



November 1, 2021

Schooner Yacht Association
73 Harbor Drive
Stamford, CT 06902

Attention: Mr. Tony Olmer

Reference: Underwater Investigations of Timber Pilings at Schooner Cove Yacht Association

Dear Mr. Olmer:

On October 6, 2021, RACE Coastal Engineering, LLC ("RACE") led an underwater investigation to review the condition of the 68 timber piles to the South dock and 30 piles to the North dock along with the fixed platform at the gangway at the Schooner Cove Yacht Association ("SCYA") in Stamford, Connecticut. RACE's scope of work was to perform ASCE Level 1 visual and tactile investigation. This letter report provides a description of the existing conditions, a summary of RACE's visual evaluation, and recommended actions.

Executive Summary

The timber piles were observed to be in generally in **Fair/Good** Condition. However, significant damage was observed on 7 piles that are recommended for replacement. These piles include #6, #16, #22, #26, #79, #83, #85, F-1, F-3, and F-4 as identified in Pile Location Sketch included in Appendix B.

In addition, RACE recommends the following actions to be performed:

1. Replace pilings 6, 16, 22, 26, 79, 83, 85, F-1, F-3, and F-4 with a timber pile or composite pile.
2. Address pile guides damaging piles: 1, 9, 23, 24, 25, 27, 29, 32, 35, 38B, 45, 46, 50, 51, 54, 63, 64, 65, 66, 75, 80, 89, 96.
3. Address pile height as related to storm surge elevations. Existing storm anchors do not appear to be adequate to restrain the dock system if the piles are overtopped. It is understood that the U.S. Army Corps of Engineers Hurricane Barrier, when closed, will limit surge level. However, it is important that SCYA understand the relatively low pile cut-off elevations could be cause for concern in certain situations.
4. Several storm anchors are missing or in deteriorated condition. If these are determined to be necessary for marina performance than they should be appropriately addressed.
5. Schedule maintenance program to replace piles as necessary in the future
6. Perform an updated routine inspection in 2025.

RACE's observations for individual structural elements and recommendations for follow-up actions are based upon the results of the underwater investigation. The Underwater Investigations Standard Practice Manual (ASCE, 2001) was used as a guideline for condition ratings.

Introduction

RACE was contracted by the Schooner Cove Yacht Association to perform a routine underwater investigation for the timber float piles for the marina and associated “storm anchors”. Storm anchors include gravity anchors connected with rope and/or chain to the floating docks. It is understood that the intention of these anchors is to retain the floating dock system in situation where storm water levels would have the docks float over the piles.

The underwater investigation was performed on October 6, 2021, by a four-person inspection team consisting of Engineer/Diving Supervisor from RACE supported by a Diver, Dive Tender, and Back-Up Diver from Shoreline Diving Services. The diving investigation was conducted by using scuba consisting of two steel 80 tanks with free flow regulator. All observations were recorded by RACE topside personnel.

The underwater investigation included a visual or tactile inspection over one hundred percent (100%) of the accessible components (Level I). The purpose of a Level I inspection effort is to detect obvious damage or deterioration, extensive biological growth, or attack from visual and tactile inspection methods. The Diver also removed growth in sporadic areas as well as sounded pilings at various depths.

This report summarizes the findings of the underwater investigation of the timber piles supporting the marina’s floating docks. The appendices contain selected site photographs of observed conditions and a sketch of piling layout to cross-reference the conditions. Video of piling conditions of the piles was also taken by the divers and can be provided to the Client upon request.

The existing conditions of the piles were rated by the categories defined in Routine Condition Assessment Ratings outlined by the American Society of Civil Engineers (ASCE) in their *Waterfront Facilities Inspection and Assessment Manual* No. 130, dated 2015.

Table 1: ASCE Rating Descriptions

Rating	Description
Good	No visible damage, or only minor damage is noted. Structural elements may show very minor deterioration, but no overstressing is observed. No repairs are required.
Satisfactory	Limited minor to moderate defects or deterioration are observed, but no overstressing is observed. No repairs are required.
Fair	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. Repairs are recommended, but the priority of the recommended repairs is low.
Poor	Advanced deterioration, overstressing, or breakage may have significantly affected the load-bearing capacity of the structure. Repairs may need to be carried out with moderate urgency.
Serious	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. Repairs may need to be carried out on a high-priority basis with urgency.
Critical	Very advanced deterioration, overstressing, or breakage has resulted in localized failure(s) of primary structural components.



	More widespread failures are possible or likely to occur, and load restrictions should be implemented as necessary. Repairs may need to be carried out on a very high priority basis with strong urgency.
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Description of Structure

The Schooner Cove Yacht Association Marina has five entry points from land to the timber floating docks. The marina has a total of 97 timber piles, as well as storm anchor connection points and anchors. Divers only identified 4 existing storm anchors to the marina system.

Observed Conditions

Storm Anchors:

Storm anchors include gravity anchors or helical anchors connected with rope and/or chain rode to the floating docks. It is understood that the intention of these anchors is to retain the floating dock system in situation where storm water levels would have the docks float over the piles. It is not evident to RACE that these anchors, even if fully intact, would perform successfully in this capacity.

Storm Anchors that were intact and able to be observed include: # 1, #2, #4, and #5 per the plan provided to RACE by SCYA. RACE identified at multiple locations either broken chain or snapped lines as shown in the photo below.



Photograph 1: Typical condition of broken line where anchor connection is located

Please refer to Appendix B for Storm Anchor locations.

Table 2: Storm Anchor Condition

Storm Anchor	Notes on Anchor Condition
1	1/2" chain to a helical anchor that has 4' of termination end sticking out, shackles not moused.
2	1/2" chain to a helical anchor that has 4' of termination end sticking out, shackles not moused.
3	Chain broken at connection
4	250 mushroom anchor with 1/2" chain, shackles not moused
5	1/2" chain exposed then embedded into the mud over 2'
6	Unable to locate
7	Unable to locate
8	Unable to locate
9	Unable to locate
10	Unable to locate
11	Broken chain. Unable to locate anchor.
12	Broken line. Unable to locate anchor.
13	Unable to locate
14	Broken line. Unable to locate anchor.
15	Broken line. Unable to locate anchor.
16	Unable to locate
17	Broken line. Unable to locate anchor.
18	Broken line. Unable to locate anchor.



Timber Piles:

Investigation started at the south end of the floating dock system and worked their way west going through each pile. The findings that were identified from each pile were reported topside. RACE recorded the data and performed a low water review of the piling while on site.

Numerous timber piles had marine borer damage as shown, please see Photograph 2. Marine borer damage can be classified as two types: crustacean borers and molluscan borers. The *Limnoria* is waterborne, surface crustacean. It is also known as the wood loose or gribble. Gribbles tunnel their way through the wood with a 1/4" size hole and continue to burrow through a pile over time causing the pile to become deteriorated and have a sponge like feel.



Photograph 2: Typical marine borer damage at knot of piling

The second type is *Teredo* and *Bankia* which are both internal marine borers. These are also known as shipworms. Shipworms start at low treated areas on a pile and work their way to the center of the pile.

Extent of damage caused by marine borers is difficult to determine from a Level 1 inspection. This is because this type of inspection is limited to the surface of the inspected pile while borer infestation occurs within the pile. Destructive testing by removing and cutting open a pile is the most definitive way to ascertain internal damage level. Figure 1, below, depicts damage on timber piles from marine borers.

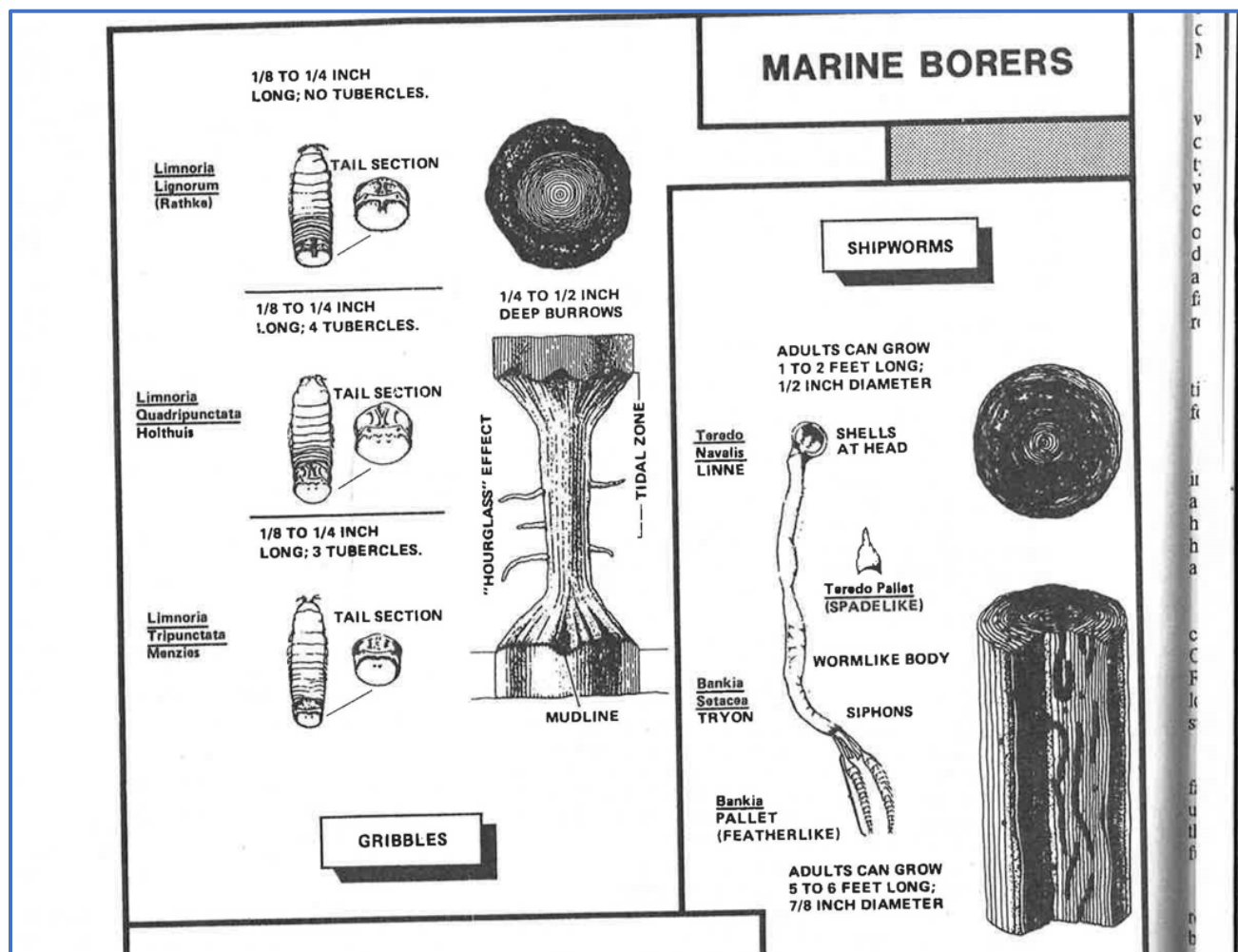


Figure 1: Marine Borer Damage

Significant marine borer damage was observed on pile numbers 6, 16, 22, 26, 79, 83, 85, F-1, F-3, and F-4. The pilings on the fixed platform, which is located north of the property, are in **Poor/Serious** condition. In this area half of the piles were deteriorated by ice and marine borer damage.

Please refer photograph #3 and photograph #4 following. Photograph 3 depicts conditions of a current, in-service pile, with marina borer damage. Photograph #4, which was provided by SCYA, shows a broken pile with apparent, extensive borer damage. The purpose of showing these two photographs is to demonstrate that there may be much more damage within the pile than is visible at the surface.





Photograph 3: Typical marine borer damage to pilings listed as Poor/Serious



Photograph 4: Broken Pile provided by SCYA

Also, on numerous piles there was abrasion damage caused by either the piles being out of plumb or guide assemblies missing rollers. Please see photograph #3. Piles exhibiting abrasion damage were typically rated **Satisfactory / Fair**.



Photograph 5: Typical wear and tear from pile guide

Pile Condition Summary:

As noted, a Level 1 inspection of piles was performed as part of this inspection effort. Following Table details observations and ratings.

Table 3: Pile Conditions:

Pile	Pile Grade	Notes on Piling Condition
1	Satisfactory	Pile installed out of plumb causing abrasion damage on guide assembly
2	Fair	Minor rot in pile
3	Fair	Minor ice damage
4	Good	
5	Fair	
6	Poor	Multiple marine borer holes
7	Satisfactory	
8	Fair	Minor marine borer damage approximately 13' below Mean High Water (MHW)
9	Fair	Minor abrasion damage from guide pile



10	Satisfactory	Splits in pile above MHW; possibly due by impact hammer
11	Fair	Abrasion from ice damage in intertidal region
12	Fair	Minor rot in pile
13	Fair	Minor rot in pile
14	Fair	
15	Fair	Minor abrasion from ice damage
16	Poor	Abrasion from ice damage in intertidal region. Bore damage 13' from MHW, piling is thinning
17	Fair	Minor marine borer damage at knot 6' from MHW
18	Fair	Minor mariner borer damage
19	Satisfactory/Fair	Minor rot in pile
20	Satisfactory	Pile noted in satisfactory condition. Noted that there was a derelict pile broken near mudline near this location and remnant pile has extensive marine borer damage
21	Fair	
22	Poor	Significant marine borer damage
23A	Fair	Marine borer damage at a knot 10' below MHW
23	Fair	Abrasion damage from pile guide
24	Satisfactory	Abrasion damage from pile guide
25	Fair	Pile installed in position pinned against pile guide causing abrasion damage
26	Poor	Significant marine borer damage
27	Poor	Pile guide deteriorated and causing pile damage. Marine borer damage at 15' below MHW.
28	Fair	Minor marine borer damage at knot at low tide mark
29	Fair	Abrasion damage due to pile guide. Pile guide missing a nut
30	Satisfactory	Minor abrasion from ice damage
31	Fair	Minor rot in pile
32	Fair	Abrasion damage from apparent past pile guide. New pile guide installed
33	Satisfactory	Abrasion damage due to pile guide
34	Fair	Marine borer damage at knot
35	Fair	Abrasion damage due to pile guide
36	Good	
37B	Good	



38B	Fair	Abrasion damage from apparent past pile guide. Newer pile guide currently installed.
38B*	Good	
39	Good	Greenheart pile
40	Good	Greenheart pile
41	Satisfactory	Newer
42	Good	Greenheart pile
43	Good	Greenheart pile
44	Fair	Marine borer damage 12' below MHW
45	Satisfactory	Abrasion damage due to pile guide
46	Fair	Abrasion damage due to pile guide
47	Good	Greenheart pile
48	Fair	Marine borer damage at mudline, 21' below MHW
49	Satisfactory	
50	Satisfactory	Abrasion damage from apparent past pile guide. New pile guide installed Sistered to Pile 51.
51	Satisfactory	Abrasion damage from apparent past pile guide. New pile guide installed Sistered to Pile 50.
52	Fair	Abrasion from ice damage
53	Fair	Marine borer damage 15' below MHW.
54	Fair	Abrasion damage due to pile guide
55	Fair	2"x1" Marine borer hole 16' below MHW
56	Fair	Marine borer damage 11' below MHW at knot
57	Fair	Minor marine borer damage in pile
58	Fair	Minor marine borer damage in pile
59	Fair	Marine borer damage in sporadic areas in pile, three different locations: depth approximately 1-1/2"
60	Fair	Marine borer damage in sporadic areas in pile, three different locations: depth approximately 1-1/2"
61	Fair	Marine borer damage causing splits in pile only 1" deep
62	Good	
63	Fair	Abrasion damage due to ice / pile guide
64	Satisfactory	Abrasion damage due to ice / pile guide
65	Satisfactory	Abrasion damage due to ice / pile guide



66	Fair	Abrasion damage due to ice / pile guide
67	Good	
68	Good	
69	Fair	Marine borer damage minor and splits in pile near mudline; depth 10'
70	Good	
71	Fair	Minor abrasion damage due to ice
72	Fair	Minor abrasion damage due to ice
73	Fair	Minor abrasion damage due to ice
74	Fair	Minor splits in pile depth less 1 1/2"
75	Fair	Abrasion damage due to pile guide
76	Satisfactory	
77	Fair	Marine borer damage at knot occurring 11' below MHW
78	Fair	Minor splits in pile depth less 1 1/2"
79	Fair/Poor	3 x3x3 hole in pile due marine borer damage
80	Fair	Abrasion damage due to pile guide
81	Good	Newer pile
82	Fair	Minor marine borer damage occurring near mudline 19' below MHW (2"x1")
83	Fair/Poor	Bore damage occurring 11' from mudline
84	Good	Abrasion damage due to pile guide
85	Serious	Significant marine borer damage
86	Fair	Minor abrasion damage due to ice
87	Fair	Marine borer damage at knots causing spilt
88	Fair	Minor marine borer damage occurring near mudline 19' below MHW (2"x1")
89	Satisfactory	Abrasion damage due to pile guide
90	Good	Newer
91	Good	Newer
92	Good	Newer
93	Good	Newer
94	Fair	Minor abrasion damage due to ice
95	Fair	Marine borer holes started in various areas
96	Fair	Abrasion damage due to pile guide
F-1	Fair/Poor	Marine borer holes started in various areas
F-2	Fair/Poor	Marine borer holes started in various areas
F-3	Fair/Poor	Marine borer holes started in various areas
F-4	Poor	Significant marine borer damage



Recommendations

Based on our observations RACE offers the following recommendations and suggested timeframe for implementation:

Recommendation	Time Frame
Replace damaged piles: 6, 16, 22, 26, 79, 83, 85, F-1, F-3, F-4.	1-2 years
Address pile guides damaging piles: 1, 9, 23, 24, 25, 27, 29, 32, 35, 38B, 45, 46, 50, 51, 54, 63, 64, 65, 66, 75, 80, 89, 96.	1-2 years
Undertake routine maintenance program to replace remaining piles at up to 25% of piles annually	3-10 years
Address need for storm anchors and replace if necessary	1-2 years
Considered increasing pile cut-off elevations for new piles	As installed
Perform a routine pile inspection	4-5 years

Our primary recommended measure would be to address first and second recommendations related to the damaged piles and guides. These actions in combination will aid in furthering the service life of the marina. Timber in the marine environment typically has a service life of 30 years with routine maintenance. RACE also recommends developing a maintenance plan for reinspecting piles and replacing piles, up to 25% per year of your total pile count. The 25% limit would fall under maintenance in the general permit for the Connecticut Department of Environment and Energy Protection licenses.

An additional consideration would be to use composite piles in lieu of timber. While these piles are typically more expensive than timber, they would not be subject to marine borer attack which is evidenced in a number of piles in the marina.

RACE can assist in providing further engineering analysis and repair recommendations upon request. Also, RACE would be pleased to discuss these findings in greater detail if you have questions or comments.

Very Truly yours,

RACE COASTAL ENGINEERING



Chris Kane, E.I.T
Engineer/Field Operations Specialist



Devin J. Santa, P.E.
President

Enclosures: Appendix A: Representative Photographs
 Appendix B: Piling Layout Sketch



Appendix A

Representative Photographs



APPENDIX A: REPRESENTATIVE PHOTOGRAPHS



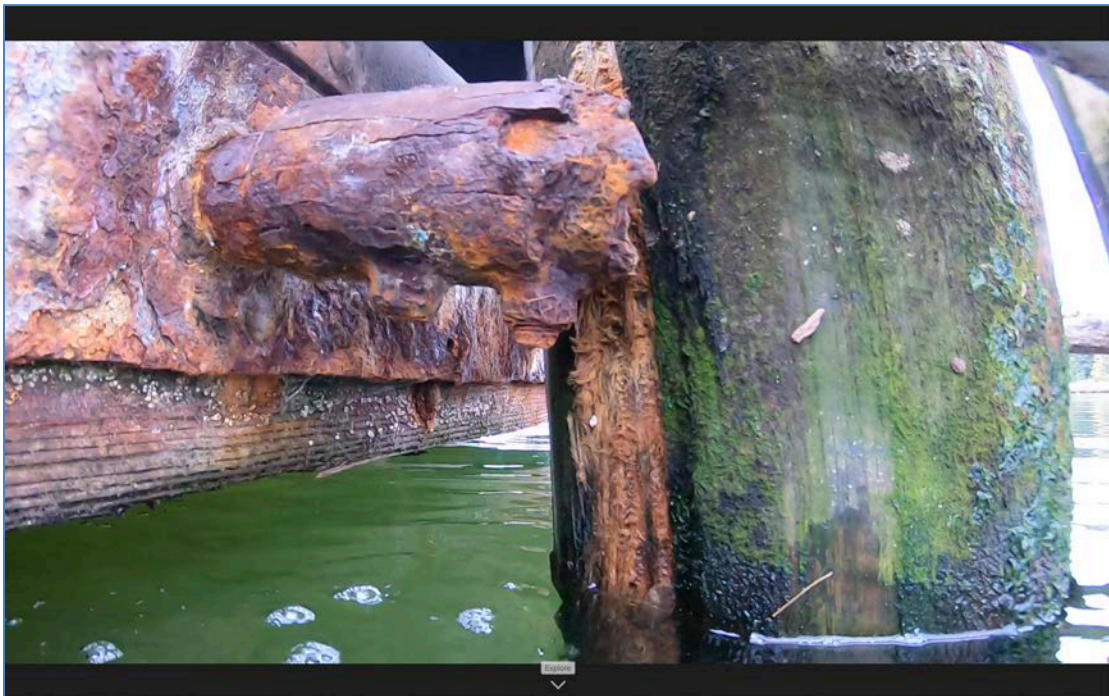
Photograph 1 – Pile number 44 is outlier in pile layout; only area with a tie off pile



Photograph 2 – Typical abrasion damage from pile guide



Photograph 3 – 3/8" line broken where anchor attachment location is marked



Photograph 4 – Abrasion damage from broken pile guide



Photograph 5 – Marine borer damage at a knot in the pile



Photograph 6 – Marine borer damage in pile



Photograph 7 – Significant marine borer damage in pile

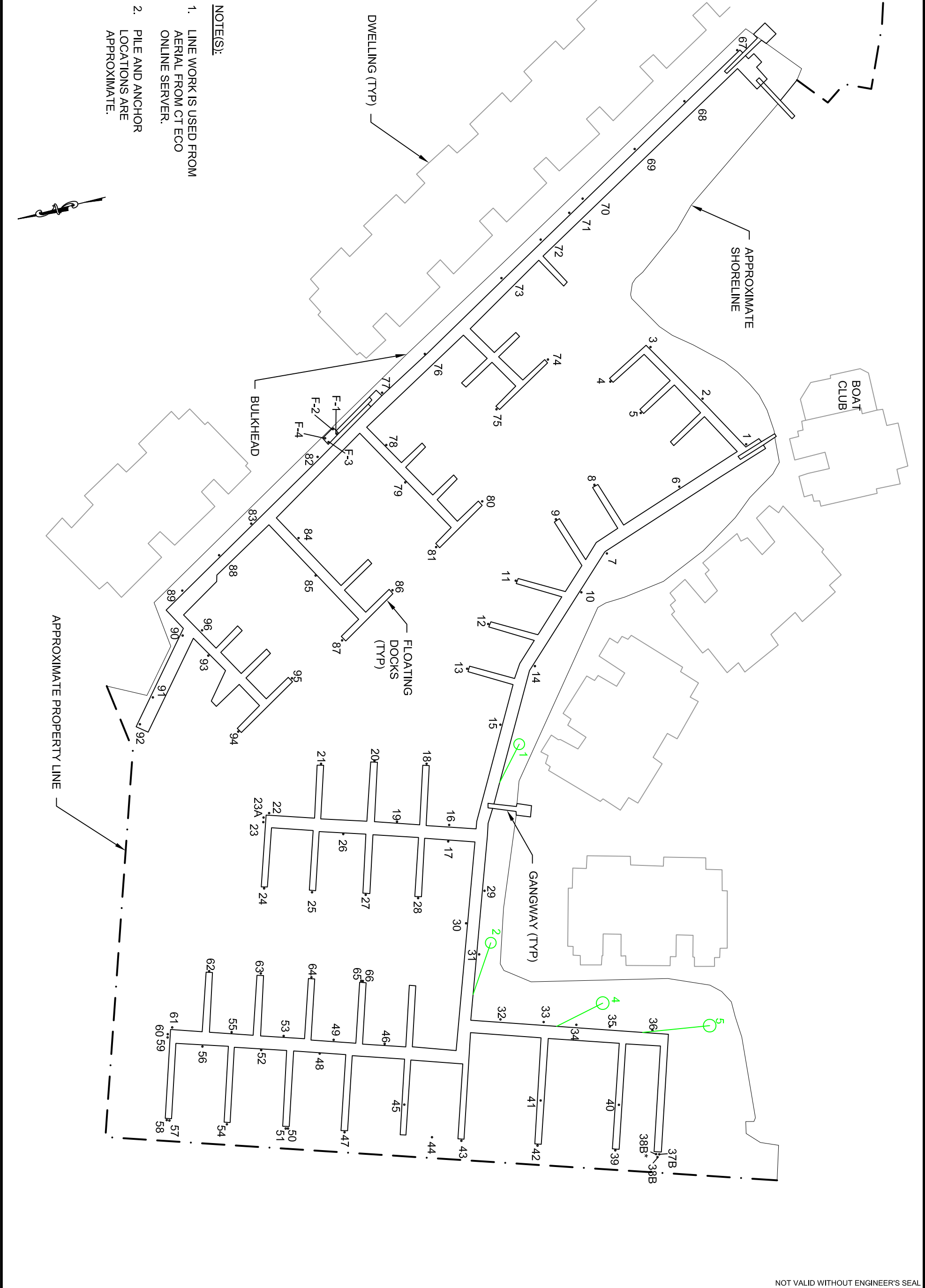


Photograph 8 – Severe ice damage in pile 5' below Mean High Water

Appendix B

Pile Layout Sketch

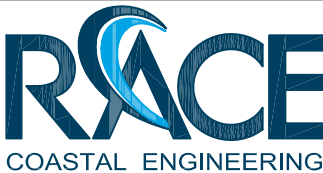




- NOTES:**
- 1. LINE WORK IS USED FROM AERIAL FROM CT ECO ONLINE SERVER.
 - 2. PILE AND ANCHOR LOCATIONS ARE APPROXIMATE.



NOT VALID WITHOUT ENGINEER'S SEAL

Date: 10-07-2021		Rev.:		Prepared For: SCHOONER COVE YACHT ASSOCIATION HARBOR DRIVE STAMFORD, CT		<div><p>RACE COASTAL ENGINEERING</p><p>611 Access Road Stratford, CT 06615 Tel: 203-377-0663 racecoastal.com</p></div>	<div><p>OWNERSHIP AND CONDITIONS OF USE:</p><p>Drawings and Specifications, as instruments of professional service, are and shall remain the property of RACE Coastal Engineering, LLC. Documents are not to be used, in whole or in part, for other projects or purposes or by any other parties than those authorized by contract without the specific written authorization of RACE Coastal Engineering, LLC. The use of this document is contingent upon payment to RACE Coastal Engineering, LLC for services rendered. Non-payment shall give RACE Coastal Engineering, LLC the authority to bar document use by any and all parties.</p><p>THIS DRAWING IS COPYRIGHTED</p></div>
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Drawing No.: 1 of 1		Project No.: 2021079					