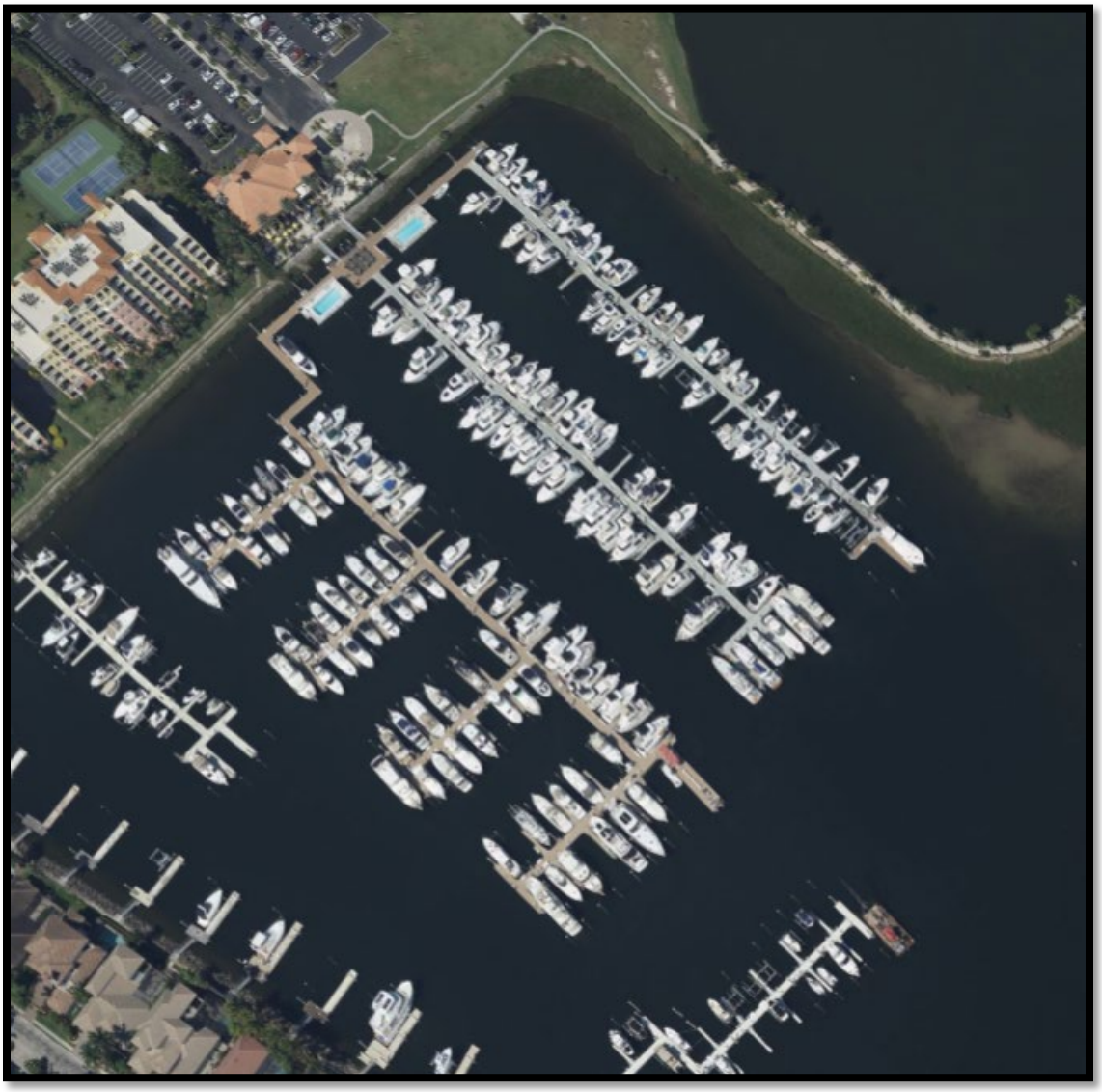
Prepared for: Riviera Dunes Marina, Palmetto, FL

Floating Dock Assessment Report



Prepared by:

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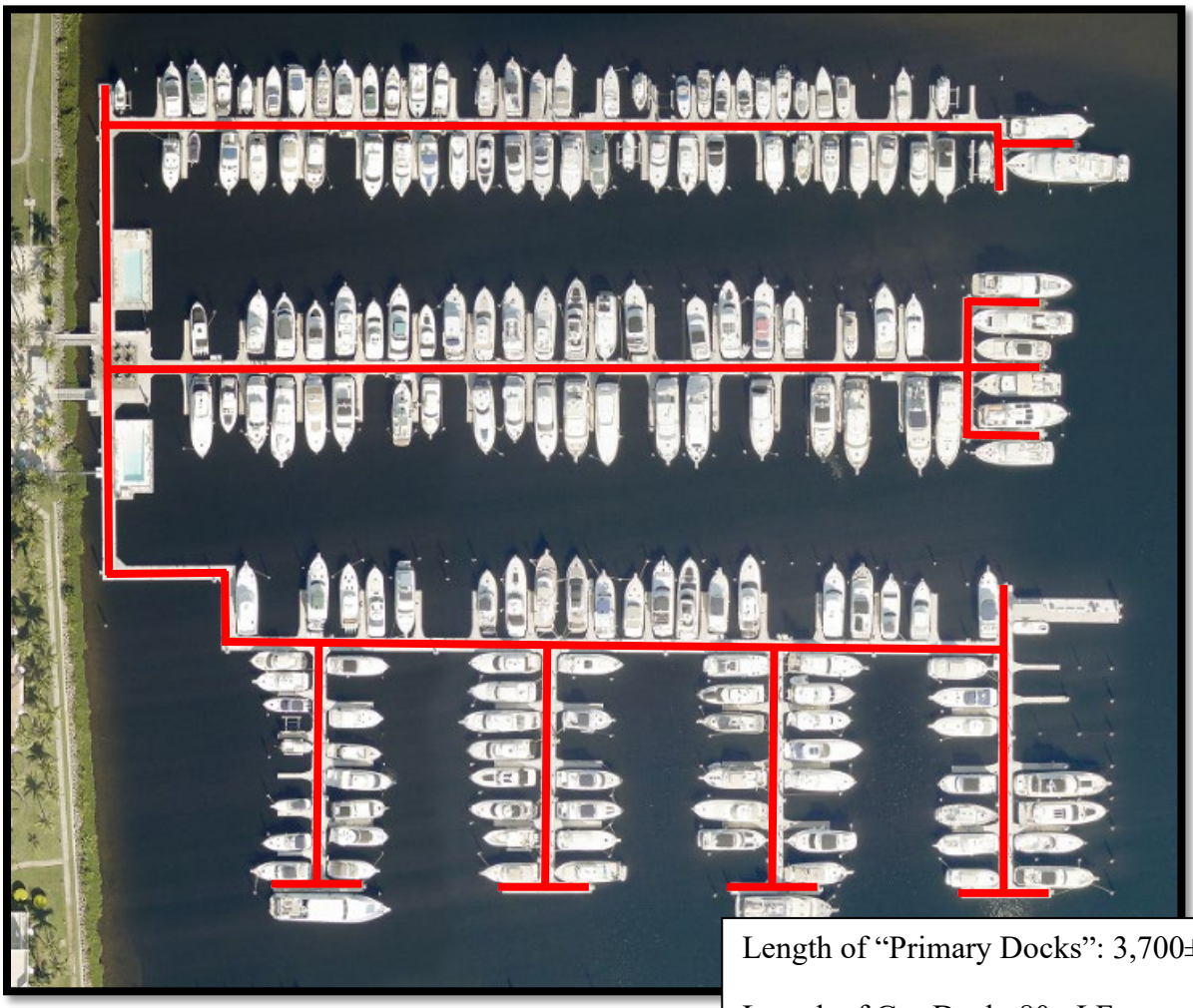
Submitted: June 2024

Introduction

In April-May 2024, J Foster Consulting (JFC), a marine structural engineering firm, was contracted to evaluate the condition of the floating docks and mooring piles located at Riviera Dunes Marina in Palmetto, Florida. The subject marina is located along a portion the northern shoreline in a manmade basin that is roughly 1500' wide by 2000' long. Given the relatively large length of the marina, small waves can develop in the basin which can impact the outer finger piers during high wind events. The assessment includes the evaluation of the major structural components of the floating docks (floats, c-channels, wood bracing, filler foam), the concrete piles which anchor the docks, and the timber mooring piles.



Length of "Primary Docks": 3,700± LF

Length of Gas Dock: 80± LF

Number of Finger Piers: 98

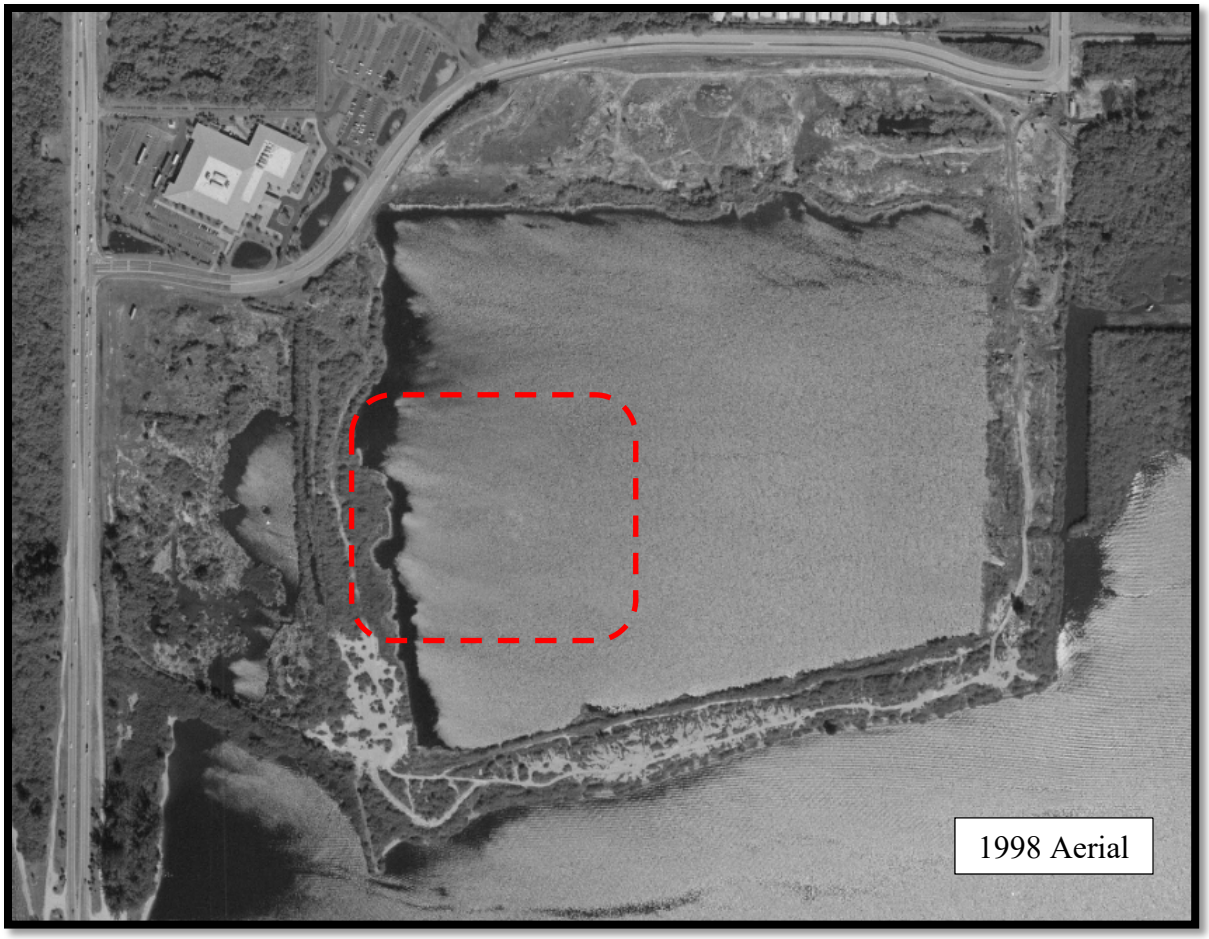
The purpose of the inspection was to observe and document the existing conditions of the docks for a baseline condition report, identify the areas with structural deficiencies, provide recommendations & details for repair methods to a sufficient level to be used for budgetary pricing, and provide phases and timeframes on when repairs should be carried out.

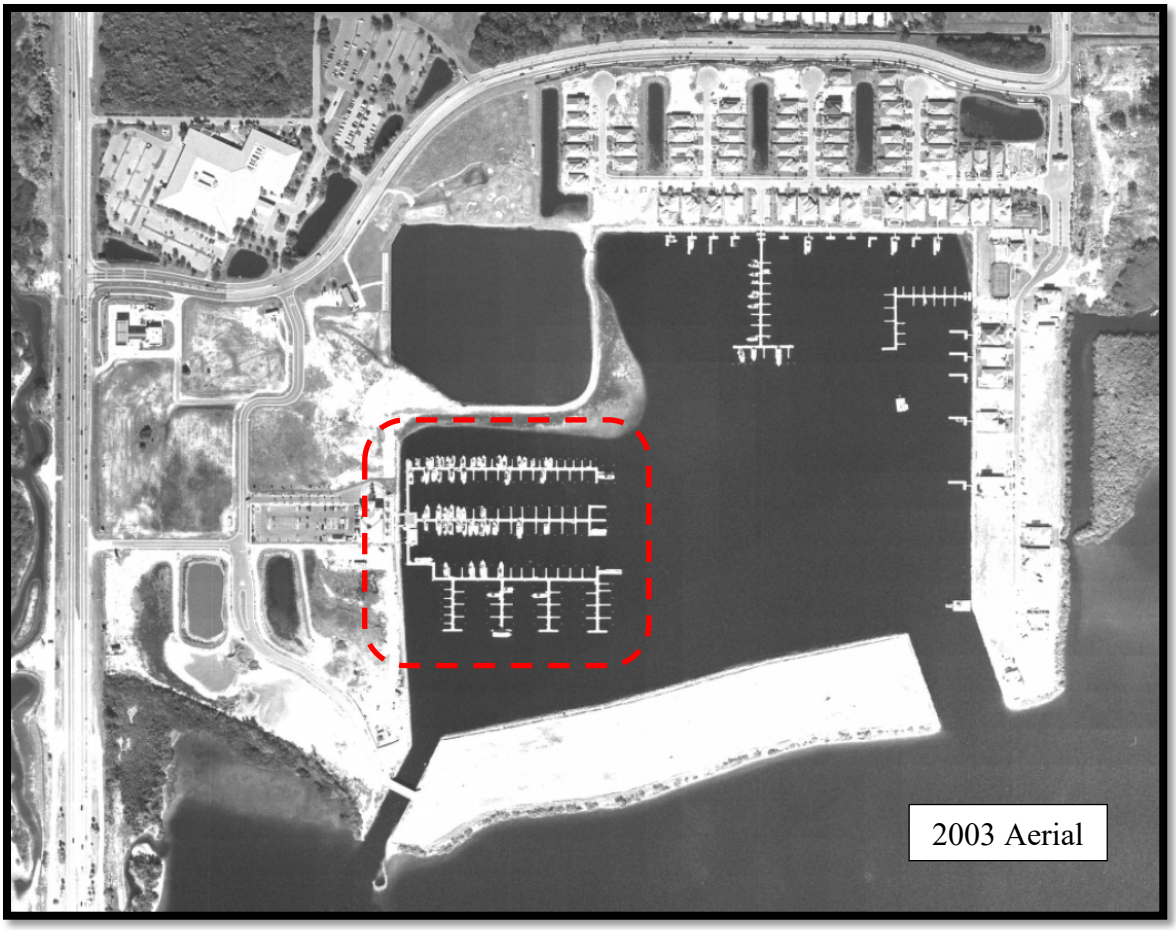
General

The inspected marina consists of approximately 3,700 linear feet (LF) of "main docks," a gas dock measuring approximately 80 LF, and 98 finger piers. The individual floating dock modules measure approximately 26' long by 10' wide. The finger piers are approximately 4' wide and range from 25' to 40' in length. The gas dock is constructed of six floating dock modules (three long by two wide) joined together, and measures approximately 78' long by 16' wide.

History

A review of historical aerials shows that the subject marina was constructed sometime between 1998 and 2003. This makes the subject seawall approximately 25 years old. The approximate design life of the concrete floating docks used at the subject marina is 25 years, placing these docks near the end of their design life. It should be noted that the concrete deck slabs were resurfaced sometime between 2019 and 2020.


1998 Aerial


2003 Aerial

Terms and Definitions

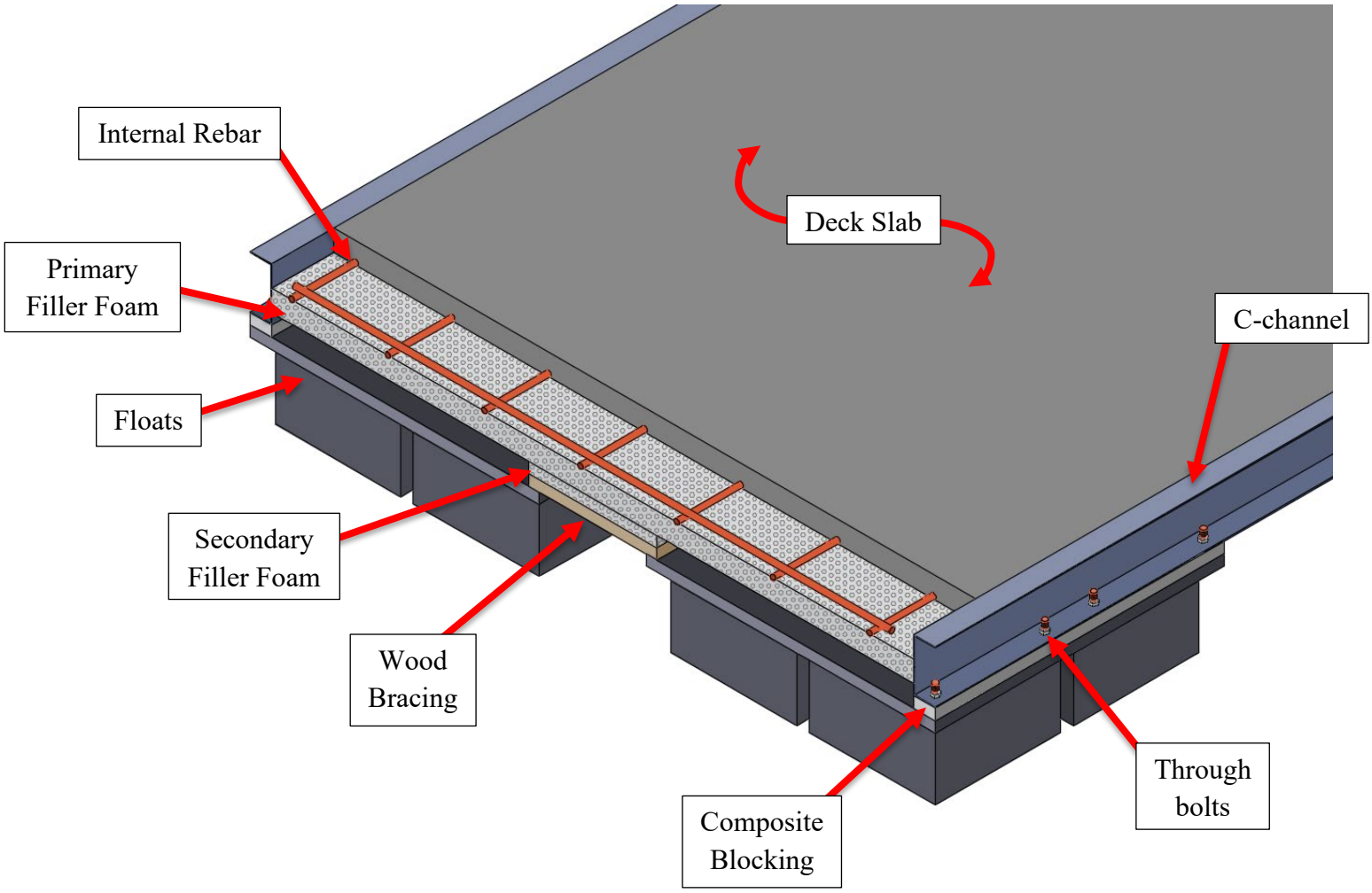
For the purposes of this report and to develop an understanding of the structural components of the subject floating docks, the following terms and schematic are presented below:

Deck Slab – Concrete slab, reinforced with internal rebar, serving as decking for the floating docks.

C-channel – Steel structural member serving as connection between floats and concrete deck slab, fastened to the floats with through bolts through composite blocking.

Filler Foam – Foam between deck slab and floats, serving as blocking and providing additional rigidity to the deck slab.

Floats – Dock floats providing buoyancy to keep docks afloat.



Methodology

Prior to the onsite field work, an aerial map was examined. A walkthrough of the entire project area was completed, identifying the areas to be considered in the scope of work. The inspection included a Level I inspection effort based on the American Society of Civil Engineers (ASCE) Waterfront Facilities Inspection and Assessment Manual. A Level I inspection is a visual inspection performed at a level of detail necessary to detect major deteriorations or structural defects.

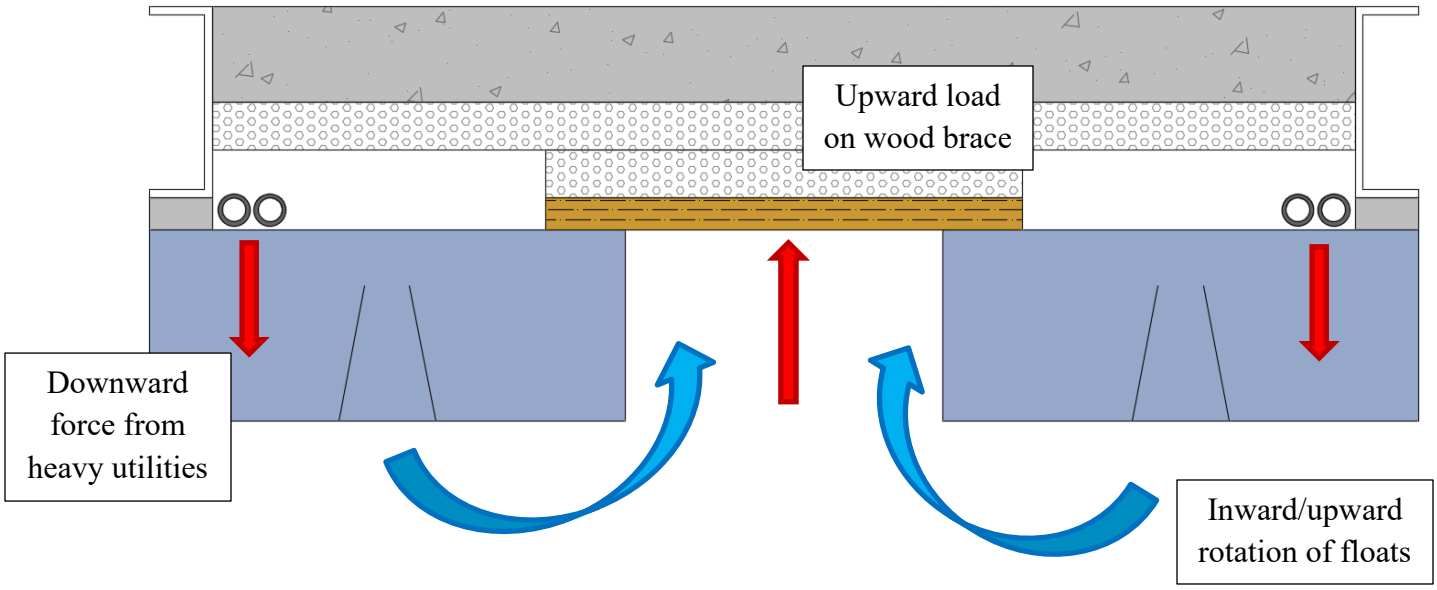
The components of the survey include:

a) Visual observations of each floating dock with any structural defects noted within field notes – Completed by Foster Consulting
b) Visual observations of a sample of mooring piles, including physical probing, with any structural defects noted withing field notes – Completed by Foster Consulting
c) Bathymetric survey measuring water depths in fairways and at mooring piles.
d) Documentation – The documentation from the inspection includes field notes, photographs, and video (including underwater) taken of the general conditions encountered. Select site inspection photographs collected during the inspection are presented in the Observations portion of this report.

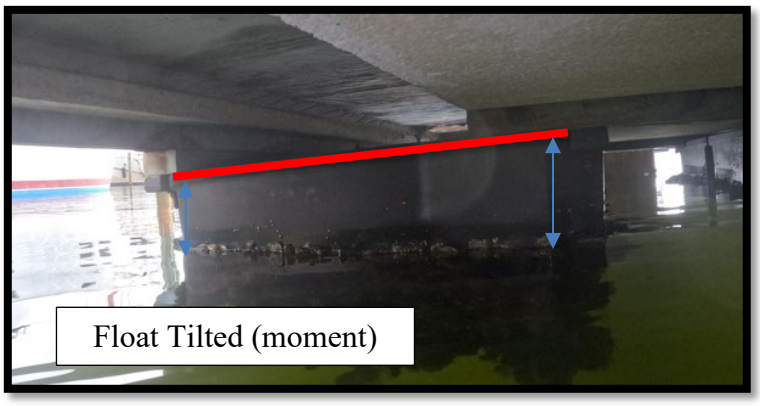
Common Defects

There are several predominant defects/issues that were observed in the floating docks and are described below.

1) **Bowing/Crowning of Concrete Deck Slabs** – A common defect found in the majority of the floating docks is visible upward bowing of the concrete deck slabs. This causes cracking in the deck slabs, with rust stains present indicating the internal rebar is beginning to corrode and deteriorate. The internal rebar that is corroding is the top cord of the dock truss system, the lower cord is the wood block that spans between the poly floats. It was noted that this bowing is more prominent in the South Docks rather than the North Docks. The likely reason for this difference is that the North Docks have a rigid foam that underlays the concrete deck slab. This added rigid foam stiffens the upper slab that has the corroded rebar. Given that the utilities are NOT acting over the centroid of the float, a moment is created which is causing the floats to push upward in the middle.


Upward load
on wood brace
Downward
force from
heavy utilities
Inward/upward
rotation of floats

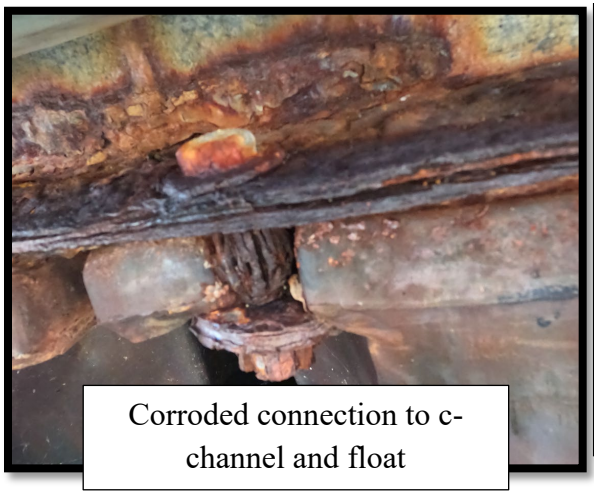

TOOTH FAIRY
ST. LOUIS, MISSOURI
Crack from slab bowing


Float Tilted (moment)

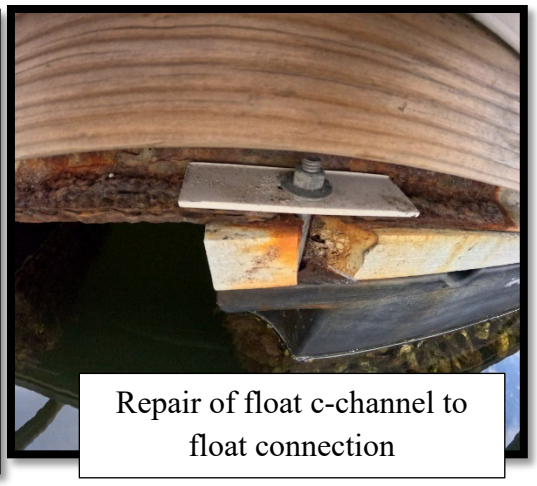
2) **Underside of Concrete Deck Corrosion** – Where the finger piers and docks are most exposed to wave action, it was observed that longitudinal cracks and spall were occurring on the underside of the concrete slab. This is evidence that the internal steel within the concrete is corroding.

Corroded rebar on underside of concrete dock

3) **Float to C-Channel Connection** – The connection between the float and the c-channel is completed with a through bolt and nut. Given that that this can be a high stress point in the channel and the bolt/washers can retain moisture it often develops rust. This connection keeps the floats in place. It was observed that sporadic repairs were completed at this connection by a bolt/washer/nut replacement, some areas also had added steel channel to help with this connection.



Corroded connection to c-channel and float



Repair of float c-channel to float connection

4) **Corroding C-Channel** – A prevalent defect in the floating docks is the corrosion of the c-channel which joins the deck slab to the floats underneath. In some extreme cases, there was visible material loss, such that the through bolts providing connection to the floats had no material to bear upon. The outer finger piers exposed the greater amount of wave action and sea spray are in poorer condition, which should be anticipated.

5) **Utility brackets –** Some of the utility lines are supported with metal brackets; many of the original brackets are rusted and or have been replaced due to corrosion.

Observations/Data

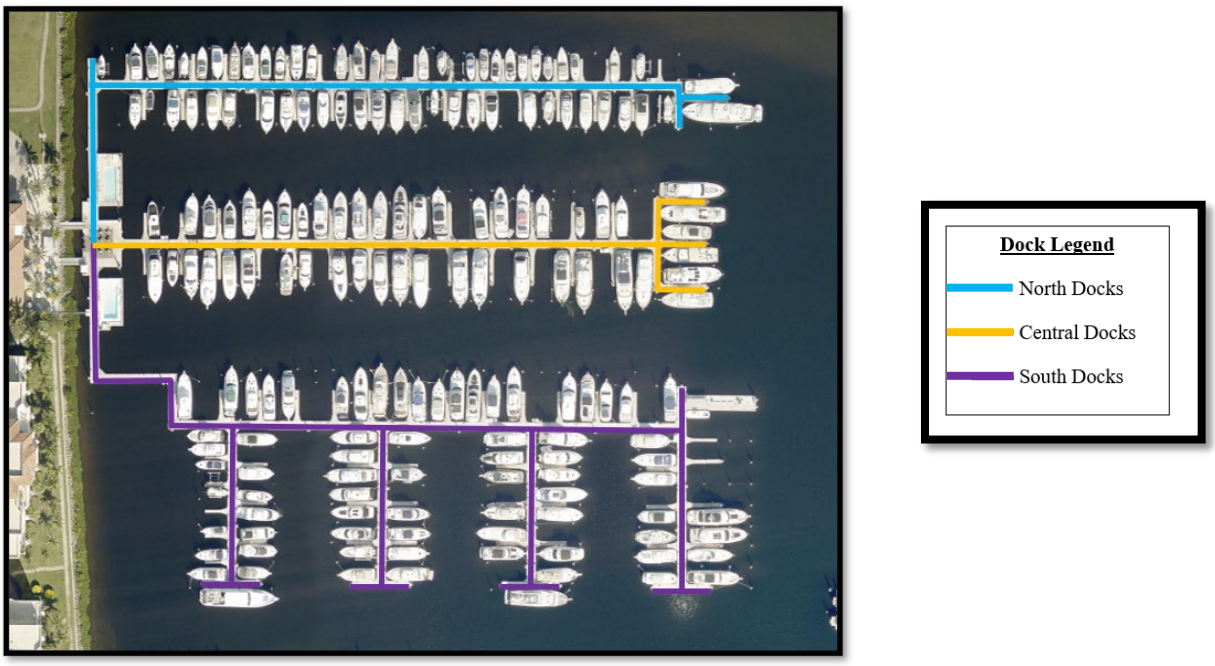
Data was collected for each dock module and finger pier. The dock modules range between 8’ and 10’ wide and 26’ in length, the finger piers range from 3’ to 4.5’ wide and 25’ to 40’ long. The condition of each segment and finger pier was rated based on the following system:

Usable/Minor – May have minor rust/stains of the steel frame, minimal cracking if any cracking in the concrete deck, very minor to negligible rust stains in the concrete deck, minor rust in pile guides. Minor rust on float to c-channel connection.

Poor/Moderate – May have rust with scaling and minor material loss of the steel frame, visual cracks in the concrete deck, minor camber of concrete deck, moderate rust stains in the concrete deck, rust with scaling and minor material loss of pile guides, rust with scaling of bolt to float connection.

Very Poor/Severe – May have significant rust with material loss of steel frame, significant cambering of concrete deck, spall on underside of concrete deck, heavy rust stains in the concrete deck, significant material off and scaling of pile guides.

For the purposes of this report, the subject floating docks have been broken down into three sections, based on location and condition. See site map below.



Dock Module C-Channel Condition:

	Total Count	As a Percentage of Dock Section
North Docks – Severe	16	43%
North Docks – Moderate	6	16%
North Docks – Minor	15	41%
Central Docks – Severe	18	49%
Central Docks – Moderate	9	24%
Central Docks – Minor	10	27%
South Docks – Severe	39	53%
South Docks – Moderate	18	25%
South Docks – Minor	16	22%

Deck Slab Condition:

	Total Count	As a Percentage of Dock Section
North Docks – Severe	0	0%
North Docks – Moderate	13	36%
North Docks – Minor	23	64%
Central Docks – Severe	3	8%
Central Docks – Moderate	3	8%
Central Docks – Minor	31	84%
South Docks – Severe	34	43%
South Docks – Moderate	37	47%
South Docks – Minor	8	10%

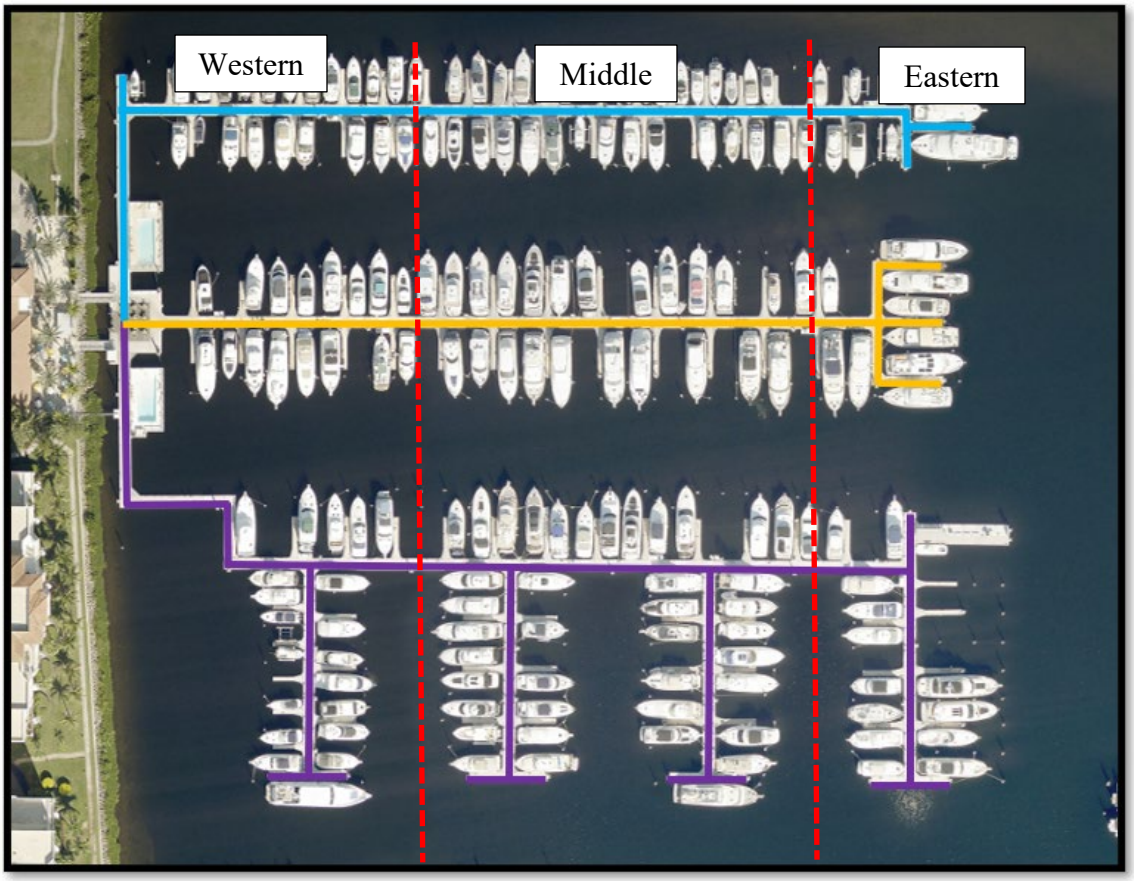
Finger Pier Condition:

	Total Count	As a Percentage of Dock Section
North Docks – Severe	10	30%
North Docks – Moderate	18	55%
North Docks – Minor	5	15%
Central Docks – Severe	8	31%
Central Docks – Moderate	10	38%
Central Docks – Minor	8	31%
South Docks – Severe	14	36%
South Docks – Moderate	18	46%
South Docks – Minor	7	18%

See Appendix A for the location of each deck slab and finger pier.

Discussion

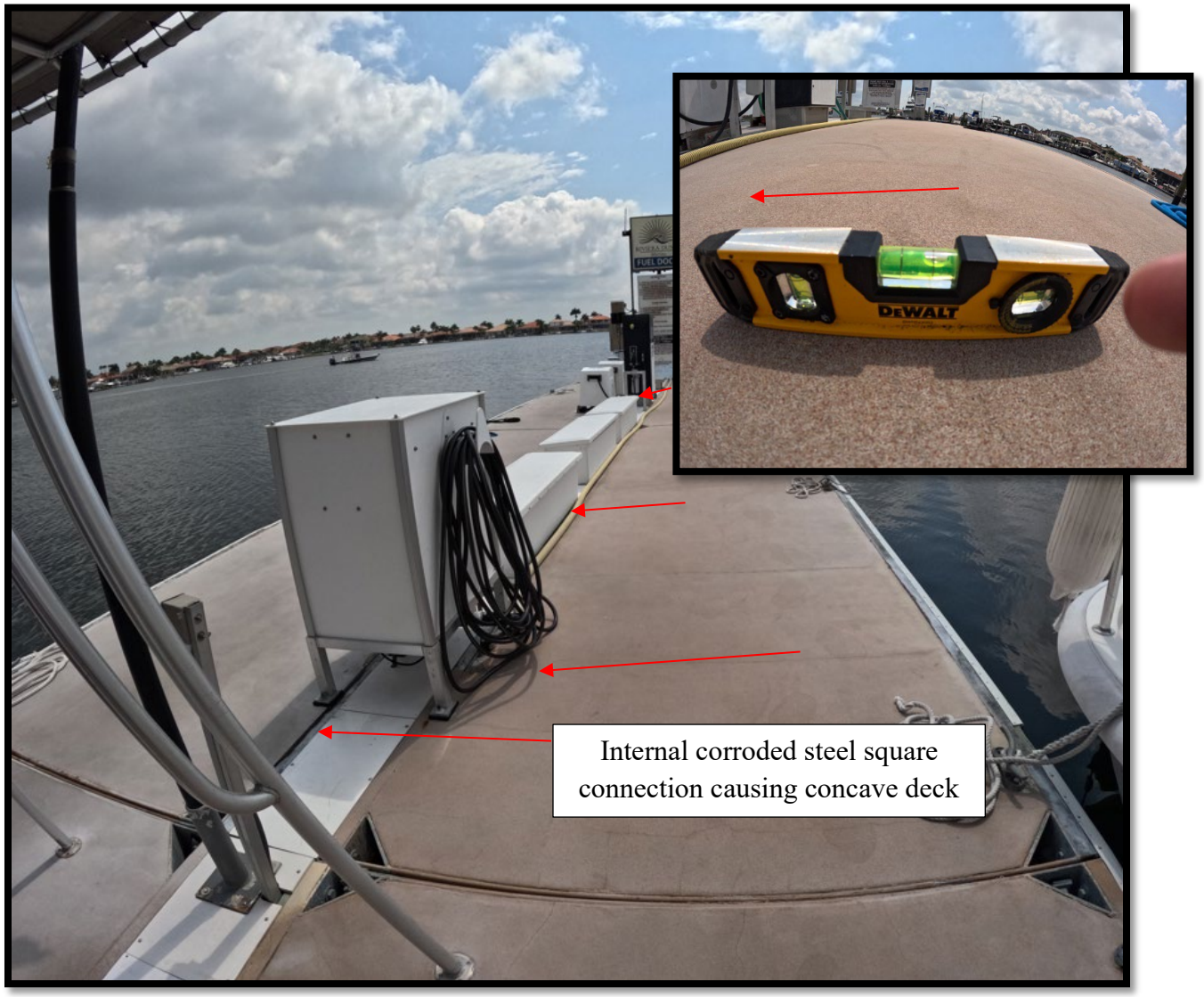
Overall, the floating docks are showing defects common to their age. Typically, the typical design life of floating docks in this environment is 25-years. The docks along the outer edges that are exposed to more wave action and sea spray are in poorer condition relative to the interior portion of docking facility. This is very evident when you split the marina into thirds going from the seawall out to the main waterbody: Western, Middle, Eastern.



Approximately 28% of the docks and finger piers in the western third are in usable condition, approximately 27% of the docks and finger piers in the center third are in usable condition, and approximately 22% of the docks and finger piers in the eastern third are in usable condition. It was also observed that the rate of "Severe" or "Very Poor" condition was far greater in the docks located in the eastern third (see Appendix A).

The gas dock steel frame also has significant deterioration, and the centerline of the dock is more concaved in comparison to the other docks where the centerline is more convex. This is because the gas dock is composed of two floating docks that are bolted together with a square steel

connection where the heavy utilities are run. The square steel connection has significant rust, and the connection is starting to fail which is causing the dock to be more concave.



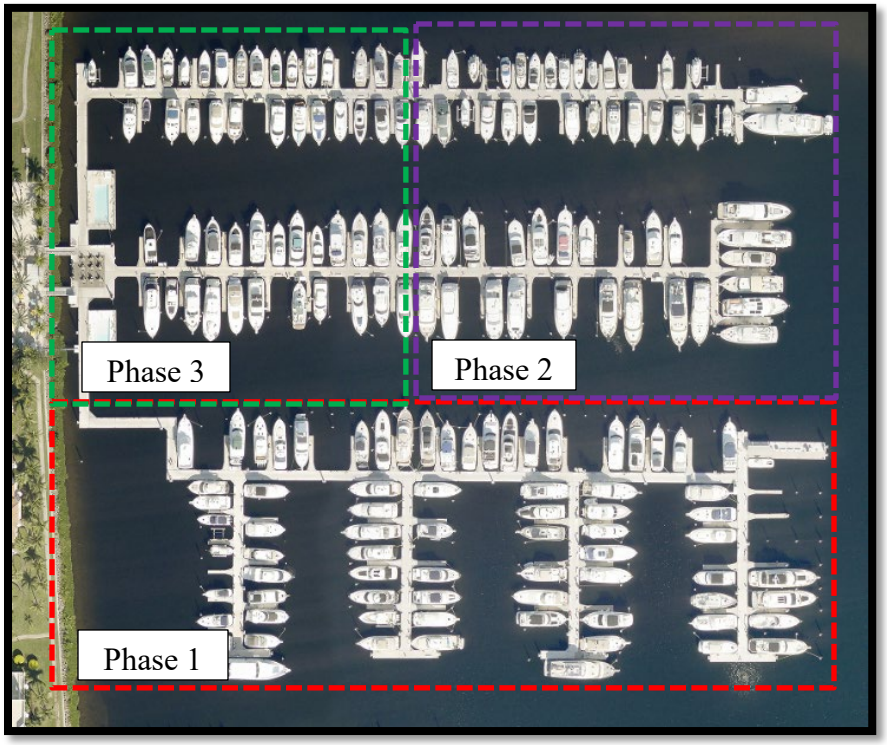
Conclusion

Overall, the docks are nearing the end of their useful life. Based on the collected data, the outer docks that are exposed to more wave action and sea spray are in poorer condition in comparison to the docks that are more sheltered. Additionally, the South Docks are showing more signs of cambering in comparison to the central and northern docks, which is likely attributed to the lack of additional structural foam beneath the middle section of the dock modules. The concrete piles are in good condition; therefore, efforts should be made to integrate them into the new design. For this reason, we are proposing a phased plan to replace the existing docks with new floating docks, though it is recognized that there are other ways to carry out the dock replacement.

Phase 1 – Given that the gas dock is a significant revenue source for the marina, and the utility lines that service this dock run along the South Dock, and the South Docks are in the poorest condition, it is recommended that these docks be replaced first. Additionally, a fuel spill could result in significant fines from environmental agencies, should a line break.

Phase 2 – Given that the condition of the North and Central Docks worsen toward the east end of the marina, the eastern portions of the North and Central docks should be replaced next.

Phase 3 – Replace the remaining docks.



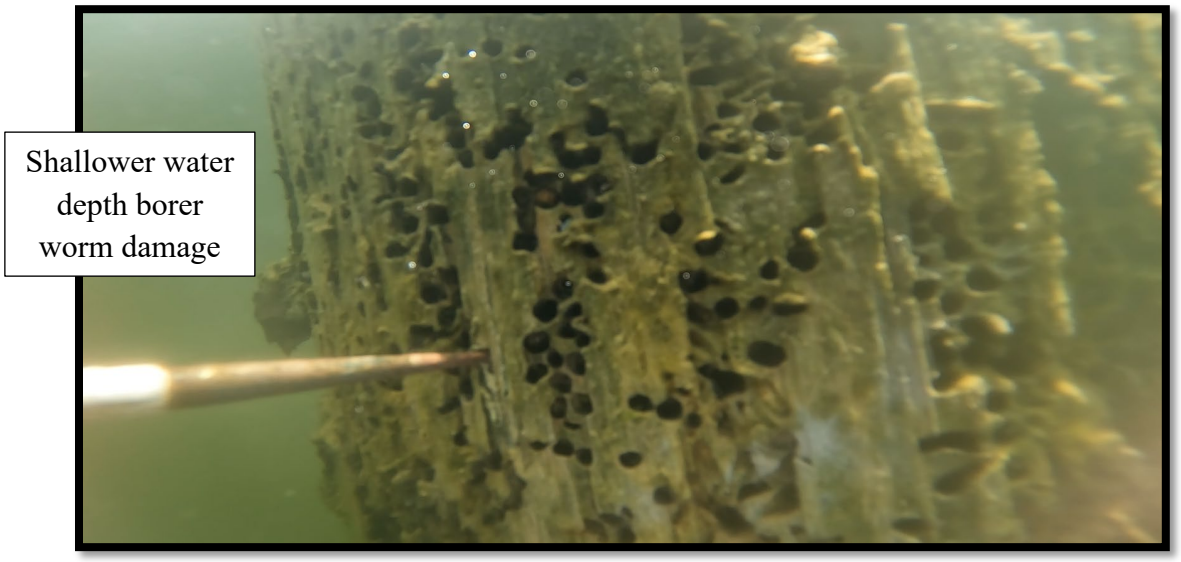
For budgetary purposes, rough estimates of the anticipated costs are listed below. It should be noted that these figures are contingent on the existing utilities being reused.

	Aluminum Floating Docks (~$200/Sq Ft)	Concrete Floating Docks (~$300/Sq Ft)
Phase 1 (~23,500 Sq Ft)	$4,700,000	$7,050,000
Phase 2 (~13,000 Sq Ft)	$2,600,000	$3,900,000
Phase 3 (~15,000 Sq Ft)	$3,000,000	$4,500,000

Piles

Included in the scope of work was to check roughly 20% of the wood and concrete piles to assess their condition.

Wood Piles – A prevalent defect observed in the wood tie piles is borer worm damage, possibly from the teredo worm, Teredo navalis, as they are commonly found in these local waters. These wood destroying organisms penetrate the pile, thereby creating voids which reduces the strength and stability of the piles.

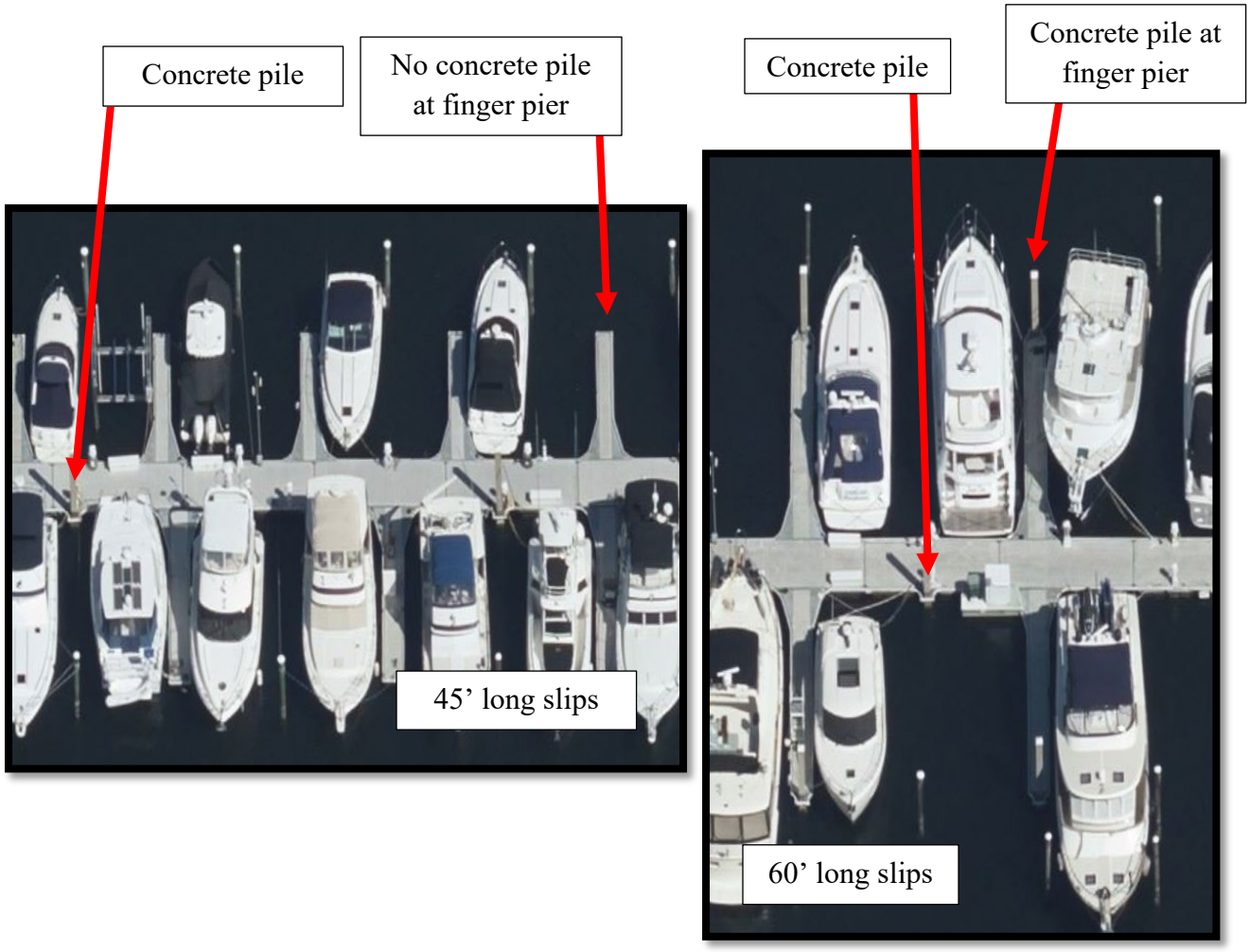


Shallower water depth borer worm damage

Deeper water depth borer worm damage

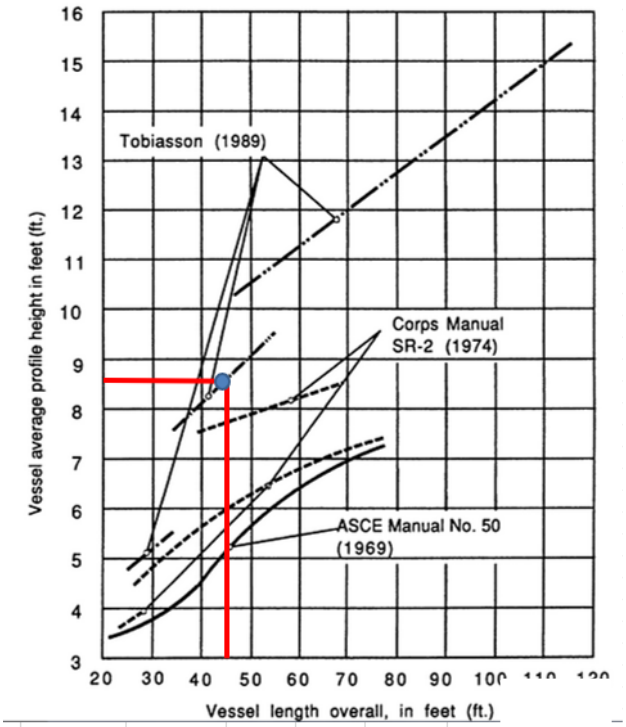
Concrete Piles – Overall, the concrete piles are in usable to good condition as no major structural defects were observed in the piles (e.g. longitudinal cracks or areas of spall). It was noted that some of the piles have gouges roughly 5’ from the top of the pile, which may be remnants from a concrete anchor that was installed for signage.

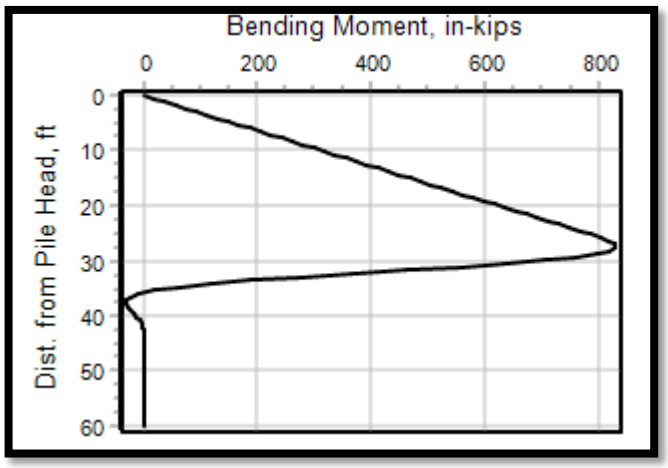
The existing pile size and number of piles used to anchor the docks/vessels was reviewed, and calculations were run for 45’ slips and 60’ slips. The main difference between the 45’ long slip vs the 60’ slip is that the 60’ slips have concrete piles at the terminal ends of the finger piers. Calculations were performed based on maximum tropical force storm winds of 74 MPH, because any winds above this amount (hurricane force) typically result in the vessels being vacated from the slips.



The results of the calculations are as follows:

- The loading on the wood mooring piles at the 45’ long slips is 33% greater than the allowable capacity.
- The loading on the wood mooring piles at the 60’ long slips is 1.5 times greater than the allowable capacity.
- The loading on the concrete piles at the 45’ long slips is nearly 3 times greater than the allowable capacity.
- The loading on the concrete piles at the 60’ long slips is nearly 4 times greater than the allowable capacity.



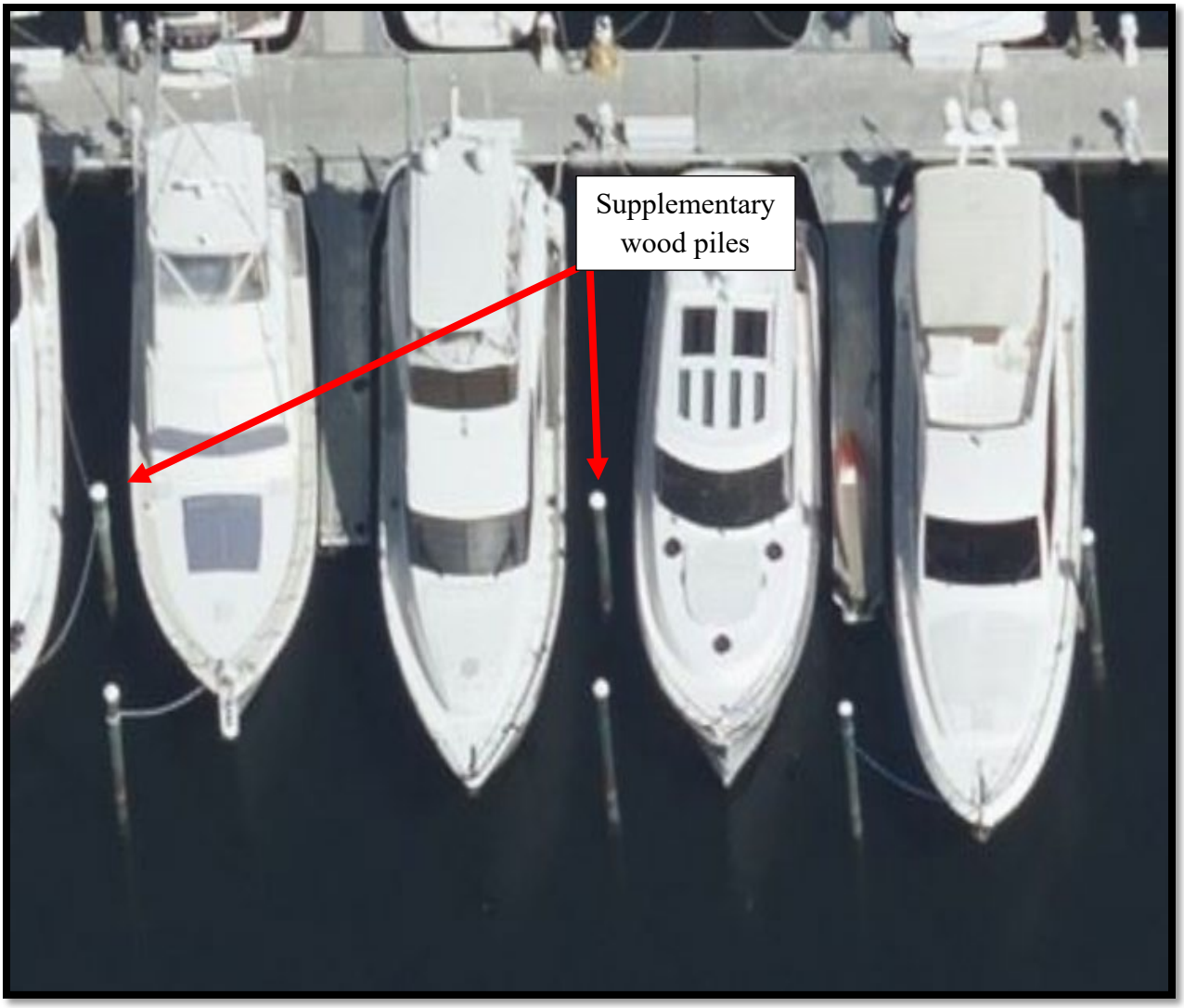


Vessel Length (ft)	Vessel Avg Profile (ft)	Vessel Sq. Ft. (sq. ft)	Wind Speed (mph)	Windage (lbs/sq. ft.)	Latera Load (lbs)
45	8.5	382.5	74	14.0	5,3

Borer Worm Damage – Borer worm damage is present in the piles; therefore, a reduction of the capacity of the wood piles should be assumed. It is very difficult to determine the section loss of each pile unless you slice the pile. For this reason, a section loss of 2" of diameter can be assumed, so for the sake of the calculations, the 14" diameter pile was given a net 12" effective diameter. This equates to the following:

- The loading on the wood mooring piles at the 45' long slips is 1.6 times greater than the allowable capacity.

- The loading on the wood mooring piles at the 60' long slips is 2.5 times greater than the allowable capacity.



It should be noted that these calculations assume a significant elevated tide, which is commonly associated with tropical systems. It was also observed that some slips appeared to have supplemental wood piles which will help reduce the stress on the existing wood piles.

When the dock replacement is undertaken, additional piles will be required to ensure that the piles are not overloaded.

Required to Reconstruct – When the marina is rebuilt, State, Federal (USACE), and Local permits will be required. The State permit should be completed through the ERP permit process. The USACE permit should be able to be completed under a Nationwide permit; this assumes that the existing marina has a USACE permit. The contractor who will perform the work will secure the local building permit (Local). Due to the USACE lengthy review time, an 18-month post submittal timeframe should be accounted for to secure the permit. The State and Local permits should be a much shorter timeframe.

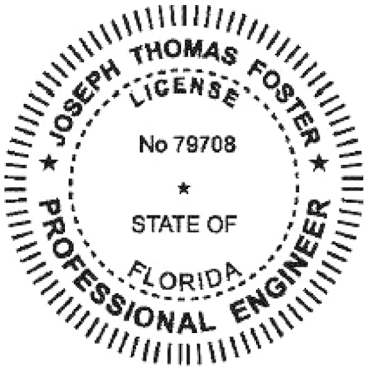
If there are any questions, please call. Thank you for the opportunity to be of service.

Sincerely,

Joseph T. Foster

Joseph T. Foster, P.E.

FL Lic No. 79708
NJ Lic No. 24GE05181200
DE Lic No. 18618



Joseph Foster
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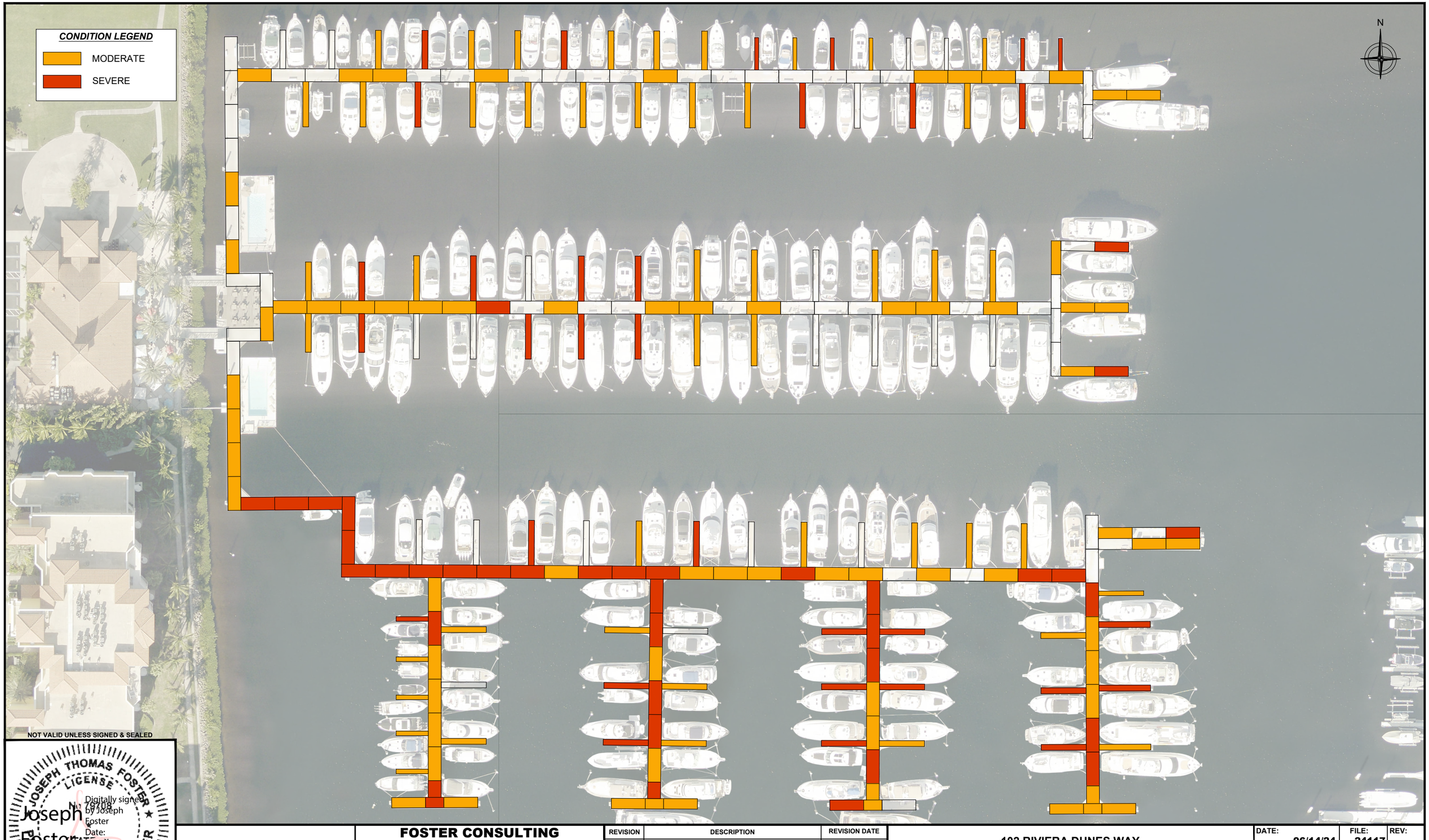
APPENDIX A

Deck Slab/Finger Pier Condition Map



NOT VALID UNLESS SIGNED & SEALED

JOSEPH THOMAS FOSTER LICENSE NO 79408 STATE OF FLORIDA PROFESSIONAL ENGINEER

Joseph Foster

Digitally signed by Joseph Foster
Date: 2024.06.19 15:41:45 -04'00'

FOSTER CONSULTING

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REVISION	DESCRIPTION	REVISION DATE
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102 RIVIERA DUNES WAY
PALMETTO, FLORIDA

DECK SLAB/FINGER PIER CONDITION MAP

DATE: 06/14/24	FILE: 24117	REV:
DRAWN BY: SIP	SHEET: 01 OF 01	
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SCALE: AS NOTED		