, the cap is almost entirely missing, exposing the tops of the sheet piles (Photo Nos. 13, 14, and 15).

Significant erosion of the backfill material (up to 6-feet deep from the top of the cap) was observed from Stations 1+40 to 1+55, 2+80 to 3+05, and 3+25 to 3+40 (Photo Nos. 16, 17, and 18). This erosion is undermining the adjacent concrete pavement, and appeared to be caused by torch-cut holes in the sheeting approximately 12-inches in diameter at about 7-feet from the top of the cap at each eroded location (Photo No. 19). Overall, the concrete cap was observed to be in poor to failed condition.

Wale: The steel HP-section wale is mounted to the inboard face of the existing bulkhead, and could not be observed except at about Station 1+47 (Photo No. 20). The wale is bolted to the sheeting with four (4) bolts, which are located in every other sheet pile belly, and is located approximately 5'-2" from the top of the cap to its web (Figure 2).

At the time of the inspection, water and soil were trapped in the web of the wale, and the web, flanges, and hardware were moderately corroded. Overall, the limited exposed area of the wale indicated it was in poor condition.

Tiebacks: The tieback anchors are fitted with steel caps and encased in concrete about 5'-8" below the top of the concrete cap (Figure 2) (Photo No. 6). Therefore, the tiebacks were not accessible for inspection. In general, the concrete encasements appeared to be in fair condition, except around Station 1+15, where two (2) encasements are spalled and the tieback caps are visible.

Sheet Piles: The steel sheet piles are approximately 20-inches-wide (i.e., 40-inches per pair) by 14-inches-deep (Figure 2). Three pipe outfalls were observed at Stations 1+10, 3+87, and 4+88. The outfalls were about 72-inches, 12-inches, and 12-inches in diameter and were located about 9'-9", 7'-0", and 10'-6" from the top of the concrete cap, respectively (Photo Nos. 21, 22, and 23).

At Stations 0+15 and 5+50, the sheet piles are heavily damaged, possibly due to vessel impacts (Photo Nos. 13 and 15). At about Station 3+00, the sheet piles and cap lean inboard about 1-foot over a 5-foot length.

The existing coating on the sheet piles is cracked and chipping above Mean High Water (MHW, El. +3.15), and is almost completely missing between MHW and MLW. Scale, rust, and marine growth were observed from about 2-feet above MHW to MLW. Overall, the sheet piles were observed to be in fair condition above MLW.

During the inspection, ultrasonic thickness measurements of the sheet pile flanges were obtained at about MHW, 2-feet below MHW, and 2-feet above MHW. The thickness measurements were obtained about every 100 linear feet and are provided in Table B-1. In general, the sheet piles have an average flange thickness of about 0.36-inches at the measured locations.

Repairs: No repairs appear to have been made along this bulkhead type.

Fendering: As previously mentioned, rubber "D" fenders were installed along this bulkhead type at two elevations (Photo No. 8). The upper level of fenders, about 5'-0" from the top of the concrete cap, are almost entirely missing between Station 0+15 and 4+00. The lower level of fenders, about 8'-6" from the top of the concrete cap, are generally intact, but

many are damaged and deteriorated. Overall, the fendering was observed to be in poor to failed condition.

Type B Bulkhead

The Type B Bulkhead is located from about Station 5+55 to 7+40 (Figure 1 and Photo No. 3). A typical section of this bulkhead type is shown in Figure 2. In summary:

Cap: The Type B bulkhead does not have a cap. The previously mentioned timber sound barrier is also located along the entire length of the Type B Bulkhead, approximately 4-feet behind the back of the sheeting. The top of the bulkhead is about El. 8.9, and grade between the sheeting and the timber sound barrier is flat and vegetated with brush and grass (Photo No. 24).

Wale: The double C10x25 channel wale is mounted to the outboard face of the existing bulkhead about 7'-6" from the top of the sheeting (Photo No. 25). At the time of the inspection, it could not be determined how the wale was secured to the bulkhead, though the record documents indicate a welded connection between the channel flanges and the bulkhead.

Moderate pitting, corrosion, and section loss were observed throughout the length of the wale, and significant damage was noted between Station 6+90 and 7+00 (Photo No. 26). At several tie-rod connections, the flanges of the wale had completely corroded. Overall, the wale was observed to be in poor condition, with one section considered failed.

Tie-Rods: The tie-rods consist of threaded steel anchors with a nut, 9-inch square steel bearing plate, and protective gussets (Photo No. 27). The tie-rod spacing is about 6'-0" on-center (i.e., every other sheet pile pair). The majority of the tie-rod bearing plates, nuts, and protective gussets were observed to be intact, though three (3) tie-rods were observed to be bent and displaced between Station 5+88 to 6+00 (Photo No. 28). The tie-rod diameter and overall condition was not determined during the inspection due to limited access.

Sheet Piles: The PZ-38 steel sheet piles are approximately 18-inches-wide (i.e., 36-inches per pair) by 12-inches-deep (Figure 2). The facility's main effluent line outfall was observed at Station 5+90, but was located below MLW and identified by active flow coming to the water surface (Photo No. 29). The outfall diameter could not be determined, but the record documents indicate that it is a 60-inch diameter Class IV RCP pipe.

No major damage to the sheet piles was observed. The existing coating on the sheet piles is cracked and chipping above MHW, and is almost completely missing between MHW and MLW. Scale, rust, and marine growth were observed from about 2-feet above MHW to MLW (Photo No. 26). Overall, the sheet piles were observed to be in fair condition above MLW.

Due to the shallow mudline, which limited waterside access, ultrasonic thickness measurements of the sheet pile flanges were obtained from land at Station 7+35 only. The resulting measurements are provided in Table B-1. In general, the sheet pile has an average flange thickness of about 0.45-inches at the measured location.

Repairs: No repairs appear to have been made along this bulkhead type.

Fendering: There are no fenders along the Type B Bulkhead.

Summary

The rating of each bulkhead component (e.g., cap, wale, tie-rods), by bulkhead type, as well as the bulkhead's overall rating is summarized below in Table 2 (values rounded to the nearest decimal place). Refer to Table B-1 of Appendix B for more detailed information regarding how the ratings were determined.

Table 2 Bulkhead Condition Rating Summary								
Type	Station	Component						Ave. Rating
		Cap	Wale	Tie-rod	Sheet Pile above MLW	Sheet Pile below MLW	Repair	
A	0+00 to 5+55	3.8	4.0	NA	4.0	NA	NA	3.9
B	5+55 to 7+40	NA	3.5	NA	4.0	NA	NA	3.9
Overall Rating of the WPCA Bulkhead								3.9

Rating:

- 9 Excellent Condition
- 8 Very Good Condition
- 7 Good Condition
- 6 Satisfactory Condition
- 5 Fair Condition
- 4 Poor Condition
- 3 Serious Condition
- 2 Critical Condition
- 1 Imminent Failure Condition
- 0 Failed Condition

Notes:

1. Refer to Table 1 for a description of each rating.

Moving Forward

As previously mentioned, only a topside visual inspection of the existing bulkhead was performed. An underwater dive inspection was not performed and the below-water condition of the bulkhead and components discussed herein could not be ascertained. Furthermore, the condition of the anchor systems could not be ascertained, as they were below grade and could not be evaluated. Accordingly, it is recommended that an underwater dive inspection of the bulkhead be completed, in addition to shallow test pits at the anchor systems, and the findings incorporated into any recommendations made for future bulkhead repairs.

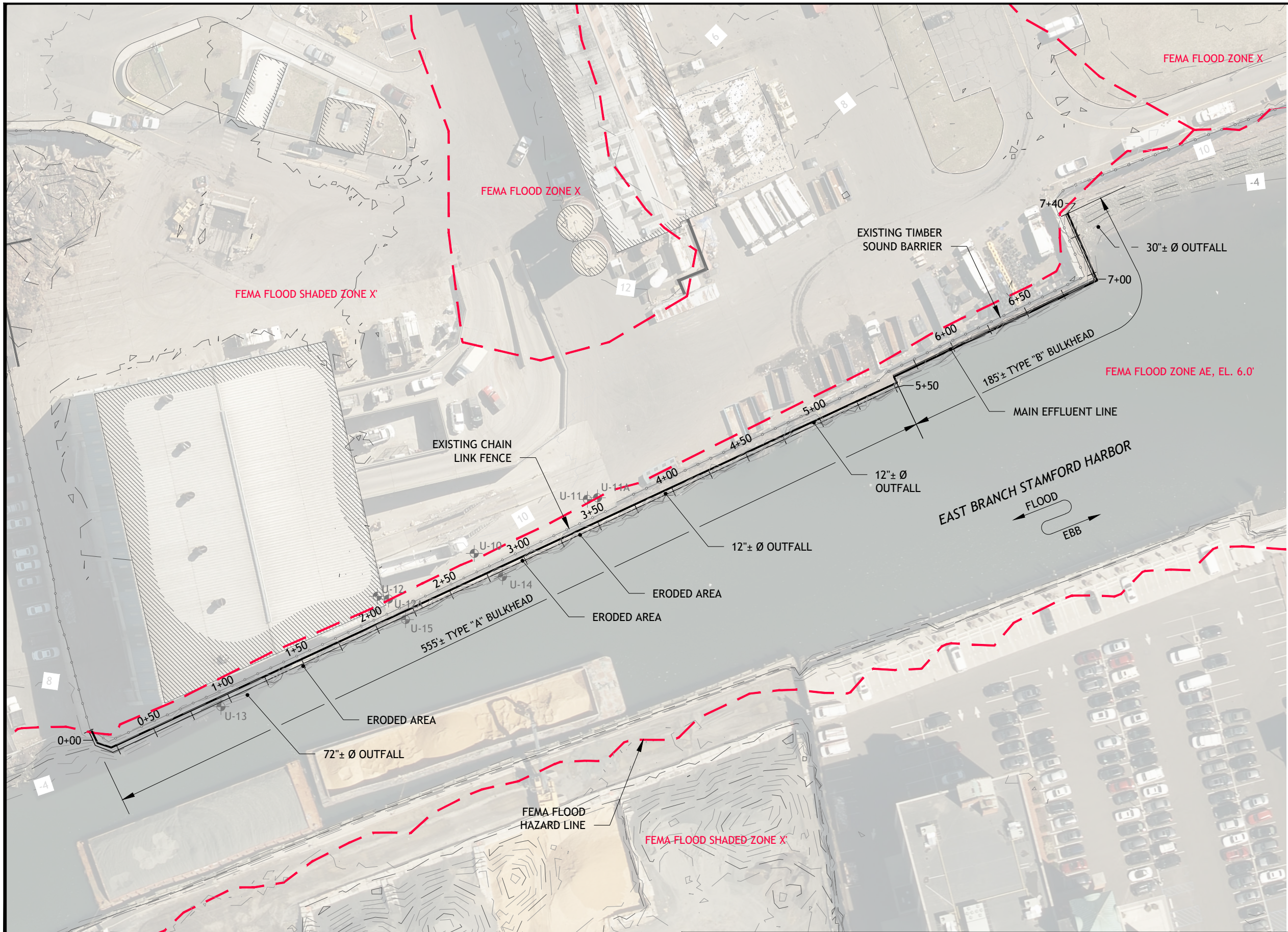
Reference Record Documents

A list of the record documents utilized to prepare this Report is provided below.

1. "Timber Bulkhead & Landfill", aerial photograph and one (1) page plan of the original timber bulkhead, dated 1971 (provided by the City);
2. "Sewage Treatment Plant Improvements and Expansion", eleven (11) page plan set prepared by Hayden and Harding Consulting Engineers, dated May, 1972 (provided by the City);
3. "Condition Survey Report: Existing Timber Bulkhead, Incinerator Plant, East Branch of the Stamford Harbor", five (5) page report prepared by the URS Company, Inc., dated 1981 (provided by the City);
4. "Geotechnical Investigation Report: Proposed Permanent Bulkhead, Existing Incinerator Plant, East Branch of the Stamford Harbor", fourteen (14) page report prepared by the URS Company, Inc., dated 1981 (provided by the City);
5. "City of Stamford Recycling and Transfer Station", forty-one (41) page plan set prepared by STV/Sanders & Thomas Engineers, Architects, Planners, dated May 1987, "as-built" dated July, 1989 (provided by the City);
6. *City of Stamford Tax Maps, Assessor's Historical Aerials (1959 and 1979)*, City of Stamford, stamfordct.maps.arcgis.com/apps/SimpleViewer/index.html?appid=123b1bcf11694f449610b3862463eeb6; and
7. *Stamford Water Pollution Control Authority*, City of Stamford, www.stamfordct.gov/water-pollution-control-authority-main.

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Figures



NOTES:

1. FEMA FLOOD ELEVATIONS SHOWN REFERENCE THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88). FLOOD INFORMATION SHOWN WAS TAKEN FROM FIRM MAP NUMBER 09001C0517G, PANEL 517 OF 626, REVISED JULY 8, 2013.

LEGEND:

U-11 SOIL BORINGS PERFORMED BY WARREN-GEORGE, INC. FOR URS COMPANY INC., FROM MAY 28 TO JUNE 10, 1981

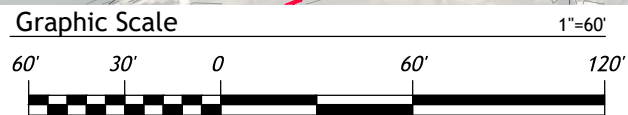
	NAVD 88	MLW
MHHW	3.48	7.08
MHW	3.15	6.75
NAVD '88	0.00	3.60
MLW	-3.60	0.00
MLLW	-3.84	-0.24

VERTICAL DATUM CONVERSION DIAGRAM

VERTICAL DATUM NOTES:

1. THE TIDAL DATA SHOWN WAS TAKEN FROM THE U.S. DEPARTMENT OF COMMERCE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA) ONLINE VERTICAL DATUM TRANSFORMATION PROGRAM, DETERMINED AT THE FOLLOWING LOCATION:
LOCATION: Bridgeport, Connecticut
LATITUDE: 41.175 N
LONGITUDE: 73.183 W

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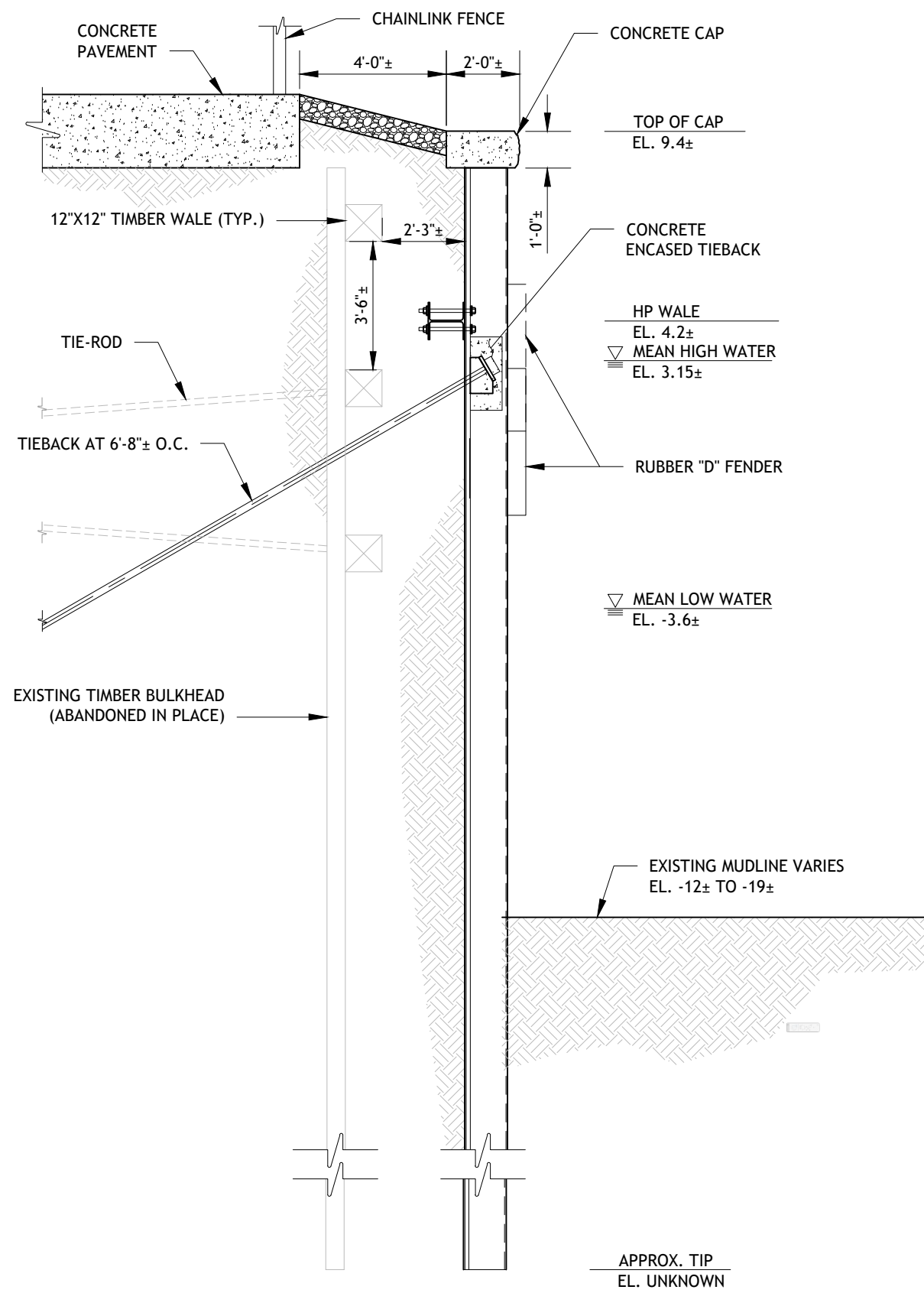
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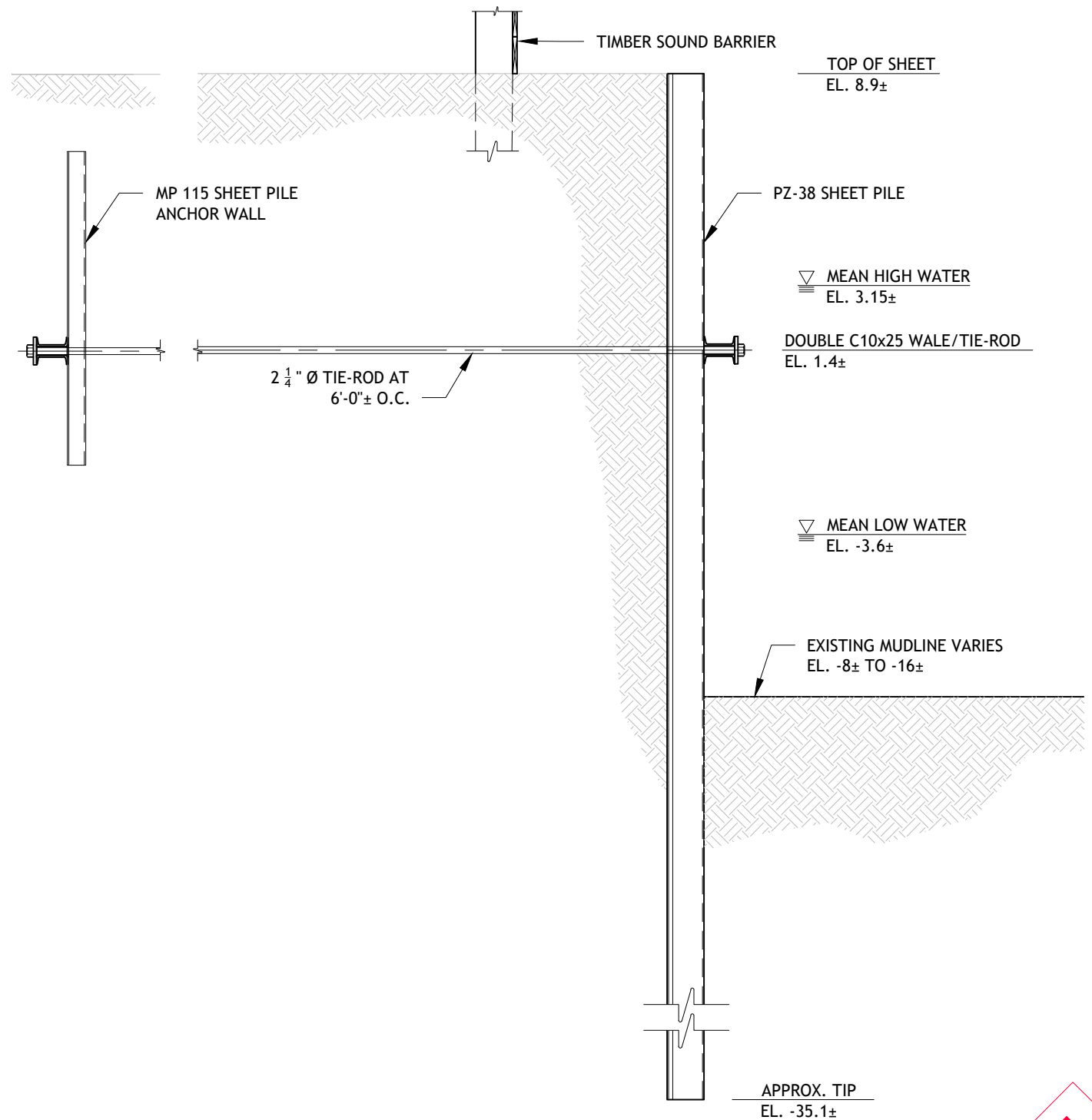
**CONDITION ASSESSMENT REPORT
WPCA BULKHEAD**

CITY OF STAMFORD
Stamford, Connecticut

**FIGURE 1
GENERAL SITE PLAN**



TYPE "A" BULKHEAD
STA 0+00 TO 5+55
SCALE: 1/4" = 1'-0"



TYPE "B" BULKHEAD
STA 5+55 TO 7+40
SCALE: 1/4" = 1'-0"

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Appendix A Photographs



Photo No. 1:
Historic aerial photograph of the WPCA facility, circa 1959.

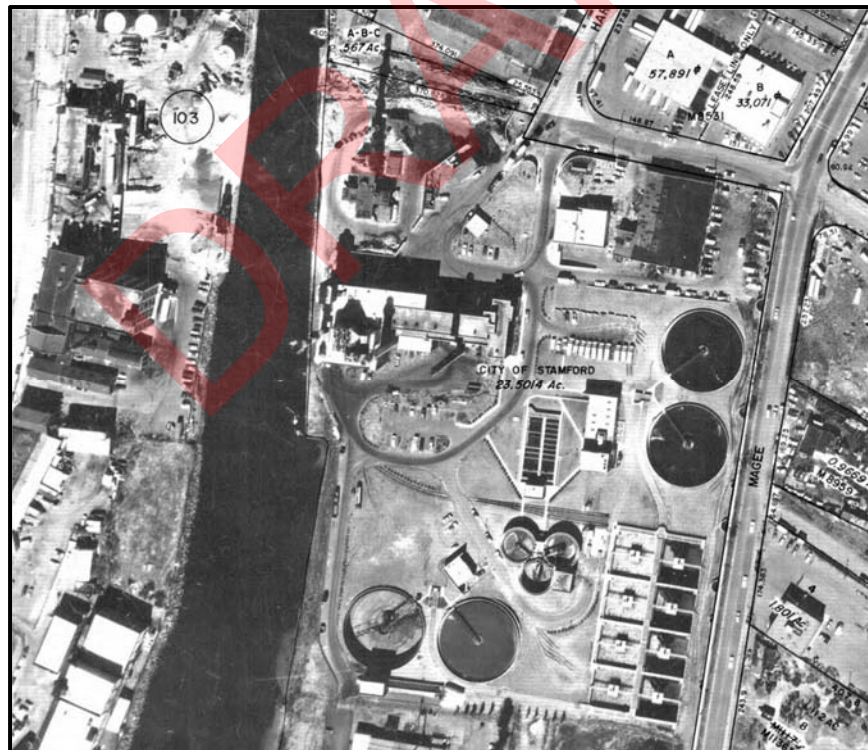


Photo No. 2:
Historic aerial photograph of the WPCA facility, circa 1979.



Photo No. 3:
Type "B" Bulkhead, STA 5+80 to 6+90, facing east, photo taken by RTG on April 16th, 2019.

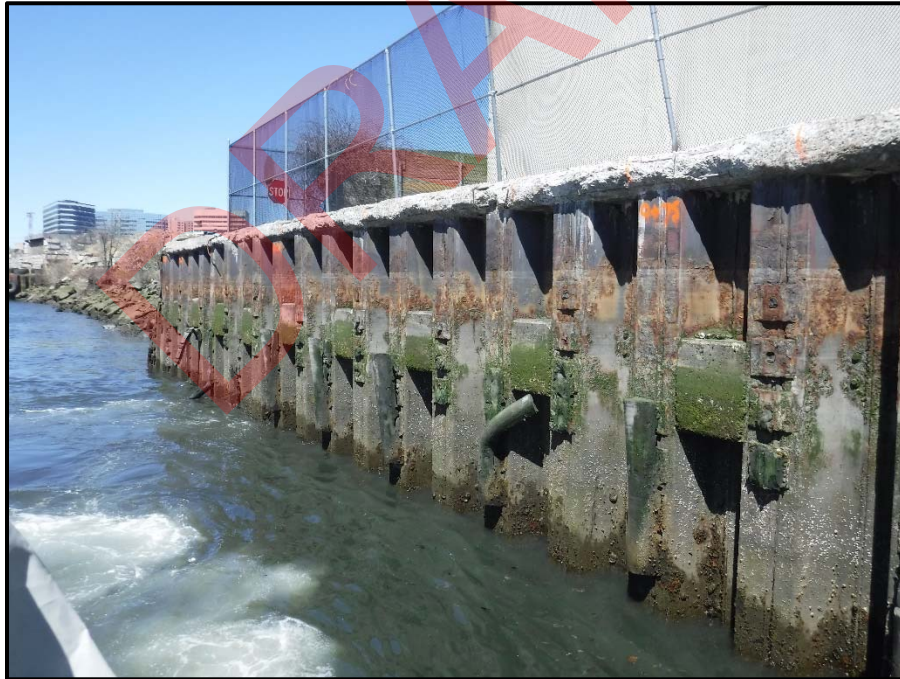


Photo No. 4:
Type "A" Bulkhead, STA 0+15 to 0+75, facing north, photo taken by RTG on April 16th, 2019.

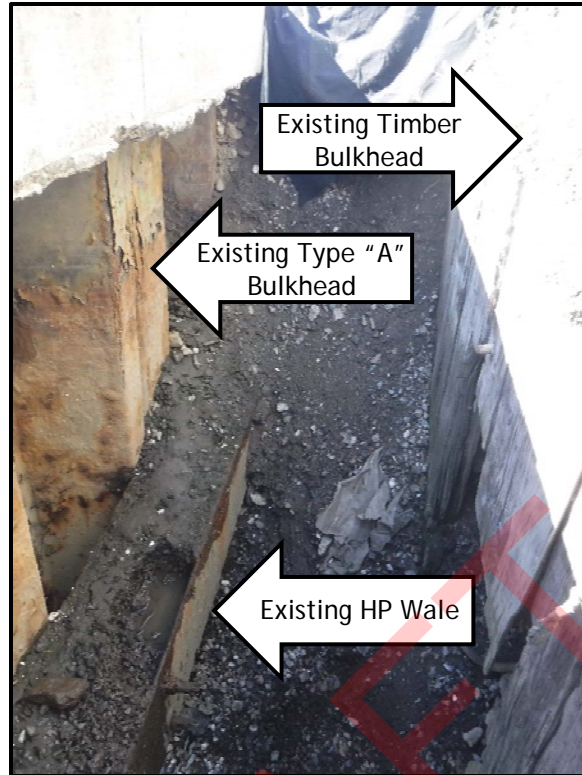


Photo No. 5:
Type "A" Bulkhead, STA 1+47, facing northwest, photo taken by RTG on April 16th, 2019.



Photo No. 6:
Type "A" Bulkhead, STA 0+57 to 1+00, facing east, photo taken by RTG on April 16th, 2019.



Photo No. 7:

Type "A" Bulkhead, STA 0+10, facing southwest, photo taken by RTG on April 16th, 2019.



Photo No. 8:

Type "A" Bulkhead, STA 5+20 to 5+50, facing east, photo taken by RTG on April 16th, 2019.



Photo No. 9:

Type "A" Bulkhead, STA 1+90, facing southeast, photo taken by RTG on April 16th, 2019.



Photo No. 10:

Type "A" Bulkhead, STA 3+70, facing southeast, photo taken by RTG on April 16th, 2019.



Photo No. 11:
Type "A" Bulkhead, STA 4+70 to 5+00, facing northeast, photo taken by RTG on April 16th, 2019.



Photo No. 12:
Type "A" Bulkhead, STA 1+00, facing east, photo taken by RTG on April 16th, 2019.



Photo No. 13:
Type "A" Bulkhead, STA 0+10 to 0+20, facing west, photo taken by RTG on April 16th, 2019.



Photo No. 14:
Type "A" Bulkhead, STA 2+50, facing southwest, photo taken by RTG on April 16th, 2019.



Photo No. 15:

Type "A" Bulkhead, STA 5+50, facing southeast, photo taken by RTG on April 16th, 2019.



Photo No. 16:

Type "A" Bulkhead, STA 1+40 to 1+55, facing southeast,
photo taken by RTG on April 16th, 2019.



Photo No. 17:
Type "A" Bulkhead, STA 2+80 to 3+05, facing southeast,
photo taken by RTG on April 16th, 2019.

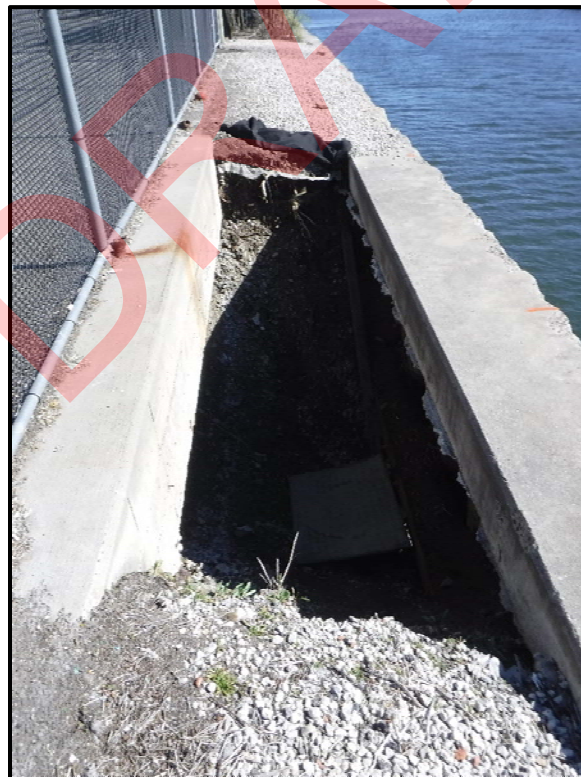


Photo No. 18:
Type "A" Bulkhead, STA 3+25 to 3+40, facing southeast,
photo taken by RTG on April 16th, 2019.



Photo No. 19:
Type "A" Bulkhead, STA 1+37 to 1+55, facing northeast,
photo taken by RTG on April 16th, 2019.



Photo No. 20:
Type "A" Bulkhead, STA 1+47, facing northwest, photo taken by RTG on April 16th, 2019.



Photo No. 21:

Type "A" Bulkhead, STA 1+10, facing northeast, photo taken by RTG on April 16th, 2019.

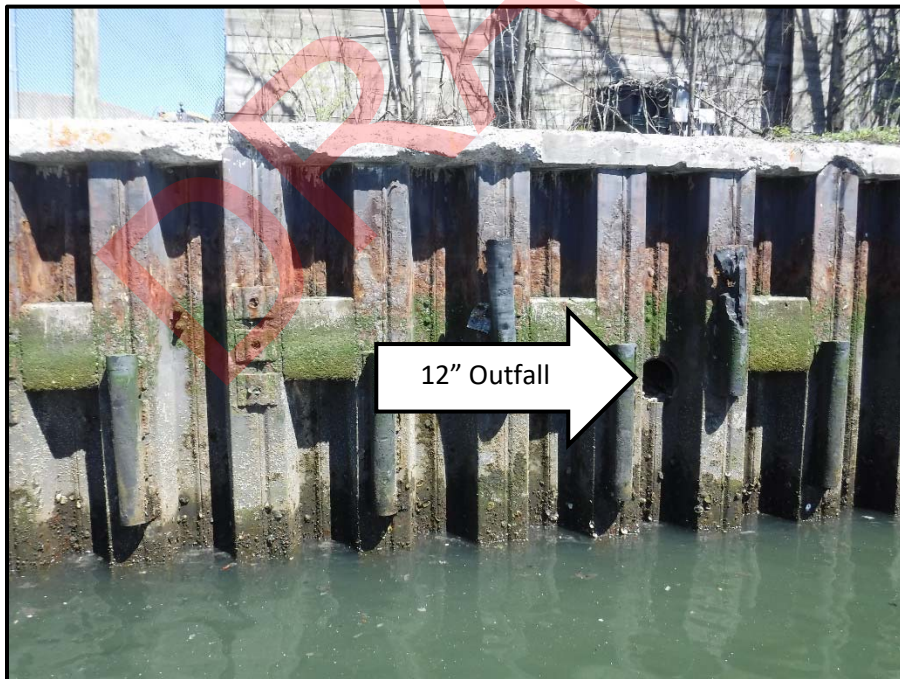


Photo No. 22:

Type "A" Bulkhead, STA 3+70 to 3+90, facing northeast,
photo taken by RTG on April 16th, 2019.



Photo No. 23:

Type "A" Bulkhead, STA 4+85 to 5+00, facing east, photo taken by RTG on April 16th, 2019.



Photo No. 24:

Type "B" Bulkhead, STA 6+00, facing southeast, photo taken by RTG on April 16th, 2019.

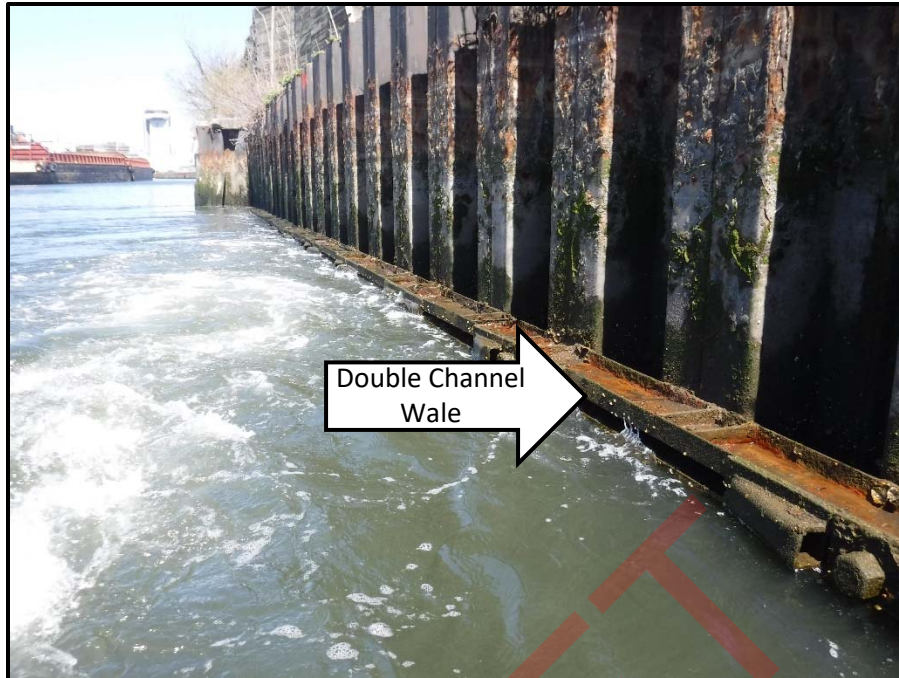


Photo No. 25:

Type "B" Bulkhead, STA 6+90, facing north, photo taken by RTG on April 16th, 2019.



Photo No. 26:

Type "B" Bulkhead, STA 6+85 to 7+40, facing northeast,
photo taken by RTG on April 16th, 2019.

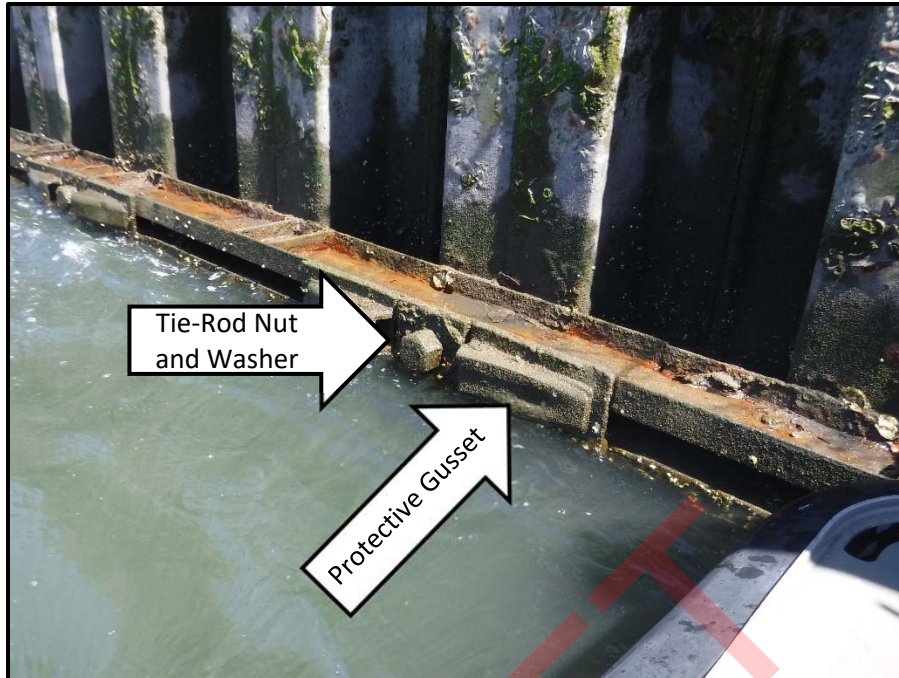


Photo No. 27:
Type "B" Bulkhead, STA 6+80, facing north, photo taken by RTG on April 16th, 2019.

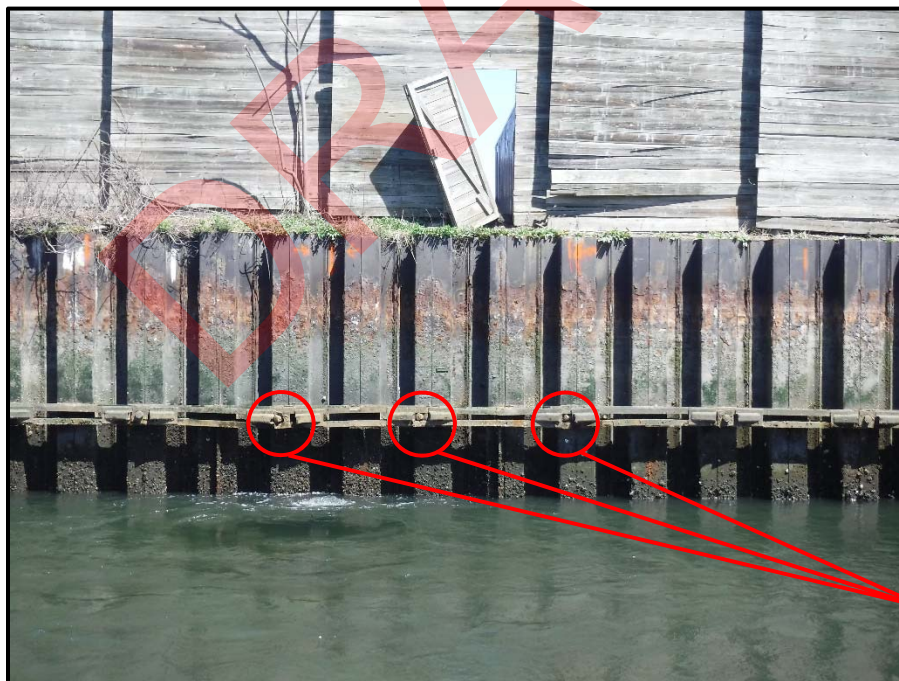


Photo No. 28:
Type "B" Bulkhead, STA 5+80 to 6+10, facing northeast,
photo taken by RTG on April 16th, 2019.



Photo No. 29:
Type "B" Bulkhead, STA 5+80 to 6+00, facing north, photo taken by RTG on April 16th, 2019.

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Appendix B
Detailed Rating Summary

TABLE B-1 Detailed Rating Summary WPCA Bulkhead City of Stamford Stamford, CT																	
Station	Cap			Wales			Tie Rod			Sheetpile					Approx. Height of Exposed Face (ft)		
	Type/Size	Rating	Notes	Size	Rating	Notes	Size @ Spacing	Rating	Notes	d x w	Rating Above MLW	Notes	Rating Below MLW	Ultrasonic Thickness Measurement	@face	15' offset from face	Water Level from Top of Cap
0+00 - 0+25	Reinforced Concrete 24" Wide x 12" Tall	2	Heavily spalled, missing between STA 1+10 and 1+17, exposed rebar throughout. 4' gravel surface treatment sloping upward from cap to concrete pavement from 0+00 to 3+70, about 1' grade change. CLF along edge of concrete pavement	Buried	NA	Wale is mounted inboard of bulkhead, buried in backfill	Unknown Diameter, S = 6'-8"± o.c.	NA	Tiebacks noted every other belly, heads are encased in concrete. Could not access tiebacks within backfill material	16" x 40"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2', sheets heavily damaged at STA 0+15	NA	STA 0+10 Approx. MHW + 2' = 0.38" Approx. MHW = 0.36" Approx. MHW - 2' = 0.37"	20	23	*water level from cap @12:15 PM 8.6' from TOC
0+25 - 0+50	Reinforced Concrete 24" Wide x 12" Tall	4	Heavily spalled, exposed rebar throughout	Buried	NA		Unknown Diameter, S = 6'-8"± o.c.	NA		16" x 40"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2'	NA	NA	20	23	*water level from cap @12:15 PM 8.6' from TOC
0+50 - 0+75	Reinforced Concrete 24" Wide x 12" Tall	4	Heavily spalled, exposed rebar throughout	Buried	NA		Unknown Diameter, S = 6'-8"± o.c.	NA		16" x 40"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2'	NA	NA	23	23	*water level from cap @12:15 PM 8.6' from TOC
0+75 - 1+00	Reinforced Concrete 24" Wide x 12" Tall	4	Heavily spalled, exposed rebar throughout	Buried	NA		Unknown Diameter, S = 6'-8"± o.c.	NA		16" x 40"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2'	NA	NA	23	24	*water level from cap @12:25 PM 9' from TOC
1+00 - 1+25	Reinforced Concrete 24" Wide x 12" Tall	4	Heavily spalled, exposed rebar throughout	Buried	NA		Unknown Diameter, S = 6'-8"± o.c.	NA		16" x 40"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2', 72" outfall at STA 1+10	NA	STA 1+00 Approx. MHW + 2' = 0.38" Approx. MHW = 0.37" Approx. MHW - 2' = 0.38"	25	25	*water level from cap @12:25 PM 9' from TOC
1+25 - 1+50	Reinforced Concrete 24" Wide x 12" Tall	4	Heavily spalled, exposed rebar throughout, significant erosion between STA 1+40 and 1+55	HP12 Section, 0.5" Flange and Web	4	Corrosion, pitting, section loss	Unknown Diameter, S = 6'-8"± o.c.	NA		16" x 40"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2'	NA	NA	23	24	*water level from cap @12:25 PM 9' from TOC
1+50 - 1+75	Reinforced Concrete 24" Wide x 12" Tall	4	Heavily spalled, exposed rebar throughout	Buried	NA		Unknown Diameter, S = 6'-8"± o.c.	NA		16" x 40"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2'	NA	NA	23	24	*water level from cap @12:25 PM 9' from TOC
1+75 - 2+00	Reinforced Concrete 24" Wide x 12" Tall	4	Heavily spalled, exposed rebar throughout	Buried	NA		Unknown Diameter, S = 6'-8"± o.c.	NA		16" x 40"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2'	NA	NA	24	23	*water level from cap @12:36 PM 9.3' from TOC
2+00 - 2+25	Reinforced Concrete 24" Wide x 12" Tall	4	Heavily spalled, exposed rebar throughout	Buried	NA		Unknown Diameter, S = 6'-8"± o.c.	NA		16" x 40"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2'	NA	STA 2+00 Approx. MHW + 2' = 0.37" Approx. MHW = 0.36" Approx. MHW - 2' = 0.38"	24	24	*water level from cap @12:36 PM 9.3' from TOC
2+25 - 2+50	Reinforced Concrete 24" Wide x 12" Tall	2	Heavily spalled, missing between STA 2+45 and 2+51, exposed rebar throughout	Buried	NA		Unknown Diameter, S = 6'-8"± o.c.	NA		16" x 40"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2'	NA	NA	24	24	*water level from cap @12:36 PM 9.3' from TOC
2+50 - 2+75	Reinforced Concrete 24" Wide x 12" Tall	4	Heavily spalled, exposed rebar throughout	Buried	NA		Unknown Diameter, S = 6'-8"± o.c.	NA		16" x 40"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2'	NA	NA	24	24	*water level from cap @12:36 PM 9.3' from TOC
2+75 - 3+00	Reinforced Concrete 24" Wide x 12" Tall	4	Heavily spalled, exposed rebar throughout, significant erosion between STA 2+80 and 3+05	Buried	NA		Unknown Diameter, S = 6'-8"± o.c.	NA		16" x 40"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2'	NA	NA	26	26	*water level from cap @12:44 PM 9.5' from TOC

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Station	Cap			Wales			Tie Rod			Sheetpile					Approx. Height of Exposed Face (ft)		
	Type/Size	Rating	Notes	Size	Rating	Notes	Size @ Spacing	Rating	Notes	d x w	Rating Above MLW	Notes	Rating Below MLW	Ultrasonic Thickness Measurement	@face	15' offset from face	Water Level from Top of Cap
Type "A" Bulkhead	3+00 - 3+25	Reinforced Concrete 24" Wide x 12" Tall	4	Heavily spalled, exposed rebar throughout	Buried	NA	Unknown Diameter, S = 6'-8"± o.c.	NA		16" x 40"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2', sheets lean inboard about 1' at STA 3+00	NA	STA 3+00 Approx. MHW + 2' = 0.22" Approx. MHW = 0.36" Approx. MHW - 2' = 0.36"	26	26	*water level from cap @12:44 PM 9.5' from TOC
	3+25 - 3+50	Reinforced Concrete 24" Wide x 12" Tall	4	Heavily spalled, exposed rebar throughout, significant erosion between STA 3+25 and 3+40	Buried	NA	Unknown Diameter, S = 6'-8"± o.c.	NA		16" x 40"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2'	NA	NA	27	27	*water level from cap @12:44 PM 9.5' from TOC
	3+50 - 3+75	Reinforced Concrete 24" Wide x 12" Tall	4	Heavily spalled, exposed rebar throughout, CLF ends at STA 3+70, timber sound barrier begins	Buried	NA	Unknown Diameter, S = 6'-8"± o.c.	NA		16" x 40"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2'	NA	NA	27	27	*water level from cap @12:44 PM 9.5' from TOC
	3+75 - 4+00	Reinforced Concrete 24" Wide x 12" Tall	4	Heavily spalled, exposed rebar throughout	Buried	NA	Unknown Diameter, S = 6'-8"± o.c.	NA		16" x 40"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2', 12" outfall at STA 3+87	NA	STA 3+90 Approx. MHW + 2' = 0.36" Approx. MHW = 0.36" Approx. MHW - 2' = 0.36"	28	26	*water level from cap @12:44 PM 9.5' from TOC
	4+00 - 4+25	Reinforced Concrete 24" Wide x 12" Tall	4	Heavily spalled, exposed rebar throughout, cleat at STA 4+04	Buried	NA	Unknown Diameter, S = 6'-8"± o.c.	NA		16" x 40"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2'	NA	NA	27	26	*water level from cap @12:55 PM 10' from TOC
	4+25 - 4+50	Reinforced Concrete 24" Wide x 12" Tall	4	Heavily spalled, exposed rebar throughout	Buried	NA	Unknown Diameter, S = 6'-8"± o.c.	NA		16" x 40"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2'	NA	NA	28	28	*water level from cap @12:55 PM 10' from TOC
	4+50 - 4+75	Reinforced Concrete 24" Wide x 12" Tall	4	Heavily spalled, exposed rebar throughout	Buried	NA	Unknown Diameter, S = 6'-8"± o.c.	NA		16" x 40"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2'	NA	NA	28	28	*water level from cap @12:55 PM 10' from TOC
	4+75 - 5+00	Reinforced Concrete 24" Wide x 12" Tall	4	Heavily spalled, exposed rebar throughout	Buried	NA	Unknown Diameter, S = 6'-8"± o.c.	NA		16" x 40"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2', 12" outfall at STA 4+88	NA	NA	26	26	*water level from cap @12:55 PM 10' from TOC
	5+00 - 5+25	Reinforced Concrete 24" Wide x 12" Tall	4	Heavily spalled, exposed rebar throughout	Buried	NA	Unknown Diameter, S = 6'-8"± o.c.	NA		16" x 40"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2'	NA	STA 5+00 Approx. MHW + 2' = 0.36" Approx. MHW = 0.36" Approx. MHW - 2' = 0.36"	26	26	*water level from cap @12:55 PM 10' from TOC
	5+25 - 5+55	Reinforced Concrete 24" Wide x 12" Tall	3	Heavily spalled, missing at STA 5+53, exposed rebar throughout, bulkhead returns 90-degrees into Type "B" Bulkhead	Buried	NA	Unknown Diameter, S = 6'-8"± o.c.	NA		16" x 40"	4	Surface scale and pitting, coating missing below MHW, and is heavily damaged up to MHW + 2', sheets heavily damaged at STA 5+50	NA	NA	26	27	*water level from cap @13:02 10.5' from TOC
Type "B" Bulkhead	5+55 - 5+75	No Cap	NA	Concrete cap ends at STA 5+55, top of sheets exposed. timber sound barrier continues	Double channel wale, 3" flng, 10" wide	4	Corrosion, pitting, section loss	NA	Surface corrosion visible, otherwise could not be evaluated, all tie-rods have a 9" sq. plate washer and nut	12"x36"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2'	NA	NA	22	24	*water level from cap @13:02 10.5' from TOC

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	Type/Size	Rating	Notes	Size	Rating	Notes	Size @ Spacing	Rating	Notes	d x w	Rating Above MLW	Notes	Rating Below MLW	Ultrasonic Thickness Measurement	@face	15' offset from face	Water Level from Top of Cap
Type "B" Bulkhead	5+75 - 6+00	No Cap	NA	Double channel wale, 3" flng, 10" wide	4	Corrosion, pitting, section loss	Unknown Diameter, S = 6'-0"± o.c.	NA	Surface corrosion visible, otherwise could not be evaluated, three (3) bent / displaced tie-rods noted between STA 5+88 to 6+00	12"x36"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2', main effluent line at STA 5+90	NA	NA	20	25	*water level from cap @13:02 10.5' from TOC
	6+00 - 6+25	No Cap	NA	Double channel wale, 3" flng, 10" wide	4	Corrosion, pitting, section loss	Unknown Diameter, S = 6'-0"± o.c.	NA	Surface corrosion visible, otherwise could not be evaluated	12"x36"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2'	NA	NA	18	20	*water level from cap @13:02 10.5' from TOC
	6+25 - 6+50	No Cap	NA	Double channel wale, 3" flng, 10" wide	4	Corrosion, pitting, section loss	Unknown Diameter, S = 6'-0"± o.c.	NA	Surface corrosion visible, otherwise could not be evaluated	12"x36"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2'	NA	NA	15	17	*water level from cap @13:09 10' from TOC
	6+50 - 6+75	No Cap	NA	Double channel wale, 3" flng, 10" wide	4	Corrosion, pitting, section loss	Unknown Diameter, S = 6'-0"± o.c.	NA	Surface corrosion visible, otherwise could not be evaluated	12"x36"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2'	NA	NA	14	15	*water level from cap @13:09 10' from TOC
	6+75 - 7+00	No Cap	NA	Double channel wale, 3" flng, 10" wide	2	Wale is failed between STA 6+90 and 7+00	Unknown Diameter, S = 6'-0"± o.c.	NA	Surface corrosion visible, otherwise could not be evaluated, tie-rods no longer in contact with wale because of damaged wale	12"x36"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2'	NA	NA	13	NA	*water level from cap @13:09 10' from TOC
	7+00 - 7+25	No Cap	NA	Double channel wale, 3" flng, 10" wide	4	Corrosion, pitting, section loss	Unknown Diameter, S = 6'-0"± o.c.	NA	Surface corrosion visible, otherwise could not be evaluated	12"x36"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2'	NA	NA	NA	NA	NA
	7+25 - 7+40	No Cap	NA	Double channel wale, 3" flng, 10" wide	4	Corrosion, pitting, section loss	Unknown Diameter, S = 6'-0"± o.c.	NA	Surface corrosion visible, otherwise could not be evaluated	12"x36"	4	Surface scale and pitting, coating missing below MHW and is heavily damaged up to MHW + 2'	NA	STA 7+35 Approx. MHW + 2' = 0.50" Approx. MHW = 0.40" Approx. MHW - 2' = 0.40"	NA	NA	NA
Average of All Bulkheads		3.8			3.8			NA			4.0		NA	AVERAGE BULKHEAD RATING PER TYPE:			
Overall Type "A" Bulkhead	3.8			4.0			NA			4.0			NA	3.9	AVERAGE TYPE "A" BULKHEAD RATING		
Overall Type "B" Bulkhead	NA			3.8			NA			4.0			NA	3.9	AVERAGE TYPE "B" BULKHEAD RATING		
NOTE: 1. Overall Ratings Rounded Down to Nearest Whole Number. 2. The fender systems were not rated in the Table above because they are no longer a necessary component of the existing bulkhead.														3.9		OVERALL BULKHEAD RATING	