



# ARTIBUS DESIGN

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ENGINEERING AND PLANNING

## Structural Assessment Report for the existing Edward B. Knight Pier

Property Address:  
**Edward B. Knight Pier**  
**1900 White Street, Key West, FL 33040**



Google Earth, Imagery Date: 2/2/2018

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Serge Mashtakov, PE, FL License No. 71480

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Date

This item has been digitally signed and sealed by Serge Mashtakov, P.E. on the date adjacent to the seal. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

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EDWARD B. KNIGHT PIER

AUGUST 2025





**Figure 1:** Location Map, Key West (Google Earth Imagery Date: 2/2/2018)

## **Introduction**

### **Purpose of Assessment**

Artibus Design, LLC was contracted by the City of Key West (City), to complete a structural assessment of the existing pier. The intent of the assessment is to:

1. Determine the existing condition of the structure and identify items in need of repair
2. Provide a recommended timeline for repair
3. Provide an opinion of probable repair costs
4. Discuss options for long-term maintenance, repair, and/or replacement of the structure

### **Scope of Assessment and Observations**

This assessment is based on observations made during the following site visits:

- 03/26/2025 Justin Henika P.E.
- 03/31/2025 Justin Henika P.E. & Serge Mashtakov P.E.
- 04/01/2025 Justin Henika P.E. & Serge Mashtakov P.E.
- 06/13/2025 Justin Henika P.E.

This assessment is based on visual observations (above and below the waterline) of readily accessible structural elements. Observations were made from atop the structure, as well as from in the water. In water observations were made by wading during low tides (approximately -0.5'), allowing for observations 2' below the Mean



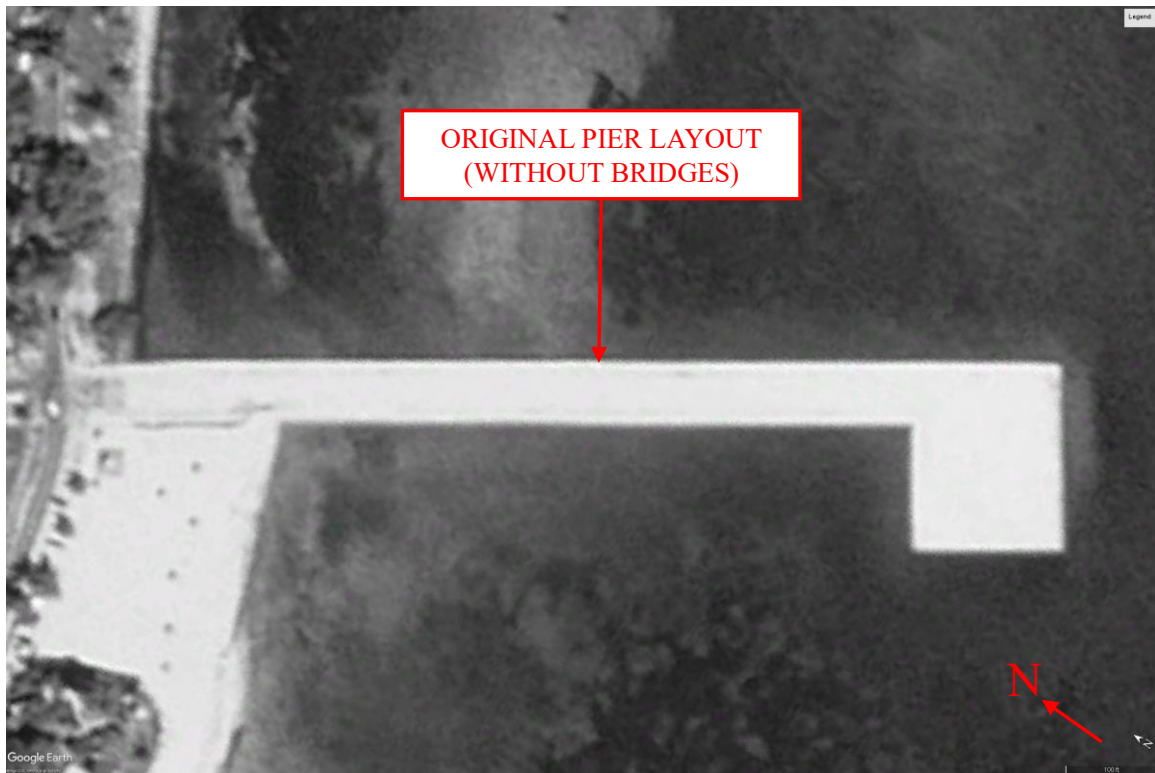
High Water Line. Nearly half of the structure was fully exposed (to the sand seabed) during these low tide observations.

It should be noted that no exploratory-demolition, excavation, or in situ testing was performed. This assessment is related to the structural members only. This assessment is intended for use by the City of Key West (City) and may not be relied upon, used by, or referenced by any third party.

### **Description of the Structure**

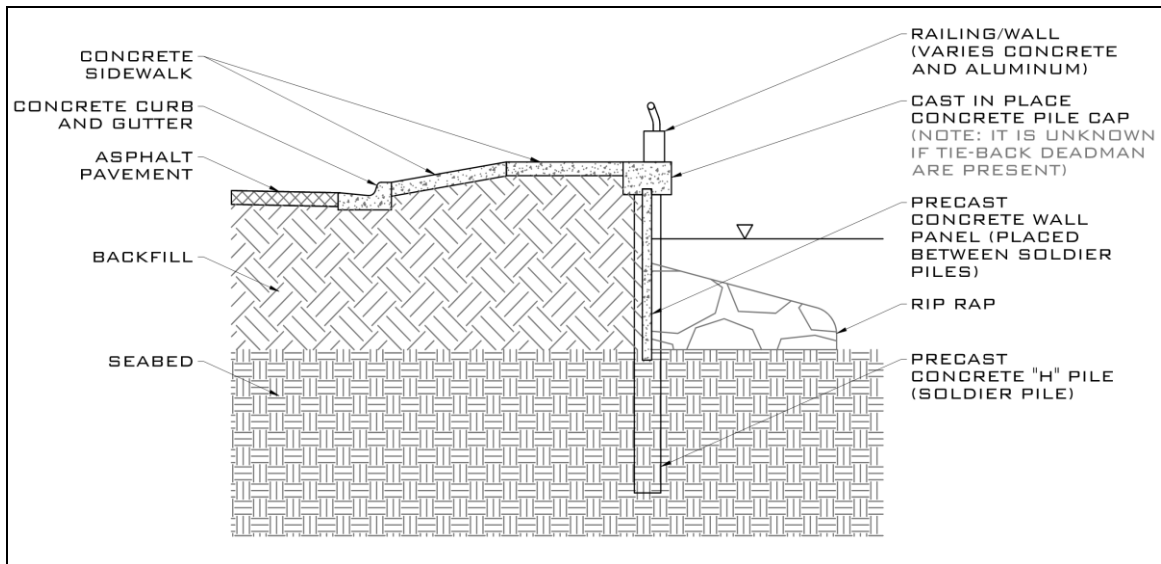
#### **General**

The structure was originally constructed in 1959, as a recreational fishing pier, extending White Street into the ocean. Original construction generally consisted of two parallel sea walls with fill placed between them to create usable land. The usable land was paved with concrete and asphalt.



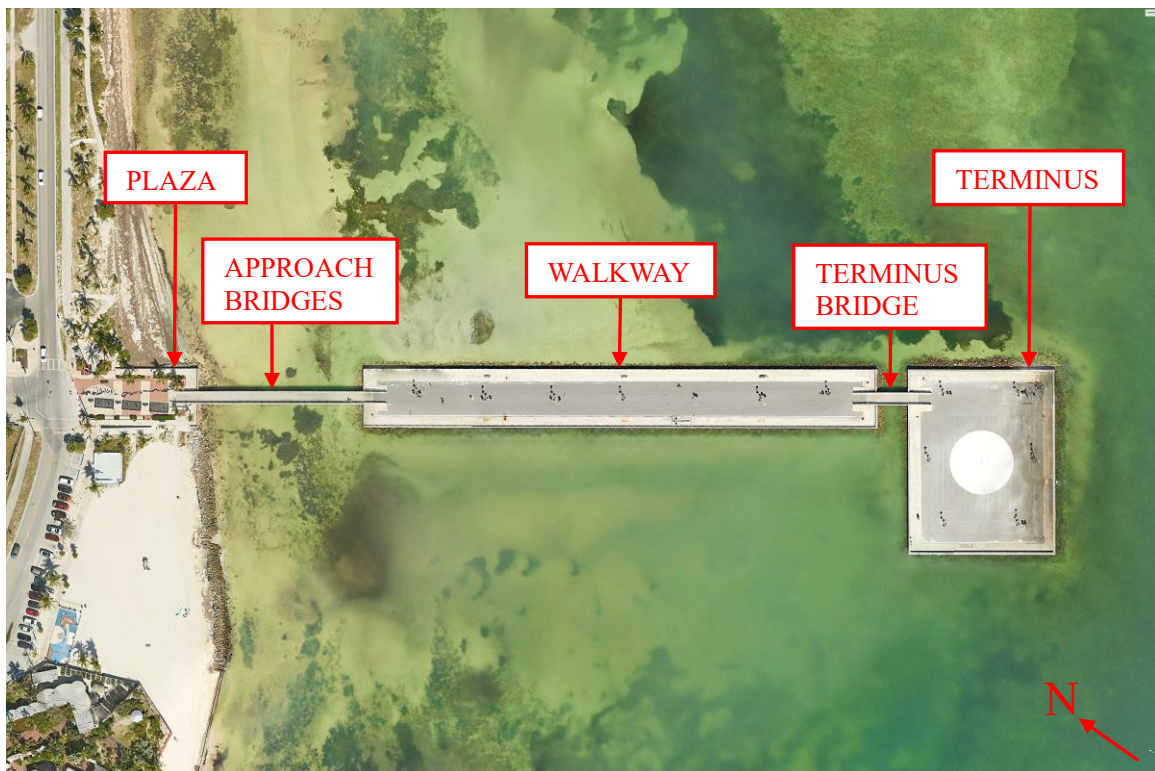
**Figure 2:** Original Layout Site Map (Google Earth Imagery Date: 1/14/1994)





**Figure 3: Typical Section**

After 34 years of service, the pier was modified to allow better water flow. The modification involved replacing two sections of the pier with bridges, mitigating poor water flow and the build of sand, seaweed, and debris. The figure below designates the sections of the current pier, as referenced in this assessment.



**Figure 4: Site Map (Google Earth Imagery Date: 2/2/2018)**



### Loading

The structure is loaded by pedestrian live loads, along with the occasional vehicle (typically mid-sized trucks used for maintenance and trash collection). Additionally, the structure experiences significant hydrodynamic loads from breaking waves during high winds and hurricanes.

### Historic Timeline

The information below is the known history of construction and repairs based on information provided by the City of Key West Engineering Department, engineering firms of previous projects, and public records requests to various agencies. **This is not a complete history**; it is included for reference only. Research on the complete history of the site and structure is beyond the scope of this report.

Year	Event	Resource
1959	Construction started, funded by Monroe County and the State Road Department (currently the Florida Department of Transportation, FDOT)	Key West Citizen Newspaper (Historic Article)
1960	Construction completed and opened to the public	Key West Citizen Newspaper (Historic Article)
1986	Assessment by CH2M Hill (Note: Document not found, however, reference to this document was made in the 2005 assessment by G.M. Selby & Associates, Inc.)	2005 assessment by G.M. Selby & Associates, Inc.
1991	Quitclaim Deed (FDOT to Monroe County)	FDEP public records request
1991	Quitclaim Deed (Monroe County to City of Key West)	FDEP public records request
c1994	Portions of the pier removed and replaced with bridges to improve water flow (partial set of plans dated 1994, Kisinger Campo and Associates Corp.)	Kisinger Campo and Associates Corp.
2005	Hurricane Wilma	
2005	Structural assessment (G.M. Selby & Associates, Inc.)	Provided by City of Key West
c2006	Light pole replacement (plans dated 2006, G.M. Selby & Associates, Inc.)	Provided by City of Key West
c2015	Repave asphalt (plans dated 2015 & 2016, City of Key West Engineering Department)	Provided by City of Key West
2017	Hurricane Irma	
c2017	Sidewalk repair at terminus (south end) (plans dated 2017, Artibus Design LLC)	Artibus Design Records
c2018	Approach bridge span 1 replacement (plans dated 2018, Artibus Design, LLC)	Artibus Design Records
c2018	Light fixture replacement, light poles to remain (plans dated 2018, K2M Design)	Provided by City of Key West





## **Findings & Discussion**

### **General**

The overall structure is considered to be acceptable for continued use. However, significant damage is present throughout the structure and it is expected that the rate of damage will continue to increase with time. Furthermore, the existing damage reduces the structure's ability to withstand hurricanes and large storm events.

Nearly all damage observed is related to:

1. Corrosion
  - a. Spalling
    - i. Spalling is a common defect observed in steel reinforced concrete throughout the Florida Keys. In general spalling is caused by corroded steel reinforcement expanding within the concrete. This expansive force causes cracking of the concrete member. If unrepaired, spalling will cause section loss of the concrete member and the steel reinforcement, resulting in reduced member capacity and ultimately structural failure. The presence of chlorides and moisture in the concrete member plays a large role in the formation and exacerbation of spalling damage. It is expected that the existing reinforced concrete has experienced significant chloride penetration. Therefore, the remaining un-spalled concrete is also expected to experience corrosion and spalling damage in the future.
  - b. Corroding hardware (Railing and light pole anchor bolts)
  - c. Corroding manholes
2. Erosion
  - a. Scattered rip rap and erosion of sand adjacent to the structure
  - b. Loss of backfill
    - i. Voids in the backfill will lead to an unstable structure. Currently this is causing settlement and partial collapse of the concrete sidewalks. However, if loss of backfill is not mitigated, it could lead to collapse of portions of the seawall
  - c. Eroding concrete members, contributing to loss of backfill

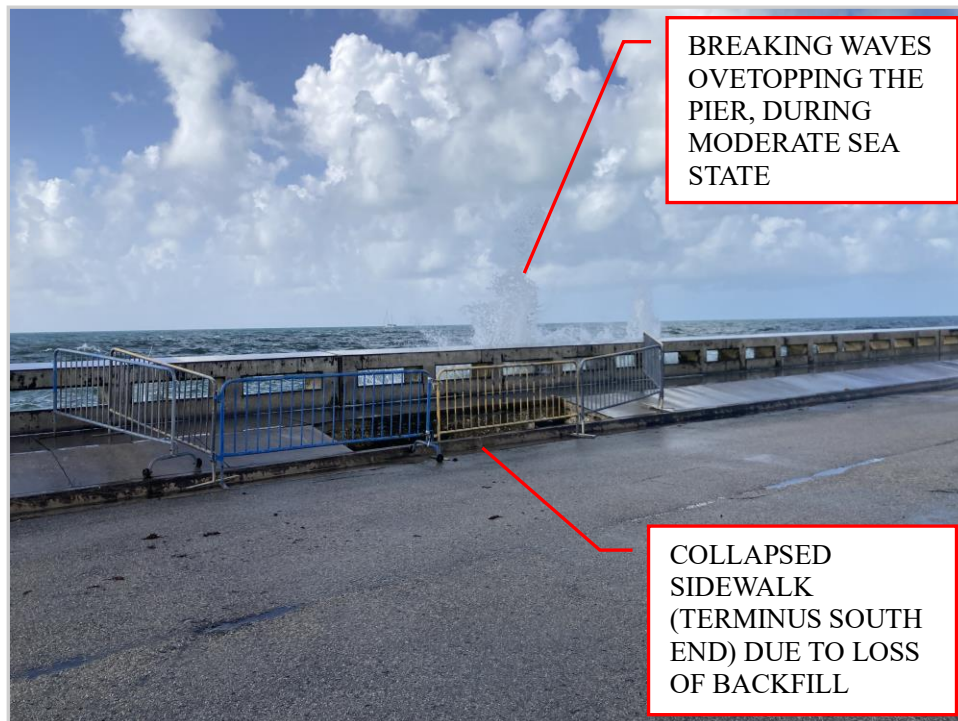
The following is a general discussion of damages, organized by failure mode or member type. Appendix A provides the layout and photos of all damage observed. As discussed in the recommendations sections of this report, the structure is recommended for a planned replacement. Therefore, discussion in this section often references "entire pier replacement."



## Wave Action

The pier is continuously exposed to waves that exert a tremendous force on the structure and cover all parts of the structure in saltwater. This exposure is the primary cause of the erosion and corrosion observed. Storm events drastically increase the severity of these waves.

Although it is impossible to avoid these waves, it is recommended that the rip rap be repaired/replenished, as discussed below. Additionally, it is recommended that all repairs and replacement construction be detailed and constructed to resist the harsh marine environment. Furthermore, the pier should be monitored following any storm events, to ensure that unsafe conditions did not (or do not) form.



## Rip Rap [Repair Timeline: 2 years & ongoing]

Rip rap is present at the perimeter of the pier. Rip rap re-directs wave energy, mitigating sediment erosion and wave impact on the structure. The existing rip rap is in fair condition, however there are some areas that would benefit from rip rap repair/replenishment.

It is recommended that rip rap be repaired/replenished, with a focus on the areas shown in figure 5.

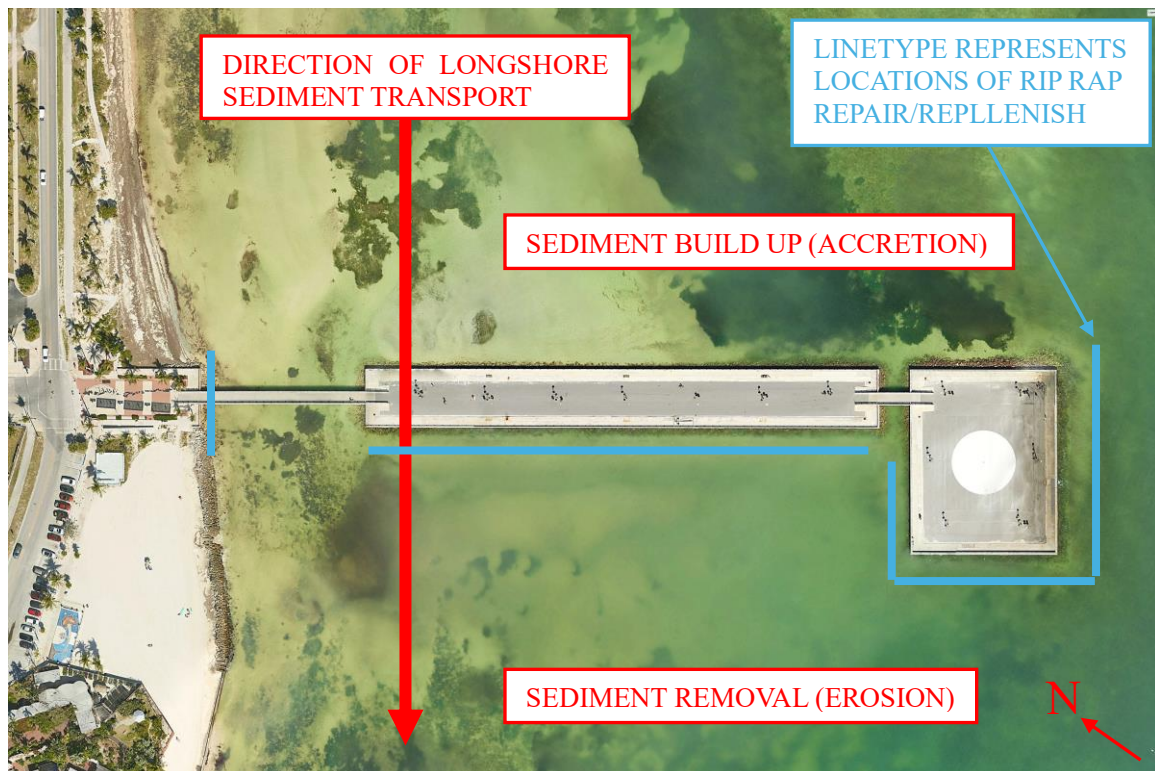




## **Sediment Transport [Repair Timeline: 2 years & ongoing]**

The pier is experiencing sediment build up (accretion) on the east side and sediment removal (erosion) on the west side. This is evident when observing the water depths around the pier. Accretion and erosion occur with all "hard structures" that extend into the ocean. Key West experiences a predominant east-southeast wind, causing east-to-west longshore sediment transport. Therefore, the west side of the pier experiences erosion and is much more susceptible to loss of backfill.

It is recommended that backfill mitigation efforts be focused on the west side of the walkway, as well as the south face of the terminus (due to wave exposure).



**Figure 5:** Site Map: Sediment and Rip Rap (Google Earth Imagery Date: 2/2/2018)



## **Loss of Backfill [Repair Timeline: 2 years & ongoing]**

As shown by the typical section above, the Plaza, Walkway, and Terminus are constructed of earth fill with surrounding sea walls. Loss of backfill is causing settlement and partial collapse of the adjacent concrete sidewalk (as pictured below). If loss of backfill is not mitigated, it reduces the structure's capacity to resist wave loads and could lead to collapse of portions of the seawall. It is expected that backfill is being lost through pile-panel joints and undermining of the sea wall panels (where erosion has exposed, or nearly exposed the bottom of the panels). Both of these conditions allow for the flow of water through the sea wall causing loss of backfill.

It is recommended that loss of backfill be repaired and mitigated by excavating limited areas of concern, patching pile-panel joints (from the inside face), replacing backfill with flowable fill, and reconstructing the sidewalks. Additionally, geotextile fabric may be a useful inclusion to mitigate backfill loss.



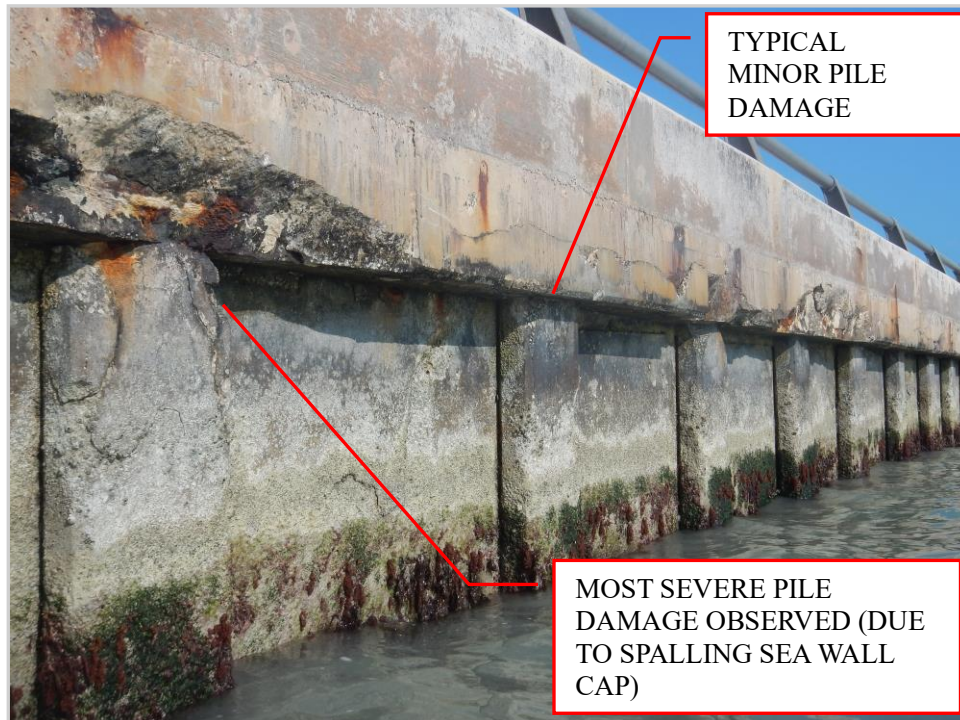
## **Sea Wall Piles [Repair Timeline: 15-25 years]**

The sea wall is constructed of driven concrete piles (typically "H" piles) with precast wall panels spanning between piles. The pile and wall panel configuration retains the backfill and is tied together with the cast-in-place concrete cap. The piles evidenced minimal damage. However, deterioration at the pile-panel joints, as discussed below, is the cause of significant damage, due to loss of backfill. Other minor damage to piles was observed sporadically throughout; however, this damage was minimal and generally located above the waterline.

It is recommended that existing sea wall piles remain as is, until entire pier replacement. However, where pile damage coincides with sea wall cap repairs, the piles shall be repaired.

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### **Sea Wall - Wall Panels [Repair Timeline: 2 years & ongoing]**

Generally, these panels did not evidence extensive damage. However, erosion at the pile-panel joint is the cause of significant damage, due to loss of backfill. This damage is consistent across the south face of the terminus and is likely caused by continuous wave exposure. Additionally, some minor damage was observed at the panel-cap interface. However, this damage does not pose a significant hazard to the structure.

It is recommended that pile-panel joints be repaired, by packing the interior face of joints with repair mortar (or other material) to mitigate the flow of water. These repairs should be completed where they coincide with areas of backfill mitigation. Repair of the panel-cap joint should be made wherever they coincide with sea wall cap repairs.



DAMAGED PILE-PANEL  
JOINT, WATER FLOWING IN  
AND OUT WITH EACH  
WAVE



MINOR DAMAGE, WALL  
PANEL-CAP JOINT







## **Sea Wall Cap (Plaza, Walkway, & Terminus) [Repair Timeline: 5-10 years & ongoing]**

The sea wall cap evidenced minor to severe damage throughout the structure. The majority of the cap evidenced moderate to severe damage, with few areas undamaged. This is due to spalling from corroding rebar. It is expected that rebar corrosion has initiated even in visually undamaged areas. The cap is critical to the structural integrity of the sea wall; however, it does not pose an immediate risk of structural failure. The remaining capacity of the cap as well as the incidental support provided by the concrete railing and the adjacent concrete pavement provides a stable structure.

It is recommended that limited sections of the cap be reconstructed, as required to maintain use of the structure, until entire pier replacement. Patch repairs are not recommended, as they are difficult, costly, and have a short expected service life. This is due to the damage type and the severe exposure. This recommendation is made to reduce repair cost as the City plans for replacement of the pier.

Reconstruction of sections should utilize glass fiber reinforced polymer (GFRP) rebar as well as anodic and/or cathodic corrosion protection on any remaining steel embedded in the concrete.







### **Bridge Piles [Repair Timeline: 15-25 years]**

No significant pile damage was observed at intermediate bridge piers or bridge abutments. This is consistent for the approach bridges and the terminus bridge.



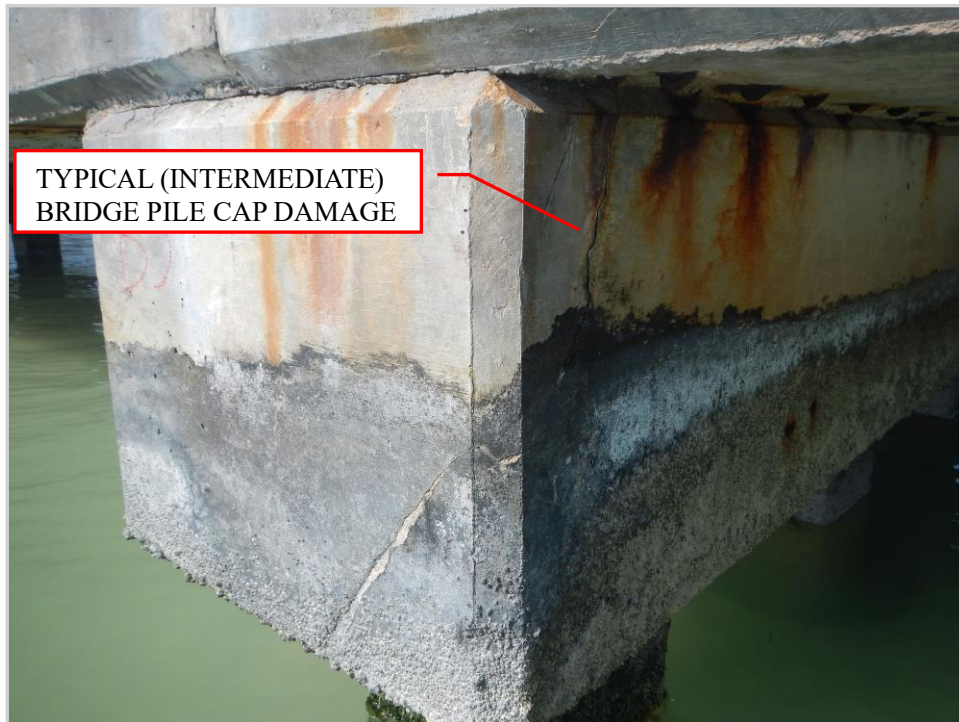


### **Bridge Pile Caps [Repair Timeline: 15-25 years]**

Minor pile cap damage was observed throughout intermediate piers and abutments. This is consistent for the approach bridges and the terminus bridge.

It is recommended that these members remain as is, until entire pier replacement. It is estimated that this damage will not increase to a significant level, within the proposed timeline for pier replacement. However, they should be monitored throughout the remaining life of the structure.









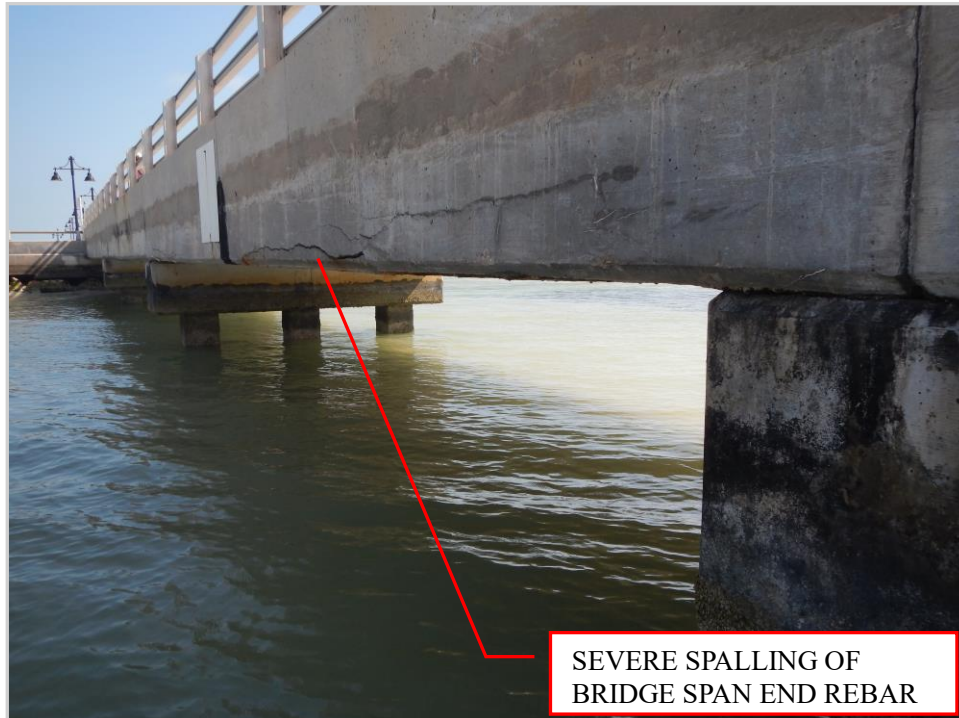
## **Bridge Spans [Repair Timeline: 5-10 years & ongoing]**

These spans were a modification to the pier and added circa 1994. Moderate to severe damage was observed throughout the approach bridge spans and the terminus bridge (with the exception that no damage was observed on the north span of the approach bridge, replaced in 2018). The most significant damage type is concrete spalling of the end rebar along the sides of the bridges. It is expected that these spans were constructed of cast in place concrete with standard grade 60 rebar, utilizing metal rebar chairs. These construction materials have proven to be insufficient, considering that significant damage has occurred within 31 years of service. While these bridge spans were constructed using design and material standards typical at the time, the fact that they are located in the saltwater splash zone has significantly reduced their service life.

Although more dramatic spalling is present on the sea wall cap, the bridge span rebar is more critical and provides a greater concern for structural integrity. This damage does not pose an immediate risk of structural failure; however, it is expected to worsen with time. Further corrosion of the rebar will reduce the capacity and eventually lead to failure.

Additionally, it was observed that steel rebar chairs were used during construction. The chair legs are exposed and corroding on the underside of the bridge spans. This does not pose an immediate structural deficiency; however, this condition will accelerate the deterioration of the spans by allowing a pathway for chlorides to penetrate the member and reach the rebar. The corroded rebar chairs may remain, as it is impractical to repair this condition.

It is recommended that this damage be monitored, with the expectation that major repairs and/or span replacement will be required, prior to entire pier replacement. Repairs and replacement should utilize type 316 stainless, ChromX, and GFRP rebar, in lieu of plain steel. Concrete mix should be designed to meet or exceed the Florida Department of Transportation specifications for concrete located in the saltwater splash zone. An epoxy coating should be utilized to protect the concrete from salt spray.





## **Concrete Knee Walls (Throughout)** **[Repair Timeline: 5-10 years & ongoing]**

The concrete knee walls evidenced moderate damage throughout, with some areas of severe damage. However, this damage does not currently pose a concern for structural integrity or occupancy safety. The rate of this damage is expected to increase over time, as the existing cracks allow water and chlorides to readily penetrate the concrete member.

It is recommended that this damage be monitored, with the expectation that limited section replacement will be required, prior to entire pier replacement. Repairs and replacement should utilize GFRP rebar, in lieu of plain steel. Concrete mix should be designed to meet or exceed the Florida Department of Transportation specifications for concrete located in the saltwater splash zone.







**Aluminum Railing (Plaza, Approach Bridge, Walkway, Terminus Bridge)**  
**[Repair Timeline: 5-10 years & ongoing]**

The aluminum railing (atop the concrete knee wall) was observed to be in acceptable condition. However, the railing anchor bolts are badly corroded. It is assumed that galvanized anchor bolts were used.

It is recommended that these anchor bolts be replaced throughout. New anchor bolts should be type 316 stainless steel and utilize a separation barrier (Teflon washers and bituminous paint) where in contact with aluminum. It is recommended that the existing railing be shifted, allowing new anchors to be installed in sound concrete. Some sections of railing will require modification, due to shifting. Existing anchors may be cut flush with the concrete surface, then covered with an epoxy coating. This approach will require isolated concrete repair as abandoned bolts corrode over time. This is recommended in lieu of complete anchor bolt removal and concrete patching, to reduce repair costs as the City plans for replacement of the pier.







## **Sidewalks (Plaza, Walkway, & Terminus)** **[Repair Timeline: 2 years & ongoing]**

One area of collapsed sidewalk was observed (at terminus) and multiple areas of concern were identified (west side of walkway & south side of terminus). This sidewalk damage is the result of loss of backfill, as discussed above. Otherwise, the existing sidewalk was observed to be in acceptable condition with minor surface erosion.

It is recommended that backfill stabilization (see "Loss of Backfill") be completed in the damaged areas. Additionally, the City should continuously monitor the sidewalk for signs of settlement and unsafe conditions (e.g. tripping hazards). Backfill stabilization and sidewalk reconstruction should be completed as required, until entire pier replacement.







## **Curbing (Plaza, Walkway, & Terminus)** **[Repair Timeline: 15-25 years]**

No significant curb damage was observed.

It is recommended that the City monitor the curbing to ensure trip hazards or unsafe conditions do not form. Patch repairs should be made where necessary.



## **Storm Drains & Manholes (Plaza, Walkway, & Terminus)** **[Repair Timeline: 2 years & ongoing]**

The stormwater inlets (identified in appendix A) present an unsafe condition due to severe spalling and corroding manholes. These manholes and slabs are heavily deteriorated and at risk of collapse. Furthermore, the spalling concrete has enlarged the inlet opening. This opening could cause a foot trap or allow access by small children and dogs.

It is recommended that access to these areas be restricted until repairs are made. Repairs should include complete reconstruction of the concrete slabs covering the stormwater inlet. Reconstruction should utilize type 316 stainless, ChromX, or GFRP rebar, in lieu of plain steel. Replacement slabs should not include manholes, or include non-metallic manholes (if required). The remaining inlets should be monitored by the City and reconstructed as required, until entire pier replacement.

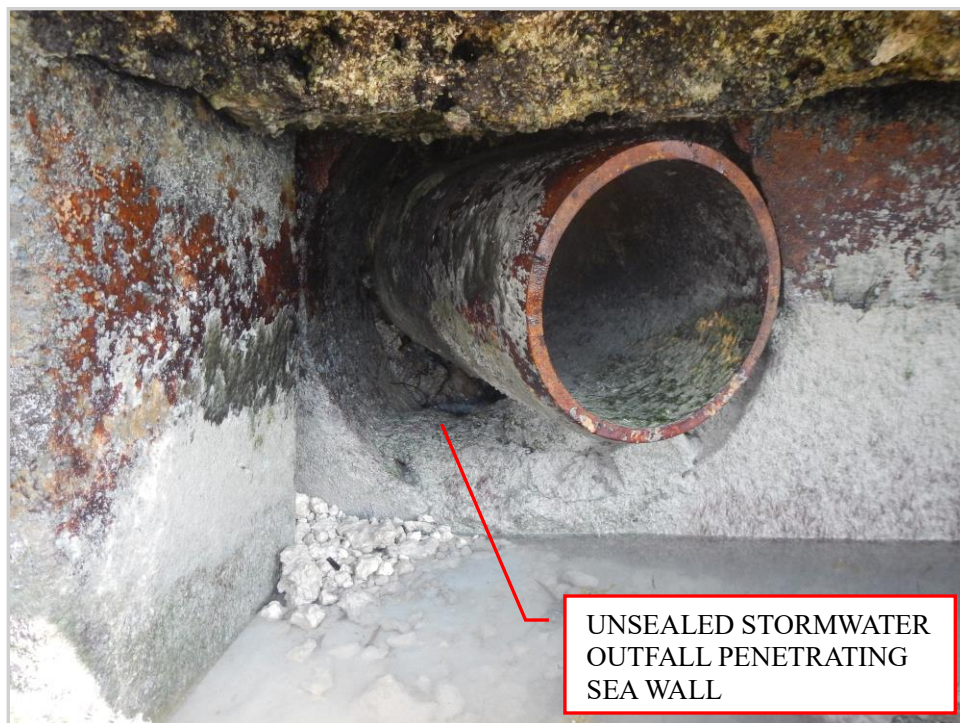
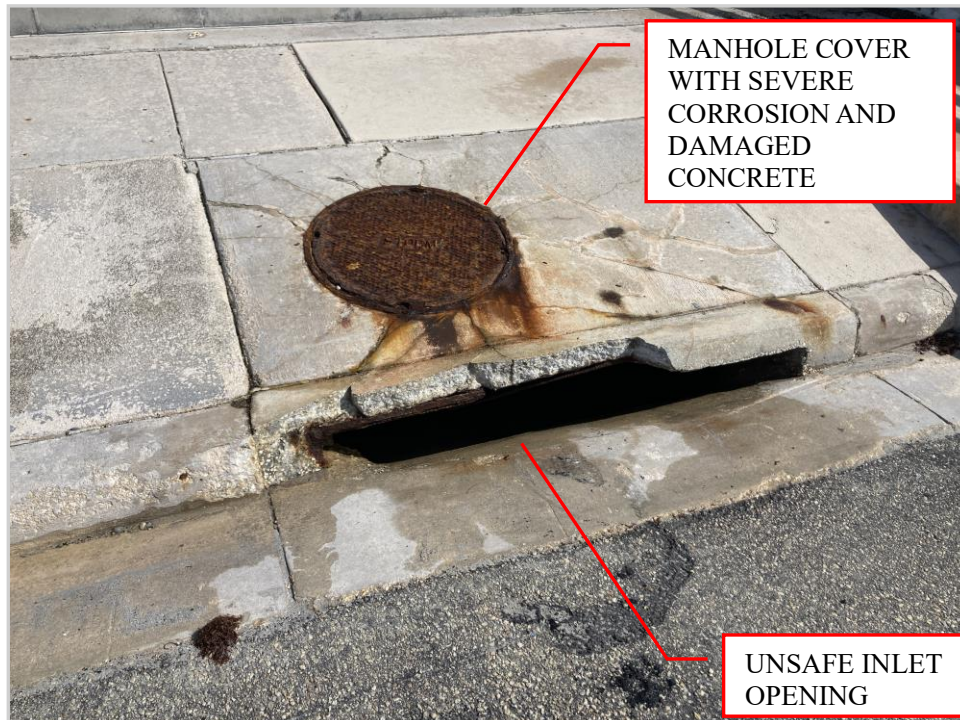
Additionally, the stormwater outfalls evidenced moderate damage. Some drainage outfalls were not properly sealed (grouted) and may contribute to loss of backfill.

It is recommended that unsealed outfalls be grouted to stop water intrusion and the loss of backfill.

Furthermore, the current use of internal gutters and drains provides unnecessary cost & complexity to the structure. The internal drains provide opportunity for damage (inlets, outlets, manholes) and water intrusion leading to erosion. Additionally, they provide no water treatment, however, they are at risk of blockage. It is recommended that the new pier be graded to include surface drainage, via scuppers. This is a typical drainage design for docks, bridges, and piers.

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**Asphalt (Walkway & Terminus) [Repair Timeline: 5-10 years & ongoing]**

No significant asphalt damage was observed. However, it is expected that asphalt repaving will be required prior to entire pier replacement.





## Concrete Pavement (Plaza) [Repair Timeline: 15-25 years]

No significant concrete pavement damage was observed.





## **Light Poles (Plaza, Walkway, & Terminus)** **[Repair Timeline: Immediate]**

The observed light pole anchor bolts are severely corroded and present an unsafe condition. It is assumed that galvanized anchor bolts were used. Two light pole bases were observed; the remainder had covers concealing the anchor bolts. However, it is expected that all anchor bolts are severely corroded. These anchor bolts are considered structurally failed due to corrosion.

It is recommended that the light poles be removed while the anchor bolts be reconstructed. This will likely require new foundations, however, retrofitting the existing foundations may be a feasible solution, after further analysis.







## **Conclusion**

### **General**

The overall structure is considered to be acceptable for continued use. The damage observed does not present an immediate risk of structural failure. However, the structure is nearing its useful life, considering its age (66 years old) and the current condition. It is expected that the planned design life for this structure was 50 yrs. The structure was built by the State Road Department in 1959 with similar construction to a bridge approach causeway. Per the American Society of Civil Engineers - 2025 Infrastructure Report Card, bridges of this age have "planned design lives of 50 years. However, since 2007, new highway bridges are required to have a minimum 75-year design life." The simple and robust design of the structure has allowed it to exceed its design life. Steel rebar corrosion is considered the limiting damage, as this damage is costly to repair and nearly impossible to halt once initiated.

Although the life of the structure could be prolonged indefinitely with extensive maintenance and repairs; this is not considered practical. Significant degradation of materials has occurred, including chloride intrusion of concrete, erosion of concrete, and corrosion of steel. This degradation results in costly repairs with short effective life spans. Furthermore, the rate of deterioration is expected to increase with time. Existing damages expose the structure to more rapid degradation due to the severe environment.

## **Recommendations**

### **General**

It is recommended that the City plan for the replacement of the structure within 15-25 years. During this time, repairs should be made to maintain safe operation of the pier and the City should monitor the structure for changes that result in safety risks. Additional monitoring should occur immediately after and for a period of time following hurricanes and large storm events.

It is acceptable to make limited repairs, as shown in the timeline below. This recommendation is made to reduce repair costs as the City plans for replacement of the pier. However, it should be noted that unrepaired damages:

- Reduce the structures ability to resist hurricanes and large storm events, although they do not pose an immediate threat to structural failure.
- Require monitoring, as these damages may become critical if they increase in size and severity.
- Result in more rapid deterioration of both the damaged member and the surrounding members.
- Negatively affect the aesthetics of the structure and may cause concern for the users.



# ARTIBUS DESIGN

## ENGINEERING AND PLANNING

### **Recommended Repair Timeline & Opinion of Probable Costs**

#### OPINION OF PROBABLE COST:

#### **Phase 1: Immediate Repairs (Completed within 2 Years)**

Work Description	Approx. Qty	Units	Cost
Replace Light Poles	15	QTY	\$ 180,000
Reconstruct Area of Collapsed Sidewalk	350	SF	\$ 53,000
Reconstruct Area of Settling Sidewalk	2,300	SF	\$ 276,000
Rip Rap Replenishment	1,150	LF	\$ 633,000
Reconstruct Stormwater Inlets (Manholes)	9	QTY	\$ 198,000
Grout Stormwater Outlets	3	QTY	\$ 27,000
SUBTOTAL			\$ 1,367,000
<b>ADDITIONAL</b>			
Design and Engineering	5%	Percent of Subtotal	\$ 68,350
Engineering Bid Phase and Construction Phase	5%	Percent of Subtotal	\$ 68,350
Mobilization & Demobilization	10%	Percent of Subtotal	\$ 136,700
TOTAL			\$ 1,640,400
Additional Contingency (20% Percent of Subtotal)			\$ 273,400

#### OPINION OF PROBABLE COST:

#### **Phase 2: Midterm Repairs (Completed within 5-10 years)**

Work Description	Approx. Qty	Units	Cost
Sea Wall Cap Spalling - Reconstruct Sections (Incl. Concrete Knee Wall Above)	455	LF	\$ 455,000
Repair Settling Sidewalk	2000	SF	\$ 202,000
Concrete Knee Wall - Reconstruct Sections	100	LF	\$ 40,000
Bridge Span Spalling Repairs/Reconstruction	1.5	QTY	\$ 660,000
Asphalt - Repave	1	Lump Sum	\$ 150,000
Railing Anchor Bolt Repair	2065	LF	\$ 103,000
SUBTOTAL			\$ 1,610,000
<b>ADDITIONAL</b>			
Design and Engineering	5%	Percent of Subtotal	\$ 80,500
Engineering Bid Phase and Construction Phase	5%	Percent of Subtotal	\$ 80,500
Mobilization & Demobilization	10%	Percent of Subtotal	\$ 161,000
TOTAL			\$ 1,932,000
Additional Contingency (20% Percent of Subtotal)			\$ 322,000

**Inflation Note:** The values above represent current opinion of probable costs. The City of Key West Finance Department must be consulted for an inflation adjusted cost estimate, based on the targeted repair timeline.



# ARTIBUS DESIGN

## ENGINEERING AND PLANNING

### OPINION OF PROBABLE COST:

#### Phase 3: Pier Replacement (Completed within 15-25 years)

Work Description	Approx. Qty	Units	Cost
Demolition, Disposal, & Temporary Facilities	1	Lump Sum	\$ 2,500,000
New Sea Wall (Concrete Soldier Pile)	2140	LF	\$ 6,506,000
New Bridge Bents	8	QTY	\$ 1,600,000
New Bridge Spans (±37' ea.)	6	QTY	\$ 2,640,000
New Concrete Railing w/ Aluminum Components	2790	LF	\$ 1,395,000
New Concrete Pavement	76170	SF	\$ 2,437,000
Additional Backfill (Flowable Fill)	5642	CY	\$ 1,834,000
Rip Rap	2,140	LF	\$ 803,000
New Lighting	1	Lump Sum	\$ 700,000
SUBTOTAL			\$ 20,415,000
<b>ADDITIONAL</b>			
Design and Engineering	5%	Percent of Subtotal	\$ 1,020,750
Engineering Bid Phase and Construction Phase	5%	Percent of Subtotal	\$ 1,020,750
Mobilization & Demobilization	10%	Percent of Subtotal	\$ 2,041,500
TOTAL			\$ 24,498,000
Additional Contingency (20% Percent of Subtotal)			\$ 4,083,000
<b>Inflation Note:</b> The values above represent <u>current</u> opinion of probable costs. The City of Key West Finance Department must be consulted for an inflation adjusted cost estimate, based on the targeted replacement timeline.			

### Replacement Considerations

The replacement structure should be simple and robust; allowing it to exceed a 75-100 year design life, with minimal maintenance. Concrete Soldier pile design similar to the existing construction, has proven to be a long lasting option. This design could be greatly improved by avoiding the use of plain carbon steel, detailing the pile-panel joints to be more robust, and using a stabilized backfill (flowable fill).

The following material alternatives should be used for reconstruction. These materials drastically improve the design service life of the proposed structure and reduce maintenance cost. Therefore, the added initial cost is likely to provide significant lifetime savings.

- Where steel is required, only type 316 stainless steel, duplex stainless steel, or ChromX should be used
- GFRP rebar may be utilized for select applications
- Concrete mix should meet or exceed the Florida Department of Transportation specifications for concrete located in the saltwater splash zone, resulting in a more durable and less permeable concrete.

Additionally, it is recommended that the pier be designed to drain on the pavement surface through scuppers, in lieu of the current internal drain system. This provides a simple and robust drainage solution that is typical for docks, bridges, and

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AUGUST 2025





# ARTIBUS DESIGN

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## ENGINEERING AND PLANNING

piers. Drainage design is subject to U.S. Army Corps of Engineers (ASACE) and the Florida Department of Environmental Protection (FDEP) approval.

### **Permitting (USACE & FDEP)**

Replacement of the structure requires permitting through the U.S. Army Corps of Engineers and the Florida Department of Environmental Protection. During this coordination and permitting, it may be determined that the replacement is required to minimally impact the surrounding environment. If so, constructing a new structure within the footprint of the existing seawall may be practical. Additionally, this would likely reduce construction costs. However, it will result in a smaller structure and may pose design difficulties.

Repairs may require (based on scope) permitting through the U.S. Army Corps of Engineers and the Florida Department of Environmental Protection.

### **Sea Level Rise**

All work on the structure should consider sea level rise for the planned life of the structure and beyond. Key West currently experiences "king tide" events that limit the use of certain areas of the island. Therefore, it is recommended that the replacement structure be elevated to allow for use during projected future king tides.

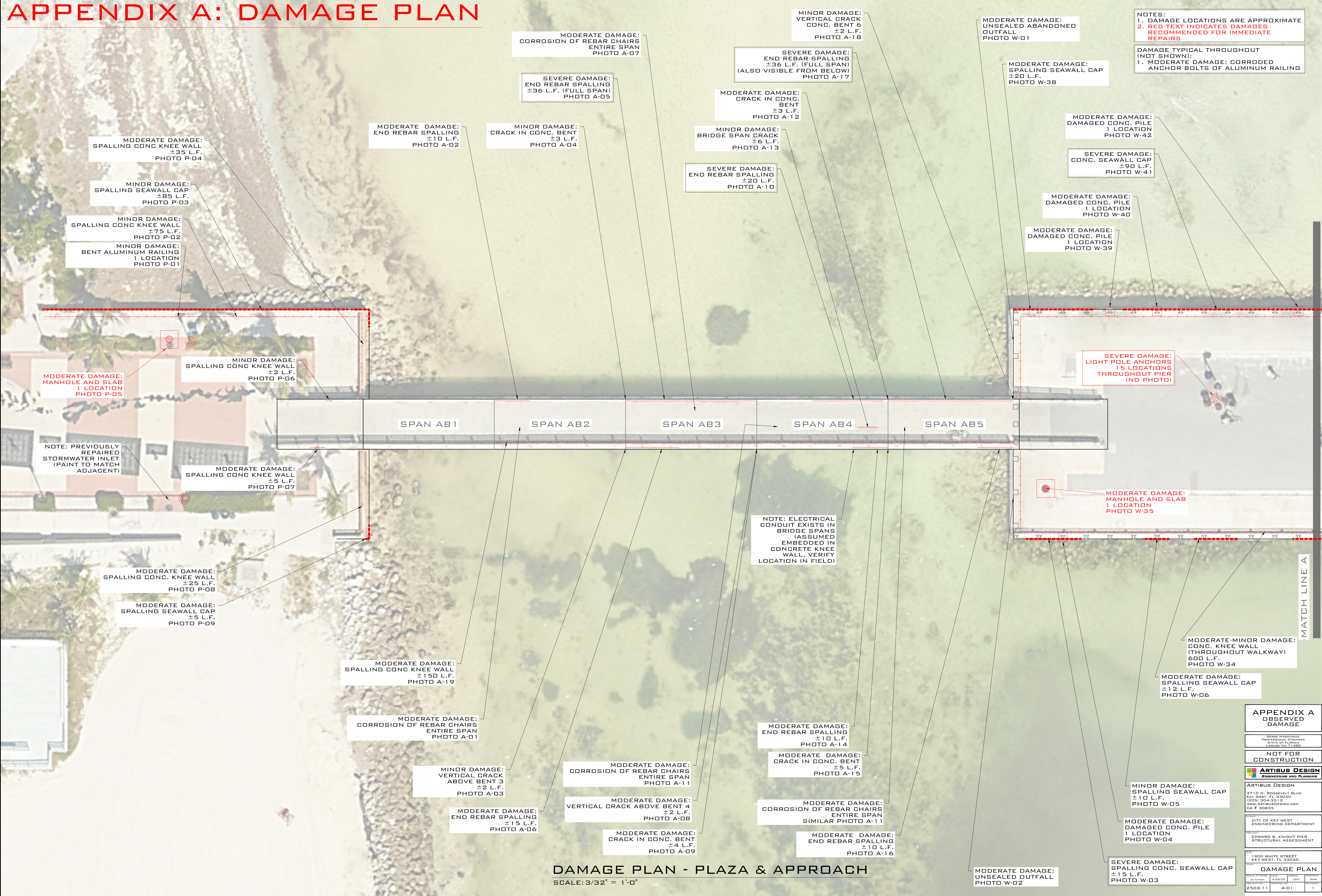
### **Limitation of Recommendations**

The opinions of this report are based on observations of readily visible members at the time of the assessment. Non-visible conditions that currently exist may affect the conclusions and recommendations of this assessment.

Sincerely,  
Artibus Design LLC  
Serge Mashtakov, P.E.  
President



APPENDIX A: DAMAGE PLAN



NOTES:  
1. DAMAGE LOCATIONS ARE APPROXIMATE  
2. RED TEXT INDICATES DAMAGES RECOMMENDED FOR IMMEDIATE REPAIRS

DAMAGE TYPICAL THROUGHOUT (NOT SHOWN):  
1. MODERATE DAMAGE: CORRODED ANCHOR BOLTS OF ALUMINUM RAILING

APPENDIX A  
OBSERVED  
DAMAGE

GEORGE MANTAKOY  
PROFESSIONAL ENGINEER  
STATE OF FLORIDA  
LICENSE NO. 71480

NOT FOR  
CONSTRUCTION

ARTIBUS DESIGN  
ENGINEERING AND PLANNING

ARTIBUS DESIGN  
3710 N. ROOSEVELT BLVD  
KEY WEST, FL 33040  
(305) 304-3312  
WWW.ARTIBUSDESIGN.COM  
CA # 30835

CITY OF KEY WEST  
ENGINEERING DEPARTMENT

PROJECT:  
EDWARD B. KNIGHT PIER  
STRUCTURAL ASSESSMENT

1900 WHITE STREET  
KEY WEST, FL 33040

TITLE:  
DAMAGE PLAN

DATE OF FIELD  
AS SHOWN: 8/26/25

DATE: 8/26/25

DRAWN: JCH

CHECKED: SAM

PROJECT NO: 2502-11

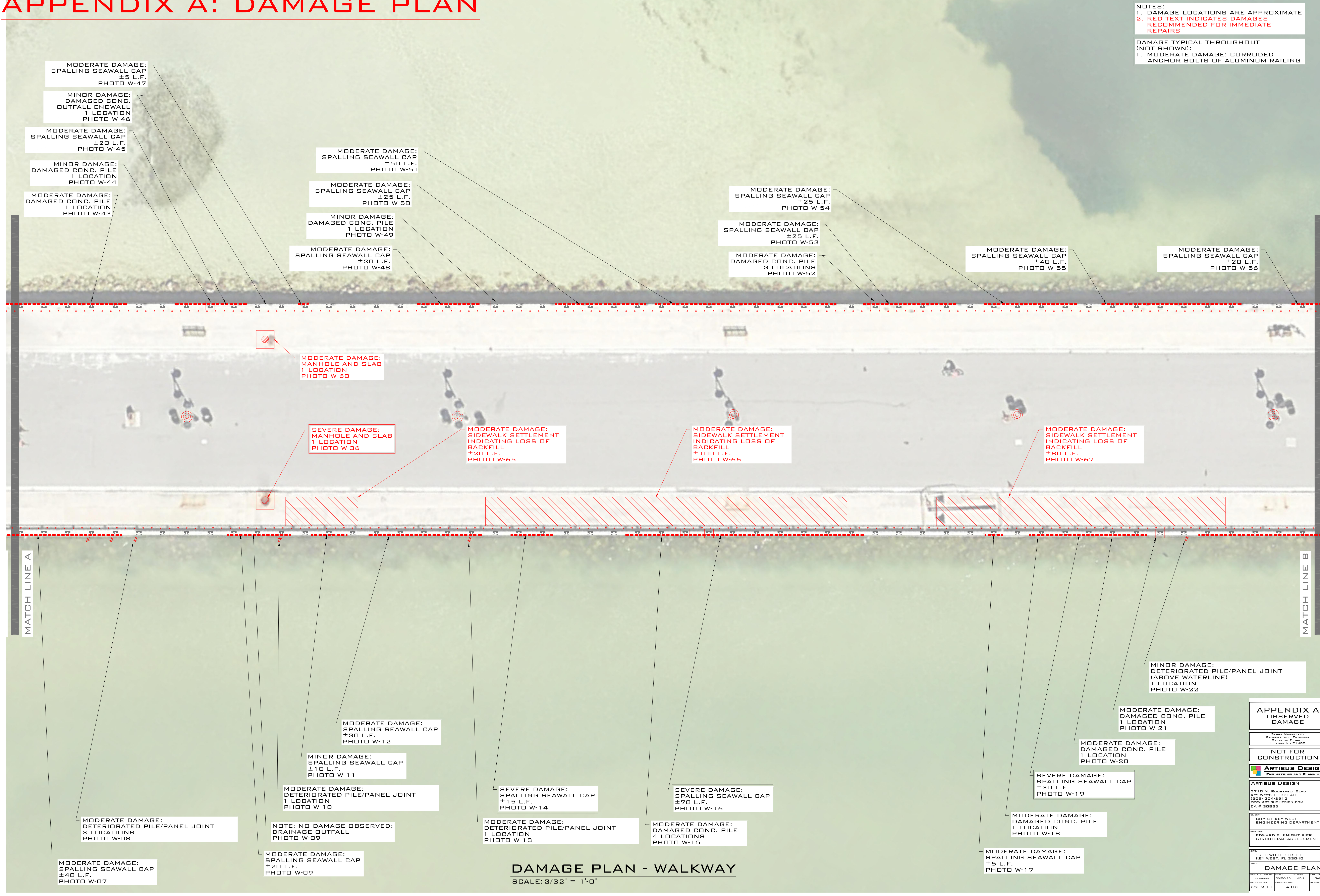
DATE: A-01

REVISION: 1

DAMAGE PLAN - PLAZA & APPROACH  
SCALE: 3/32" = 1'-0"



APPENDIX A: DAMAGE PLAN



**APPENDIX A  
OBSERVED  
DAMAGE**

GERGE MANTAKOY  
PROFESSIONAL ENGINEER  
STATE OF FLORIDA  
LICENSE NO. 71480

**NOT FOR  
CONSTRUCTION**

**ARTIBUS DESIGN**  
ENGINEERING AND PLANNING

ARTIBUS DESIGN  
3710 N. ROOSEVELT BLVD  
KEY WEST, FL 33040  
(305) 304-3312  
WWW.ARTIBUSDESIGN.COM  
CA # 30835

CLIENT:  
CITY OF KEY WEST  
ENGINEERING DEPARTMENT

PROJECT:  
EDWARD B. KNIGHT PIER  
STRUCTURAL ASSESSMENT

TITLE:  
1900 WHITE STREET  
KEY WEST, FL 33040

**DAMAGE PLAN**

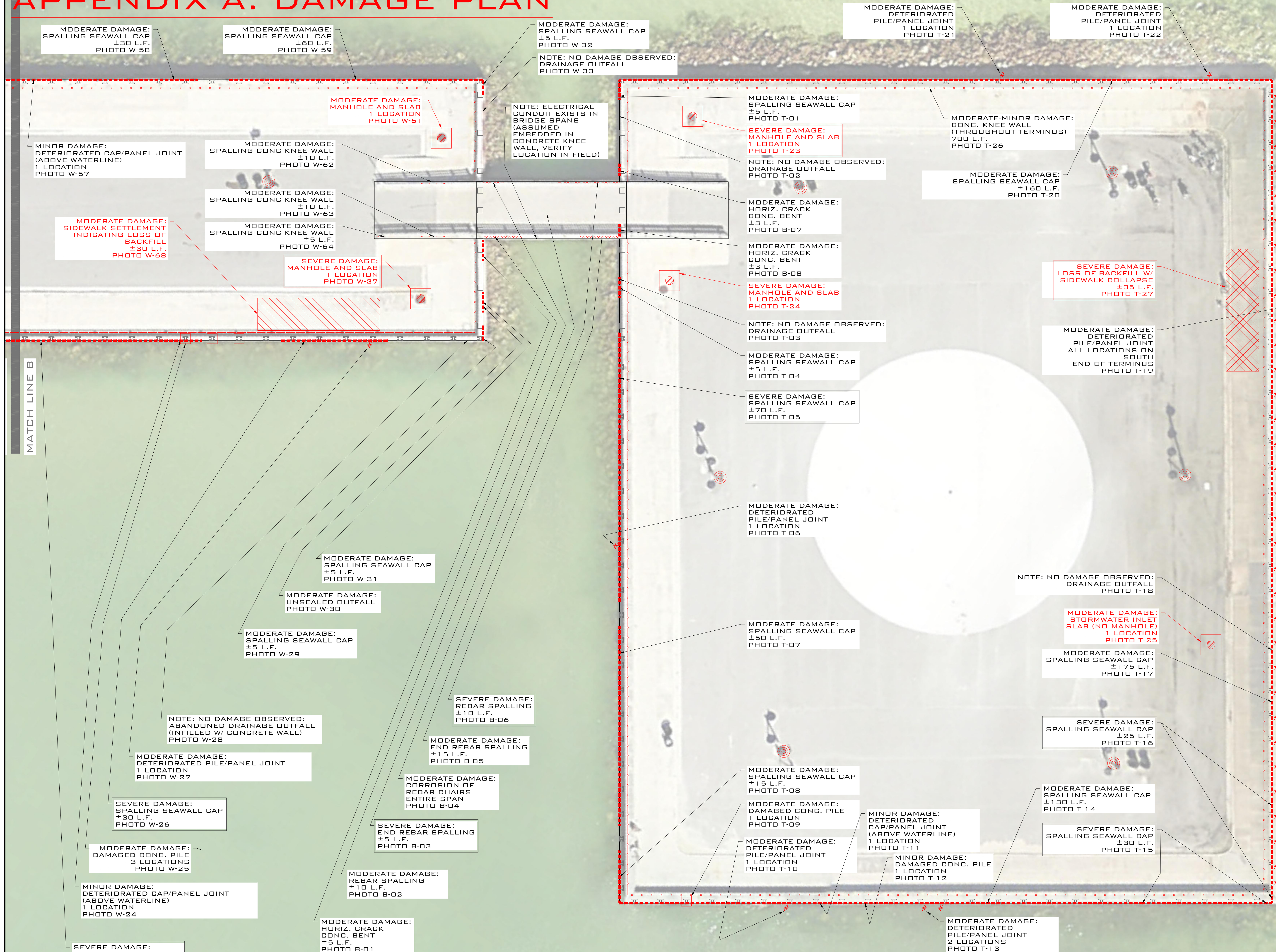
DATE	BY	DATE	BY	DATE	BY
2502-11	2502-11	2502-11	2502-11	2502-11	2502-11



## APPENDIX A: DAMAGE PLAN

NOTES:  
1. DAMAGE LOCATIONS ARE APPROXIMATE  
2. RED TEXT INDICATES DAMAGES  
RECOMMENDED FOR IMMEDIATE  
REPAIRS

DAMAGE TYPICAL THROUGHOUT  
(NOT SHOWN):  
1. MODERATE DAMAGE: CORRODED  
ANCHOR BOLTS OF ALUMINUM RAILING



## APPENDIX A

### OBSERVED DAMAGE

SERGE MASHTAKOV  
 PROFESSIONAL ENGINEER  
 STATE OF FLORIDA  
 LICENSE NO 71480

**NOT FOR  
CONSTRUCTION**

**ARTIBUS DESIGN**  
ENGINEERING AND PLANNING

---

**ARTIBUS DESIGN**  
710 N. ROOSEVELT BLVD  
WEST, FL 33040  
(954) 304-3512  
[www.ARTIBUSDESIGN.COM](http://www.ARTIBUSDESIGN.COM)  
Fax # 30835

CITY OF KEY WEST  
ENGINEERING DEPARTMENT

**EDWARD B. KNIGHT PIER  
STRUCTURAL ASSESSMENT**

1900 WHITE STREET  
KEY WEST, FL 33040

## DAMAGE PLAN

DATE:	06/26/25	DRAWN:	JDH	CHECKED:	SAM
SHEET NO:	DRAWING NO:			REVISION:	
502-11	A-03			1	

## DAMAGE PLAN - BRIDGE AND TERMINUS

SCALE: 3/32" = 1'-0"



APPENDIX A: PLAZA PHOTOS



PHOTO P-01



PHOTO P-02



PHOTO P-03



PHOTO P-04



PHOTO P-05



PHOTO P-06



PHOTO P-07



PHOTO P-08



PHOTO P-09

APPENDIX A OBSERVED DAMAGE		
SERGE MARITAKOV PROFESSIONAL ENGINEER STATE OF FLORIDA LICENSE NO. 71280		
NOT FOR CONSTRUCTION		
ARTIBUS DESIGN ENGINEERING AND PLANNING		
ARTIBUS DESIGN 3710 N. ROOSEVELT BLVD KEY WEST, FL 33040 (305) 304-3312 WWW.ARTIBUSDESIGN.COM CA # 30835		
CLIENT: CITY OF KEY WEST ENGINEERING DEPARTMENT		
PROJECT: EDWARD B. KNIGHT PIER STRUCTURAL ASSESSMENT		
SITE: 1900 WHITE STREET KEY WEST, FL 33040		
TITLE: PHOTOS		
DATE OF PHOTO: AS SHOWN	DATE: 06/26/25	DRAWN BY: JCH
PROJECT NO: 2502-11	SCALE: A-04	ISSUED BY: SMP
		REVISION: 1



APPENDIX A: APPROACH BRIDGE PHOTOS



PHOTO A-01



PHOTO A-02

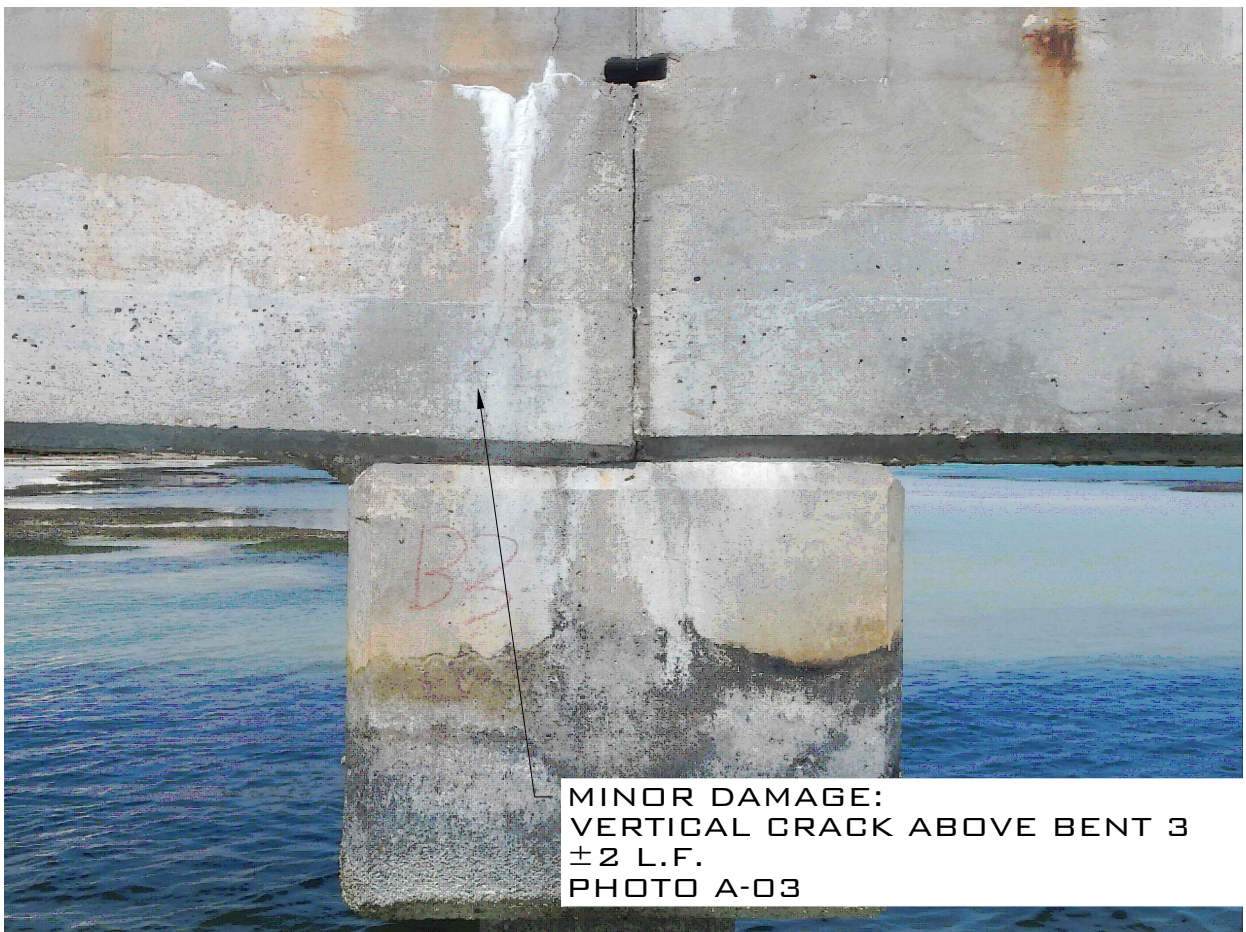


PHOTO A-03



PHOTO A-04



PHOTO A-05



PHOTO A-06



PHOTO A-07



PHOTO A-08



PHOTO A-09



PHOTO A-10



PHOTO A-11



PHOTO A-12

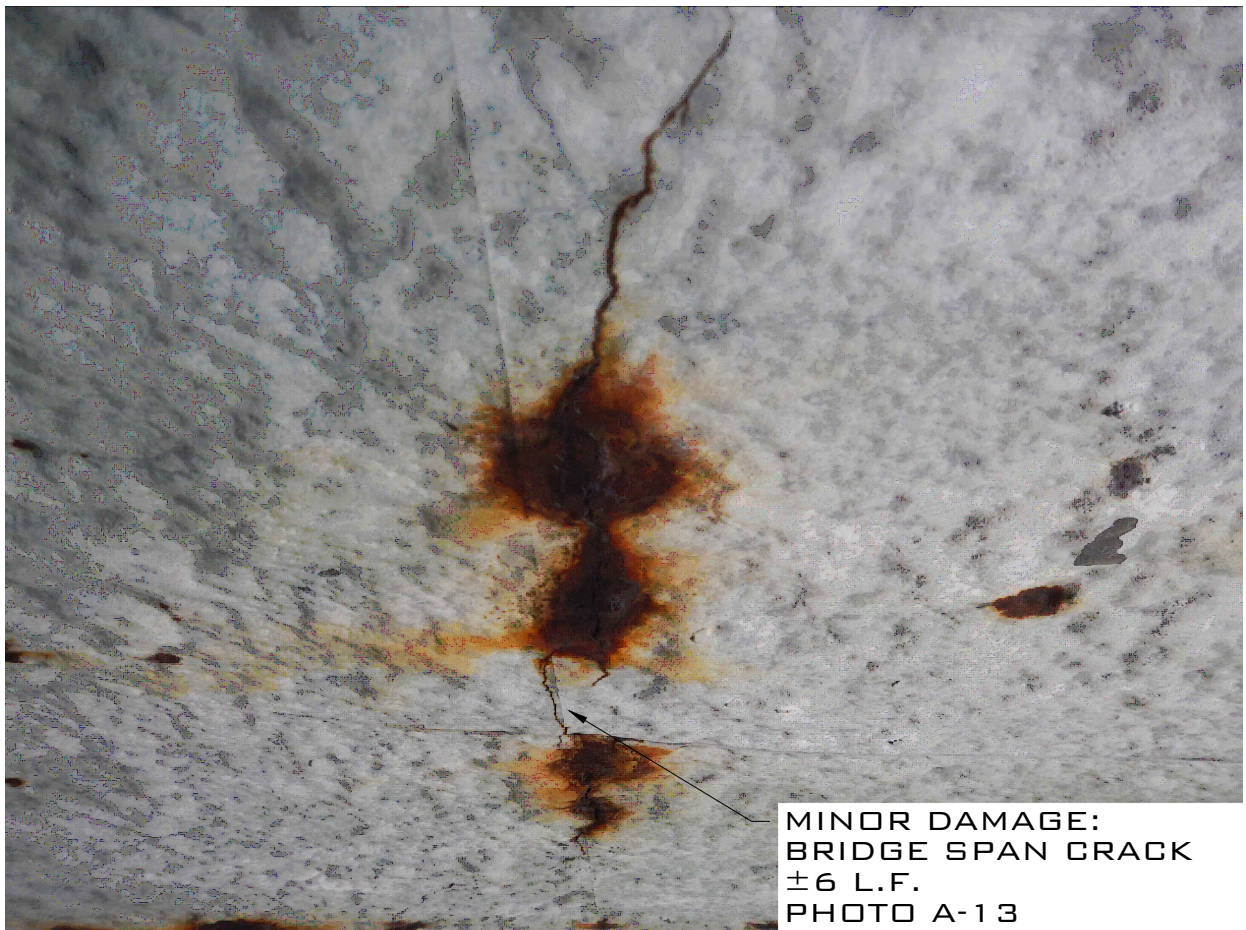


PHOTO A-13



PHOTO A-14



PHOTO A-15



PHOTO A-16



PHOTO A-17



PHOTO A-18



PHOTO A-19

APPENDIX A  
OBSERVED  
DAMAGE

SEAN MANTAKOV  
PROFESSIONAL ENGINEER  
STATE OF FLORIDA  
LICENSE NO. 71280

NOT FOR  
CONSTRUCTION

ARTIBUS DESIGN  
ENGINEERING AND PLANNING

ARTIBUS DESIGN  
3710 N. ROOSEVELT BLVD  
KEY WEST, FL 33040  
(305) 304-3312  
WWW.ARTIBUSDESIGN.COM  
CA # 30835

CITY OF KEY WEST  
ENGINEERING DEPARTMENT

PROJECT:  
EDWARD B. KNIGHT PIER  
STRUCTURAL ASSESSMENT

1900 WHITE STREET  
KEY WEST, FL 33040

PHOTOS

DATE OF PHOTO	DATE	DRAWN	CHECKED
AS SHOWN	06/26/25	JCH	SAM
PROJECT NO.	2502-11	DESIGN NO.	A-05
		REVISION	1



APPENDIX A: WALKWAY PHOTOS



PHOTO W-01



PHOTO W-02



PHOTO W-03



PHOTO W-04



PHOTO W-05



PHOTO W-06



PHOTO W-07



PHOTO W-08



PHOTO W-09



PHOTO W-10



PHOTO W-11



PHOTO W-12



PHOTO W-13

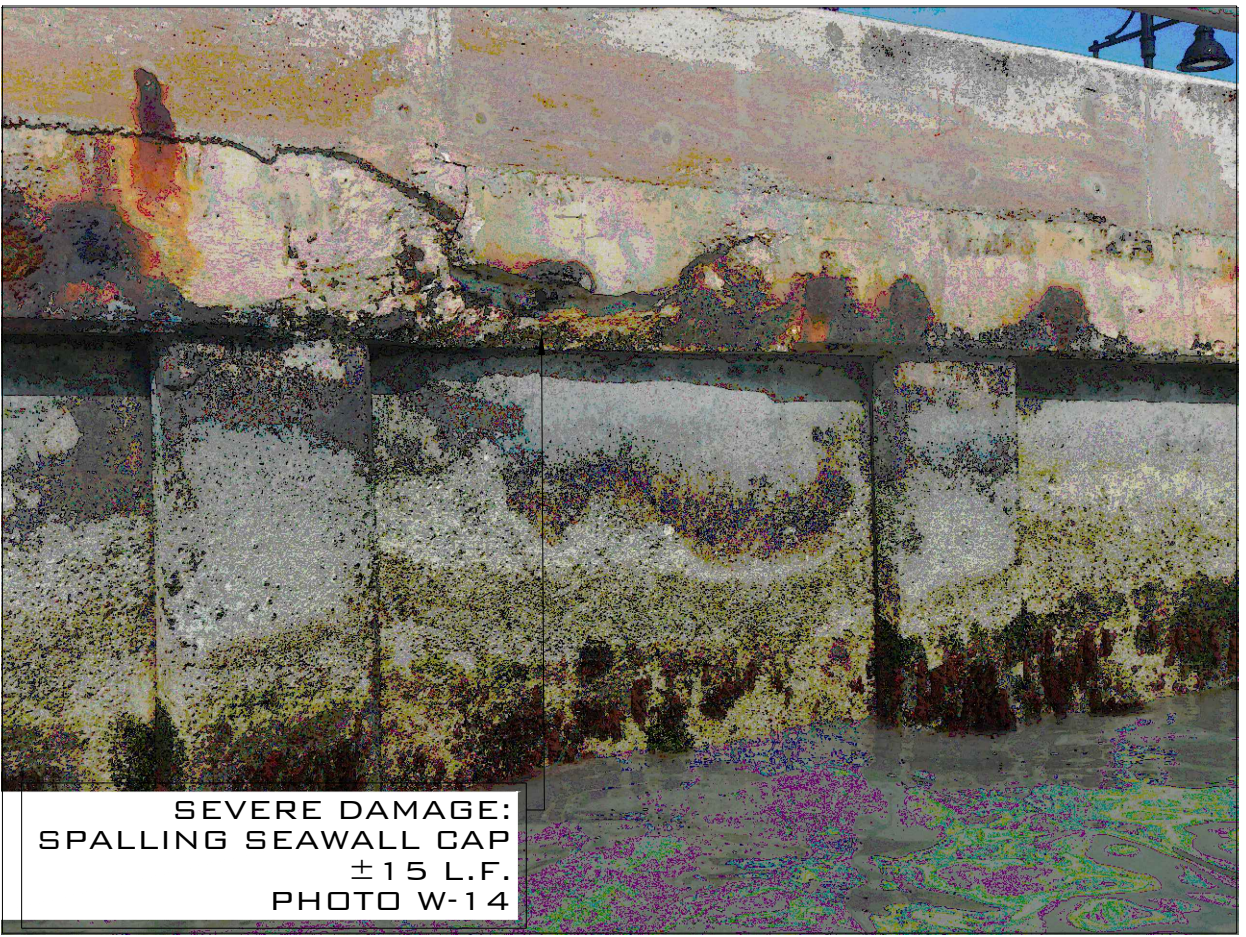


PHOTO W-14



PHOTO W-15



PHOTO W-16



PHOTO W-17



PHOTO W-18



PHOTO W-19

APPENDIX A  
OBSERVED  
DAMAGE

GEORGE MANTAKOS  
PROFESSIONAL ENGINEER  
STATE OF FLORIDA  
LICENSE NO. 71480

NOT FOR  
CONSTRUCTION

ARTIBUS DESIGN  
ENGINEERING AND PLANNING

ARTIBUS DESIGN  
3710 N. ROOSEVELT BLVD  
KEY WEST, FL 33040  
(305) 304-3312  
WWW.ARTIBUSDESIGN.COM  
CA # 30835

CLIENT:  
CITY OF KEY WEST  
ENGINEERING DEPARTMENT

PROJECT:  
EDWARD B. KNIGHT PIER  
STRUCTURAL ASSESSMENT

TITLE:  
1900 WHITE STREET  
KEY WEST, FL 33040

TITLE:  
PHOTOS

DATE OF PHOTO:  
AS SHOWN

DATE:  
06-26-25

DRAWN:  
JOH

CHECKED:  
SAM

PROJECT NO:  
2502-11

APPENDIX:  
A-06

REVISION:  
1



APPENDIX A: WALKWAY PHOTOS



PHOTO W-20



PHOTO W-21



PHOTO W-22



PHOTO W-23



PHOTO W-24



PHOTO W-25



PHOTO W-26



PHOTO W-27



PHOTO W-28



PHOTO W-29



PHOTO W-30



PHOTO W-31



PHOTO W-32



PHOTO W-33



PHOTO W-34



PHOTO W-35



PHOTO W-36



PHOTO W-37

APPENDIX A  
OBSERVED  
DAMAGE

GEORGE MARITAKIS  
PROFESSIONAL ENGINEER  
STATE OF FLORIDA  
LICENSE NO. 71488D

NOT FOR  
CONSTRUCTION

ARTIBUS DESIGN  
ENGINEERING AND PLANNING

ARTIBUS DESIGN  
3710 N. ROOSEVELT BLVD  
KEY WEST, FL 33040  
(305) 304-3312  
WWW.ARTIBUSDESIGN.COM  
CA # 30835

CITY OF KEY WEST  
ENGINEERING DEPARTMENT

PROJECT:  
EDWARD B. KNIGHT PIER  
STRUCTURAL ASSESSMENT

1900 WHITE STREET  
KEY WEST, FL 33040

PHOTOS

DATE OF PHOTO	DATE	DRAWN	CHECKED
AS SHOWN	06/26/25	JCH	SAM
PROJECT NO.	ISSUE NO.	REVISION	
2502-11	A-07		1



APPENDIX A: WALKWAY PHOTOS



PHOTO W-38



PHOTO W-39



PHOTO W-40



PHOTO W-41



PHOTO W-42



PHOTO W-43



PHOTO W-44



PHOTO W-45



PHOTO W-46



PHOTO W-47



PHOTO W-48



PHOTO W-49



PHOTO W-50



PHOTO W-51



PHOTO W-52



PHOTO W-53



PHOTO W-54



PHOTO W-55



PHOTO W-56

APPENDIX A  
OBSERVED  
DAMAGE

GEORGE MANTAKOS  
PROFESSIONAL ENGINEER  
STATE OF FLORIDA  
LICENSE NO. 71280

NOT FOR  
CONSTRUCTION

ARTIBUS DESIGN  
ENGINEERING AND PLANNING

ARTIBUS DESIGN  
3710 N. ROOSEVELT BLVD  
KEY WEST, FL 33040  
(305) 304-3312  
WWW.ARTIBUSDESIGN.COM  
CA # 30835

CLIENT:  
CITY OF KEY WEST  
ENGINEERING DEPARTMENT

PROJECT:  
EDWARD B. KNIGHT PIER  
STRUCTURAL ASSESSMENT

TITLE:  
1900 WHITE STREET  
KEY WEST, FL 33040  
PHOTOS

DATE OF PHOTO:	DATE:	DRAWN:	CHECKED:
2502-11	06/26/25	JOH	SAM
PROJECT NO:	ISSUED BY:	REVISION:	
2502-11	A-08		1



APPENDIX A: WALKWAY PHOTOS



PHOTO W-57



PHOTO W-58



PHOTO W-59



PHOTO W-60



PHOTO W-61



PHOTO W-62



PHOTO W-63



PHOTO W-64



PHOTO W-65



PHOTO W-66



PHOTO W-67



PHOTO W-68

APPENDIX A OBSERVED DAMAGE			
SERGE MAMTAKOV PROFESSIONAL ENGINEER STATE OF FLORIDA LICENSE NO. 71280			
NOT FOR CONSTRUCTION			
ARTIBUS DESIGN ENGINEERING AND PLANNING			
ARTIBUS DESIGN 3710 N. ROOSEVELT BLVD KEY WEST, FL 33040 (305) 304-3312 WWW.ARTIBUSDESIGN.COM CA # 30835			
CLIENT: CITY OF KEY WEST ENGINEERING DEPARTMENT			
PROJECT: EDWARD B. KNIGHT PIER STRUCTURAL ASSESSMENT			
SITE: 1900 WHITE STREET KEY WEST, FL 33040			
TITLE: PHOTOS			
DATE OF PHOTO: AS SHOWN	DATE: 06/26/25	DRAWN: JCH	CHECKED: SAM
PROJECT NO: 2502-11	ISSUED BY: A-09	REVISION: 1	



APPENDIX A: TERMINUS BRIDGE PHOTOS



PHOTO B-01



PHOTO B-02



PHOTO B-03

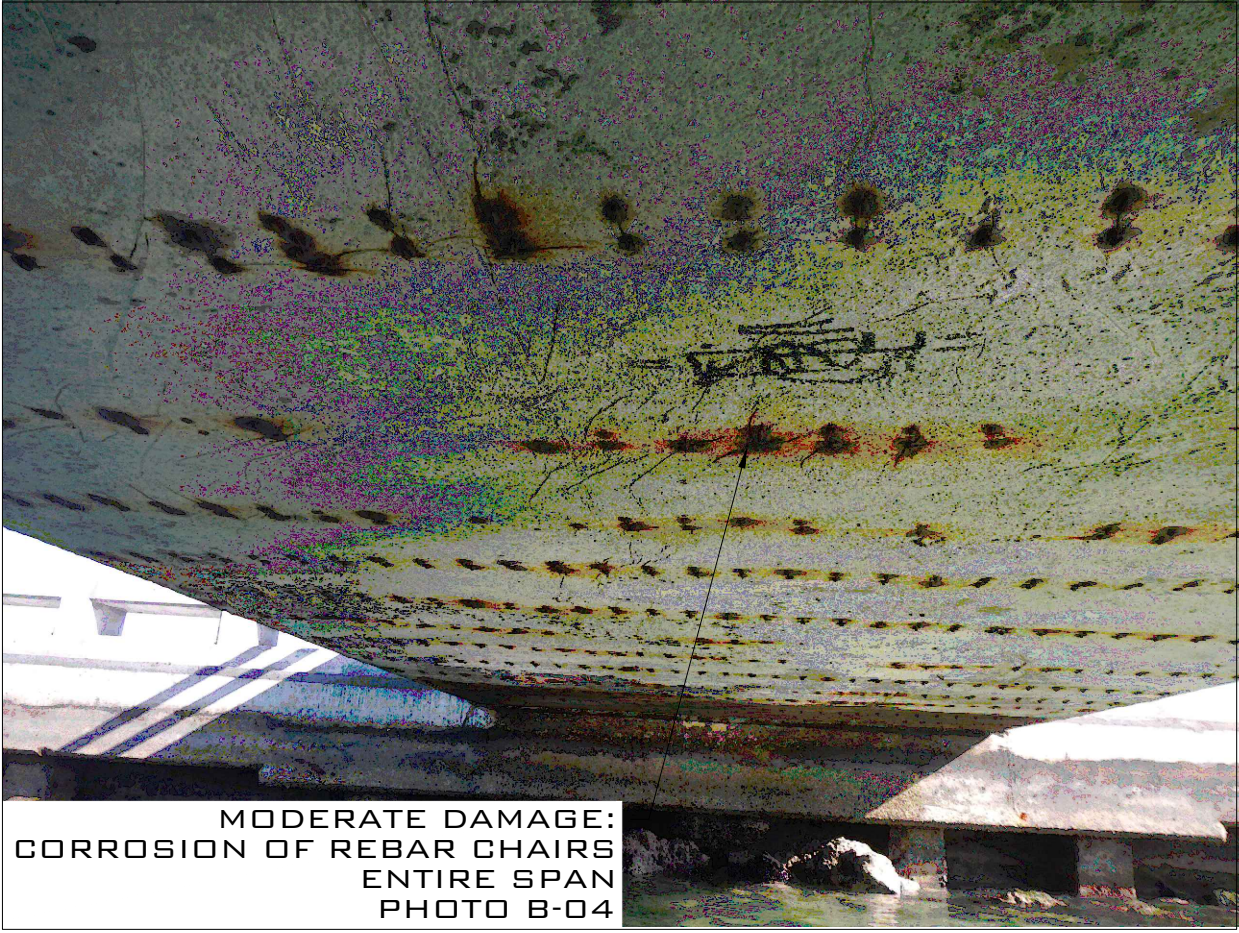


PHOTO B-04



PHOTO B-05



PHOTO B-06



PHOTO B-07



PHOTO B-08



APPENDIX A: TERMINUS PHOTOS



PHOTO T-01



PHOTO T-02



PHOTO T-03



PHOTO T-04



PHOTO T-05



PHOTO T-06



PHOTO T-07



PHOTO T-08



PHOTO T-09



PHOTO T-10



PHOTO T-11



PHOTO T-12



PHOTO T-13



PHOTO T-14

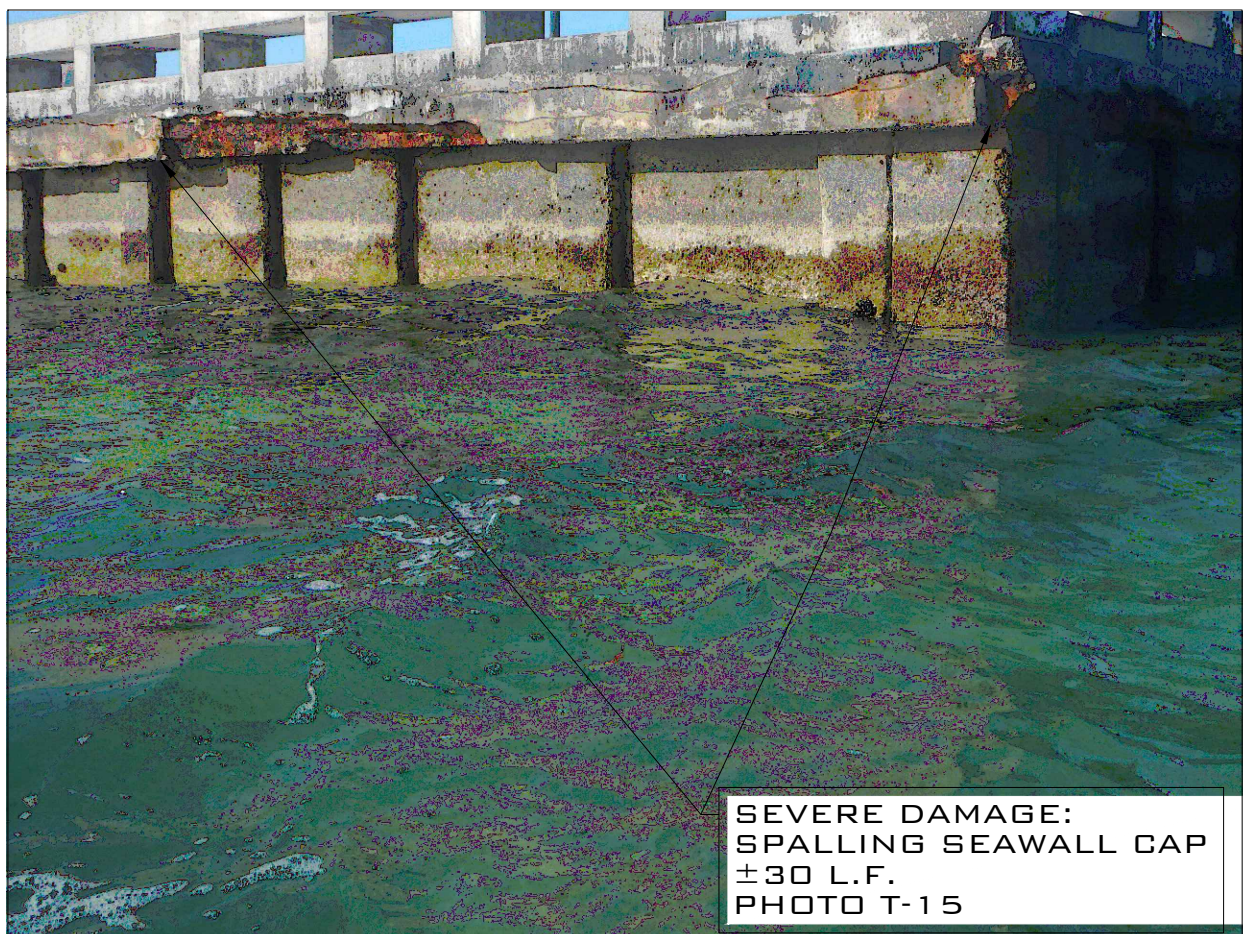


PHOTO T-15



PHOTO T-16



PHOTO T-17



PHOTO T-18



PHOTO T-19

APPENDIX A  
OBSERVED  
DAMAGE

GEORGE MANTAKOS  
PROFESSIONAL ENGINEER  
STATE OF FLORIDA  
LICENSE NO. 71480

NOT FOR  
CONSTRUCTION

ARTIBUS DESIGN  
ENGINEERING AND PLANNING

ARTIBUS DESIGN  
3710 N. ROOSEVELT BLVD  
KEY WEST, FL 33040  
(305) 304-3312  
WWW.ARTIBUSDESIGN.COM  
CA # 30835

CLIENT:  
CITY OF KEY WEST  
ENGINEERING DEPARTMENT

PROJECT:  
EDWARD B. KNIGHT PIER  
STRUCTURAL ASSESSMENT

SITE:  
1900 WHITE STREET  
KEY WEST, FL 33040

TITLE:  
PHOTOS

DATE BY FIELD: 06/26/25  
AS SHOWN: 06/26/25  
PROJECT NO: 2502-11

DATE: 06/26/25  
DRAWN: JCH  
CHECKED: SAM

REVISION: 1



APPENDIX A: TERMINUS PHOTOS



PHOTO T-20



PHOTO T-21



PHOTO T-22



PHOTO T-23



PHOTO T-24



PHOTO T-25



PHOTO T-26



PHOTO T-27