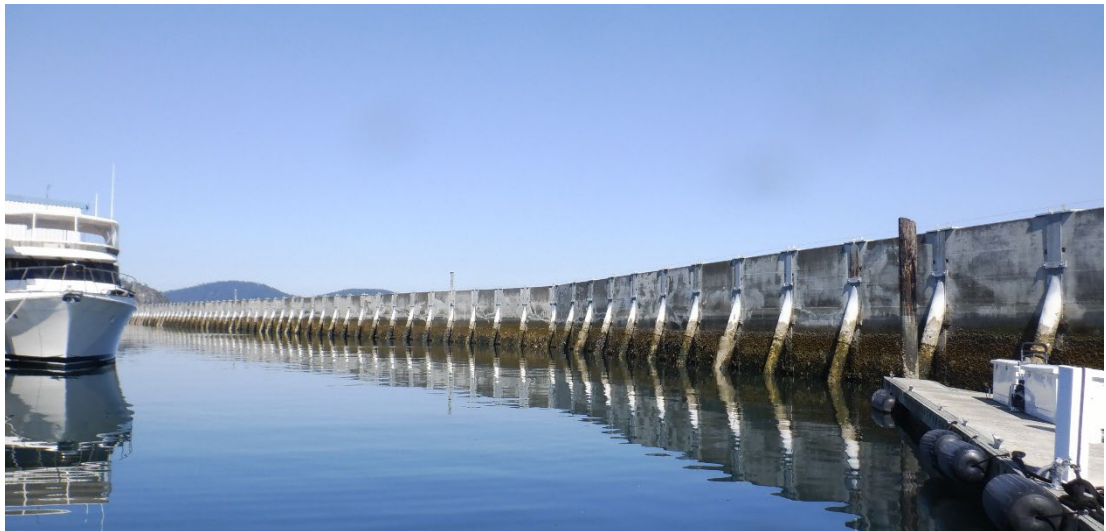




ECHELON ENGINEERING, INC.

Civil/Marine Consulting Engineers

**Sample Inspection & Assessment
of Steel Batter Piles
East Breakwater
Fidalgo Marina
Anacortes, WA**



Prepared For:

Fidalgo Marina Owners Association, Inc.
3101 V. Place
Anacortes, WA 98221

ATTN: Mr. Ed Stubbs
Treasurer

Prepared By:

Echelon Engineering, Inc.
21027 61st Avenue West
Lynnwood, WA 98036

ATTN: Ms. Shelley Sommerfeld, PE
President
Tel: 425 / 672.8924

September 2024
24-2669

October 14, 2024

Fidalgo Marina Owners Association, Inc.
3101 V. Place
Anacortes, WA 98221

ATTN: Mr. Ed Stubbs
Treasurer

**RE: Sample Inspection & Assessment of Steel Batter Piles
East Breakwater, Fidalgo Marina, Anacortes, Washington**

Dear Mr. Stubbs:

This report documents the findings of our recent inspection of a sampling of the batter piles within the East Breakwater at the Fidalgo Marina in Anacortes, WA. The project included inspection and assessment a sampling of 59 steel batter piles within the Fidalgo Marina East Breakwater. These piles were not included in the construction repairs that have been conducted since Echelon's previous inspection of the structure in 2021. The purpose of the inspection is to obtain additional detailed information on the current condition of these piles which can be compared to the data previously obtained in order to evaluate the estimated rate of corrosion and estimated remaining service life.

INTRODUCTION

The Fidalgo Marina is located on the southwestern shore of Fidalgo Bay, south of downtown Anacortes, WA. The marina consists of primarily covered moorage slips for large motor yachts. A small number of uncovered slips are available at the north end and the south end of the marina. The marina floats are constructed using foam filled concrete pontoons secured together with treated timber wales. The moorage slips are protected by three steel pile and concrete panel breakwaters located on the north and east sides of the facility. The three breakwaters have been identified as the Northwest, North and East Breakwaters. The Northwest Breakwater is owned by the City of Anacortes. The North and East Breakwaters are the property of the Fidalgo Marina.

The East Breakwater was the focus of this investigation and provides protection for the entire eastern side of the marina. The structure is constructed with 79 pairs of vertical H-piles and

pipe pile batters and 78 concrete wave barrier panels. The piles in this section are numbered consecutively 1 – 79 from the north.

The breakwater is constructed with vertical steel H-piles and steel pipe batter piles. Design drawings indicate that the majority of the H-piles are HP 14 x 89, with an original flange and web thickness of 0.615 inches. A steel 12.75” dia. x 3/8” battered pipe pile is welded to each vertical pile. The pipe piles are secured to the H-piles using a larger diameter pipe pile socket and welded connection. These batter piles also have a 40 ft. minimum length of HP 14 x 79 H-pile welded to the bottom most embedded portion of the pile. All of the breakwater piles are protected with a galvanized coating. Pre-cast concrete panels have been installed within the channels of the adjacent H-piles. The panels have been secured in place with bolted restraint plates and bolted connections.

Echelon Engineering conducted an inspection of the North and East Breakwater structures in 2021. That investigation found a number of the batter piles had sustained significant section loss and perforation due to corrosion. As a result, maintenance design and follow on construction was conducted to install concrete encasement of the damaged piles from the splash zone to the mudline. Sacrificial anodes were also installed on the vertical steel H-piles throughout the breakwater. This project included a one day effort to investigate the 59 steel pipe batter piles within the East Breakwater which were not included in the recent pile repair contract for the structure.

The results of the investigation are presented within this report. The findings of the project are discussed in the Observed Conditions section of this report. Photographs illustrating typical conditions encountered are presented in Appendix A. Appendix B provides a pile plan showing the location and identification of the inspected piling. Specific information on the condition of the inspected piling is presented in tabular format in Appendix C.

QUALIFICATIONS OF INSPECTORS

The investigation was conducted by a crew composed of professional and technical personnel capable and experienced in both the underwater and topside inspection and assessment of structural members. The personnel utilized on this project included the following Echelon Engineering staff:

S.D. Sommerfeld, P.E.	Project Manager/Engineer - Diver Licensed Professional Engineer - WA, AK, Guam 35 Years' Experience in Marine Structures Inspection and Design
G.Y. Tzortzis	Inspection Technician – Diver 3 Years' Experience in Marine Structures Inspection
A. Rosales	Inspection Technician 0.5 Years' Experience in Marine Structures Inspection

METHODOLOGY AND RATING SYSTEM

The project was conducted diligently, with properly qualified personnel and in conformance with the usual standards of similar companies performing similar services under similar circumstances. The inspection was conducted as a Routine Inspection on a sampling of the batter piles as outlined in the *ASCE Manuals and Reports on Engineering Practice No. 130 (MOP 130); Waterfront Facilities Inspection and Assessment*. For this project the inspected members were subjected to Level I, II, and III inspection techniques.

All 59 batter piles received Level I visual / tactile inspection from their tops to the mudline. The piles were examined to assess the integrity of the protective galvanized coating and to identify any gross mechanical or corrosion related damage. Level II cleaning and Level III testing was conducted on seven (7) batter piles which were previously subjected to Level III testing in 2021. The Level III testing involved ultrasonic thickness readings and was conducted at various elevations including the intertidal, submerged, and mudline zones using an Cygnus ultrasonic thickness gauge.

A corrosion potential survey was conducted on these same seven (7) piles, to assess the effectiveness of the cathodic protection (i.e. the galvanized coating, and the anodes on adjacent piles). The survey was conducted using a Copper Copper Sulphate reference cell. The corrosion potential (CP) measurements were taken at five foot intervals from the water surface to the mudline and were obtained at the highest tide available during the inspection. All readings were taken on the inside of the breakwater wall.

Throughout the discussion the overall condition of the inspected members is described as good, fair, or poor in accordance with the following definitions:

- A member in **good condition** has no damage or has sustained only minor damage.
- A member in **fair condition** has sustained minor to moderate damage, with no evidence of overstressing.
- A member in **poor condition** has sustained major to severe damage that affects the member's load bearing capacity. This damage may be evident as advanced deterioration, overstressing or breakage.

Steel Piling

The condition of the steel pipe piles is based on the overall damage noted along the length of the member by visual inspection and as augmented by various testing techniques. A breakdown of the member rating classifications is as follows:

- Members identified as **Undamaged** were found to have no damage or were noted to have minor blemishes such as:
 - protective coating or wrap intact

- light surface rust
- no apparent loss of material
- Members identified as having **Minor damage** were noted to have:
 - Protective coating or wrap damaged and loss of thickness up to 15 percent of nominal at any location
 - Less than 50 percent of perimeter or circumference affected by light corrosion at any elevation or cross section
 - Loss of thickness up to 15 percent of nominal at any location
- Members identified as having **Moderate damage** were noted to have:
 - Protective coating or wrap damaged and loss of thickness 15 to 30 percent of nominal at any location
 - Over 50 percent of perimeter or circumference affected by corrosion at any elevation or cross section
 - Loss of thickness 15 to 30 percent of nominal at any location
- Members identified as having **Major damage** were noted to have:
 - Protective coating or wrap damaged and loss of nominal thickness 30 to 50 percent at any location
 - Partial loss of flange edges or visible reduction of wall thickness on pipe piles
 - Loss of nominal thickness 30 to 50 percent at any location
- Members identified as having **Severe damage** were noted to have:
 - Protective coating or wrap damaged and loss of wall thickness exceeding 50 percent of nominal at any location

OBSERVED CONDITIONS

The field investigation was carried out on September 9, 2024. Weather was sunny with clear skies and calm conditions. The tide level during the inspection fluctuated between a low of +1.9 feet and a high of +4.1 feet (Chart Datum). Underwater visibility was poor, ranging from approximately one-half foot to three feet. These conditions negatively impacted the quality/resolution of the underwater photos included in this report. No currents were encountered during the investigation. Findings of the investigation are as follows:

1. Refer to Appendix C, Table 1, Table 2, and Table 3 for detailed Level I visual inspection results, Level III ultrasonic thickness measurements and the results of the corrosion potential survey, respectively.
2. Based on cursory observation, the overall condition of the East Breakwater, including the vertical piles, batter piles, concrete panels and the recent repairs, found it to be in fair to good condition. The condition of the 59 steel pipe batter piles included within this project

was found to be fair. Currently, these piles are being protected from further corrosive section loss by the sacrificial anode system.

3. The investigation of the 59 pipe batter piles inspected within this sample investigation found visible evidence of past surface corrosion and minor pitting, but no visible active orange corrosion or perforation on any of these piles. Based on the Level III testing, which did not indicate any significant increase in surface corrosion, pit size or on-going corrosion, all 59 piles (100%) have been rated in the Moderate Damage category.
4. Design drawings indicate that these piles are 12.75 inch dia. X 3/8 inch pipe piles (i.e. nominal thickness = 0.375 in.) For comparative purposes Level III ultrasonic thickness readings were taken on seven of the piles on which thickness readings were taken in the 2021 inspection. The data obtained during this investigation found the remaining thicknesses to range from 0.240 inches to 0.390 inches with an average thickness of 0.307 inches (~18.1% loss). The most significant losses were measured throughout the submerged length of the piles below ~El. 0 ft. (MLLW).

Pile Number	2024 Readings		2021 Readings		Combined Average Loss (%)
	Average Thickness (inches)	Average Percent Loss (%)	Average Thickness (inches)	Average Percent Loss (%)	
9 Br	0.318	15.3%	0.295	21.3%	18.3%
20 Br	0.290	22.7%	0.321	14.3%	18.5%
38 Br	0.315	16.0%	0.293	22.0%	19.0%
45 Br	0.290	22.7%	0.300	20.0%	21.3%
56 Br	0.289	23.0%	0.345	8.0%	15.5%
65 Br	0.306	18.3%	0.353	6.0%	12.2%
79 Br	0.343	8.7%	0.283	24.7%	16.7%

Thickness readings on several piles indicate a greater thickness in 2024 than was obtained in 2021. This is because the exact location of the previous readings are almost impossible to replicate. However, the readings do provide additional data of the overall thickness and loss of the piles sampled. As can be seen in the table above, the overall average loss of thickness ranges from 12.2% to 21.3%.

5. Level III corrosion potential measurements were obtained on seven steel batter piles on which readings were also taken in 2021. For this survey, electrical contact was made to the top of the pile(s) tested, and the Copper Copper Sulphate half-cell was lowered from the water surface to the mudline with the measured values recorded at 5 foot intervals.

The CP values as determined relative to a CuCuSO₄ reference cell were all found to be above the -0.850 V threshold that indicates cathodic protection of steel in seawater. The CP values were found to range from -0.984 to -1.060 V which indicate that the steel is being protected by the sacrificial anode system.

6. Cursory observation of the concrete encasement repairs and the sacrificial anode installation found the repairs to be of overall good workmanship.

SUMMARY


This inspection has found that the overall condition of the 59 steel pipe batter piles included in the sample inspection of the East Breakwater, to be fair to good with all of these piles rated in the Moderate Rating category. No areas of bright orange active corrosion were found on any of the inspected piles during the Level I visual inspection or after Level II cleaning. Level III ultrasonic thickness readings found similar losses when compared to the data obtained in 2021 with the overall average loss of thickness on these piles to range from 12.2 – 21.3%. Data obtained from the Level III corrosion potential survey ranged from -0.984 to -1.060 V which indicate that the steel is being protected by the sacrificial anode system.

Visual inspection, thickness readings and the data obtained from the corrosion protection survey confirms that although the piles have previously sustained surface corrosion and loss of section, the recently installed sacrificial anodes are providing protection of the steel.

Based on the recent concrete encasement of the heavily damaged piles and the findings of this inspection, and ASCE guidelines, it is recommended that periodic re-inspections of the entire facility be carried out on a five to six-year schedule. These inspections will help to monitor the condition of the facility, as well as identify any specific members that may require maintenance. Such an approach will help to ensure the structural integrity and longevity of the facility.

It has been a pleasure to have worked with you on this project. Should you have any questions concerning this report, or if we can assist you further in your inspection and maintenance program for the facility, please do not hesitate to contact our office.

Yours Truly,
Echelon Engineering, Inc.



Ms. Shelley D. Sommerfeld, P.E.
President

SDS:ebv
enclosures



PHOTO No. 1:

East Breakwater, Looking North - This investigation focused on inspection of the batter piles which were not included in the recent concrete encasement and anode installation contract. Note the piles which have been encased in concrete from the intertidal zone to the mudline (refer to arrow).



PHOTO No. 2:

Batter Pile No. 79 - Note the overall good condition of the batter pile in 2024 and the lack of any visible active orange surface corrosion in the intertidal zone.



The small insert photo, taken in 2021, shows areas of bright active orange corrosion indicative of on-going section loss. As indicated above, no active orange corrosion was found on any of the piles included within this sample inspection.





PHOTO No. 3: Batter Pile No. 27 - Note the moderate marine growth on the pile in the lower intertidal zone. Also note the lack of bright orange surface corrosion which was evident on the pile during the previous 2021 inspection.



PHOTO No. 4: Batter Pile No. 27 - Inspection of the piles in the submerged and mudline zones, also found no indication of bright orange surface corrosion that is indicative of on-going section loss.





PHOTO No. 5: Batter Pile No. 38 - Note the generally good condition of the pile in areas which are not covered by marine growth (refer to arrow). Also note the lack of active orange surface corrosion on the pile.



PHOTO No. 6: Batter Pile No. 38 - Visual investigation of the piles along with the data obtained from the Corrosion Potential survey, found the batter piles to be protected from on-going corrosion. These conditions were typical of the inspected piles with no evidence of active surface corrosion noted.



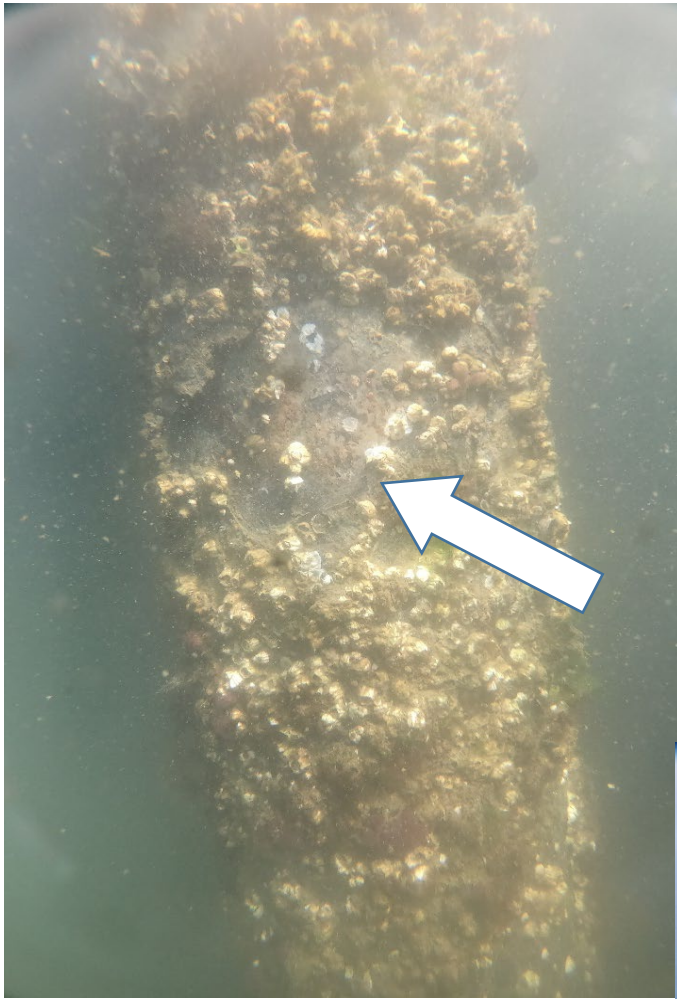
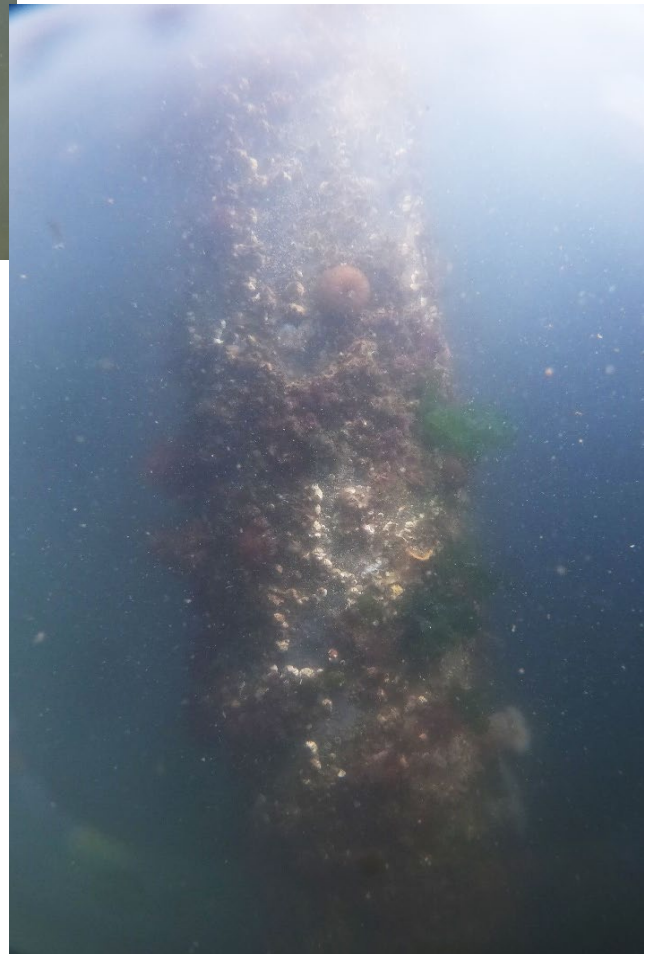


PHOTO No. 7: Batter Pile No. 56 - Note the general good condition of the steel on this pile in the intertidal zone (refer to arrow).

PHOTO No. 8: Batter Pile No. 56 - Inspection of the pile in the submerged zone also did not identify any active on-going corrosion of the steel.



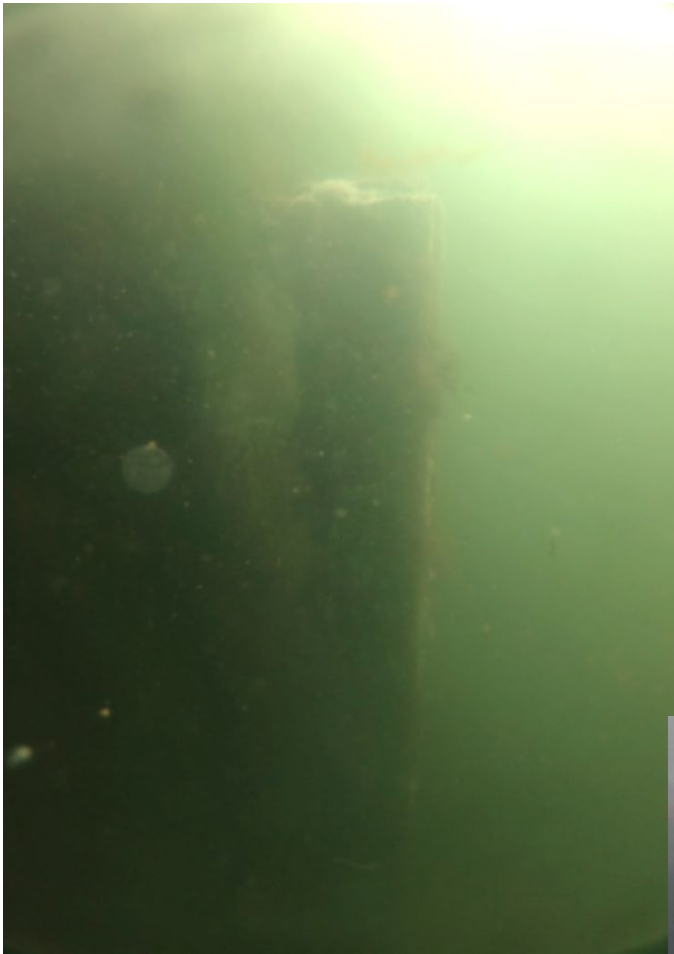
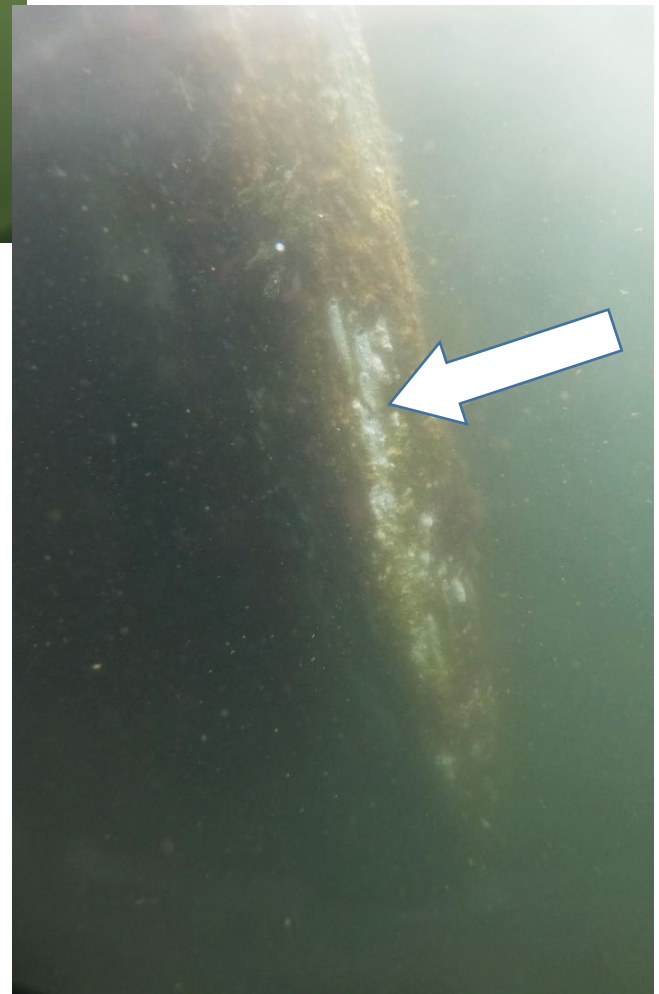
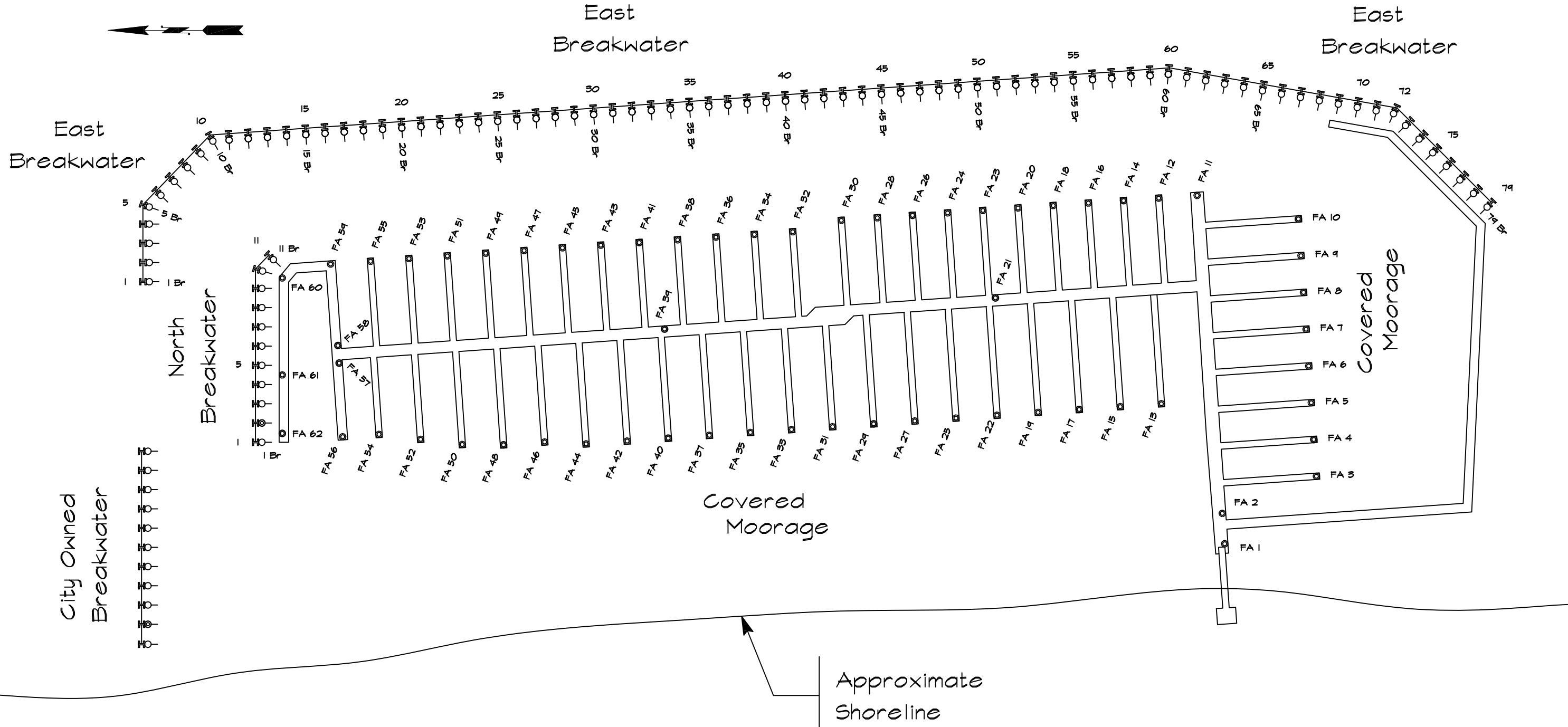


PHOTO No. 9: Vertical Pile No. 27, Anode
- Cursory observation of the anodes which have been installed on the vertical piles throughout the breakwater found them to be in good condition with an estimated 95-99% of their volume remaining.

PHOTO No. 10: Vertical Pile No. 27, Anode
Close-up - Close investigation of several anodes found them to be functioning, as evidenced by areas that are clean of marine growth (refer to arrow).





10/1/2024 9:36 AM 2669-Sht 1.dwg SDS / JDS, Echelon Engineering, Inc.

LEGEND

- Concrete Float Anchor Pile
- Steel H - Pile
- Steel Pipe Pile Batter

PLAN

SCALE: Not To Scale	
Fidalgo Marina Owners Association	
PILE PLAN	
Fidalgo Marina Anacortes, Washington	
DATE: Sept. 2024	ECHELON ENGINEERING, INC. Civil/Marine Consulting Engineers Lynnwood, Washington Tel: (425) 672-8424
PROJECT: 24-2669	
SHEET: 1 of 1	
DRAWN: SDS / JDS	

TABLE 1
STEEL PILE INSPECTION DATA

PILE IDENTIFICATION		MEMBER RATING	CONDITION / DAMAGE	
Pile Number	Pile Type		Elevation (Chart Datum)	Details / Remarks
9 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/8" Scale & Minor Pitting No visible active corrosion
10 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/8" Scale & Minor Pitting No visible active corrosion
11 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/8" Scale & Minor Pitting No visible active corrosion
19 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/8" Scale & Minor Pitting No visible active corrosion
20 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
21 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
22 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
25 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/8" Scale & Minor Pitting No visible active corrosion
26 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
27 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
28 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion

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29 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
30 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
31 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
32 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
33 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
34 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
35 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
36 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
37 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
38 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
39 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion

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Pile Number	Pile Type		Elevation (Chart Datum)	Details / Remarks
40 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
41 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
42 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
43 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
44 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
45 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
46 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
47 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
48 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
49 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
50 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion

TABLE 1
STEEL PILE INSPECTION DATA

PILE IDENTIFICATION		MEMBER RATING	CONDITION / DAMAGE	
Pile Number	Pile Type		Elevation (Chart Datum)	Details / Remarks
51 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
52 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
53 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
54 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
55 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
56 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
57 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
58 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
59 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
60 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
61 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion

TABLE 1
STEEL PILE INSPECTION DATA

PILE IDENTIFICATION		MEMBER RATING	CONDITION / DAMAGE	
Pile Number	Pile Type		Elevation (Chart Datum)	Details / Remarks
63 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
64 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
65 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
66 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
67 Br	Steel Pipe Pile	Undamaged	SPL ITZ / MDL	95-99% Coating Intact Concrete Encasement Repair - UD
68 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
69 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
70 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
71 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
72 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/2" Scale & Minor Pitting No visible active corrosion
73 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion

TABLE 1
STEEL PILE INSPECTION DATA

PILE IDENTIFICATION		MEMBER RATING	CONDITION / DAMAGE	
Pile Number	Pile Type		Elevation (Chart Datum)	Details / Remarks
75 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
76 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
77 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
78 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion
79 Br	Steel Pipe Pile	Moderate Damage	SPL ITZ / MDL	95-99% Coating Intact 0-25% Coating Intact, 1/4" Scale & Minor Pitting No visible active corrosion

TABLE 2
STEEL PILES - LEVEL III THICKNESS READINGS

PILE IDENTIFICATION			2024 THICKNESS READINGS, (inches)						2021 READINGS		Average Percent Loss (%) (2021 & 2024)
Pile Number	Pile Type	Nominal Thickness (in.)	Splash Zone	Intertidal Zone	Submerged zone	Mudline	Average	Average Percent Loss (%)	Average	Average Percent Loss (%)	
9 Br	Pipe Pile	0.375	0.380	0.390	0.250	0.250	0.318	15.3%	0.295	21.3%	18.3%
20 Br	Pipe Pile	0.375	0.375	0.285	0.250	0.250	0.290	22.7%	0.321	14.3%	18.5%
38 Br	Pipe Pile	0.375	0.375	0.285	0.310	0.290	0.315	16.0%	0.293	22.0%	19.0%
45 Br	Pipe Pile	0.375	0.370	0.240	0.310	0.240	0.290	22.7%	0.300	20.0%	21.3%
56 Br	Pipe Pile	0.375	0.370	0.260	0.240	0.285	0.289	23.0%	0.345	8.0%	15.5%
65 Br	Pipe Pile	0.375	0.375	0.260	0.295	0.295	0.306	18.3%	0.353	6.0%	12.2%
79 Br	Pipe Pile	0.375	0.380	0.320	0.285	0.385	0.343	8.7%	0.283	24.7%	16.7%

TABLE 3
LEVEL III Corrosion Potential Readings

BREAKWATER	POTENTIAL READINGS (V) All Readings are to Cu/CuSO ₄					
	Depth of Reading (ft.)					Mudline Depth at Time of Readings (ft.)
Pile No.	Surface	-5'	-10'	-15'	-20'	
9 Br	1.054	1.028	1.017	1.020	1.030	-15' Mudline
20 Br	1.030	1.012	1.000	1.000		-14' Mudline
38 Br	1.026	1.005	1.002	1.000		-13' Mudline
45 Br	1.022	1.001	0.989	0.985		-12' Mudline
56 Br	1.014	1.012	0.991	0.984		-14' Mudline
65 Br	1.011	1.012	0.993	0.996		-15' Mudline
79 Br	1.060	1.043	1.030			-9' Mudline